FRDC
FISHERIES RESEARCH & DEVELOPMENT CORPORATION

National Social and Economic Survey of Recreational Fishers

2018-2021

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Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

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Executive Summary

The Executive Summary is available as a separate file.

1.0 Introduction

Chapter authors: Andy Moore & Jacki Schirmer

Recreational fishing is an important pastime for many Australians. In 2000, when Australia's first national scale recreational fishing survey was conducted, an estimated 19.5% of Australians aged five and older fished in a typical 12 months (Henry and Lyle 2003). This is substantially more than the 10.5% estimated to participate in recreational fishing worldwide (Arlinghaus et al. 2015). This popular activity is often described as having a wide range of potential social and economic benefits, from supporting economic activity in areas where fishing takes place, to having positive impacts on the health and wellbeing of those who go fishing[1] (see for example McManus et al. 2011, Potts et al. 2022). However, while many of these benefits have been documented in small-scale studies, a national understanding of the nature and extent of social and economic benefits of recreational fishing has remained a significant gap in understanding.

The National Recreational and Indigenous Fishing Survey (NRIFS), conducted during 1999 to 2000, was a significant breakthrough in understanding recreational fishing in Australia. It produced the first comprehensive national picture of participation in recreational fishing in Australia, and of fishing effort and catch. The NRIFS developed and implemented a robust methodology which was subsequently applied in a number of state and territory-based studies of recreational fishing conducted in the subsequent two decades. It also provided insights into some economic and social aspects of recreational fishing, including the reasons people choose to go fishing and how much they spend on fishing (Henry and Lyle 2003).

Two decades on from the NRIFS, a new national survey of recreational fishing in Australia was needed for many reasons. First, the Australian population had changed significantly since the NRIFS was conducted: the population had grown in size, become more urban, and changed socially and culturally (ABS 2022e, Centre for Population 2021). All these things have potential to result in changing participation in recreational fishing (discussed in Chapter 4). It was considered likely that the number of Australians participating in recreational fishing had changed, and that the types of people who go fishing had changed: findings of surveys conducted in some Australian states and territories in the two decades after the NRIFS suggested there were changing participation rates (e.g. Lyle et al. 2019, West et al. 2021). However, as discussed in Chapter 4, evidence from state and territory-based surveys suggests sometimes inconsistent trends, and the use of differing methods for some surveys reduces comparability across the different surveys. The in-depth studies conducted in several states and territories provide detailed data on recreational fishing catch and effort in those regions, as well as on rates of participation in fishing and some of the social and economic aspects of recreational fishing. However, they do not provide a nationwide picture of recreational fishing. A new national study was needed to understand what participation in recreational fishing looked like across all of Australia twenty years after the NRIFS was undertaken.

Second, during those two decades a growing number of studies identified that outdoor recreational activities make significant contributions to our social and economic lives (discussed in Chapters 6 to 11). For example, in the area of health and wellbeing, a growing body of evidence has shown that spending time outdoors in nature areas has multiple benefits for a person's health and wellbeing and may be an effective public health investment (see for example Britton et al. 2018, Gascon et al. 2017, Lovell 2016, Twohig-Bennett and Jones 2018). As discussed in Chapter 9, spending time outdoors has been shown to support recovery from challenging physical and mental health problems (e.g. McManus et al. 2011, Wheeler et al. 2020). As a result, some doctors are writing 'nature prescriptions', and health intervention programs are being designed that use outdoor, nature-based

[1] Throughout this report, the term 'fishing' refers to recreational fishing, unless otherwise specified.

activities to support recovery from physical and mental health challenges (Kondo et al. 2020). Emerging evidence suggests that spending time outdoors isn't just good for recovery from health challenges but can also act as a preventative measure that reduces the risk of poor health and wellbeing. Along with this recognition, methods for estimating and understanding these contributions to health and wellbeing have evolved considerably. This meant there was opportunity to investigate whether and under what circumstances recreational fishing was an outdoor recreational activity that could contribute positively to the health and wellbeing of those who take part in it.

Similarly, conducting a national study provided an opportunity to better understand the contribution fishing makes to the economy in different regions of Australia. Some studies have examined the economic contribution of recreational fishing in individual states and territories (e.g. Ernst and Young 2009, 2015, 2020, McIlgorm and Pepperell 2013). However, as discussed in Chapter 7, studies conducted for individual jurisdictions can have limitations in capturing the full economic contribution of recreational fishing. This is particularly the case given that over the past two decades, use of online purchases means a fisher based in one part of Australia may purchase gear and supplies from many other parts of the country, thus contributing to economic activity in locations that may be located a significant distance from where they live or where they fish. As a result, it is typically difficult to capture the flows of economic contributions between regions. A national survey is a useful way of understanding the extent to which the fishing trips of people located in one region contribute to other regions across Australia, whether through purchasing gear online, or through travelling to go fishing.

Since the NRIFS, several Australian states and territories have invested in collection of data to estimate both recreational fishing catch and effort and key social and economic aspects of recreational fishing (studies include Lyle et al. 2009, 2014, 2019; Jones et al. 2009; Taylor et al. 2012; West et al. 2012, 2015, 2021; Ryan et al. 2013; Giri and Hall 2015; Webley et al. 2015, DPI NSW 2020, Tate et al. 2020; Texeira et al. 2020). However, it has not typically been possible to examine a wide range of social and economic contributions in depth as part of these studies, although almost all have invested in examining some social or economic aspects of fishing. Additionally, it is not known how generalisable some of the findings on social and economic contributions are to other parts of Australia. This, combined with growing interest in understanding social and economic contributions of activities such as recreational fishing, suggested a need for a national study focused specifically on understanding economic and social contributions of recreational fishing.

Third, there has been rapid change in the methods used to conduct social and economic surveys. Since 2000, the rapid growth of online surveys, and tools that can be used to easily design and implement them, means that almost anyone can design and put a survey into the field (Callegaro et al. 2014, Blom et al. 2016). At the same time, however, rapidly declining survey participation rates and changing availability of 'sample frames' (lists of contact details for a particular group or population) have led to growing difficulty achieving robust samples of survey respondents (Marken 2018, Arcos et al. 2020). At the time when the first NRIFS was conducted, online surveys were in their infancy. Most Australians had their addresses and a home phone number listed in the White Pages, making it possible to conduct a phone or mail survey that achieved a large and robust response based on random selection of a sample from the White Pages. Since 2000, online surveys have grown in importance; while at the same time there has been reduced use of landlines, reduced listing in common directories such as the White Pages, and rapidly declining survey response rates. These changes have resulted in increasing costs and challenges when seeking to use the types of survey methods that were employed in the first NRIFS in 1999-00. They have also led to interest in investigating how to use the opportunities presented by the growth of online surveys, while still ensuring the data collected are valid and reliable. This suggested a need to examine the potential to implement different approaches to sampling and surveying recreational fishers, particularly those that were not yet feasible when the NRIFS was conducted during 1999-00.

These factors collectively led to the initiation of the National Recreational Fishing Survey (NRFS), conducted between 2019 and 2021. The NRFS aimed to produce a national picture of the social and

economic contributions of fishing across Australia, with the findings presented in this report. It also aimed to examine the use of differing methods for conducting social and economic surveys of recreational fishers. Specifically, the extent to which online surveys and other emerging survey methods can be used to generate an understanding of the social and economic contributions of recreational fishing was explored as part of the study.

It is important to note that the NRFS differed to the NRIFS in several respects. First, the NRFS focused on examining social and economic contributions, enabling a more in-depth picture of these aspects of recreational fishing than has been possible from previous studies. To enable this in-depth picture, the NRFS did not attempt to measure recreational fishing catch and effort, something that was done in the NRIFS. This decision was made as there is ongoing investment by different Australian states and territories in measuring catch and effort, as noted above. The NRFS focused solely on recreational fishing and did not include fishing undertaken for cultural purposes by Indigenous Australians (recreational fishing by Indigenous Australians was included).

Originally, the NRFS was intended to occur during 2019 to 2020, and involve an initial survey of the Australian population, followed by an in-depth survey of recreational fishers, and a tracking survey conducted monthly for a year. However, the COVID-19 pandemic resulted in significant change to the project. With many recreational fishers significantly restricted in their ability to go fishing for significant periods of time due to movement restrictions put in place in response to COVID-19, the time period for data collection was extended to the end of 2021. In 2021, the COVID-19 pandemic was still impacting fishing, with movement restrictions in place in many regions for periods of time during 2021. Ongoing international travel restrictions meant that it was not possible to collect data on recreational fishing activity by visitors from other countries as part of the NRFS. This meant that some of the analyses originally planned as part of the NRFS were not feasible, and presented challenges for achieving others. However, it was possible to produce estimates of recreational fishing participation during 2018-19 – the year prior to the pandemic – as well as identify how the pandemic impacted fishing participation during 2020 and 2021. The extended time over which the study was conducted also provided an opportunity to identify whether findings regarding the social contributions of fishing were consistent over three years of data collection.

This report presents the findings of the NRFS. First, the objectives of the study are summarised (Chapter 2), followed by description of the methods used (Chapter 3). The results are presented across several chapters, that together examine the following social and economic contributions of fishing:

- Participation in recreational fishing in Australia and how it varies across different regions and groups (Chapter 4)
- Impacts of natural disasters and COVID-19 on recreational fishing (Chapter 5)
- The substitutability of recreational fishing and other activities (Chapter 6)
- Economic contributions of recreational fishing (Chapter 7)
- Physical activity and recreational fishing (Chapter 8)
- Wellbeing and recreational fishing (Chapter 9)
- Social licence of recreational fishing (Chapter 10)
- Recreational fishing and environmental stewardship (Chapter 11).

The final chapter of results (Chapter 12) examines the results achieved when implementing the different approaches to sampling and surveying recreational fishers undertaken as part of this study.

2.0 Objectives

The original objectives of this project were to:

1. Assess social and economic contribution of recreational fishing using multiple methods, including direct and flow-on economic benefits, and market and non-market benefits

2. Identify which approaches to recruiting survey participants and completing surveys produce the most representative and robust results

3. Recommend appropriate and cost-effective survey methods that can be used to track change in social and economic aspects of recreational fishing in Australia over time

The Black Summer bushfires, followed by the COVID-19 pandemic, occurred after data collection had started for this project. This reduced the feasibility of some of the approaches previously planned for use to test the robustness of survey methods. At the same time, it provided an opportunity to identify how these events affected some aspects of recreational fishing. Given this, a fourth, ad hoc objective was included in the project:

4. Identify how fishing activity changed in response to the Black Summer bushfires and the COVID-19 pandemic.

3.0 Method

Chapter authors: Jacki Schirmer & Andy Moore

3.1 Key points

- The National Recreational Fishing Survey (NRFS) project collected data in three stages, each of which contributed to the project in different ways.
- Stage 1 examined participation in recreational fishing amongst the adult Australian population in 2018 by including questions about participation in fishing in the annual Regional Wellbeing Survey (RWS), a nationwide survey of adult Australians. Participants could complete the survey online or on a paper form. Including questions about fishing participation as part of a larger, existing omnibus survey was done for two reasons. The first was to reduce the risk of 'salience bias' in responses - in this case the risk of those interested in fishing being more likely to take part in a survey. The second was to reduce the cost of collecting data on participation in recreational fishing.
- Stage 2 involved collection and analysis of economic and social data via a stand-alone nationwide survey of recreational fishers, with a smaller comparison dataset of non-fishers also collected. Participants could complete the survey online or using a paper form. A large proportion of the economic and social data examined in this report were collected from the 20,463 people who participated in this stage.
- Originally, Stage 2 was to be completed in 2019; however, disruptions resulting from the 2019-20 bushfires, followed by COVID-19, meant data collection for Stage 2 occurred over an extended period, from September 2019 to May 2020
- In Stage 1 and 2, multiple methods were used to recruit survey participants. The sample achieved using each method was compared to identify whether any recruitment method resulted in sampling bias that could not be sufficiently addressed through the use of statistical weighting.
- Stage 3 involved more detailed -trip-based surveys of a subsample of the recreational fishers who participated in Stage 2; Stage 3 involved collecting data once every one to three months, with participants able to complete the surveys online or on a paper form.
- Multiple social and economic analysis techniques were applied when analysing different aspects of the data. This chapter focuses on data collection methods and the data weighting method. Methods specific to each chapter are included in the relevant chapter.

3.2 Introduction

This chapter describes the methods used to collect survey data in different stages of the NRFS, and the methods used to develop statistical weights that enable analysis of that survey data to identify social and economic characteristics of recreational fishing. The data analysis methods used to examine different types of social and economic contribution are not described in this chapter; they are presented together with the findings of each analysis, as part of Chapters 4 to 12. This means that this chapter provides an overview of methods, but additional detail is provided as each specific analysis is reported. For example, while this chapter provides a summary of the types of survey questions asked, more detailed information, including discussion of the limitations and interpretation of specific measures, and how they were analysed, is provided in the chapter in which findings generated from those measures are presented.

The NRFS involved three stages of data collection. An overview of the three stages of data collection and the purpose of each, and a guide summarising which chapters draw on data from each stage of

data collection, are provided in the next section. Sections 3.4, 3.5 and 3.6 provide a detailed description of the methods used to collect and process data in Stages 1, 2 and 3 respectively. These sections explain, for each stage:

- The purpose/objectives of data collection
- Data collection methods, including design of survey instruments and survey recruitment materials, survey sample recruitment methods and sample achieved
- Data processing methods, including data coding and cleaning, and weighting methods.

3.3 NRFS data collection – overview of three stages

The NRFS project collected data in three stages, each of which contributed to the project in different ways. The three stages overlapped with each other. Stage 1 involved data collection in 2018, and again in 2020. Stage 2 involved data collection between September 2019 and May 2020. Stage 3 data collection began in March 2020 and was completed in 2021. Figure 3.1 summarises when data were collected in each stage and the type of population sampled.

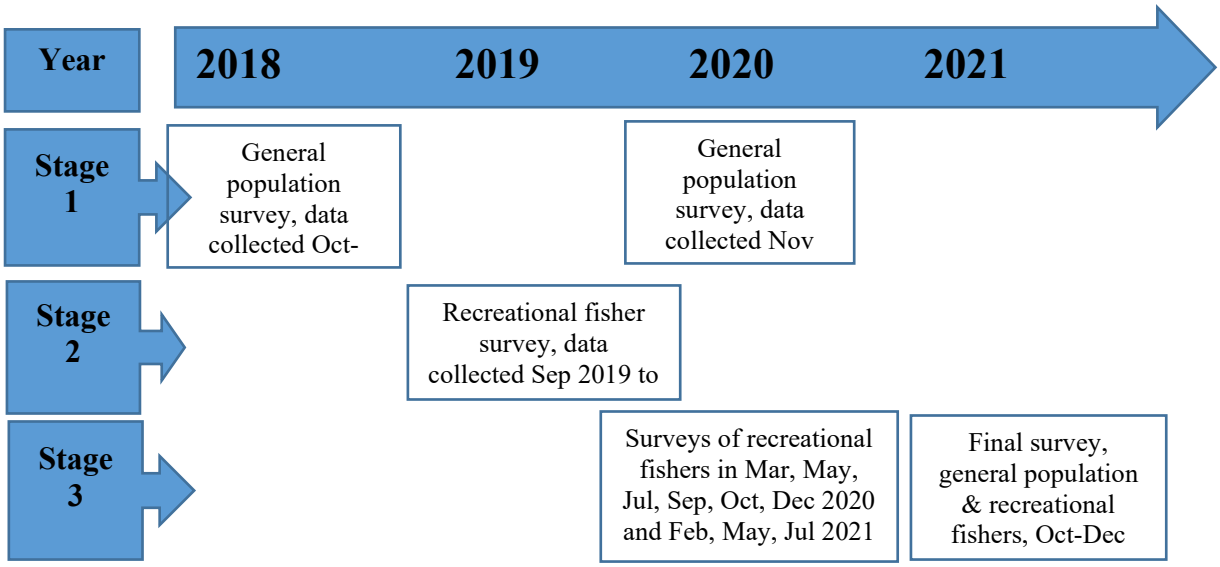

Figure 3.1 Timing of data collection across the three stages of the National Recreational Fishing Survey, 2018 to 2021

The design of the three stages resulted in large part from the need to collect data that could estimate numbers of recreational fishers in Australia, followed by more intensive collection of data about social and economic aspects of their fishing. It is important to note that in Australia, at the time this study was conducted, it was not possible to estimate recreational fishing participation nationwide using data from recreational fishing licence databases. This was because not all jurisdictions required recreational fishing licences, and amongst those using licences, some population groups were not required to obtain a licence to fish.

Table 3.1 summarises the objectives and data collection undertaken in each stage, while Table 3.2 identifies which chapters of this report present findings from data collected in each stage. Stage 1 had two objectives:

- Objective 1: estimate participation in recreational fishing amongst the adult Australian population
- Objective 2: trial different survey recruitment methods to evaluate their effectiveness in collecting data that can be used to estimate recreational fishing participation, and to better understand social and economic dimensions of fishing.

In Stage 1, participants in the annual Regional Wellbeing Survey (RWS), a nationwide survey of adult Australians, were asked to complete a small number of questions about recreational fishing participation, effort and experiences. This enabled analysis of data on participation in fishing (Chapter 4). Multiple recruitment methods were used to invite participation in the RWS, including random selection, social media promotion, direct survey mailout, and online survey panel. The method by which a person was recruited was recorded, enabling subsequent analysis of the differences in the sample of recreational fishers achieved using each method. The data collected were compared based on survey recruitment method, to evaluate the extent to which the use of different recruitment methods led to variation in findings (Chapter 12).

Table 3.1 Summary of data collected in each stage of the NRFS

	Objectives	Population studied	Social/economic aspects of fishing examined	Methods-related goals
Stage 1	• Estimate fishing participation and avidity • Evaluate difference in estimates resulting from samples recruited in different ways • Wellbeing measurement	• Adult population of Australia (fishers & non-fishers) •	• Fishing participation • Fishing avidity • Fishing motivations • Wellbeing	• Evaluate suitability of different survey recruitment techniques
Stage 2	• Measure social and wellbeing outcomes associated with fishing • Measure economic contribution of fishing in Australia	• Adult recreational fishers • Recreational fishers living in household	• Fishing avidity • Fishing substitutability • Physical activity • Fishing motivations • Social connection • Barriers to/ enablers of fishing experience • Wellbeing • Fishing expenditure	• Evaluate suitability of different survey recruitment techniques
Stage 3	• Measure social and wellbeing outcomes associated with fishing • Economic evaluation – recall testing	• Adult recreational fishers • Information on fishing activities of survey respondent's household	• Fishing expenditure • Impacts of COVID-19 • Stewardship • Use of fishing apps • Wellbeing	• Evaluate use of online monthly recall surveys to measure expenditure

Table 3.2 Data used to analyse the different social and economic contributions of recreational fishing

Chapter	**Some/all data sourced from…**		
	Stage 1	**Stage 2**	**Stage 3**
Chapter 4 Participation in fishing and barriers to participation	✓	✓	×
Chapter 5 Impacts of natural disasters and COVID-19 on recreational fishing	✓	×	✓
Chapter 6 Should I go fishing or do something else this weekend?	×	✓	✓
Chapter 7 Economic contribution of recreational fishing	×	✓	✓
Chapter 8 Physical activity and recreational fishing	×	✓	×
Chapter 9 Wellbeing and recreational fishing	✓	✓	✓
Chapter 10 Social licence of recreational fishing	✓	×	×
Chapter 11 Recreational fishing and environmental stewardship	×	×	✓
Chapter 12 Survey data collection methods	✓	✓	✓

Stage 2 (2019-2020) involved collection and analysis of economic and social data via a nationwide survey of recreational fishers, with a smaller comparison data set of non-fishers also collected. The Stage 2 survey collected a large proportion of the economic and social data examined in this report, including the data used to examine the substitutability of recreational fishing and other activities (Chapter 6), the economic contribution of recreational fishing (Chapter 7), and much of the data used to examine social and wellbeing contributions of recreational fishing (Chapters 8 to 11). Originally,

this stage was to be completed in 2019; however, disruptions resulting from the 2019-20 Black Summer bushfires, followed by COVID-19, meant data collection for Stage 2 occurred over an extended period, from September 2019 to May 2020. Stage 2 also included testing of the effectiveness of using a range of methods to recruit participants to recreational fishing surveys, and further testing of the use of online survey panels to recruit a general population sample that included both fishers and non-fishers (see Chapter 12 for analysis). Non-fishers who participated in Stage 2 were asked questions about their views on recreational fishing and reasons for non-participation.

Stage 3 (2020-2021) involved recreational fishing activity surveys conducted once every one to three months, followed by a final 'wash-up' survey. The 'monthly' surveys (referring to the 1-3 monthly survey) asked participants about the number of fishing trips engaged in during the period since the previous survey, their fishing expenditure, and their subjective wellbeing. Some Stage 3 surveys also included questions about a 'special topic'. For example, the first survey, conducted in March 2020, asked participants how much their recreational fishing had been disrupted by the Black Summer bushfires occurring the previous summer. Subsequent surveys evaluated impacts of COVID-19 on fishing as lockdowns occurred in different parts of Australia. Data from Stage 3 are analysed as part of Chapter 5, 9 and 12.

3.4 Stage 1: General population survey

3.4.1 Objectives

Data collection in Stage 1 had two primary objectives:

- Estimate the proportion of Australian adults participating in recreational fishing, and key characteristics of fishers such as avidity
- Evaluate the extent to which estimates of fishing participation and avidity vary depending on the survey recruitment method used

A secondary objective was to collect data that could contribute to an evaluation of recreational fishers' wellbeing (to be analysed in conjunction with data collected in Stage 2 and Stage 3).

Achieving these objectives required a survey of Australian adults, including both fishers and non-fishers. Conducting this survey could also contribute to achieving the objectives of subsequent stages of the project. Recreational fishers who participated in Stage 1 were invited to participate in the surveys conducted in Stages 2 and 3 and formed part of the sample examined in those stages.

3.4.2 Data collection methods

Key considerations and decisions

In Stage 1, it was important to conduct a survey that could provide a robust estimate of the proportion of Australian adults who engage in recreational fishing. A key consideration in achieving this was ensuring the survey approach chosen minimised the risk of salience bias - a bias in responses resulting from a person having a specific interest in the survey topic. It was important to ensure that being a recreational fisher did not increase or decrease the likelihood that a person would choose to participate in the survey. More generally, it was important to ensure the sample achieved could be statistically weighted to produce results representative of the adult Australian population.

The risk of salience bias was addressed in two ways:

- Including questions about participation in recreational fishing as part of a broader 'omnibus' survey of the general population that does not specifically focus on participation in fishing.

- Designing the phrasing of survey recruitment materials to be 'neutral' in terms of their likelihood of recruiting recreational fishers, meaning that recreational fishers would be just as likely as non-fishers to participate in the survey. In Stage 1, this was achieved by having survey recruitment materials that referred to the broader objectives of the survey, and did not refer to recreational fishing at all.

Stage 1 data were collected as part of the University of Canberra's annual Regional Wellbeing Survey (RWS). Since 2013, the RWS has examined wellbeing, resilience and liveability in Australia's rural and regional areas. From 2016, the survey expanded to include a sample of people living in major cities as well as those living in regional and rural areas. Incorporating questions about fishing in this 'omnibus' survey reduced potential for salience bias related to recreational fishing, as questions about fishing formed a small part of the survey, and survey recruitment materials did not specifically identify recreational fishing as a particular focus of the survey.

Multiple omnibus surveys operate in Australia, including the RWS. The RWS was considered suitable for this project as it provided capacity to compare differences in responses when using a number of different survey recruitment methods (analysed in Chapter 12), enabled participants to respond either using an online survey or paper survey form, and had been used in a range of previous projects to generate insights into the Australian population using model-based statistical weighting (described subsequently in this chapter). A detailed description of the RWS, methods used in each survey wave, and approaches to sampling, can be found in Schirmer and Mylek (2023).

Trialling inclusion of questions on recreational fishing as part of an omnibus survey enabled assessment of whether more regular monitoring of participation in recreational fishing could be achieved in future through asking small numbers of questions about fishing as part of one or more omnibus surveys. While the RWS was used in this instance, if the addition of a small number of recreational fishing questions on omnibus surveys is considered to be effective, many other omnibus surveys in Australia could potentially be utilised in a similar manner, subject to assessment of the effectiveness and appropriateness of their overall methods.

Survey timing

Stage 1 data were first collected in the 2018 RWS, which collected data during October to December 2018. A total of 11,463 valid respondents answered questions about their participation in recreational fishing. A valid respondent means a person who provides a survey response considered to be valid after the survey responses were inspected to remove responses where there was evidence a person did not pay attention to the questions when responding, completed the survey more than once, or completed only a small part of the survey (see Schirmer and Mylek 2023 for details). The data collected from respondents in the 2018 RWS survey was the primary source of information for principal Stage 1 of this survey. In 2020, key questions were repeated in the 2020 RWS, with a further sample of 9,234 collected during November 2020 to January 2021.

Survey instrument

As it is an omnibus survey used to collect data for multiple studies, the RWS includes questions about many topics each year. The following types of survey questions were analysed for Stage 1 of the NRFS:

- Questions about recreational fishing were designed, based on questions asked in previous telephone-based studies of recreational fishing in Australia, with wording modified in some cases to suit the online/paper survey mode used for the RWS. Questions included:
    - Likelihood of respondent and other members of household going recreational fishing in the next 12 months
    - Historical participation in recreational fishing

    - Satisfaction with recreational fishing in the past 12 months
    - Importance of different aspects of recreational fishing
- Socio-demographic characteristics (gender, age, cultural background, household structure, educational attainment, labour force participation, household income, geographic location of residence). Survey items measuring these characteristics were designed to ensure comparability to Australia's 2016 *Census of Population and Housing*, enabling assessment of the representativeness of the sample and development of statistical weights using *Census* data as the population benchmark
- Wellbeing: all survey participants were asked questions to measure their subjective wellbeing, using existing validated measures (see Chapter 9 for discussion of how and why these measures were chosen, and key references for the measures used)
- Social licence: 2018 RWS participants were asked how acceptable they found a range of activities, including recreational fishing. This was included somewhat opportunistically: the RWS had for several previous years asked questions about social acceptability of multiple activities such as mining, agriculture and forestry, but had not included recreational fishing in this list (see Chapter 10 for discussion of the measure used).
- Participation in a range of outdoor activities in the previous 12 months.
- Identification of how each respondent was recruited to participate in the survey (Chapter 12 compares estimates of participation in fishing across different survey recruitment methods).

Recreational fishing was described as 'recreational fishing (whether you caught anything or not, including fishing, crabbing, yabbying, spearfishing and collecting shellfish)'. See Chapter 4 for discussion of definitions of recreational fishing; this definition represents a simplified form of the definition recommended by FAO (2012). In both 2018 and 2020, the draft questionnaire was tested in focus groups, revised, professionally formatted, and formally pilot tested with a sample of 110 people. Following pilot testing, a final revision of items was undertaken before the survey was launched. Pilot testing resulted in two minor changes to phrasing of survey items asking about recreational fishing.

The exact survey items[2] related to recreational fishing included in the 2018 RWS and 2020 RWS can be found in Appendix 2.1 and 2.2 respectively.

Survey mode and recruitment materials

Survey participants could complete the Stage 1 surveys via two modes: online, or by completing a paper form which was provided with a pre-paid return envelope. All survey recruitment materials invited participation in the Regional Wellbeing Survey using a broad description of the survey as examining 'resilience, wellbeing and liveability', with some specific questions on recreational activities. Fishing was not specifically mentioned in the recruitment materials, to reduce risk of salience bias. Appendix 2.3 provides an example of the typical wording used in emails, letters, social media ads and flyers that were used to invite participation in the survey.

Survey recruitment methods

One of the two primary objectives of Stage 1 was to identify whether using different methods to recruit survey participants resulted in significant differences in estimates of participation in recreational fishing, or fishing avidity/characteristics. 'Recruitment methods' here includes the choice of population frame or sampling frame (if applicable), the type of method used to select a sample e.g.

[2] A survey 'item' means an individual statement a respondent was asked to respondent to in a survey. This might be a direct question, or a statement not phrased as a question, to which they are asked to provide a rating such as an extent of agreement or disagreement.

random selection, stratified sampling, quota sampling, and the recruitment communication method (e.g. an email, a flyer, a letter, an online advertisement).

As discussed in Chapter 12, factors such as reduced availability and coverage of population frames, declining survey response rates, and rapid growth of online surveys, mean that survey researchers often have to identify which of a diverse range of survey recruitment methods are both feasible and robust for a given project. These include probability-based survey recruitment methods (in which the probability of a person being selected to participate in a survey can be calculated), and quasi- and non-probability methods (in which the probability of a person being selected cannot be calculated, and other methods are used to achieve a suitable sample of respondents, such as sampling from different groups until a pre-set quota is reached). There is often limited information on likely biases associated with using different survey recruitment methods. The 2018 RWS was designed to collect data via a number of differing methods, to enable comparison of differences in characteristics of recreational fishers recruited in different ways.

In Stage 1, three sample selection methods were used - stratified random sampling from a population frame, quota sampling from a survey panel, and opportunistic sampling (where there was no sample frame):

- Stratified random sampling from a postal address database: Probability-based sampling in which a sample is selected from different strata, with greater sampling from regions or groups that have smaller populations (thus ensuring sufficient sample size from these smaller population regions/groups to examine them as part of analysis).
- Quota sampling: In quota sampling, sampling continues until a set quota of participants from different categories is reached (such as different genders, age groups or people living in different regions). Stratified quota sampling was used to sample from an online survey panel; the principle of quota sampling was also used to guide social media sampling, with social media advertising differentially targeted to different cohorts to achieve desired quotas.
- Opportunistic sampling: This refers to achieving opportunistic samples through methods such as word of mouth (for example, asking organisations to email their memberships about the survey, or to pass information about the survey on to their social networks).

A total of five recruitment communication methods were used, some of which used random sampling, and some quota and opportunistic sampling:

- Flyers delivered to a randomly selected sample of households (stratified random sampling from a sample frame, in this case a postal address database covering all of Australia)
- Online survey panel using quota sampling via an online panel provider (the Qualtrics blended panel) which has strict criteria in place for managing the quality of survey participants and screening quality of survey responses (quota sampling, with random sampling from the panel participants until quota reached)
- Social media advertising on Facebook and Instagram: displaying advertisements in social media feeds that invited participation in the survey. These advertisements were targeted to specific groups and regions and displayed to users of these social media platforms who met those specified demographic and geographic criteria. This type of recruitment was opportunistic sampling; however it was possible to specify criteria for the display of advertisements that ensured this method achieved some properties of quota sampling, with randomness of display within quotas.

- ‘Word of mouth’: People encouraging their networks to participate in the survey, whether by email, online sharing of posts, or including items about the survey in a newsletter (opportunistic sampling).
- Existing participants in the long-term online omnibus Regional Wellbeing Survey. These existing participants were originally recruited using a range of methods, which included both probabilistic (direct invitation to randomly selected households) and non-probabilistic (word of mouth, social media advertising) methods. The majority were originally recruited using probabilistic selection methods (Schirmer and Mylek 2023).

A more detailed description of each recruitment method, including the population sampled, the type of sampling undertaken, and known limitations of the population frame from which the sample was recruited, is provided in Appendix 2.4. For all methods, participants could choose to complete the survey via either or two modes: an online survey, or a paper copy of the survey (Appendix 2.3 provides an example of how this choice was explained to participants in survey promotional materials).

All survey participants were asked to identify how they heard about the survey when completing it, enabling comparison of participants recruited using different methods. Additionally, for some methods independent information was available to identify how the respondent was recruited. For example, the Qualtrics panel participants had a unique online survey link compared to those recruited in other ways.

A survey prize draw was offered to all participants *other* than those recruited via the online survey panel. The use of incentives such as prize draws can reduce some types of survey response bias, particularly salience bias, as some participants will complete a survey in order to enter a prize draw or receive a monetary incentive even when not highly interested in the survey topic. Studies investigating the impact of survey incentives on survey responses have identified that incentives typically increase survey participation, and in at least some cases increase representation of those otherwise less likely to respond to the survey, thus reducing some forms of respondent bias (see for example Preece et al. 2010, Olsen et al. 2012). A prize pool of $7,000, comprised gift cards to differing values, was offered. Winners could choose a Flight Centre, Coles- Myer, WISH or Bunnings gift card. Online survey panel participants were offered rewards for participating in surveys as part of their panel membership and were not eligible for the prize draw.

3.4.3 Sample and weighting

Valid sample

Prior to data analysis, RWS data were processed and cleaned. This involved entering data from paper surveys into the online survey form, checking entered data for errors, numeric coding, and removal of invalid surveys (see Schirmer and Mylek 2023 for further information). Duplicate surveys (for example, in which a participant began the survey more than once) were removed, as were any responses in which participants had deliberately completed the survey multiple times. All surveys in which a participant had completed fewer than 15 items were also removed, as this was the minimum number of items for which meaningful analysis (including analysis of response bias in non-complete surveys) could be undertaken.

After removal of invalid surveys (which represented less than 1% of total surveys completed), the total sample of people who completed questions about fishing activities in the 2018 Regional Wellbeing Survey was 11,463[3]. This included 600 or more recruited via each recruitment method

[3] Note that the total 2018 RWS sample was 15,083 people; however many farmers (a group that was substantially over-sampled for purposes of studies other than this one) were not asked fishing questions in order to reduce length of their survey.

(Appendix 2.5 and Chapter 12 discuss the assessment of the quality of the sample achieved via each method, and decision making regarding their retention in the final weighted sample):

- Existing survey participants (RWS): 2,750 (35% response rate to invitations)
- Online survey panel (Qualtrics): 4,867 (no response rate as quota sampling used)
- Flyers to households: 1,467 (2.9% response rate to flyers sent, with approx. 50,000 sent to randomly selected households[4])
- Social media advertising: 1,084 (2.0% response rate, with boosted posts reaching 53,692 people in total)
- Word of mouth (online): 630 (no response rate possible as the total number of people to whom the survey link was sent is unknown)
- Unknown (did not complete question about how they heard of survey and no other information available to enable identification of survey recruitment method): 665.

In the 2020 RWS, the total sample of people who completed questions about fishing activities was 9,234:

- Existing survey participants (RWS): 2,184 (33% response rate to invitations)
- Online survey panel (Qualtrics): 3,606
- Flyers (20,000) and direct invitation letters (30,000) to selected households: 1,681 (3.3% response rate overall
- Emails sent to specific mailing lists of farmers by farming organisations, including research and development organisations and grower organisations (413)
- Social media advertising: 510 (1.9% response rate)
- Unknown: 840.

Weighting

RWS data are weighted to be representative of the Australian adult population (defined as people living in Australia who are aged 18 and older). Weights are used to adjust for differences in the characteristics of the sample when compared to the general population; doing this enables production of findings that are more representative of the general population.

The dataset was weighted as a blended sample, in which the weighting process was applied to the pooled sample achieved across all recruitment techniques, rather than to each individual sample recruited in different ways. This was done as an assessment of responses, reported in detail in Chapter 12, identified that there was sufficient similarity in responses of participants recruited in different ways to support weighting the sample as a pooled sample[5]. Weighting a pooled sample reduced the risk of introducing error due to weighting small groups of people (Kaltan and Maligalig 1991), an issue discussed in more detail in Appendix 2.5.

The RWS weights were developed using model-based weighting. In model-based weighting, rather than using design-based weights (where weighting is based on a person's probability of being recruited into a sample), weighting is done against a superpopulation that specifies the characteristics of the population being sampled – in the case of the RWS, the adult population of Australia.

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[4] As the RWS uses non-traditional survey recruitment methods, response rates provided above are indicative only – for example, of the 50,000 flyers mailed, it is not known how many flyers successfully reached households and were read by a household member.

[5] Chapter 12 examines in detail the use of different survey recruitment methods. The analysis presented in Chapter 12 underpinned the decision to weight a blended sample. However, this analysis is presented separately in Chapter 12, rather than in this chapter, as it is also relevant to Chapter 12, and presenting it only once reduced repetition in this report.

Effectively, the 'superpopulation' is a model that specifies the known characteristics of the population being studied (Little 2004). The model-based weighting approach involved comparing characteristics of the RWS sample to benchmark data and calculating multipliers for each group of people to ensure each group is represented in findings at the same proportion they have in the population. Survey weights were developed the raking/rim weighting method, described in more details in Appendix 2.5. When using this method, weights are developed iteratively by adding one weighting criteria (variable, e.g. gender, age) at a time. This approach was chosen because it provides a good compromise between accuracy of the weights and avoiding issues that can occur in cell weighting where the sample is 'spread too thin' (Battaglia et al., 2009), causing some cells to have very low counts, which results in unrealistically high weights for some respondents. The benchmark data set used was the Australian Bureau of Statistics 2016 *Census of Population and Housing.* The variables used to develop the weights were:

- Gender (male or female),
- Age (in four groups: 18-39, 40-54, 55-64 and 65+)
- Farmer status (farmer or non-farmer)
- Geographic region, based on Regional Development Australia (RDA) regions. RDA boundaries are useful ways to not only address urban/rural differences in sampling, with RDAs split into urban versus non-urban regions, but also differences in State/Territory and remoteness in sampling. For information about these regions, see https://www.rda.gov.au/.

These variables were chosen because when compared to the Australian adult population, survey respondents were, on average, more likely to be female, older, and more likely to be farmers, and were also distributed differently geographically (see Appendix 2.5 for detail). Weighting by RDA region corrected for the over-representation of rural and regional areas in the dataset, as well as other stratification of sampling across different rural and regional areas.

For both the 2018 and 2020 RWS samples, five raking iterations were performed, by which point the distribution of gender, age (in groups), farmer status and RDA in the survey sample was within 1% of that observed in the 2016 Census. This was deemed acceptable, and these weights were applied to all subsequent analyses.

Appendix 2.5 provides more detailed information on weighting in general, and the specific weighting procedures used for the Stage 1 surveys. Unless otherwise specified, all analyses of Stage 1 data presented in this study use the statistical weighting developed using the process described above, and in Appendix 2.5. This means that, unless otherwise reported, all Stage 1 data presented in this report are weighted to be representative of the adult population of Australia by gender, age, farming status and geographic location.

3.4.4 Stage 1 data analyses

Stage 1 data are analysed in the following chapters of findings (see also Table 2):

- Participation in fishing (Chapter 4): Stage 1 data were used to identify who participates in recreational fishing; both Stage 1 and 2 data were used to examine the socio-demographic characteristics of those who do and do not participate in fishing
- Wellbeing and recreational fishing (Chapter 9): While Stage 2 data were the primary data source for analysis of wellbeing, Stage 1 data were also used, and provided a form of triangulation, enabling identification of whether findings on the associations between wellbeing and recreational fishing were consistent across the two surveys and samples
- Social licence of recreational fishing (Chapter 10): Stage 1 data were used to examine the likely level of social licence of recreational fishing in Australia.

- Survey data collection methods (Chapter 12): The different methods used to recruit survey participants in Stage 1 were compared to identify whether they result in significantly differing estimates of key aspects of recreational fishing, including participation and avidity.

3.5 Stage 2: Recreational fisher survey

3.5.1 Objectives

Stage 2 of the NRFS focused on surveying recreational fishers, with the following objectives:

- Collect data enabling modelling of economic contribution of recreational fishing (findings reported in Chapter 7)
- Collect data enabling analysis of social and wellbeing contributions of recreational fishing (Chapters 4, 6, 8, 9 and 11)
- Evaluate different survey recruitment methods that have potential to provide a cost-effective means of achieving a suitable sample of recreational fishers in Australia (Chapter 12)

Meeting these objectives required achieving a large sample of recreational fishers.

Originally, the objectives for Stage 2 also included testing methods for collecting data on recreational fishing by international visitors to Australia, through strategies such as delivering surveys through accommodation providers in recreational fishing areas. However, international travel restrictions imposed due to the COVID-19 pandemic meant this was not feasible.

3.5.2 Data collection methods

Key considerations and decisions

While Stage 1 involved including a small number of questions in broader surveys of the general population, Stage 2 survey focused specifically on surveying recreational fishers. This increased the potential for some types of survey response bias, as the Stage 2 survey was targeted specifically to recreational fishers, rather than incidentally sampling recreational fishers as part of a larger population-wide survey. Key considerations thus included not only ensuring a sufficient sample of different groups of recreational fishers, but also ensuring that the risk of bias could be either reduced or addressed as part of the statistical weighting process. Similar to Stage 1, it was also important to collect data using multiple approaches to survey recruitment methods and compare them to identify whether using different methods led to significant differences in findings (this analysis is presented in Chapter 12).

The first key consideration was the type of sample needed in Stage 2. Stage 2 needed to achieve a sample that had sufficient responses from different regions and groups to (i) enable each state and territory to be analysed separately (excluding ACT, which was combined with NSW); (ii) enable capital cities to be analysed separately from the rest of each state/territory; and (iii) ensure a sufficient sample of the small number of very avid fishers that previous surveys suggested contributed a large proportion of fishing effort and expenditure. To achieve this, sampling methods were designed to achieve a sufficiently large sample from each of these regions and groups. This required deliberately oversampling states/territories with smaller populations, and oversampling avid fishers. Statistical weighting was then used to enable production of findings that were representative of Australian recreational fishers.

The second key consideration was addressing potential sources of bias in survey responses. First, potential sources of bias were identified. Second, methods for reducing this type of bias when recruiting survey participants were identified where this was feasible. Third, methods for addressing the biases expected to be present in the sample, using statistical weighting, were identified. Three key types of response bias were examined:

- Non-response bias: The risk that some people who are eligible to take part will not participate in the survey, and that these people will differ to those who do respond in systematic ways. Non-response bias can be a consequence of many factors, including lack of interest in the survey topic, low trust in those administering the survey, and low trust that survey data will be used appropriately.
- Salience bias: The risk of survey responses being biased towards those who have a strong interest in the survey topic – in this case, more avid recreational fishers.
- Strategic bias: This is the risk that those completing the survey will seek to modify their answers to try to ensure survey results reflect a desired outcome, something particularly identified in studies that ask survey participants to rank preferred actions or policies (Lu et al. 2008, Burton 2010, Cheng et al. 2017, Meginnis et al. 2021).

Attempting to minimise these different types of bias can be challenging, as in some cases methods used to reduce one type of bias in responses may increase the risk of another type of bias. For example, seeking to reduce non-response bias through increasing interest in the survey may increase risk of strategic bias if the method used to increase interest involves describing how the findings will be used to inform recreational fishing policy: some participants may then seek to answer questions in ways that encourage the type of policy outcome they wish to see when data are used.

Table 3.3 summarises the areas in which risk of each type of bias was identified, and the methods used to (i) reduce the risk of bias when sampling, (ii) assess whether bias was likely to have occurred in the sample achieved, and (iii) reduce impact of bias via statistical weighting processes. These methods are described further in subsequent parts of this chapter, and in Appendix 2.5.

Survey instrument

The Stage 2 survey instrument was designed using the following steps:

- Identification of social and economic contributions to be examined (see other chapters in this report for a description of these, and why each was examined).)
- Initial draft questionnaire developed, reviewed by the project Steering Committee, and revised based on feedback received.
- Questionnaire revised after pilot testing in online focus group of six recreational fishers, who reviewed questions and provided feedback on how readily they could be understood and answered
- Full online pilot test with a sample of 40 recreational fishers, who completed the online survey, with responses reviewed to check for consistency and validity. All 40 could also provide feedback at the end of the survey identifying any issues or recommended changes. This pilot test informed a final review of the questionnaire.

As the survey contained a large number of questions, a key issue identified was a need to ensure those who lacked time could still participate. To address this, participants could opt to complete a short or long version of the survey. Appendix 2.6 identifies which items were removed from the short version.

Table 3.3 Methods used to minimise risk of non-response, salience and strategic bias affecting results of the Stage 2 survey

	Non-response bias	Salience bias	Strategic bias
Risks identified	Non-response was considered more likely amongst less avid fishers (those who fished fewer days per year, and those with a lower level of interest in fishing), and less likely amongst avid fishers (those who fished more often and for whom fishing was more important), based on published work identifying a bias towards higher rates of participation in fishing surveys by avid compared to non-avid fishers (e.g. Beardmore et al. 2015, Bellanger and Levrel 2017).	Higher response was likely from those with a stronger interest in the survey: more avid fishers were considered more likely to participate in the survey than non-avid fishers.	Some survey participants may seek to over-estimate their expenditure on fishing, in order to achieve a high estimate of the economic contribution of fishing. A smaller risk was identified that fishers may overstate social benefits of fishing, for similar reasons.
How was risk minimised?	Both non-response bias and salience bias were addressed using the same methods: 1. Survey recruitment methods included prize incentives that sought to increase interest in the survey amongst those with a lower interest in the topic: several studies have identified that prize incentives reduce non-response bias (see for example Preece et al. 2010, Olsen et al. 2012). 2. Wording of survey recruitment materials and at the start of the questionnaire explicitly encouraged those with low interest in fishing to participate. 3. Recruitment methods included use of an online panel sample that had lower risk of bias to less avid fishers, providing a comparison point. 4. Number of days fished was asked about in the survey, and included as a benchmark variable when weighting survey data, enabling correction of bias identified (described in Section 3.5.3). Importance of fishing was also asked about. It was assumed that importance of fishing and number of days fished were highly correlated, and hence that bias in response for both could be corrected through weighting for days fished. This was checked through conducting correlation analysis that confirmed a high correlation between days fished and self-rated importance of fishing to a person's life (see Chapter 4 for visual presentation of these data).		1. Monitoring for strategic bias while the survey was collecting responses. This included monitoring social media posts made on recreational fishing sites about the survey; asking recreational fishing stakeholders to report whether they heard any discussions suggesting people answer survey questions a particular way; and monitoring survey responses on a daily basis to identify unusual patterns of responses. 2. Assessing validity of survey responses. All survey responses were assessed for validity, and those in which there was a pattern of response indicating likely strategic bias were removed. This was assessed based on responses to expenditure questions: if a person indicated maximum expenditure in all or almost all categories asked about, their survey response was flagged and examined for consistency of this expenditure with reported days fished and other markers of avidity. A total of 10 survey responses were removed due to having markers of strategic bias, in the form of a person reporting fishing very few days and giving inconsistent expenditure data in relation to the types of fishing and fishing equipment reported in other parts of the survey. In addition, 26 surveys that were duplicates submitted on the same day were removed. 3. Asking for estimates of expenditure by item, and providing realistic categories of expenditure for each item (e.g. ice, bait, boat fuel). 4. Assessing patterns of response by survey recruitment method to identify whether there was evidence of systematic bias in response (described further in Chapter 12 & this chapter). This was particularly useful as it enabled identification of whether those who heard about the survey from specific networks, such as fishing clubs, reported systematically higher expenditure that was not explained by factors such as higher fishing avidity.

The resulting questionnaire included items asking about the following topics (see Appendix 2.6 for the full questionnaire):

- Consent to participate, and reasons for non-participation (those who opted not to participate were asked to identify if they chose not to participate due to fishing rarely or never, not being interested, lack of time, or other reasons).
- When respondent most recently fished, and number of fishing trips others in household did without the respondent.
- Whether respondent fished more or less than usual in the past 12 months, and the reasons for fishing more or less.
- Days spent fishing in last 12 months; days spent freshwater, estuary or saltwater fishing; whether engaged in shore-based, boat-based, competition or charter/guided fishing.
- Use of catch (consumption, catch and release, giving to others, bait).
- Type of people person fishes with (proportion of fishing trips spent fishing alone, with other household members, with children, with partner, with other family or friends).
- Importance of fishing as a way of connecting socially with different people (others who live in household, children, partner, other family and friends).
- Subjective wellbeing, self-rated general health, and Kessler-6 psychological distress scale (see Chapter 9 for a description of these and their sources).
- Challenging life events experienced in past 12 months (e.g. health challenges, changing job, shifting house, separation from partner, close family or friend member passing away, other stress).
- Engagement in physical activity (using measures recommended by the Australian Institute of Health and Welfare, as described in Chapter 8).
- Self-rated importance of fishing, and importance of different aspects of fishing such as relaxing, spending time outdoors, experiencing challenge, catching fish to eat, catching fish to release, exercise, learning about nature), as well as views about what makes a good fishing trip.
- Fishing experience in the past year, focusing on whether any factors reduced quality of fishing experience, such as overcrowding of fishing areas, rubbish, poor behaviour of other fishers, difficulty affording fishing, lack of facilities such as toilets, or concerns about safety).
- Engagement in different types of hobbies, sports and outdoor recreation (including fishing), their level of self-rated importance to the person, and whether person would choose these other activities or fishing if asked to make a choice between doing one or the other on a given day.
- Socio-demographic and geographic characteristics, including gender, age, cultural background, formal educational attainment, marital status, household composition and number of household members who fish, place of residence (state, locality and postcode), engagement in work/study/caring, household income, and self-rated household financial prosperity.
- Expenditure on fishing, with expenditure on a large number of specific items asked about, and questions asking about amount spent, proportion attributable to fishing where expenditure may be partly related to fishing and partly to other purposes, location of spending, and information on distances travelled to enable estimation of total vehicle costs attributable to fishing.
- Views about priorities for investing in recreational fishing to get best value for recreational fishers and the broader community.
- Bait and berley use and knowledge.
- Those who had not fished in the past five years or who had never fished were asked what level of interest they had in fishing, the main reasons they hadn't fished, and whether issues such as lack of time, risk of injury, concern about fish welfare, lack of skills, or lack of social connections with fishers, acted as barriers to going fishing.
- Likelihood of self or others in household fishing in the next 12 months.

- How the person heard about the survey.
- Willingness to be contacted about future surveys.

Survey mode and recruitment materials

Survey participants could complete the Stage 2 survey via two modes: online, or by completing a paper form which was provided with a pre-paid return envelope. All survey recruitment materials specifically described the survey as being about recreational fishing. Appendix 2.7 provides examples of the typical wording used in emails, letters, social media ads and flyers that were used to invite participation in the survey.

Recruitment methods

Stage 2 recruited participants using multiple methods, most of which involved non-probabilistic sampling methods (discussed in detail in Chapter 12, which compares findings by recruitment method). As noted earlier, the overall aim was to achieve a sufficient sample of each group that would form a 'cell' in the statistical weighting process (see Appendix 2.5 for description of the need for sufficient sample, and what a sufficient sample is considered to be). In Stage 2, this meant achieving sufficient sample of fishers of different types to support weighting of the survey sample using model-based weighting, and to be able to report results for different states and territories, urban versus rural areas, and avid compared to less avid fishers.

As identified earlier in this chapter, model-based weighting is done against a 'superpopulation' (or benchmark population) that specifies the characteristics of the population being sampled – in this case, recreational fishers in Australia, with the methods used to develop Stage 2 weights described in detail subsequently in this chapter. Recruitment was planned to support the intended subsequent model-based weighting. Model based weighting is most successful if a large sample is achieved of people with each of the characteristics included in the weighting ("benchmark data"). As described subsequently in this chapter, for recreational fishers these benchmark characteristics included gender, age, state/territory of residence, and fishing avidity. To ensure sufficient sample for both reporting against a range of groups, and for the weighting process, recruitment was designed to achieve at minimum 100 recreational fishers in each of the following groups:

- Living in each Australian State and Territory (with the exception of the ACT which was combined with NSW).
- Male and female fishers (a goal of at least 1,000 of each).
- Fishers in different age groups, with a goal of a minimum of 200 of those aged 18-29, 30-39, 40-49, 50-59, 60-69, and 70+.
- Fishers who fished more (avid fishers) and less frequently (non-avid fishers).
- Fishers who identified as Aboriginal and/or Torres Strait Islander.
- Fishers who were from non-English speaking backgrounds.
- Fishers with different levels of household income.

The minimum sample size of 100 was selected as it was higher than the minimum size of 25 recommended by Kaltan and Maligalig (1991), and reflects typical practice, although there is limited documentation of this practice in the literature on model-based weighting (Baxter 2016). It was considered particularly important to oversample avid fishers. This was done as highly avid fishers (for example, those fishing more than 20 days a year) make up a relatively small proportion of Australia's fishers (less than 5% by some estimates) but contribute a much larger share of fishing effort and expenditure. For example, the NRIFS found that 15% of all fishers accounted for about half of all fishing effort, and that the 3% of fishers who fished more than 25 days a year contributed 20% of

national fishing effort (Henry and Lyle 2003). Oversampling avid fishers increased ability to produce robust estimates of total fishing days and fishing expenditure, through ensuring the sample of those in the 'avid' group was large enough to capture what is often significant diversity in this group, and to be confident in estimates of expenditure and fishing days estimated across all fishers as a result. The design of sampling methods to achieve a large sample of avid fishers, as well as of the other groups identified, is described further in Table 3.4. The weighting subsequently applied ensured that this oversampling did not result in over-estimation of total expenditure, fishing days, or inaccurate estimation of other social and economic characteristics of Australia's recreational fishers (see Appendix 2.8).

Table 3.4 summarises the different recruitment methods used in Stage 2 and describes why each was used. As the majority of methods were non-probabilistic in nature (see Chapter 12), it was not possible for most to specific an exact sampling ratio. Instead, a mix of methods was selected that was expected to achieve the desired sample size of different groups specified. When sending flyers to letterboxes – the one method for which stratified random sampling was possible – the sample was stratified by state/territory to over-sample states and territories with smaller populations and achieve the desired sample size from smaller population areas. When using social media advertisements – a non-probabilistic method in which there is no sample frame, but it is possible to specify what audiences ads are displayed to - a progressive sampling strategy was used. Initially, ads were targeted across all of Australia, to all adults. The number of survey responses from different groups intended to form part of model-based weighting was monitored; where lower than desired numbers of responses were achieved in initial survey stages, social media ads were targeted to the groups from which there was lower response, in order to increase response.

Table 3.4 identifies biases expected to occur when using each recruitment method: these were identified based on known biases associated with different recruitment methods. These were used as guides to achieving desired sample size of different groups. For example, the recruitment methods were selected to ensure some were more likely to achieve responses from younger respondents, and some from older respondents; others were considered more likely to achieve responses from avid fishers. As noted in Table 3.3, a prize draw was offered as an incentive to participate in the survey: this included monthly prize draws while the survey was open, and a grand prize draw after the survey closed.

Sampling continued until the minimum sample size from different groups was achieved. However, where a minimum sample size was achieved, survey responses were still accepted from that group after this point. This was done for two reasons: (i) because the recruitment methods enabled continued data collection with very little cost per survey returned, due to the use of online survey completion, and (ii) as larger samples achieved beyond the minimum could improve sample reliability.

Table 3.4 Recruitment methods - Stage 2 survey

Recruitment method	Why used?	Predicted biases?
Email to Stage 1 participants. Stage 1 participants who were recreational fishers were invited to participate via a direct email from the research team	This mirrors the typical recreational fishing recruitment approach, in which recreational fishers are identified based on an initial screening survey (Stage 1 in the NRFS), followed by surveying fishers identified in the screening survey.	Bias to avid fishers, who are more likely to participate in subsequent surveys (e.g. Henry and Lyle 2003).
Flyer in letterbox. A small random sample of households were sent flyers advertising the survey. Households were selected at random across Australia, stratified by state/territory to enable larger sample from those with smaller populations.	This was used to test the effectiveness of using a commonly used probabilistic sampling method. It was expected that despite the probabilistic sampling, response bias may mean the response is biased to avid fishers.	Bias to avid fishers, as survey recruitment material identified that the survey focused on recreational fishing.
Recreational fishing organisations. Recreational fishing organisations across Australia – from national peak organisations through to local fishing clubs – were asked to send emails inviting their members and networks to participate in the survey.	This was used as it is a useful way to reach large numbers of highly avid fishers. As only a small proportion of Australia's fishers are members of recreational fishing organisations, the resulting sample was not expected to be representative of all recreational fishers.	Strong bias to very avid and enthusiastic fishers expected, as these are more likely to be members of organisations. Higher risk of strategic bias.
Friends/family. While not a formal recruitment method, all survey participants were invited to pass information about the survey to others they knew who might wish to participate.	It was unknown what type of sample might be achieved through this 'snowball sampling'. This recruitment method was included to enable assessment of the quality of responses from those recruited using it.	Likely biases from this method were unknown. However, there was considered to be a higher risk of strategic bias than from other methods.
Social media. Social media posts were used to advertise the survey, and advertisements placed in Facebook and Instagram feeds. Advertisements were initially targeted to all adults. As data collection progressed, assessment of responses was done to check sample achieved; subsequent ads were targeted to regions/groups with lower numbers of survey responses.	The larger social media platforms have many more unique users in Australia compared to many survey databases. There is also some evidence that younger people are more likely to respond to survey invitations seen on social media than received by phone or mail.	Possible bias to younger fishers, female fishers (women are more frequent users of social media than men) and avid fishers.
Traditional media. The survey was promoted in radio shows, magazines and newspapers, with several fishing magazines and columns encouraging their readers to participate.	This was used as a 'traditional' non-probabilistic method of recruiting survey participants.	Expected bias to older fishers (higher users of traditional media) and avid fishers.
Flyer/poster in tackle shop. Some tackle shops provided flyers to customers encouraging survey participation.	This was originally intended as a significant recruitment method, however COVID-related lockdowns limited its use and few responses were received using this method.	Unknown
Online panel. The Qualtrics blended online survey panel service was used to recruit participants. This was done by specifying a quota sample that was representative of the Australian adult population as a whole. Non-fishers were recruited as well as fishers, enabling comparison to Stage 1 estimates of participation in fishing.	Used as online panels are growing rapidly in size and use, with potentially more success in recruiting younger participants than other recruitment methods, and less likely to be biased to avid fishers than other methods as participants receive an incentive to complete surveys of all types, rather than needing to be highly interested to participate.	Likely bias to younger fishers. Little to no expected bias to avid fishers (unlike all other methods).

3.5.3 Sample and weighting

Valid sample

Prior to data analysis, Stage 2 data were processed and cleaned using the same methods as those described for Stage 1. After removal of invalid surveys, the total valid survey sample was 20,368. This figure includes all respondents, whether or not they had fished in the past 12 months. Those who had last fished more than 12 months ago, or who had never fished, were included in the valid sample as these groups were analysed to provide a better understanding of fishing participation and the substitutability of fishing for other activities.

As noted earlier, some survey questions were asked only of those who indicated willingness to complete a longer survey (see Appendix 2.6). In total, 37.4% of respondents opted to complete the short survey, while 62.6% completed the long version of the survey. This means that the number of respondents to the questions asked of 'long survey' participants is, at maximum, 12,750 respondents. In reality, the number of respondents is typically lower than this, as not all respondents completed every question on the survey, although typically more than 95% of participants eligible to answer any individual survey question completed it. In some cases, imputation of missing data was used when analysing measures that had some missing data. For example, Chapter 7 reports findings of analysis that includes a small amount of imputed data. As discussed in Chapter 7 and associated appendices, where respondents had answered almost all questions about fishing expenditure, and left only a small amount of information incomplete, the missing data were imputed by imputed the average figure for those who had similar patterns of expenditure on items that were completed by the respondent. A small amount of imputation was also undertaken when analysing data on substitutability of fishing for other activities, and is described in Chapter 6. Unless otherwise stated, no imputation has been used. Where imputation was undertaken, imputed data represent a very small proportion of the data included in an analysis, and the rationale for using imputation, and method of imputation used, are described in the methods section of the relevant chapter of findings.

Table 3.5 identifies the number of survey participants recruited using different methods in the Stage 2 survey, and the subsample within each that had (i) fished within the past 12 months, and (ii) who were more avid versus less avid fishers.

Table 3.5 Stage 2 sample, by recruitment method, fishing participation, and fishing avidity

Recruitment method	Total participants (fishers and non-fishers)	Number who fished within the last 12 months	Number who fished <10 days	Number who fished 10-19 days	Number who fished 20+ days
Email to Stage 1 participants	4515	1707	886	372	449
Flyer in letterbox	374	179	117	30	32
Recreational fishing organisations	1076	931	230	215	486
Friends/family	876	594	251	112	231
Social media	4836	4215	948	962	2305
Traditional media	446	385	80	89	216
Flyer/poster in tackle shop	124	61	35	17	9
Online panel	7625	2474	1312	355	313
Did not state how they heard about survey	496				
TOTAL	20,368	10,546	2,152	4,041	3,859

Evaluating and addressing bias in survey responses

As noted earlier, all phases of the design, implementation and analysis of the Stage 2 survey sought to reduce the risk of non-response, salience and strategic bias. In addition to designing sampling methods to reduce risk of bias, survey responses were monitored as data were being collected to check for potential signs of bias, focusing on monitoring those methods with the greatest risk of strategic bias: social media, recreational fishing organisations, traditional media and friends/family. During the survey implementation phase, recreational fishing social media and news media sites, including websites of fishing organisations, were monitored to identify what was being communicated regarding the survey and whether there appeared to be any encouragement of fishers to participate in ways that may over-state economic or social contributions of fishing. Recreational fishing stakeholders involved in the project were asked to notify the research team if they became aware of any discussions that might, inadvertently or deliberately, encourage survey participants to answer some survey questions in a specific way (in particular, to overstate expenditure or social benefit). During this time, a total of 13 social media posts were identified that might encourage over-statement of spending, and three stakeholders reported that they heard discussions in which recreational fishers were encouraged to 'ensure the survey showed the full benefit of fishing' or similar. While none of these involved overt encouragement to mis-state fishing activity or expenditure, all involved fishers being encouraged to participate in order to document the full benefit of fishing. A typical example is provided below, with some words altered to protect the confidentiality of the person who posted this on a fishing club social media site:

> *It's been 20 years since a national recreational survey was done. Help show how important recreational fishing is by doing the survey here – we want all enthusiastic fishos to take part and show just how many people fish in [region]*

While often well intentioned, this type of encouragement has the potential to result in conscious or unconscious overstatement of subjects such as expenditure when answering survey questions. Where a post such as this was identified, survey responses recorded in the week after the post were analysed to identify if there was any noticeable change in the amount of expenditure or fishing importance reported by respondents. Specifically, the average score and distribution of responses for both expenditure and importance was examined, and compared to those in previous weeks, to identify whether there was an increase in the proportion of respondents reporting higher levels of importance or expenditure (see Appendix 2.8.6). No identifiable changes were found, other than a small number of invalid surveys that were removed as they had clearly inconsistent responses for expenditure on fishing relative to days spent fishing and types of fishing done in the past year.

To further examine the likely scope of strategic bias in survey responses, two methods were used. Each was used with the intention of identifying whether any survey responses should be removed from the sample due to likely strategic bias.

First, the survey team compared the survey responses to two social media posts, each of which was advertised to the same demographics in Facebook and Instagram. One post emphasised the importance of fishers ensuring Australians understanding the value of fishing – presenting the same heightened risk of strategic bias identified in the post above. The second was designed to be more neutral in phrasing and did not explicitly mention economic and social value of fishing. Surveys completed via click-through from each of these posts were compared to identify whether there was any evidence that the first ad (which may trigger unconscious strategic bias) resulted in survey responses that reported higher expenditure on fishing compared to the second ad. The findings are reported in Appendix 2.8.6 and found no significant difference in response. This suggested that it was unlikely that variations in communication about the survey of these types contributed to strategic bias at a scale that would significantly change results. This comparison was done to test the extent to which a known difference in survey promotion wording resulted in significant difference in survey responses, as this is one potential trigger of strategic bias documented in the literature. However, survey promotion methods are not the only potential factor that may cause strategic bias.

The other factor often described as having potential to trigger strategic bias is encouragement of participation in a survey by those with a high level of interest in demonstrating that recreational fishing has significant economic and social contributions. Survey findings were analysed to identify whether there was evidence consistent with this occurring. This was done by comparing the distribution of expenditure reported by survey participants by recruitment method. Two recruitment methods were expected to recruit less avid fishers who were likely to spend less on fishing and fewer days on average: recruitment of previous participants in the Regional Wellbeing Survey; and recruitment of participants from an online panel. It was expected that other recruitment methods – traditional media, social media, fishing clubs, and word of mouth amongst friends and family – would be biased to more avid fishers, who are likely to spend more on fishing and fish a larger number of days. As shown in Table 3.6, findings were consistent with expectations: fishing expenditure and fishing days were lower amongst those recruited via the RWS and online panel; and higher amongst those recruited via media, fishing clubs and word of mouth. Amongst RWS and online panel respondents, almost two-thirds of fishers who responded reported spending less than $1,000 on fishing in the previous 12 months. Meanwhile, only one in four of those recruited via a fishing club spent less than $1,000 on fishing in the previous 12 months, while 34.2% of those recruited via social media did so, as did 45.9% of those recruited via word of mouth (Table 3.6).

Importantly, expenditure was consistently correlated with days spent fishing. Once differences in days spent fishing were accounted for, there was no remaining significant effect of recruitment method. This suggests that the differences in data reflect differences in fishing avidity, with no evidence that there remained a higher level of expenditure reported by those recruited via fishing clubs, word of mouth etc after accounting for avidity. In turn, this suggested that the expected (and intended) bias to more avid fishers from some recruitment methods could be addressed in the weighting process, through ensuring data were weighted based on benchmarks for days fished, described in the next section. The high correlation between reported expenditure and days fished meant that this process could be used to effectively address the intended bias in recruitment towards more avid fishers (and addressed under-recruitment of those with lower interest in fishing). Chapter 12 discusses this in further detail, and presents findings of regression modelling to test differences between recruitment methods after controlling for factors used to weight the dataset (see next section for discussion of weighting).

Table 3.6 Distribution of expenditure on fishing reported by survey participants recruited using different methods (unweighted data)

Reported fishing expenditure in the previous 12 months	Traditional media (n=394)	Social media (n-4414)	Friends or family (n=651)	Fishing club (n=960)	Flyer or email (n=2215)	Qualtrics online survey panel (n=2077)
Less than $1,000	24.9%	34.2%	45.9%	23.6%	64.6%	67.7%
$1,000 to $2,999	16.2%	14.3%	10.3%	12.4%	8.4%	13.3%
$3,000 to $4,999	16.5%	14.9%	10.3%	17.0%	7.6%	6.3%
$5,000 to $9,999	18.3%	16.7%	15.8%	22.8%	8.0%	7.5%
$10,000 or more	12.2%	8.6%	7.5%	12.4%	5.5%	5.2%
Median number of days fished in previous 12 months	15-19 days	10-14 days	10-14 days	15-19 days	3-4 days	3-4 days

Weighting

A single step model-weighting process was used to weight Stage 2 data, in which a recreational fisher 'superpopulation' developed for this project was used to develop statistical weights that could be

applied to the sample. A superpopulation means, simply, a model that specifies what a population looks like – in this case, the population of recreational fishers. A key challenge when doing this was that there is no readily available, up to date data set that can be used to identify the characteristics of recreational fishers. Instead, a picture of what the characteristics of recreational fishers needed to be built by reviewing available information from a range of studies for consistency, and identifying the most plausible range of characteristics for recreational fishers. For some types of descriptors, such as information on the distribution of household income amongst fishers, there was only one available source of information able to be used to develop the superpopulation. Appendix 2.8 provides a detailed description of the superpopulation, including how it was developed, and the benchmark data sources used to develop it: this identifies the characteristics of fishers for which it was possible to draw on multiple sources, versus only a single source, of benchmark data.

The superpopulation model was used to generate weights that were used to generate findings from survey data. When these weights were applied, the findings generated were representative of the adult Australian recreational fishers, based on the specifications of the characteristics of these fishers included in the superpopulation model. These benchmarks are specified in Table 3.7.

Weights could be developed only for those who had fished within the past 12 months – 'current fishers'. This is because available information about recreational fishers has in almost all cases examined those who have gone fishing in the past 12 months. This means that for Stage 2 data, weights could be developed for current fishers, but not for other groups of fishers, such as those who most recently went fishing between two and five years before completing the survey (recent fishers) or those who last went fishing more than five years previously (past fishers). Stage 2 data were only used to make estimates about the whole population when weighted data could be used – in other words, when analysing current fishers. For example, the data examining the economic contribution of fishing are based on weighted data of current fishers.

Data that could not be weighted – for recent and past fishers – was used in some analyses where weighting was not necessary to generate meaningful results. Each results chapter explains whether the weights developed for Stage 2 were used when analysing data.

The recreational fisher superpopulation against which the sample was weighted specified the characteristics of Australian adult recreational fishers using the following criteria: gender, age, fishing avidity (days fished in past 12 months), state/territory of residence, whether the person lived in a major city or other location, household income, cultural background – whether a person identified as Aboriginal/Torres Strait Islander, cultural background - whether the person was born in Australia, in another English-speaking country, or in a country where English is not the main language spoken. When developing this superpopulation, for each of these criteria past studies were reviewed to identify the range within which recreational fishers were likely to fall – for example, identifying based on studies in recent years what proportion are likely to be female versus male, and the range within which these are likely to fall. As noted earlier, for some characteristics, only one source of data was available, while for others multiple sources of information could be drawn on to identify a suitable benchmark range. Appendix 2.8 specifies sources of data used. The sensitivity of findings to variation in the superpopulation model specifications were then examined, identifying how different findings were for a range of economic and social measures when using the lowest and highest points of possible variability (detail provided in Appendix 2.8, Table A2.8.18). It was found that findings had relatively low sensitivity to variation of the superpopulation parameters.

Given this, the benchmark used for the weighting represented the 'mid-point' amongst estimates of the distribution of recreational fisher characteristics such as gender, age, place of residence, education and household income. Table 3.7 details these benchmarks. In all cases, testing of sensitivity of findings to variation in weights suggested that variation resulting from the change in weighting criteria was much smaller than estimates of overall sampling error and hence much smaller than estimated confidence intervals. This means that the confidence intervals reported throughout this report are likely to give a useful guide to the likely range of true values, even if some weighting parameters are changed.

Table 3.7 Recreational fisher superpopulation model specifications used to weight sample

Characteristic	**Benchmark categories**	**Benchmark - recommended**	**Notes** (also see Appendix 2.8.4 and Table A2.8.17 for more detailed information)
Gender	Female Male	34% 66%	While survey participants could identify as being neither male or female, too few participants identified this to be used as a third gender category.
Age	18-29 30-44 45-59 60+	23% 27% 23% 27%	While these age ranges were used for purposes of weighting, age was recorded in single years in the survey, enabling the age variable to be analysed as a continuous variable or grouped variable depending on which was most appropriate for the analysis in question. It was possible to use other age ranges for grouping.
Avidity (days fished last 12 months)	1-4 days 5-9 days 10-19 days 20+ days	68% 17% 10% 5%	Data on avidity was recorded in the survey in greater detail than is shown in these categories; these four categories were used for purposes of weighting as they represented four reasonably distinct clusters of recreational fishers.
State/territory	NSW/ACT VIC QLD SA WA TAS NT	30.5% 19% 24.5% 9% 13% 2.5% 1.5%	
Urban/rural	Major city Elsewhere	59.5% 40.5%	For these characteristics, there was only one source of benchmark data: the 2018 RWS. The recommended benchmark level was identified by examining 95% confidence intervals to identify the potential range within which the true value falls. For example. The 95% confidence interval was used to identify that there was 95% confidence that between 57.7% and 61.3% of recreational fishers lived in major cities, with the mid-point being 59.5%. Appendix 2.8 presents the ranges examined.
Household income	<$20,800 $20,800-$41,599 $41,600-$90,999 $91,000-$155,999 $156,000+	11.4% 14.0% 24.5% 35.6% 14.5%	
Aboriginal/Torres Strait Islander (as	ATSI Other	4.4% 95.6%	
Born in Australia, overseas	Born Aus Born o/s – English sp. Born o/s – non-English speaking	79.5% 10.8% 9.7%	

3.5.4 Stage 2 data analyses

Data from Stage 2 were used to examine the following aspects of the economic and social contributions of recreational fishing:

- Substitutability of fishing (Chapter 6)
- Economic contribution of recreational fishing (Chapter 7)
- Physical activity and recreational fishing (Chapter 8)
- Wellbeing and recreational fishing (Chapter 9)

In addition, Stage 2 data were used together with data from Stage 1 to examine the socio-demographic characteristics of those who do and do not participate in fishing (Chapter 4) and to assess evolving methods for collecting social and economic recreational fishing data (Chapter 12).

3.6 Stage 3: Monthly surveys and 'wash-up' survey

3.6.1 Objectives

Many recreational fishing surveys in Australia use surveys conducted on a regular basis, such as once a month, to collect data on fishing catch and effort (see for example Henry and Lyle 2003, Webley et al. 2015, West et al. 2015, Ryan et al. 2019, amongst others). This has been found to be important as recall bias is minimised if a person is asked to report effort and catch within a relatively short timeframe after a fishing trip occurs, whereas recall is likely to be poorer if a person is asked about their fishing a longer time after it has occurred (Tarrant et al. 1993).

There is less evidence regarding the importance of regular data collection for assessing economic and social contribution of recreational fishing.

Stage 3 of the NRFS originally had the goal of using monthly surveys and a 'wash up' survey to test the effectiveness of expenditure and avidity recall, and to collect longer-term data on the wellbeing of fishers. However, the COVID-19 pandemic occurred shortly after monthly surveys began, and substantially affected fishers' ability to go fishing; COVID-19 also had important impacts on the wellbeing of many Australians, including recreational fishers. These factors created unique challenges for tracking whether likely changes in wellbeing were associated with changes in recreational fishing or with impacts of COVID-19. Given these challenges, the original objectives were amended to collect data over a longer time period, to understand how participation in fishing changed and what impacts COVID-19, the 2019-20 Black Summer bushfires and subsequent floods had on recreational fishing activity.

As a result, data collection in Stage 3 had the following objectives:

- Collect data on event-based fishing activity and associated expenditure
- Collect data on special topics, focused on the impacts of the COVID-19 pandemic and other challenging events, use of fishing apps, and views about participating in some types of stewardship activities
- Collect additional data examining wellbeing of recreational fishers.

3.6.2 Data collection methods

Stage 3 collected data via online surveys sent to those who in Stage 2 stated that (i) they expected they or others in their household would go fishing in the next 12 months, and (ii) gave permission to be contacted regarding participating in future surveys. The first two Stage 3 surveys were also promoted online via the NRFS website and social media, in case any additional participants wished to participate. The 'wash up' survey included both those who participated in monthly surveys during Stage 3, and an additional sample collected via the 2021 Regional Wellbeing Survey.

Key considerations and decisions

Stage 3 required asking the same group of fishers to continue participating in a survey over a long period of time. Originally, this was planned to occur in a series of ten monthly surveys conducted after the closure of the Stage 2 survey, followed by a final survey asking about recall of fishing activities over the previous 12 months (the same period the monthly surveys would have captured).

However, the Stage 2 survey was run for an extended period of time – closing in May 2020 - due to challenges including the Black Summer bushfires impacting originally planned data collection during Spring 2019 and Summer 2019-20. Consideration was given to either delaying the start of monthly surveys until after May 2020 or conducting an initial monthly survey that would not contain the full sample of people who ultimately were asked to participate in monthly surveys (due to the Stage 2

survey not yet having closed). The decision was made to conduct a survey in March 2020, as it was considered important to ask those who had completed the NRFS before January 2020 how their fishing had been impacted during the summer of 2019-20 by the Black Summer bushfires. This first survey was sent to those who had completed the Stage 2 survey up to December 2020 and asked about the full three-month period of fishing over summer 2019-20.

Following the closure of the Stage 2 survey, in late May 2020 the first 'full' monthly survey was conducted. It was apparent at this stage that COVID-19 lockdowns would be affecting fishing for some time. Some fishers had contacted the research team asking that the survey be moved to two-monthly during lockdowns when limited fishing was possible for many. The NRFS Steering Committee, in discussions about the impact of the pandemic on data collection, discussed whether to completely pause data collection, to shift to two-monthly surveys to enable data collection for a longer period of time that would better identify how fishing changed through different periods of travel restriction, or to complete monthly surveys as originally planned. A decision was made to extend the time period in which data were collected, by conducting surveys once every two to three months, each of which asked about fishing activity that occurred during each month of that two-to-three-month period. This was considered to provide the best opportunity of capturing how fishing effort changed through the COVID-19 pandemic, and potentially capturing at least some 'normal' fishing months in which fishing effort was not substantially impacted by restrictions imposed due to the pandemic.

These decisions meant that the Stage 3 surveys captured data over an 18-month period, instead of the originally planned 12-month period, and that most surveys asked participants to report on fishing activities for the previous two or three months, whereas the original intention had been to ask predominantly about a period of a single month.

Survey instruments

The Stage 3 survey questionnaires had two types of questions. First, the surveys included questions that were repeated in every survey, namely number of fishing trips undertaken by month (if the survey asked about a two-month period, respondents were asked to report for each month separately), fishing expenditure, wellbeing, and socio-demographic characteristics. Second, some surveys also asked questions about a 'special topic' that was only asked about in that specific survey. Appendix 2.9 provides the full questionnaires; a summary of the questions asked is provided below.

The following questions were asked in all surveys:

- Number of day and overnight fishing trips undertaken, by month, by person completing survey and by other members of their household
- Whether the amount of fishing undertaken in the months asked about was more or less than the amount undertaken in the equivalent months a year previously, and reasons for fishing less/more
- Type of fishing trips (freshwater, saltwater, estuary, shore-based, boat-based, competition, charter) and number of people who went fishing, and whether fishing was the main or secondary purpose of each trip
- Distance travelled, and expenditure on transport, bait, berley, ice, other fishing supplies, food and drink consumed while on the trip, fishing licence/permit, charter/guide/competition fees, boat running costs, accommodation costs
- Subjective wellbeing, overall health, and psychological distress
- Sociodemographic characteristics including gender, age, cultural background, education, work/study/caring status, and location of residence (in later surveys, participants were asked if these had changed; if they had not, information provided in earlier surveys was used).

The following special topics were asked about in the surveys:

- Impacts of Black Summer bushfires and subsequent storms/flooding on fishing
- Impacts of COVID-19 on frequency and types of fishing done
- Preferred ways of keeping in touch with fishing when unable to physically go fishing during a lockdown
- Substitution of other activities for fishing when unable to fish due to COVID-19 related restrictions
- Use of fishing apps
- Accessing fishing information, particularly about fishing responsibly
- Engagement in fishing stewardship activities
- Use of the tackle box app (findings reported in Schirmer 2021).

Survey mode and recruitment materials

Survey participants could complete Stage 3 surveys via two modes: online, or by completing a paper form which was provided with a pre-paid return envelope.

Recruitment methods

Survey participants for the Stage 3 surveys were recruited through direct email invitation sent to Stage 2 survey participants who had given their permission to be contacted for subsequent surveys. Participants were given the option to opt-out of future surveys if they did not wish to continue completing regular surveys. For each survey, up to two reminders were sent about the survey.

In addition to the online surveys, a small number of people (nine) were initially sent paper surveys, as they had indicated a preference for these. After being encouraged to use either medium, four opted to complete the survey online; the remaining five did not return a completed paper survey or complete an online survey.

For the wash-up survey conducted at the end of Stage 3, participants were recruited using the process described above, and through the Regional Wellbeing Survey (RWS). RWS participants in the final survey were recruited using the same methods described for Stage 1 of the NRFS.

3.6.3 Sample and weighting

The sample achieved in each of the Stage 3 surveys is summarised in Table 3.8. As can be seen, the largest number of survey responses was achieved in July 2020, with 1,491 survey participants. From this point, participation declined, with only 34.7% of these 1,491 participants completing the final monthly survey in July 2021. This was a high rate of drop-out compared to monthly diary surveys in other recreational fishing studies. As is discussed further in Chapter 12, the high rate of drop out was at least partly (and possibly largely) due to the following factors: lack of personal contact via phone or email, with online surveys and emails that were not personalised to the individual respondent being more impersonal; frustration with completing expenditure questions on a regular basis; and the extended time period over which data were collected with longer periods of time between each survey than originally intended.

Analyses conducted using data collected in the Stage 3 monthly surveys did not use statistical weights. Limitations of the sample considered likely to have resulted from the biases in both the fishers who opted to participate in monthly surveys, and from drop-out of participants during Stage 3, are discussed as analyses are presented.

Table 3.8 Number of respondents – Stage 3 surveys, by survey

Month in which survey was conducted	Period of fishing activity asked about in survey	Special topics asked about (if any)	Number of respondents
March 2020	Dec 2019, Jan 2020, Feb 2020	Bushfire, drought, rainfall, flood impacts on fishing Emerging COVID-19 impacts on fishing	794
May 2020	March 2020, April 2020	Use of fishing apps Accessing fishing information Staying in touch with fishing during COVID-19 Stewardship activities Tacklebox app	1286
July 2020	May 2020, June 2020	COVID-19 impacts on recreational fishing	1491
September 2020	July 2020, Aug 2020	Brief questions about COVID-19 impacts	1086
October 2020	Sep 2020	As above	693
December 2020	Oct 2020, Nov 2020	None	655
February 2021	Dec 2020, Jan 2021	None	659
May 2021	Feb 2021, Mar 2021, Apr 2021	None	584
July 2021	May 2021, June 2021	None	517
Final survey – conducted Oct-Dec 2021	Asked for recall of previous 18 months of fishing activity	Stewardship, COVID-19 impacts on fishing	8,042 (includes both regular Stage 3 participants and RWS participants)

3.6.4 Stage 3 data analyses

Data from Stage 3 surveys informed the following analyses:

- Impacts of natural disasters and COVID-19 (Chapter 5)
- Substitutability of fishing (Chapter 6)
- Recreational fishing and environmental stewardship (Chapter 11)
- Survey data collection methods (Chapter 12).

4. Participation in recreational fishing in Australia

Chapter authors: Jacki Schirmer, Krystle Keller and Andy Moore

4.1 Key points

- In 2018, an estimated 1 in 5 Australian adults went fishing at least once - this equates to 4.2 million Australians
- In 2020 there was no significant change in the proportion of people who went fishing at least once, despite the impacts of the COVID-19 pandemic (however, the number of days spent fishing did change, examined in Chapter 5)
- These estimates suggest that national participation in recreational fishing in both 2018 and 2020 was at similar levels to that recorded in 1999-00 in the NRIFS (19.5%)
- Recreational fishing participation was higher amongst males than females, younger age groups, those living in regional and remote areas compared to major cities, and Aboriginal and Torres Strait Islander peoples
- Recreational fishing participation rates were lowest in Victoria and New South Wales/the Australian Capital Territory and highest in the Northern Territory
- Most recreational fishers fished less than five days a year, however some fished more than 52 days a year
- Common reasons for fishing less in a given year were work commitments, poor weather on fishing days, increased commitments at home, a lack of available fishing companions, and poor environmental conditions.

4.1 Introduction

Past studies suggest that recreational fishing is an outdoor activity undertaken by many Australians each year (Henry and Lyle, 2003). The NRIFS estimated that approximately 19.5% (3.36 million) of Australians aged five and older had fished over a 12-month period in 1999-2000 (Henry and Lyle, 2003). However, while fishing is generally considered a popular activity in Australia, concern has been expressed that participation in recreational fishing may be declining (Winstanley, 2019). Internationally, some studies have reported decline in the proportion of people participating in recreational fishing in North America (e.g. Fedler and Ditton, 2001), Europe (e.g. van der Hammen and Chen, 2020), as well as more generally in developed countries (Arlinghaus et al. 2015).

However, as is explored further in this chapter, not all available evidence is consistent with a long-term decline in recreational fishing participation in Australia. There is very little information available on whether participation is increasing or decreasing amongst different demographic groups, or the factors motivating participation in fishing or acting as barriers to participation.

This chapter examines participation in recreational fishing in Australia, exploring:

- **Measurement of participation:** How has participation in recreational fishing been measured in previous studies, and what are the benefits and limitations of different approaches to defining and measuring participation?
- **Overall participation in recreational fishing:** What do past studies tell us about changing participation in fishing, and what are the findings of this study regarding participation?
- **Who is and isn't going fishing:** Which groups of Australians are more likely to be current fishers, past fishers who stopped fishing at some point, or to have never tried fishing?

- **Fishing avidity and importance**: Which fishers are more likely to fish frequently, and to identify fishing as being highly important to their life? What is most important about fishing for different recreational fishers?
- **Drivers of short-term and long-term change in fishing participation:** Are some fishers more likely than others to stop fishing for a year or two, or for a longer period of time? Why don't people take up fishing? Who is least likely to go fishing, and why don't they go fishing?

Before presenting findings, Section 4.2 reviews the measurement of participation in recreational fishing, including definitions of recreational fishing.

4.2 Measuring participation in recreational fishing

Many Australians participate in recreational fishing. It is useful to understand what proportion of people engage in recreational fishing, both in the short term (for example, how many have gone fishing within the previous 12 months) and in the long term (for example, how many have tried fishing at some point in their life, even if not recently). This study examined short versus longer term engagement in fishing as it was considered likely that this could help shed light on whether some people are less likely to try fishing than others, or whether particular groups of people were more likely than others to be switching from recreational fishing to other activities. Previous studies have not typically examined the differences in recent versus longer term engagement in fishing. Estimating participation is also critical for producing estimates of the economic contribution of recreational fishing, being a key variable in the estimates reported in Chapter 7.

While understanding participation is important for these reasons, it should not be assumed that higher rates of participation are always 'better'. Higher rates of participation do not necessarily equate to higher levels of economic or social benefit being achieved from recreational fishing. For example, a rapid increase in fishing participation could potentially lead to overcrowding at popular fishing spots, and a consequent decline in the social benefits of fishing for many fishers. Similarly, this overcrowding might mean some fishers who previously fished many times a year go fishing less often, and hence spend less on fishing. In this hypothetical scenario, this might result in expenditure being spread across a larger number of fishers but does not necessarily grow.

4.2.1 Who should be considered a 'recreational fisher'?

The question 'how many Australians are recreational fishers' may seem simple to answer: in reality, the answer to this question will vary considerably depending on how participation in recreational fishing is defined, and what activities are included in the definition of recreational fishing. Is a person who loves going fishing, but hasn't gone fishing for more than a year, still considered a recreational fisher? Is the answer to this question different if the person has spent money on fishing gear or fishing magazines in the last year? Is a person who went on a fishing trip not because they wanted to, but because everyone else in their family wanted to go, a recreational fisher? Does recreational fishing include spear fishing, digging for pipis, and yabbying on a farm dam? It is therefore important to clearly define who is considered to be a recreational fisher. Definitions of recreational fishing and fishers are reviewed in Appendix 3.1; this review was used to identify the definitions used in this study.

This study defines a current recreational fisher as **a person who goes fishing at least once in a 12-month period, with fishing meaning actively seeking to catch aquatic organisms for non-commercial purposes using any method.** This definition includes some types of fishing sometimes considered to be cultural, or subsistence, forms of fishing.

This definition has important limitations. It does not capture all those with an interest in recreational fishing, or all benefits generated by recreational fishing. For example, a person who spends money on fishing gear, magazines or books but does not go fishing will not be counted as a recreational fisher when using the definition above, despite having generated some economic activity that is related to

recreational fishing. It does not include people who self-identify as a recreational fisher, but who have not managed to go fishing within the past 12 months. It has potential to include people who went fishing, but who do not consider themselves to be recreational fishers. For example, a person who is asked to hold a fishing rod for someone else when spending a day with friends may technically have 'gone fishing' but have no interest in recreational fishing.

Given these limitations, some additional types of recreational fishers were also examined as part of this study, resulting in four groups being examined:

- Current fishers: Those who fished at least once in the previous 12 months
- Recent fishers: Those who did not fish in the past 12 months, but had fished within the previous five years
- Past fishers: Those who have fished at some point in their life, but last did so more than five years ago
- Non-fishers: Those who have never gone fishing at any point in their life

Ideally, this study would also examine those people who are engaged in recreational fishing in ways other than actively fishing, for example through involvement in fishing clubs, recording scores at fishing competitions, helping organise fishing days, or other activities. However, while the surveys conducted allowed identification of people in this group, there was too small a sample who met these criteria to enable analysis of their characteristics.

4.2.2 Is participation in recreational fishing declining in Australia?

It is common to hear concerns raised about declining participation in recreational fishing in Australia (e.g. Winstanley 2019). However, available evidence does not show a significant decline, instead showing varying findings depending on which studies are compared, and in what State or Territory.

The NRIFS estimated that 19.5% of Australians aged 5 and older went fishing at least once in the 12 months to May 2000. Subsequent studies of recreational fishing effort undertaken in different States and Territories (Figure 4.1 and Appendix 3.1) have estimated between 12% and 32% of adults fish in a typical year, with large differences in the rate of participation in different states and territories, and sometimes some differences identified over time in a specific state or territory. The majority of studies undertaken since 2000 have found participation rates between 18% and 26%, with lowest participation rates in NSW and Victoria, and highest participation rates in WA and the NT (Figure 4.1).

It is evident from Figure 4.1 that participation rates have been estimated infrequently in most States and Territories. Across these infrequent estimates, there is no clear trend of declining participation. For example, in NSW participation was estimated at 17.1% of residents aged five and older in 1999-00, 11.7% in 2012-13, and in this study was estimated to be 19.6% of adult Australians as of 2018. In contrast, in WA, studies recorded small growth in participation after 1999-00, with participation growing from 28.5% to 32.0% in 2010-11, and subsequently falling slightly to just over 25% based on separate studies conducted during 2017-19.

The data in Figure 4.1 do suggest it is possible that participation in fishing fell somewhat during the period 2005-06 to 2013-14, with most (but not all) studies conducted during this period showing lower participation in fishing than was identified in the NRIFS. After this time many (although not all) studies show higher participation rates.

Overall, it is not possible to state with confidence that participation in recreational fishing has risen or fallen over the long term in any of the jurisdictions shown in Figure 4.1 – particularly if confidence intervals are taken into account (these are provided in Appendix 3.1), with some of the apparent changes potentially being the result of sampling variation and differences in methods used across studies rather than of actual change in how many people go fishing.

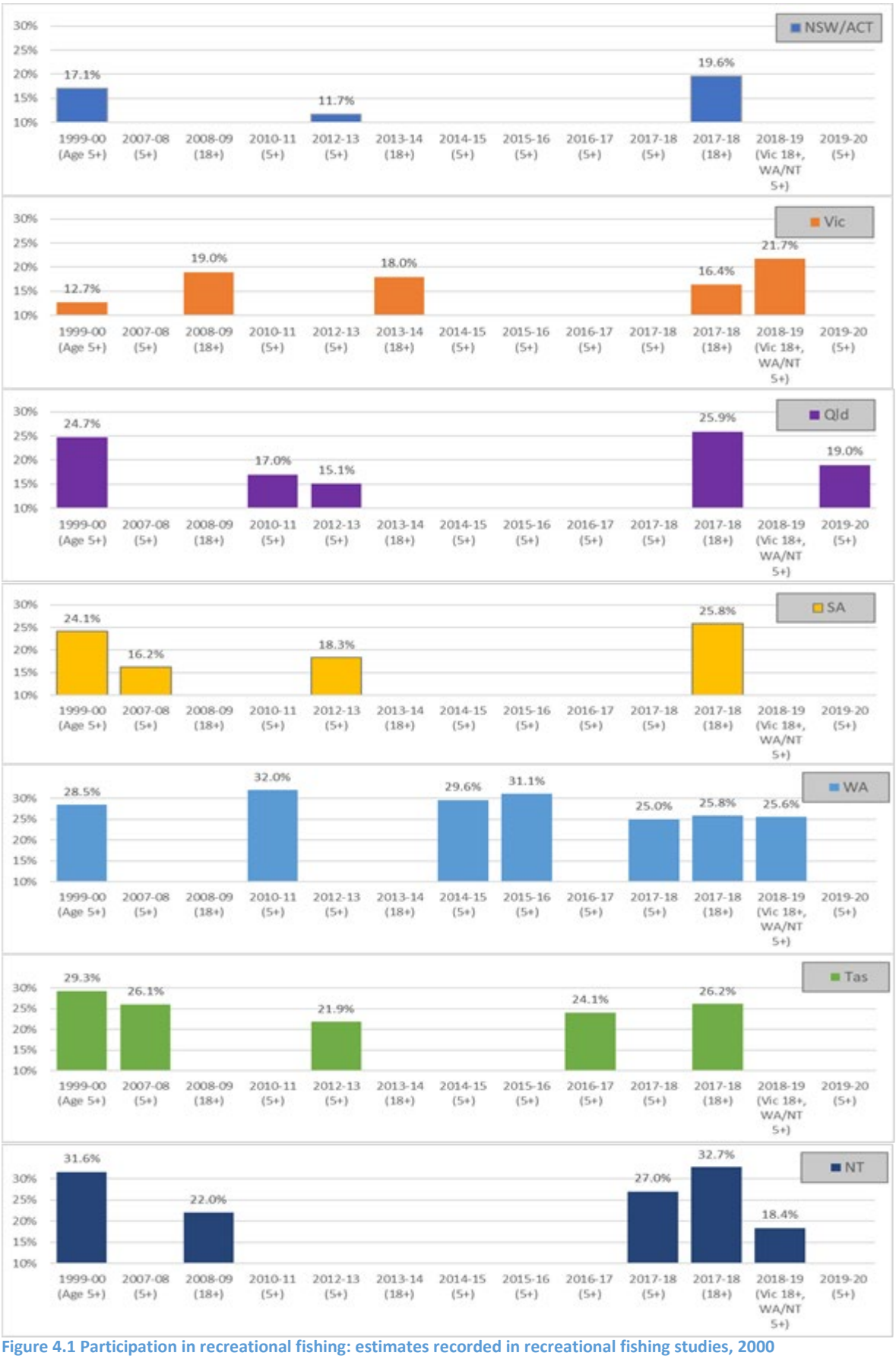

Figure 4.1 Participation in recreational fishing: estimates recorded in recreational fishing studies, 2000

Data sources for Figure 4.1 are listed in Appendix 3.1. The data shown are not completely comparable: some data show estimates that include all people aged 5 or older (indicated by '5+' in brackets) and others include only people aged 18 and older (18+). Only data collected in the 2018 RWS for Stage 1 are included; data collected in the 2020 RWS were excluded as they were near identical.

4.3 Data analysis methods

Table 4.1 summarises the sources of data used for different analyses presented in this chapter.

Table 4.1 Data sources used to examine participation in fishing

	Data from other studies	Stage 1 data	Stage 2 data
Defining recreational fishing	✓	✓	✓
Participation estimates	✓	✓	
Who is and isn't fishing	✓	✓	✓
Fishing avidity and importance	✓	✓	✓
Drivers of short-term and long-term change in recreational fishing participation		✓	✓
Why don't people try fishing?			✓
Recreational fishing by location			✓

All data presented in this chapter are weighted to be representative of the adult Australian population, except where otherwise specified. While the majority of data presented are weighted, some unweighted data are used in this chapter (see Chapter 3 for an explanation of 'weighting'). Weighted data were used when generating claims about the total population, such as the proportion of people who fish, the proportion of fishers who are male or female, and the proportion engaging in different types of outdoor recreational activity. Unweighted data were used only when examining why some people fish and some do not. This is because the sample of those who last fished 2-5 years ago, more than 5 years ago, or who had never fished, could not be readily weighted given a lack of availability of specific benchmark data to enable developing model-based weights for these groups. When unweighted data are analysed, this is identified in the text and in table and figure captions.

Appendix 3.2 provides more detailed information on the methods used in Section 4.8 to examine the specific subsample of people who had never fished or had last fished more than five years ago.

4.4 Results: Participation in recreational fishing

4.4.1 Recreational fishing participation, 2018 and 2020

Participation in fishing in the past 12 months

The results of this study found that one in five adult Australians went fishing at least once a year in 2018, with 21.4%±0.7% of adults going fishing at least once. The data have a 95% confidence range of 0.7%, meaning there is high confidence that between 20.7% and 22.1% of adult went fishing in 2018. This suggests that, at a national scale, participation in recreational fishing in 2018 was at very similar levels to the 19.5% recorded in 1999-00 in the first NRIFS.

In 2020, the second Stage 1 survey found that between 19.2% and 20.9% of adults went fishing in the 12 months to the end of 2020 (Figure 4.2), suggesting overall participation in fishing remained similar to 2018 despite the effects of the COVID-19 pandemic (Figure 4.2). However, as discussed subsequently in this chapter, frequency of fishing was lower in 2020 for many people.

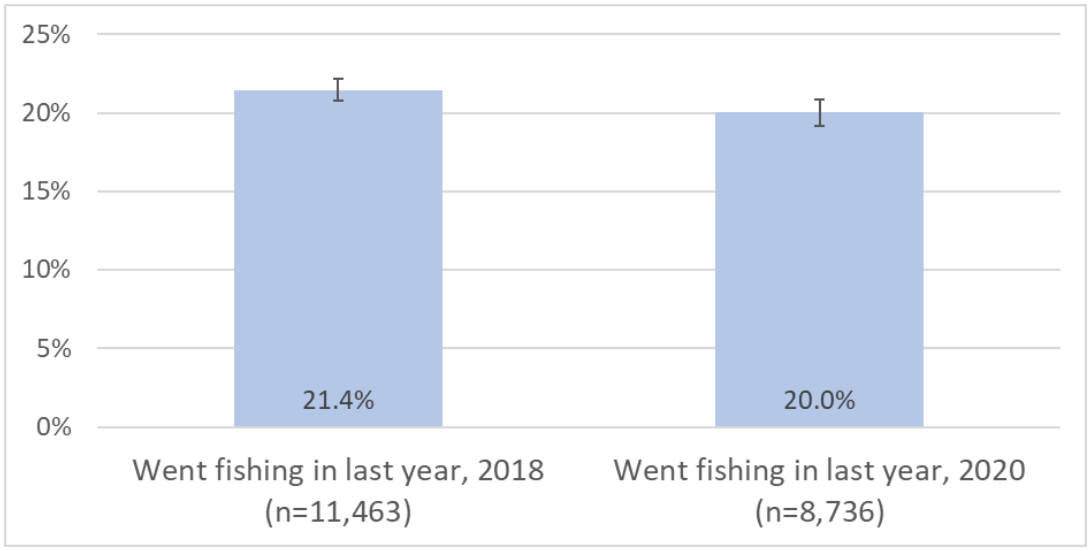

Figure 4.2 Participation in recreational fishing, 2018 and 2020 (data source: Regional Wellbeing Survey)

Figure 4.3 compares estimates from the 2000-01 NRIFS and the NRFS, for Australia as a whole, and for each State and Territory. This shows that despite the two studies examining somewhat different populations – those aged 5 and older in the NRIFS, and those aged 18 and older in the NRFS - overall, the NRIFS and the NRFS found very similar levels of participation by state and territory. Victorians were least likely to go fishing, at 16.4%, followed by New South Wales/Australian Capital Territory residents at 19.6%; those in the Northern Territory were most likely to go fishing, at 32.7%. In Queensland, South Australia, Western Australia and Tasmania participation rates were around 26%.

Figure 4.3 Participation in fishing, 1999-00 compared to 2018, by State and Territory (data sources: Henry and Lyle 2003; 2018 Regional Wellbeing Survey)

Figure 4.4 compares recreational fishing participation in 2018 and 2020 by state and territory, highlighting that while there was some year-on-year variation, there was no statistically significant change in participation levels in any state or territory during this time, despite the COVID-19 pandemic (although as noted subsequently, there was change in fishing avidity for some).

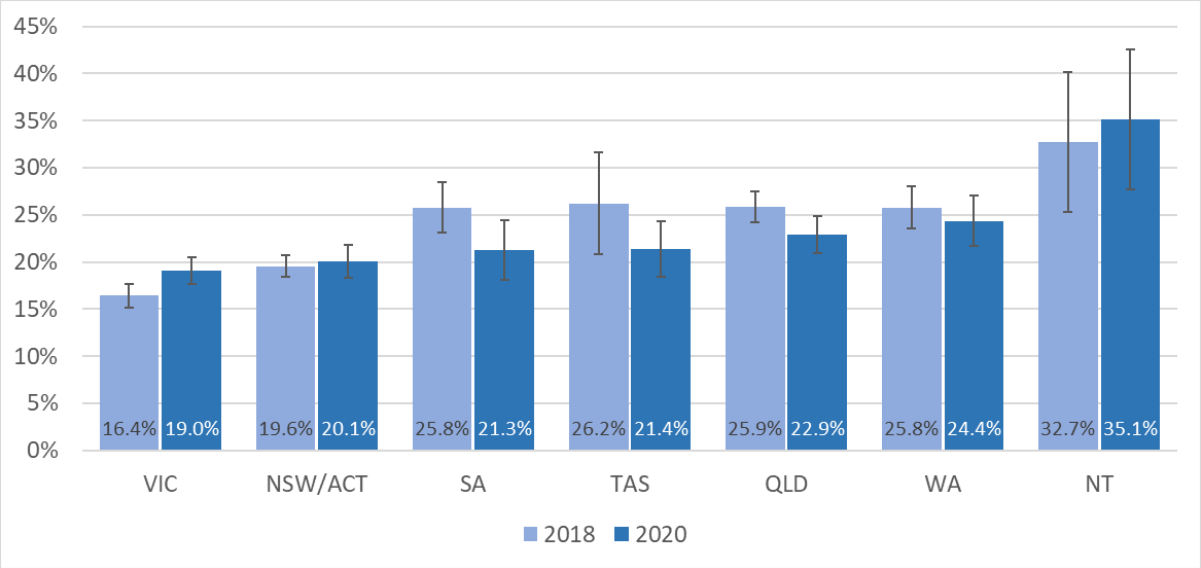

Figure 4.4 Participation in fishing by Australians aged 18 and older, 2018 and 2020 (data source: 2018 and 2020 Regional Wellbeing Survey)

These findings suggest there has not been substantial long-term change in the patterns of participation in recreational fishing over the past two decades, other than some increase in participation in Victoria, something also suggested by other recent studies of recreational fishing in Victoria (as shown in Figure 4.1). This contradicts claims that participation is declining in Australia: it suggests overall participation in fishing in 2018 and 2020 was similar to participation in 2000. However, it is important to emphasise that other aspects of fishing – such as typical levels of avidity – may have changed, even if overall rates of participation have not.

The findings are also for the most part similar to estimates from recent state/territory-based recreational fishing studies, despite most state/territory surveys estimating participation amongst those aged five and older, and the NRFS estimating participation for those aged 18 and older. In particular:

- Victoria: Both this study and recent work conducted in Victoria (Ernst and Young 2009, 2015, 2020) suggest there has been an increase in participation in fishing in Victoria over time, although the current study found a smaller increase (to 16.4%±1.2%) compared to the findings of Victorian studies examining fishers aged 18+ in 2013-14 (18.0%) and 2018-19 (21.7%). With no error estimates available from the Victorian studies, it is not possible to identify if differences in estimates are likely to be a result of sampling error.
- Western Australia: 2018 NRFS estimates (25.8% ±2.2%) were close to identical to estimates produced for 2017-18 for WA of 25.0% participation amongst those aged 5 and older (Tate et al. 2020).
- Tasmania: The 2018 NRFS estimate of 26.2% ±5.4% overlaps with the estimate produced by Lyle et al. (2019) of 24.1%±1.8% amongst those aged five and older.

However, our findings for participation in fishing in other two jurisdictions differ significantly to other recent estimates. First, 2018 NRFS estimates suggest 25.9% of adult Queenslanders fished in 2018, while Teixeira et al. (2020) estimated 18.7% participation amongst those aged 5 and older. We could identify no explanation for the difference in estimates between the two studies, other than the difference in survey methods used (despite the same difference not being associated with differing estimates in other states). Second, 2018 NRFS estimates suggest 32.7%±7.4%, of Northern Territory adults were current fishers, while West et al. (2021) estimated that there was 27.0% participation amongst non-Indigenous Northern Territory residents aged five and older as of 2017-18. The difference here is likely to reflect, at least in part, the inclusion of Indigenous residents in NRFS estimates. Aboriginal and Torres Strait Islander residents comprise a significant proportion of the

Northern Territory population, and have much higher rates of participation in fishing compared to other residents (see Chapter 4), but are not included in the West et al. (2021) study.

In South Australia and New South Wales, there are no recent estimates of participation in fishing from other studies available to compare to that examine the full adult population. In both, the most recent estimates suggest lower participation in fishing than found in this study.

Overall, both the review of past studies, and findings from this study, suggest that around 20% of Australian adults go fishing at least once a year. In terms of numbers of fishers, the 21.4%±0.7% of adults who went fishing at least once in 2018 translates into 4.22 million adults Australians who went fishing once or more in the previous 12 months[6]. The data have a 95% confidence range of 0.7%, meaning there is high confidence that between 20.7% and 22.1% of adult Australians went fishing – which translates to between 4.09 million and 4.36 million people. It is important to note that in addition to the adults who fish, many children aged under 18 also go fishing, and are not included in these estimates.

Table 4.2 summarises estimated participation in recreational fishing by adults in 2018, by state and territory. New South Wales (NSW) and the Australian Capital Territory (ACT) are combined. This table shows both the estimate of the size of the total adult population, as of June 2019, and the estimate of total number of adult recreational fishers, based on this population size. Population size estimates are drawn from the revised *Estimated Resident Population* estimates released by the Australian Bureau of Statistics in December 2022 (ABS 2022d).

Table 4.2 Estimated number of adult recreational fishers by State and Territory, 2018 (Stage 1 data)

State/territory	Estimated proportion of adults who participated in recreational fishing during 2018	Estimated adult population (aged 18), June 2019 (based on ABS 2022d)	Estimated number of fishers, end 2018 (rounded to nearest 100)
VIC	16.42%	5119957	840,900
NSW/ACT	19.55%	6616409	1,293,700
SA	25.79%	1400589	361,300
TAS	26.20%	438721	115,000
QLD	25.90%	3922248	1,015,700
WA	25.78%	2053135	529,400
NT	32.72%	185910	60,800
Other (e.g. no fixed address, migratory)			1900
Australia	21.37%	19740791	4,218,600

Historical participation in fishing

In addition to identifying how many adult Australians fished in the past 12 months ('current fishers') the proportion of people who have fished in previous years was identified (Figure 4.5).

In 2018, Regional Wellbeing Survey participants were asked if they had (i) gone fishing in the past 12 months, (ii) last fished more than 12 months ago, or (iii) had never fished. The findings, shown in

[6] This calculation uses the Australian Bureau of Statistics (ABS) *Estimated Resident Population* data series estimates published in December 2022, which reported an adult resident population in Australia of 19,740,791 as of June 2019 an adult resident being defined as a person aged 18 or older, living in Australia (ABS 2022d). This revised estimate was significantly lower than the earlier population estimate of 20,488,099 used by the ABS prior to their rebasing of estimates using data from the 2021 *Census of Population and Housing.*

Figure 4.5, suggested 37.2% last fished more than 12 months ago while 40.3% had never fished. However, survey participant feedback suggested that some of those who indicated they had never fished had in fact fished at some point in their lives – just many years previous to the survey. This suggested a need to use a more detailed measure, which was used in both the Stage 2 survey and in the 2020 Regional Wellbeing Survey. Using the more detailed measure, it is estimated that as of 2020:

- 20% of adult Australians were current fishers, having fished at some point in the past 12 months)
- 19% were recent fishers: while they had not fished in the past 12 months, they fished at some point within the past five years
- 27% were past fishers: while they had fished at some point in their lives, they had not done so within the past five years
- 34% were non-fishers who had never gone fishing at any point in their life.

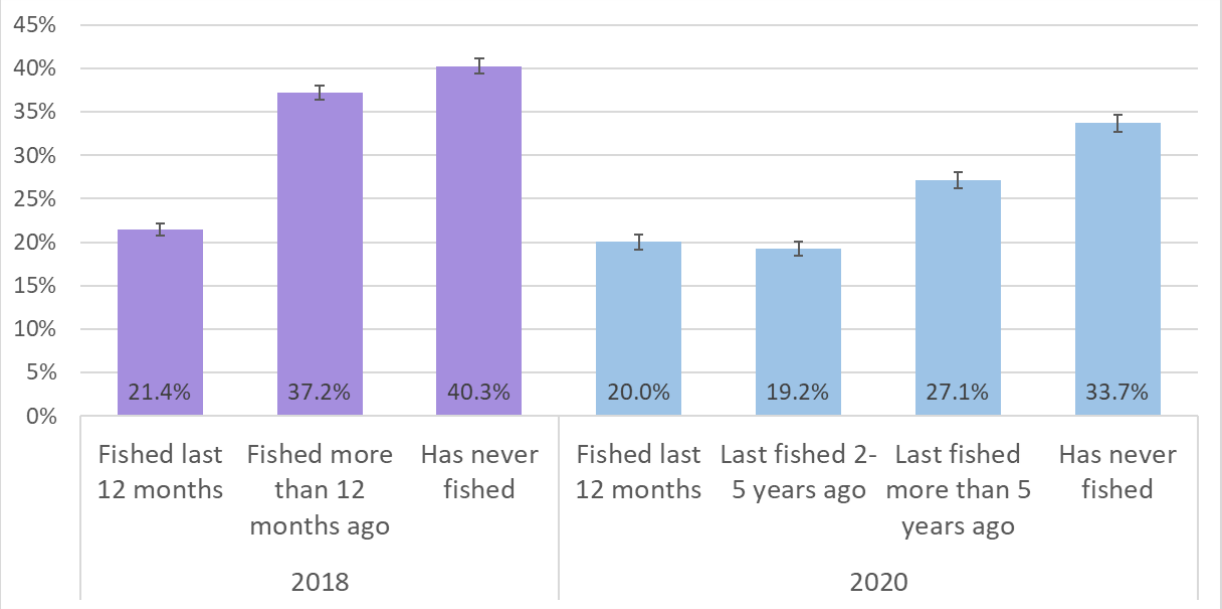

Figure 4.5 Estimates of current, recent, past and non-participation in recreational fishing using two measures, adult Australians, 2018 and 2020

4.4.2 Fishing activities

In the Stage 2 survey, those who went fishing were asked whether their fishing activities in the previous 12 months involved fishing from shore or a boat, and whether they involved fishing in freshwater, estuary areas or saltwater areas. Fishers could identify that they did more than one of these. Overall:

- 58.8% of fishers had engaged in both shore-based and boat-based fishing in the previous 12 months
- 26.4% undertook shore-based fishing only, and
- 14.8% had engaged in boat-based fishing only.

Most fishers – 71.0% - had fished in both saltwater and either freshwater or estuary areas (or both) in the last 12 months. This included 44.4% who had fished in all three and 23.8% who had fished in both estuary and saltwater areas (Figure 4.6). Very few fishers concentrated all their fishing in estuary areas (3.8%) or freshwater areas (3.4%), while 12.7% fished in saltwater areas only.

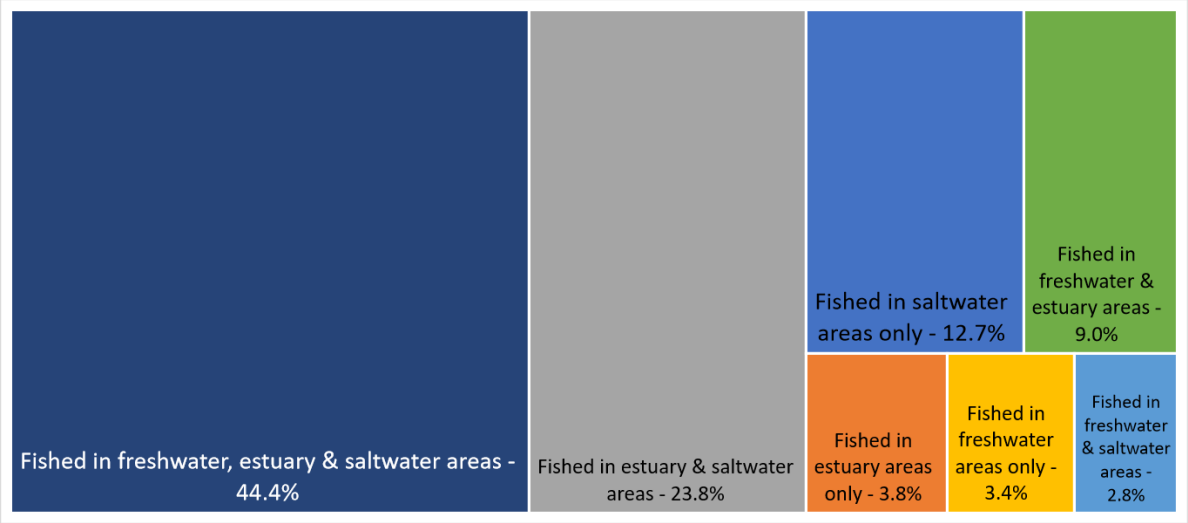

Figure 4.6 Proportion of fishers who went fishing in freshwater, estuary, and saltwater areas in previous months, Stage 2 data

4.4.3 How does participation in recreational fishing compare to other outdoor and sporting activities?

Participants in the 2018 RWS were asked to identify how frequently they participated in a range of outdoor and recreational activities (including fishing) in a 'typical year'[7]. When asked about a 'typical year', rather than specifically the past 12 months, 30.8% of adult Australians report engaging in fishing, compared to the 21.4% who indicated having fished in the past 12 months. This suggests that in reality, their answers reflect whether they are likely to participate in an activity at least once over a one to three year period, rather than specifically within 12 months. When the proportion of adults who report fishing in a 'typical year' was compared to participation in other activities (Figure 4.7), participation in fishing was reported at similar levels to participation in cycling, playing sports with others, or jogging. Somewhat more adults reported going camping, to the gym or exercise classes than going fishing in a 'typical year', while almost twice as many went bushwalking or swimming as go fishing. Walking outdoors was by far the most common activity, done by almost all adult Australians in a typical year. Other more specialised activities – kayaking/canoeing, mountain biking, horse riding, rock climbing and snow sports – were undertaken by fewer Australians.

These findings suggest recreational fishing sits in a category of relatively popular outdoor activities that, while not being undertaken by a majority of adults, are engaged in by up to one third over a typical two to three year period.

[7] Survey participants were asked how frequently they did a number of activities in a 12 month period. However, unlike the specific question about participation in recreational fishing asked earlier in the Stage 1 survey, which asked when the person had most recently gone fishing, this subsequent question asked about frequency of activities. While it asked about frequency in the past 12 months, answers given by participants suggested that many based their estimates on their participation in a recent year in which they had done the activity, rather than constraining their reporting of frequency to only the previous 12 months. This was confirmed through re-contacting 20 survey participants and asking them whether their answers reflected just 12 months of activity, or their activity over the past 2 to 3 years more generally. Three quarters indicated their answer was more reflective of the 'typical year' of participation within the past 2-3 years; some had not done an activity in the past 12 months but indicated how frequently they participated in the activity in the year prior to that. Given this, answers to these questions are best interpreted as representing whether they participated in an activity within the past two to three years and, if they had, how frequently they had participated in a typical 12 month period during the previous two to three years. None had last participated in the activity more than three years previously.

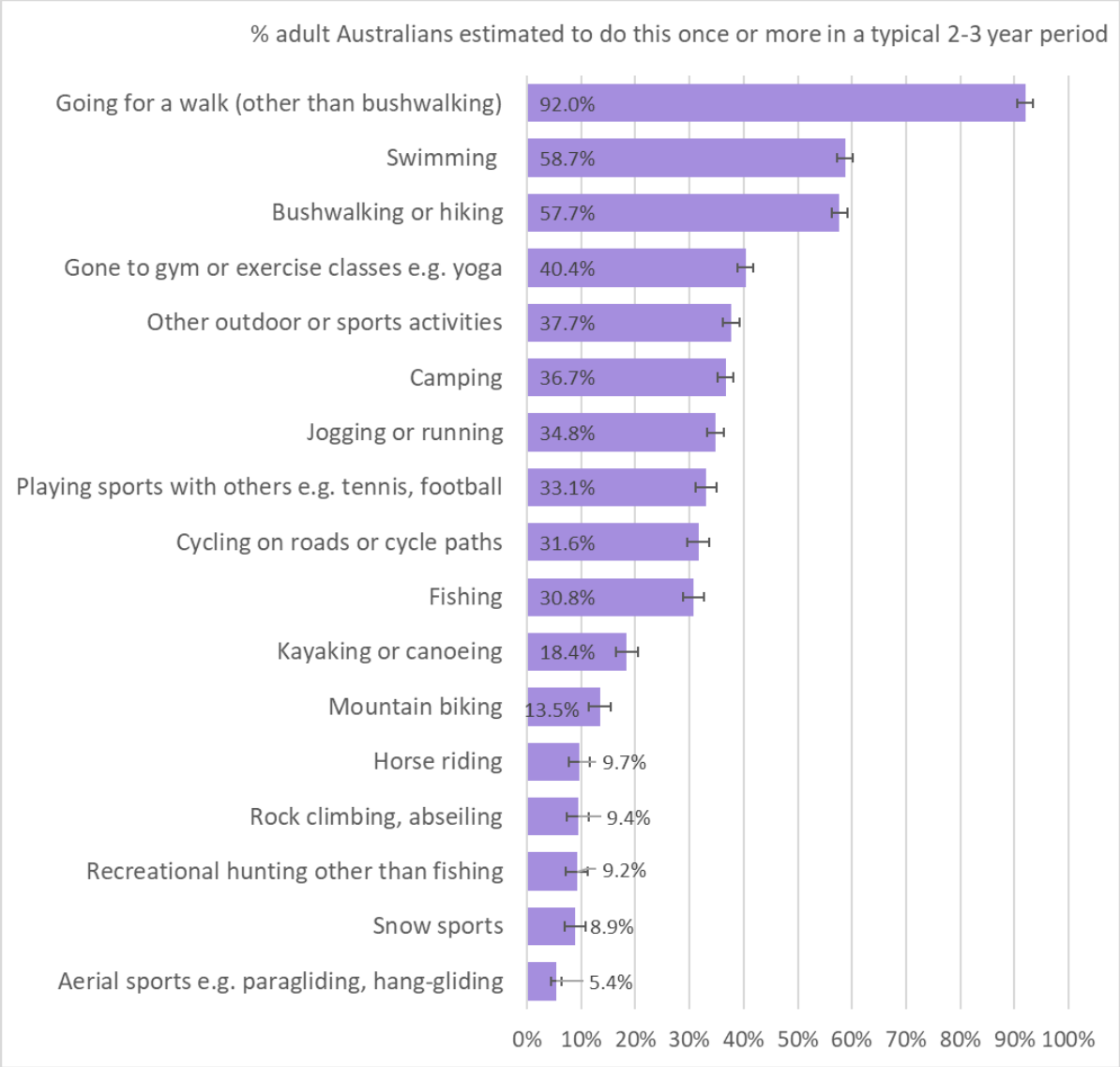

Figure 4.1 Participation in different outdoor activities and sports, adult Australians

4.5 Who is fishing – and who isn't?

This section examines which types of people are more or less likely to go fishing. The next section (Section 4.6) then examines who is more, and who is less, likely to be an avid fisher.

4.5.1 Fishing participation by age and gender

Women are much less likely to go fishing than men (Figure 4.8): 17.8% of adult female Australians participated in recreational fishing once or more in 2018 compared to 25.3% of adult males (Figure 4.8).

Participation in fishing also varies depending on a person's age (Figure 4.8). As of 2018, the age group most likely to go fishing was those aged 30-44, with 26.6% fishing at least once, followed by those aged 18-29 at 22.3%. There was lower participation amongst those aged 45 to 64 (20.1%) and those aged 65 and older (15.5%).

While participation in fishing by men and women remained similar in 2018 and 2020, participation of different age groups in fishing was different in 2020 compared to 2018 – possibly due to the COVID-19 pandemic having different effects on ability to go fishing depending on a person's stage of life and

personal responsibilities. Between 2018 and 2020 there was an increase of 2.5% in the proportion of those aged 18 to 29 who went fishing, although the increase was not statistically significant (Figure 4.8). Amongst those aged 30 to 44, in contrast, participation in fishing declined from 26.6% in 2018 to 20.6% in 2020). There was also a small (but not significant) decline in fishing participation amongst those aged 45 to 64, while there was very little change in fishing participation amongst those aged 65 and older. This may reflect the differential impacts of COVID-19 restrictions on key groups: in particular, working parents with school aged children may have had relatively reduced opportunity to go fishing during the COVID-19 lockdowns occurring in 2020, compared to those who were younger, and those who were retired.

When compared to estimates from the 2000-01 NRIFS, these findings suggest that the proportion of women who go fishing has increased over time. In 2000-01, an estimated 26.7% of males and 12.4% of females aged 5 and over were current fishers (Henry and Lyle 2003). This compared to 25.3% of adult males and 17.8% of adult women in 2018. While the two estimates examine different age ranges (those aged 5 and older in 2000-01, and those aged 18 and older in 2018-19), they do suggest that over the past two decades, the proportion of women participating in fishing has increased. This is consistent with the differences in participation identified by age group and gender by Henry and Lyle (2003) in the NRIFS: they found that amongst those aged 5 to14, 33.2% of males and 22.8% of females went fishing. Amongst males, they found participation in fishing declined gradually through the lifespan, but remained above 25% amongst those aged under 60, while amongst females, participation was 12.7% amongst those aged 15 to 29, 14.9% amongst those aged 30 to 44, and less than 10% amongst those aged 45 and older. This suggests that as of 2000-2001, there may have been growing participation in fishing amongst females, mostly reflected in those aged 5 to 14 as of 2000-01. The results of the NRFS suggest that this growth has now translated into higher rates of participation in fishing amongst females as this cohort has aged. It is reflected in the higher rates of participation amongst women aged 18 to 44 compared to older cohorts of women in 2018-19.

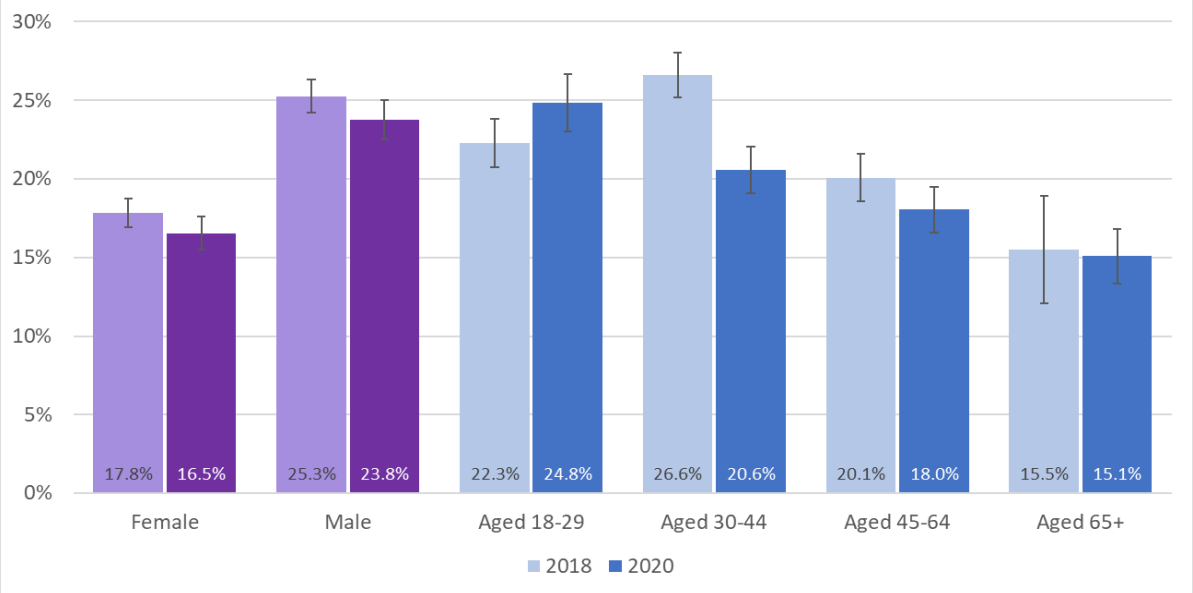

Figure 4.2 Participation in recreational fishing in the last 12 months, by gender and age group, 2018 and 2020

To further understand this, historical participation in fishing was examined, using data from the 2020 RWS (which asked for more information about when a person had gone fishing during their life than the 2018 RWS). Data on historical fishing participation show that women are much more likely than men to be non-fishers, with 39% of women reporting they had never gone fishing at any time in their life compared to 26% of men (Figure 4.9).

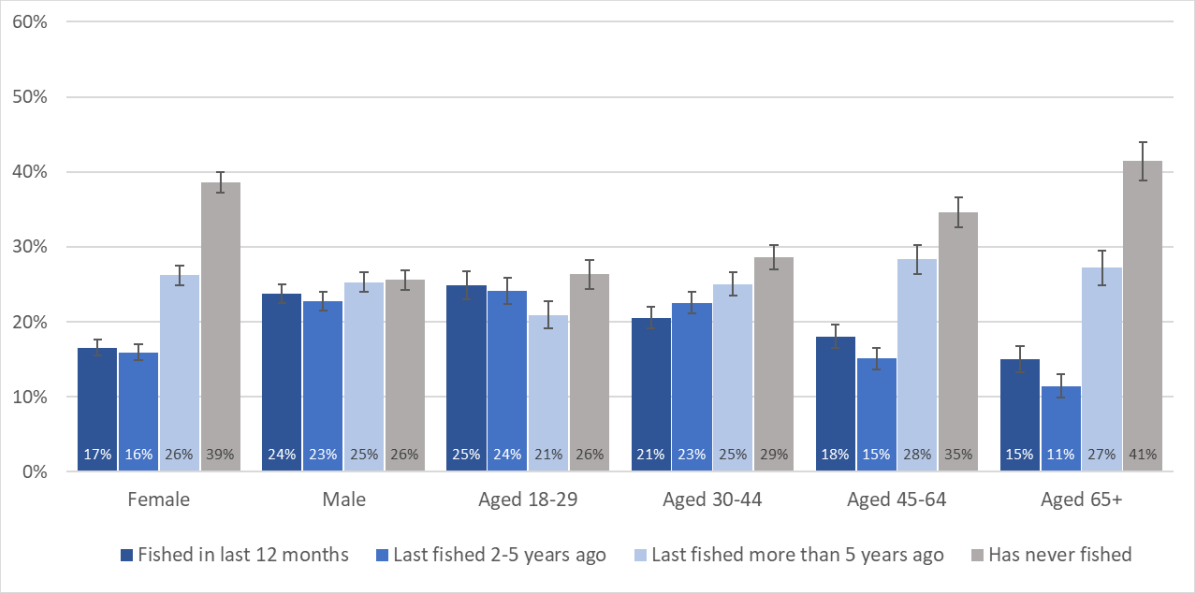

Figure 4.3 Most recent participation in recreational fishing, by gender and age group, 2020

Consistent with the view that participation in fishing is growing amongst women, particularly younger women, women aged 65 and over were much more likely to be non-fishers compared to women in other age groups, and men of any age (Figure 4.10). Amongst women, participation in fishing was highest amongst those aged 18-29 (21%) and 30 to 44 (18%) and lower amongst those aged 45-64 (14%) and aged 65 and older (5%). Amongst men, participation in fishing is higher amongst those aged 18-29 (33%) compared to other age groups, and declines as age increases.

4.5.2 Fishing participation by urban and regional residents

Most of Australia's population live in the major cities of Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra. Residents of these cities are less likely to go fishing compared to those who live in regional Australia, defined as all areas of Australia outside the major cities (Figure 4.11). In 2018, 18.0% of adults living in major cities went fishing at least once in a 12-month period, compared to 29.9% of those living in regional areas. The difference is even greater when regional areas are examined by their degree of remoteness using the Accessibility Remoteness Index Australia (ARIA). The ARIA index classifies the 'remoteness' of a community based on whether it is located in a major city, an 'inner regional' area that has fairly good access to services and infrastructure, an 'outer regional area' where access to services and infrastructure is generally poorer, or a 'remote' or 'very remote' community which often has very poor services and infrastructure. Over two-thirds of Australia's population lives in major cities; around one in five live in inner regional areas, which often contain regional cities (e.g. Wagga Wagga, Toowoomba, Albany, Mildura); a little under one in ten live in outer regional areas; and one in fifty live in remote or very remote areas (Baxter et al. 2011). Figure 4.12 shows which parts of Australia are classified as a major city, inner regional, outer regional, or remote/very remote area using this index.

Those living in remote/very remote areas are around twice as likely to go fishing as those living in major cities: in 2018, 42.5% of people in remote/very remote areas fished at least once, compared to 18.0% of those living in cities, while 34.4% of those living in outer regional and 26.4% of those living in inner regional areas went fishing (Figure 4.11).

Between 2018 and 2020, there was relatively little change in the proportion of those living in cities who went fishing, but significant decline in the proportion of regional Australians going fishing (Figure 4.11). This may reflect the impacts of COVID-19 related travel restrictions on regional Australians in 2020: all Australia's major cities other than Canberra are located in coastal areas and

with major rivers that provide opportunity for fishing close to home for many, while some who live in regional areas may typically travel further to go fishing.

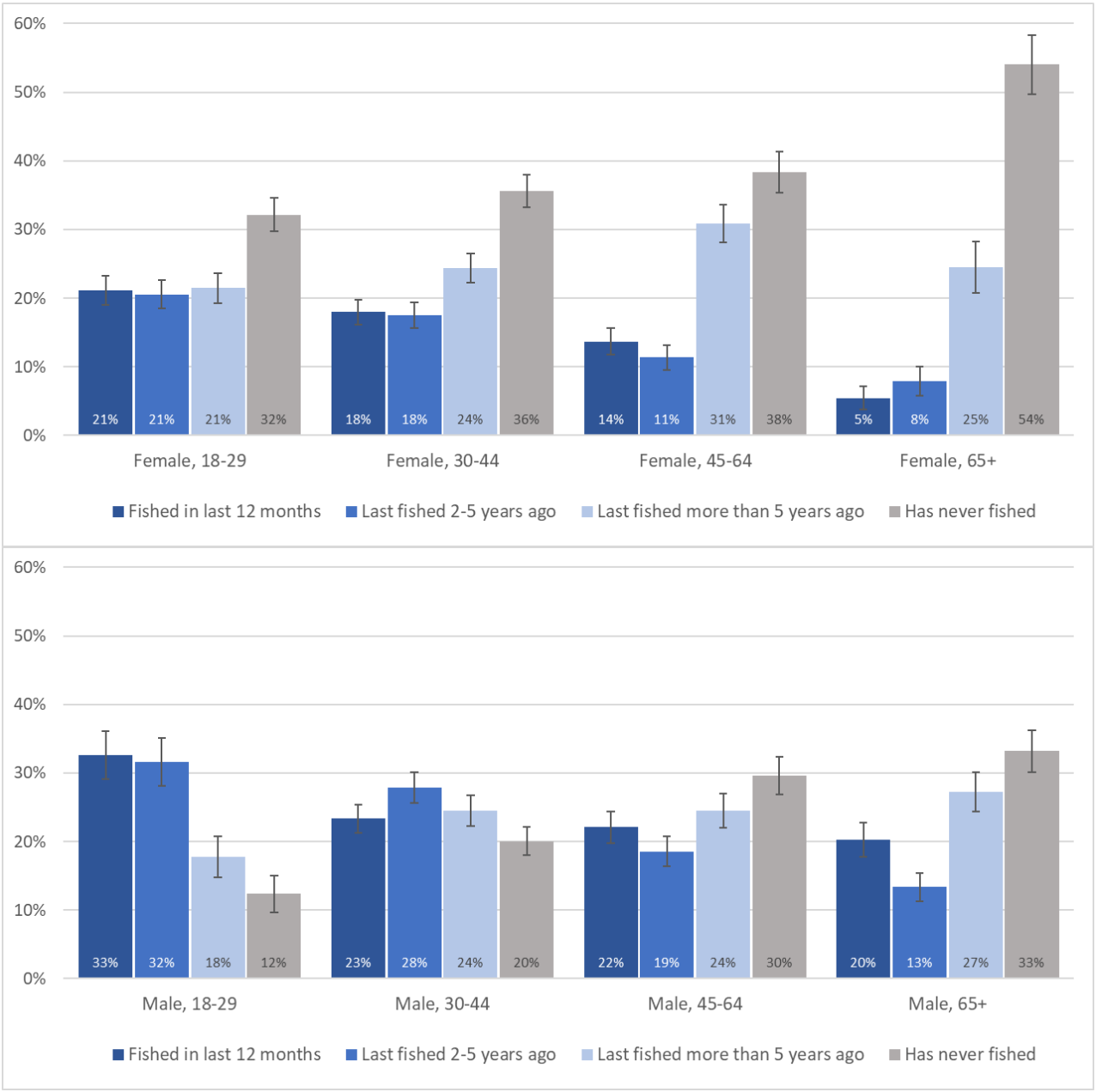

Figure 4.4 Most recent participation in recreational fishing, by gender and age group, 2020

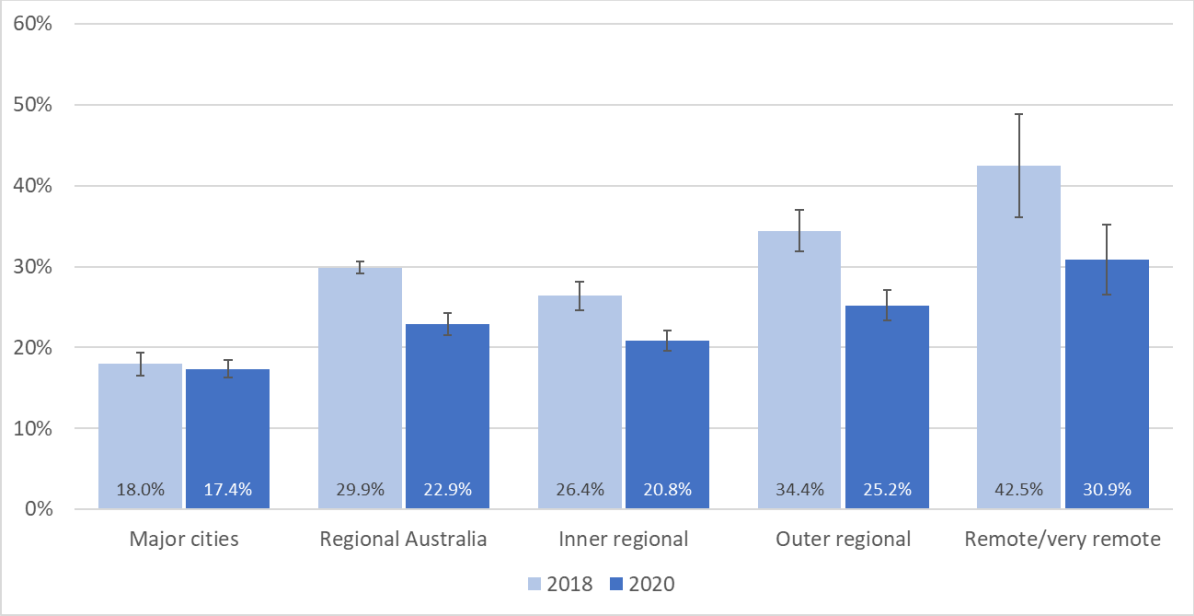

Figure 4.5 Participation in recreational fishing in the past 12 months, urban, regional and remote areas, 2018 and 2020

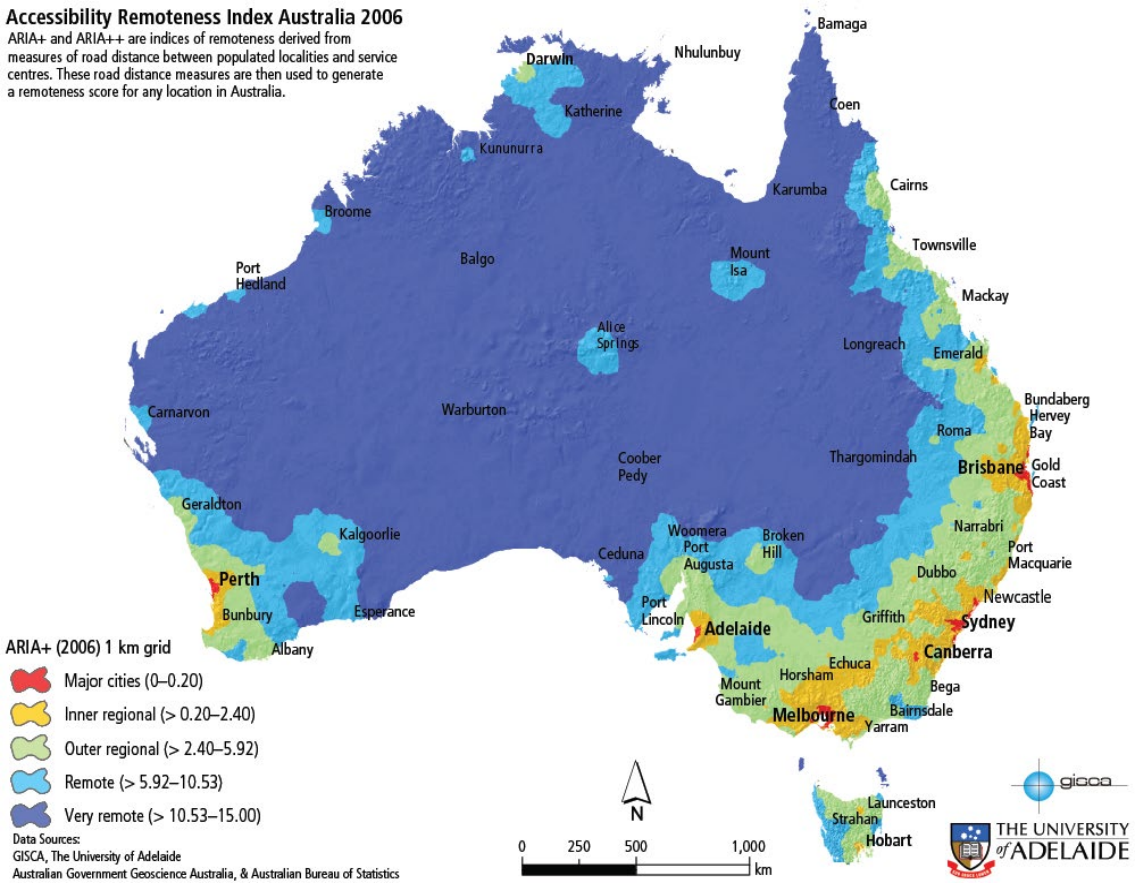

Figure 4.6 Remoteness regions across Australia (replicated from Baxter et al. 2011)

In addition to being more likely to have gone fishing in the past 12 months compared to those living in major cities, those living in remote/very remote areas of Australia were a little more likely to have gone fishing in the past two to five years than those living in other parts of Australia. They were also less likely to have last fished more than five years ago or to never have gone fishing (Figure 4.13). Those living in large cities were more likely than those living in regional and remote areas to report

never having fished, or last having fished more than five years ago. Both men and women living in regional areas were more likely to go fishing compared to their counterparts living in major cities (Figure 4.14), as were people of all age groups (Figure 4.15).

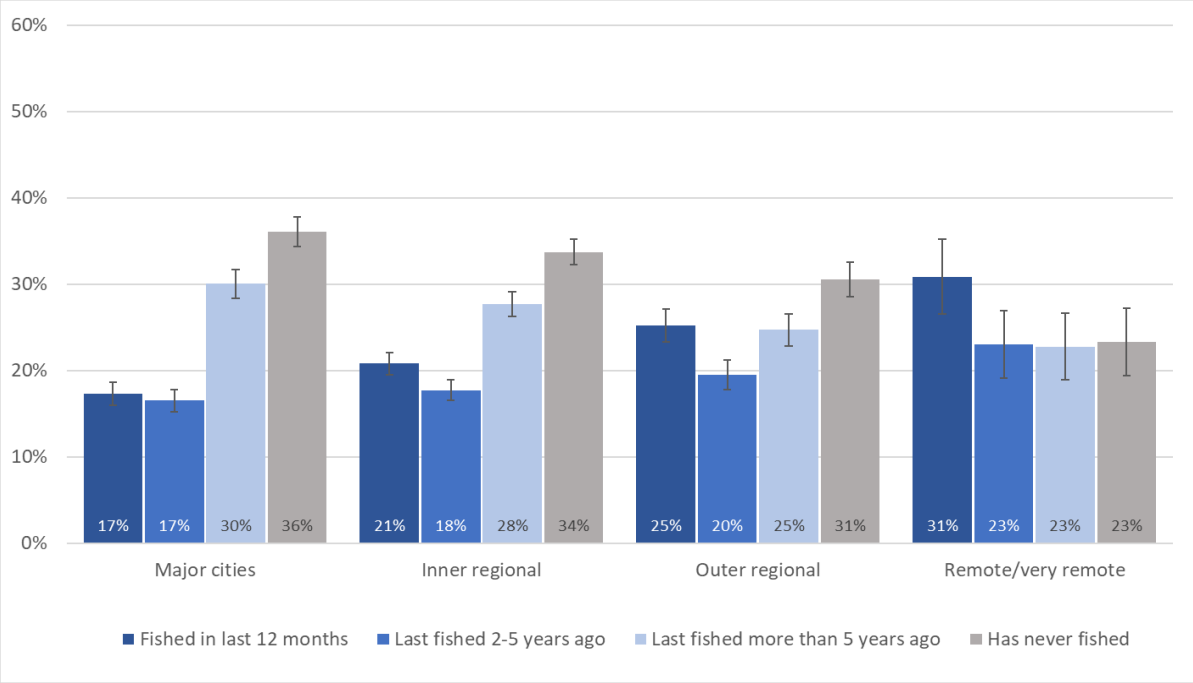

Figure 4.7 Most recent participation in recreational fishing, urban, regional and remote areas, 2020

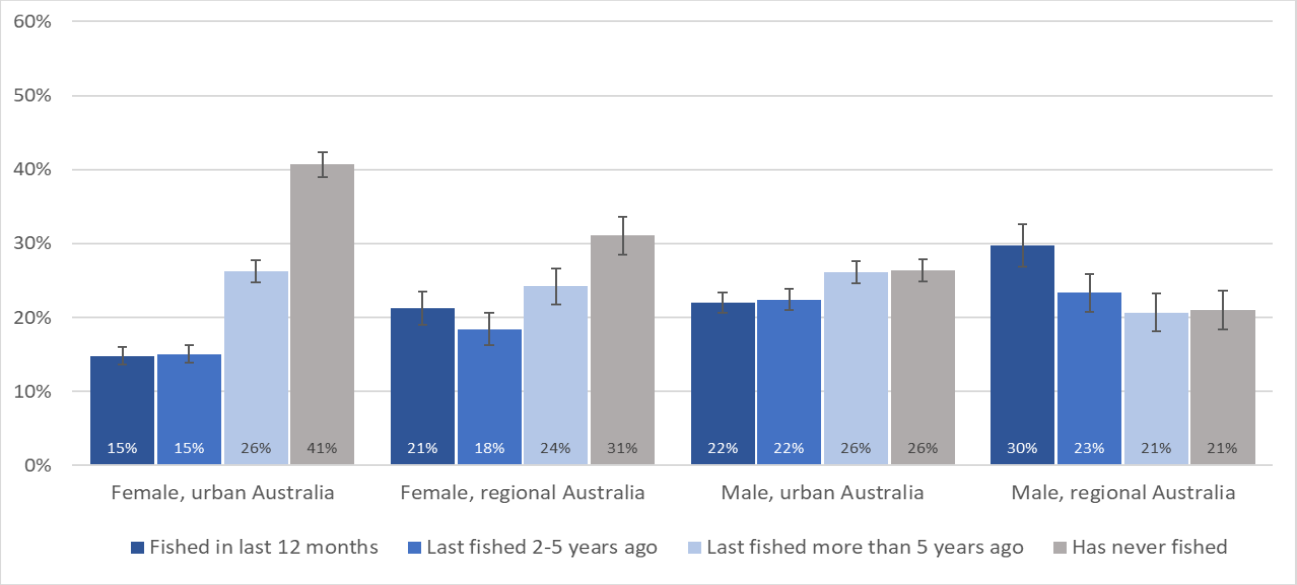

Figure 4.8 Most recent participation in recreational fishing, by gender and urban/rural location, 2020

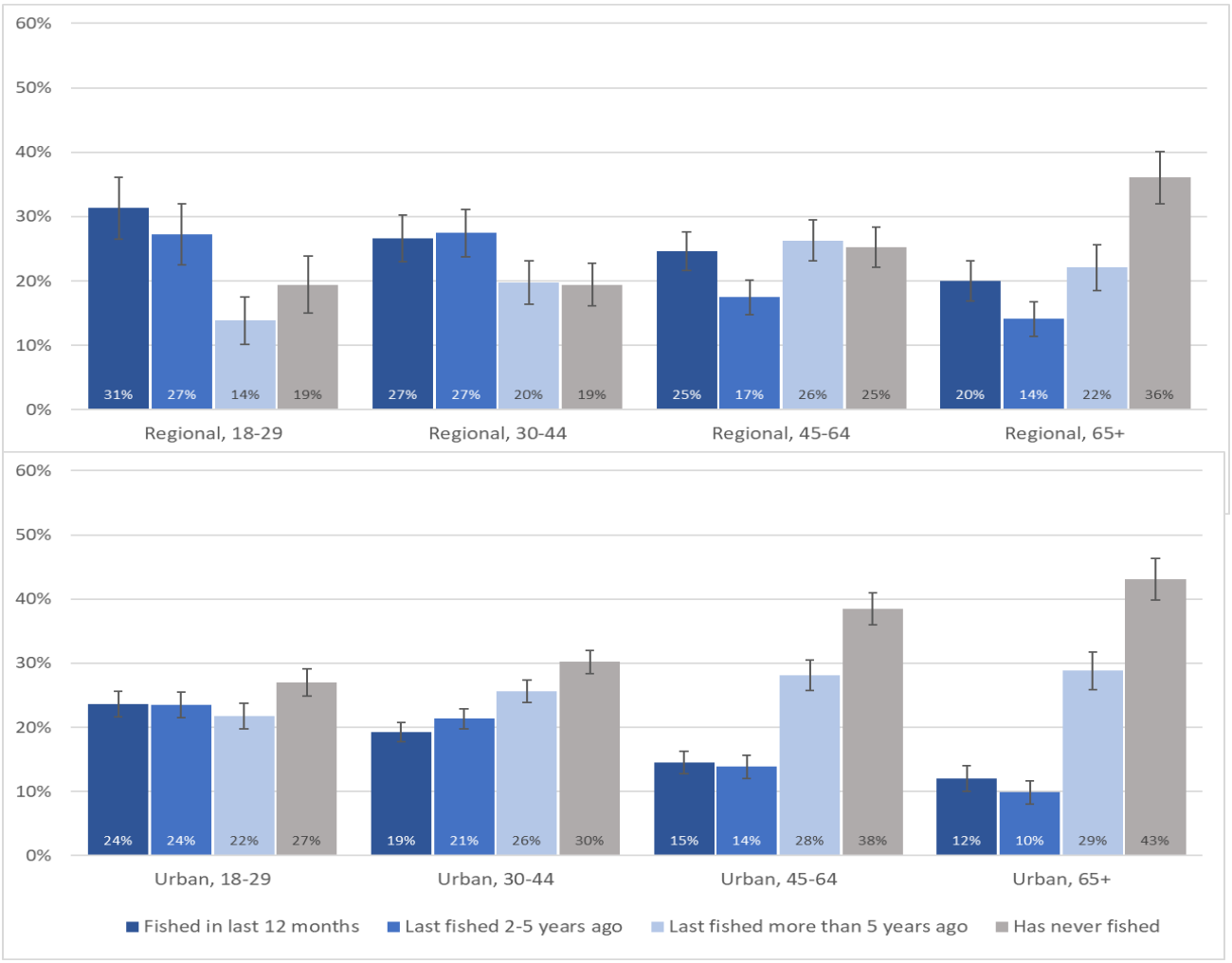

Figure 4.9 Most recent participation in recreational fishing, by age group and urban/rural location, 2020

4.5.3 Fishing participation amongst those with different life circumstances and cultural background

As of 2018, those who provided unpaid care for children and those who worked full time were more likely to participate in fishing (27.5% and 26.3% respectively) compared to those who provided unpaid care for people other than children (22.1%) and those who were retired (16.8%) (Figure 4.16)[8]. There was a significant decline in participation in fishing between 2018 and 2020 amongst those who cared for people other than children and those with full-time work, possibly a result of the impacts of COVID-19 restrictions and changed access to things such as support for caring duties.

[8] From this point on, all references to carers (of children or others) refer only to unpaid carers.

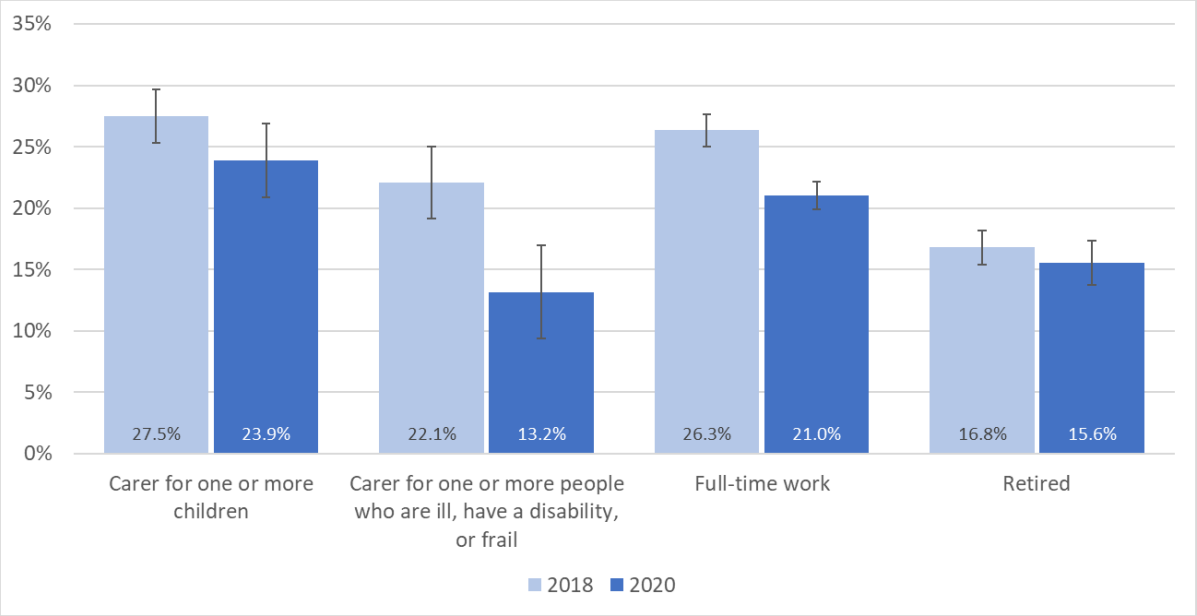

Figure 4.10 Participation in recreational fishing in the past 12 months, by employment and caring duties, 2018 and 2020

Those who identify as Aboriginal and/or Torres Strait Islander were much more likely to go fishing compared to others: in 2018, 38.1% of Aboriginal and Torres Strait Islanders reported fishing compared to 21.0% of others (Figure 4.16). There was a large decline in reported participation in fishing amongst Aboriginal and Torres Strait Islanders between 2018 and 2020: while statistically significant, the factors causing this decline are not known, but may relate to COVID-19 travel restrictions and their impact on being able to go fishing in usual locations.

Those born in Australia are more likely to go fishing than those born in other countries (23.0% compared to 16.9% as of 2018, Figure 4.17).

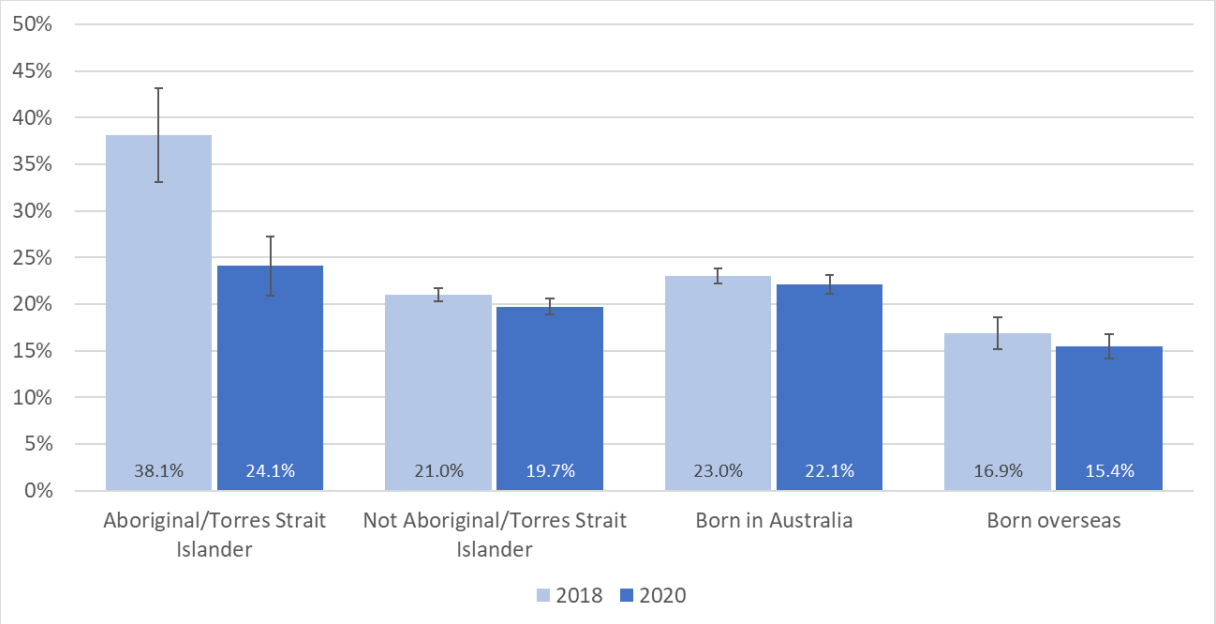

Figure 4.11 Participation in recreational fishing in the last 12 months, by cultural background, 2018 and 2020

4.6 Fishing avidity and importance

4.6.1 Fishing effort

Some people go fishing once or twice a year, while others go fishing once or twice a week. In 2000-01, it was estimated that the 3,362,990 fishers aged 5 and older who went fishing at least once in the 12-month period examined 'expended an estimated 20.6 million fisher days of effort during the period May 2000 to April 2001, representing 23.2 million separate fishing events or 102.9 million fisher hours' (Henry and Lyle 2003).

Analysis of Stage 2 data was undertaken to estimate total fishing effort during 2018-19[9]. Overall, Australia's 4.38 million adult recreational fishers engaged in an estimated 28.59 million fishing events, defined as a day in which they went fishing for one or more hours. This estimate does not include fishing by those aged 5 to17, whereas the 2000-01 estimate did, and thus is not directly comparable to the original[10]. It does however suggest it is likely that total fishing effort, measured as fishing events, has grown in Australia over time. With Australia's total population growing by 32.9% between March 2001 and December 2019, it is to be expected that the total fishing days have also grown: even if the proportion of people participating in fishing had declined (which this study suggests has not happened), total fishing effort would most likely have increased due to this population growth.

The 68.0% of recreational fishers who fished for five days or less during 2018-19 contributed 25.5% of total fishing effort (Figure 4.18). Meanwhile, the 5.0% of fishers who fished 20 or more days a year contributed 31.5% of fishing effort, and the 27% who fished between 5 and 19 days contributed 27% of effort.

The distribution of fishing effort across different States and Territories largely reflects the relative proportion of Australia's population living in them (Figure 4.19). In both 2000-01 and 2018-19, the largest proportion of fishing effort was undertaken by those living in NSW/ACT, followed by Queensland, and South Australia. In Victoria, there was lower fishing effort relative to population size compared to the rest of Australia, in both 2000-01 and 2018-19.

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[9] Data from this point forward in this chapter are drawn from the Stage 2 survey and reflect the period 2018-19. Any data referred to as '2018-19' are drawn from the Stage 2 survey.

[10] In this study, fishing hours were not examined. The measure used was closest to the fishing events measured in the first NRFS, with fishers being asked to identify on how many days they went fishing in the past year, irrespective of whether they fished for a small or large number of hours on each day. Fishers were asked to identify if they had fished 1-2, 3-4, 5-9, 10-14, 15-19, 20-29, 30-51, or 52 or more days. Total fishing days were then estimated by taking the mid-point of each category and, in the case of the '52 or more days' category, using a conservative estimate that the average person in this category fished 52 days in the year.

This method is based on 12 month recall of fishing effort, and uses mid-points. While the standard error cannot be readily calculated due to the method of estimation, sensitivity analysis suggested that changing from the mid-point of each category asked about to the 25th percentile or 75th percentile within each category (for example, assuming those who reported fishing 1-2 days on averaged fished 1.25 or 1.75 days a year, rather than 1.5), and increasing the assumption from 52 to 57 days for the highest category in the upper estimate, resulted in a reduction of 9.1% in the estimate when using the lower estimate, and increase of 10.5% if using the upper estimate.

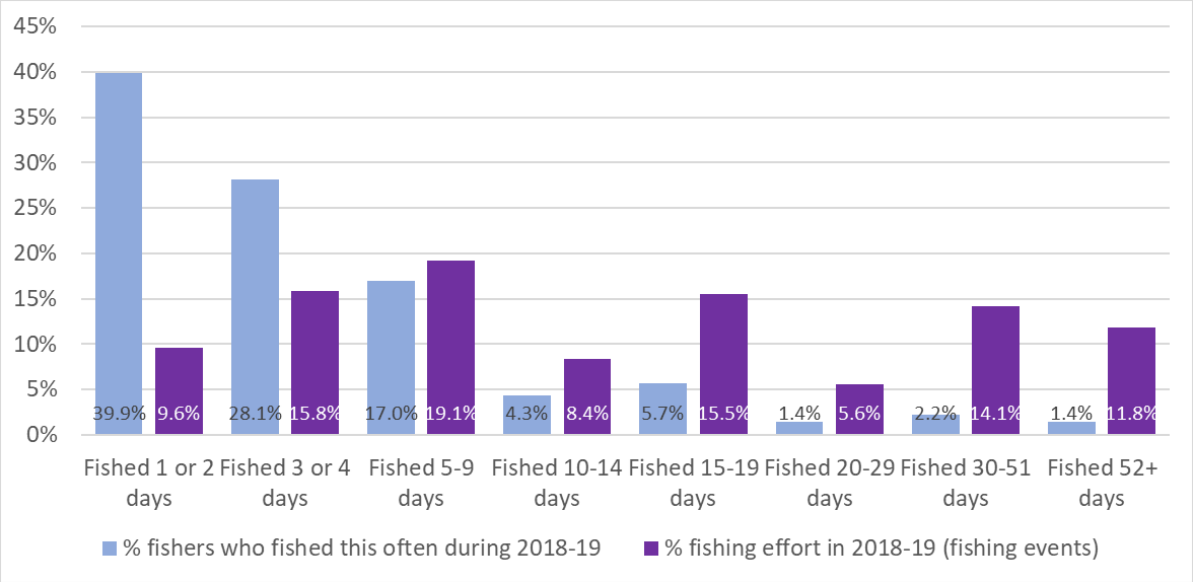


Figure 4.12 Total fishing effort contributed by those who fished more and less, Australian fishers aged 18+, 2018-19, NRFS Stage 2 data

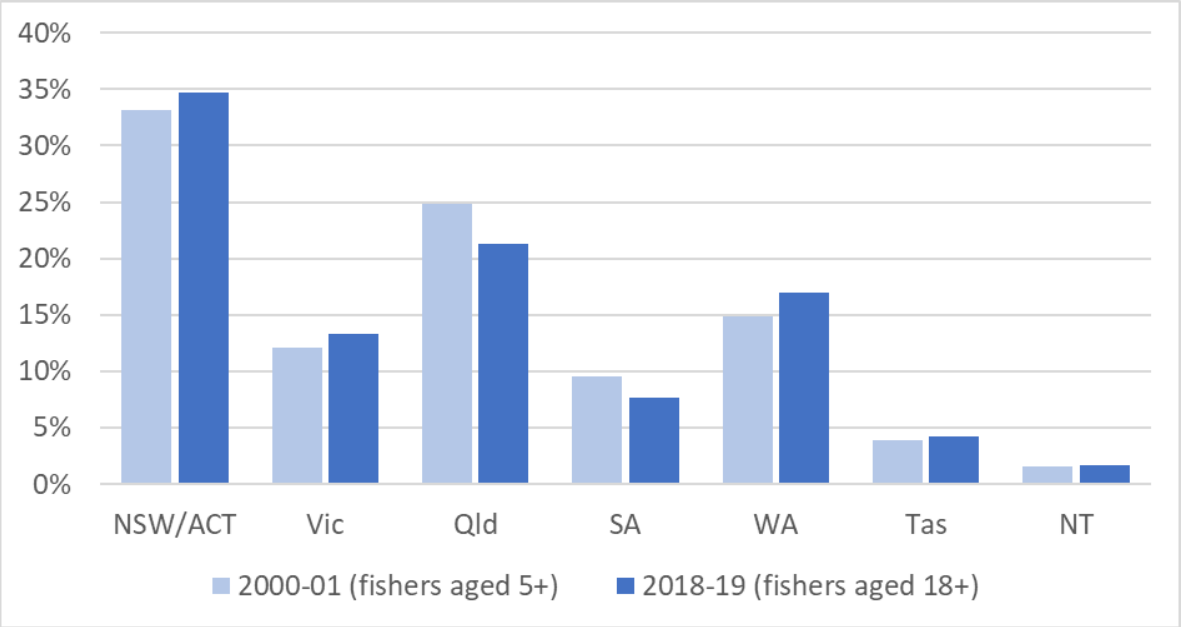


Figure 4.13 Distribution of fishing effort by State/Territory, 2000-01 (fishers aged 5+) and 2018-19 (fishers aged 18+, NRFS Stage 2 data)

Table 4.3 compares total fishing events by State and Territory in 2018-19 compared to 2000-01. While not directly comparable, the findings suggest that total fishing effort may have grown less in South Australia and Queensland over time, and more in Victoria (where fishing effort per fisher has historically been lower than in other States/Territories), Western Australia and the Northern Territory.

While the majority of recreational fishers live in one of Australia's major cities (Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra), urban fishers typically go fishing less often than those who live in rural and remote parts of Australia (regional Australia). As a result, those living in regional areas contributed 54.5% of fishing effort in 2018-19, compared to 45.5% of effort coming from those living in the cities of Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Darwin and Canberra (Figure 4.20). The difference was largest in NSW, where regional residents contributed almost one quarter of Australia's fishing effort, compared to 11.4% from those living in Sydney.

Table 4.3 Estimated fishing events, 2000-01 (fishers aged 5+) and 2018-19 (fishers aged 18+, NRFS Stage 2 data)

	2000-01 – fishing events, fishers aged 5 and older (source: Henry and Lyle 2003)	**2018-19 – fishing events, fishers aged 18 and older (source: NRFS Stage 2 data)**	**Difference between 2000-01 and 201819** *(differences in measurement method reduce comparability)*
NSW/ACT	7,702,000	9,934,987	29.0%
Vic	2,812,000	3,812,029	35.6%
Qld	5,766,000	6,079,916	5.4%
SA	2,216,000	2,198,172	-0.8%
WA	3,442,000	4,845,843	40.8%
Tas	913,000	1,225,666	34.2%
NT	354,000	494,922	39.8%
Australia	23,205,000	28,591,535	23.2%

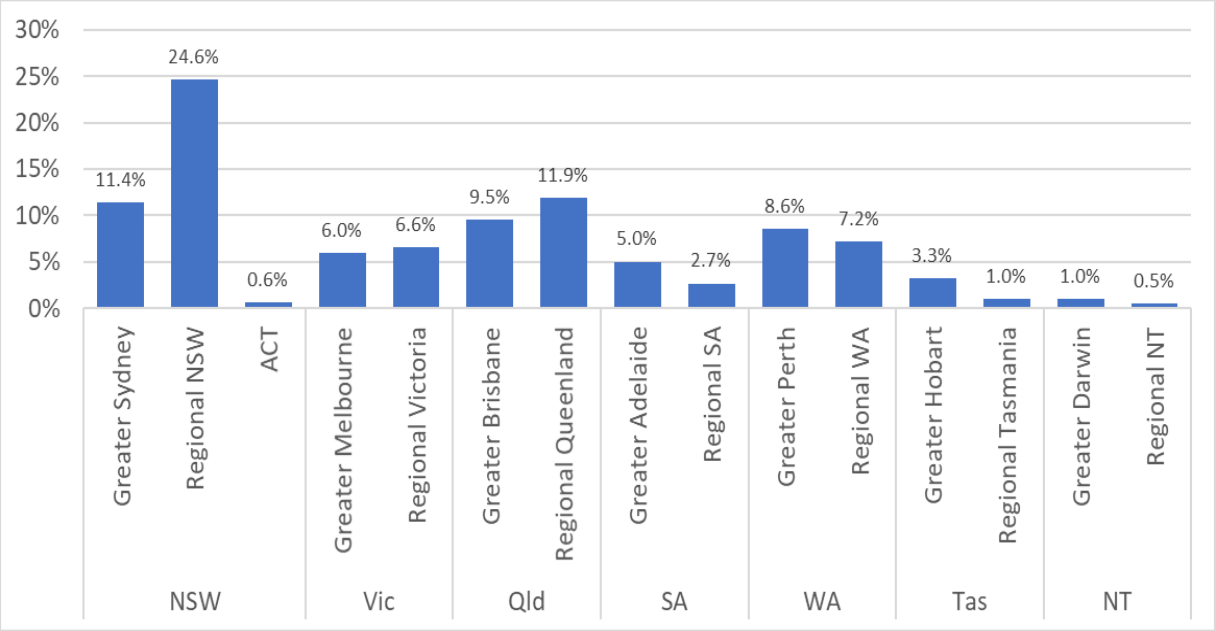


Figure 4.14 Distribution of fishing effort by urban and regional areas and State/Territory, 2018-19 (fishers aged 18+, NRFS Stage 2 data)

4.6.2 Fishing avidity: do some people fish more than others?

Different groups of fishers were compared to identify whether some types of fishers tend to fish more often than others. As shown in Figure 4.21, there are multiple differences:

- Region: People living in major cities typically fish less often than those living in regional areas
- Gender: Female fishers typically fish fewer days than male fishers, as well as being less likely to fish overall, meaning that women contribute significantly less to overall fishing effort than men
- Age: Despite being more likely to go fishing than older fishers, those aged under 30 years typically fish fewer days in a year compared to older fishers.
- Those born overseas in non-English speaking countries typically fish fewer days a year than those born in Australia, or born overseas in an English-speaking country
- Aboriginal and Torres Strait Islander fishers typically go fishing more often than other fishers
- Those who have never been married fish less often than those who are married, divorced/separated or widowed: this is likely to reflect differences in age, with those who have never been married typically younger in age
- Having caring duties, for either children or others, is associated with fishing fewer days compared to those with less caring duties; those who work fish fewer days compared to those who are retired.

The findings on region and age are particularly important to understand. They mean that despite a minority of fishers living in regional areas, regionally based fishers contribute more fishing effort than those who live in major cities. They also indicate that, despite fewer people aged 65 and over fishing compared to younger age groups, these older fishers contribute proportionally greater fishing effort than those aged under 30 or aged 30 to44. This is because, on average, younger fishers go on fewer fishing trips per year compared to older fishers.

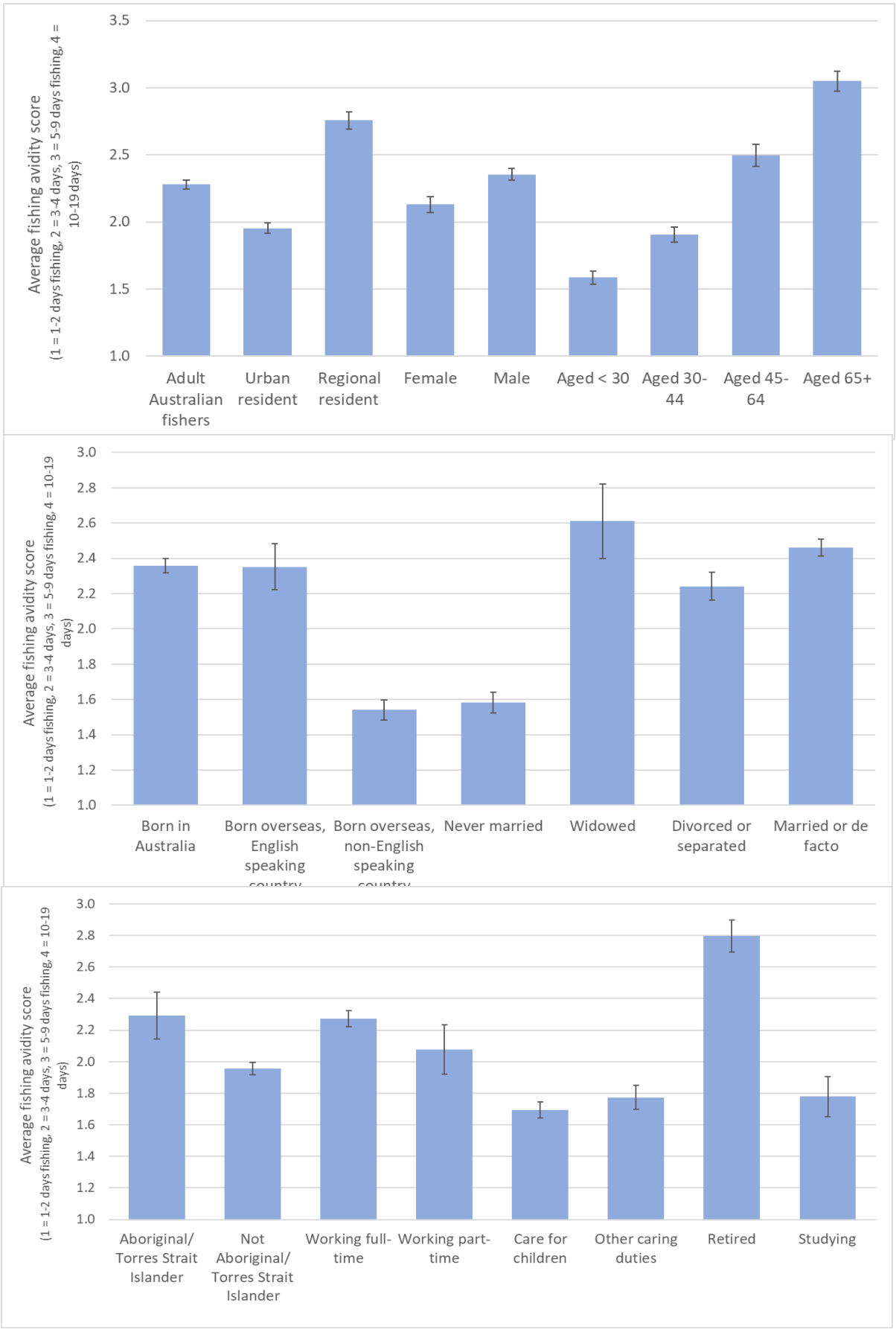


Figure 4.15 Average fishing avidity, by socio-demographic group, adult Australian fishers, 2018-19, NRFS Stage 2 data

4.6.3 Fishing importance: do some people consider fishing a more important part of their life than others?

Sometimes, it is assumed that the importance of fishing to a person's life is reflected in how often they go fishing: those who find fishing more important go fishing more often, and vice versa. However, while this may be the case for many fishers, it is not always the case. Some people may consider fishing very important to their lives but experience barriers to fishing as often as they want to: this means that their frequency of fishing does not reflect the importance of fishing to their life.

In the Stage 2 survey, fishers were asked to rate how important fishing was to their life on a scale from 0 (not at all important) to 10 (very important). Figure 4.22 compares overall fishing avidity with the average rating of fishing importance[11]. Overall, it is clear that those who fish more days have, on average, a higher rating of the importance of fishing to their lives.

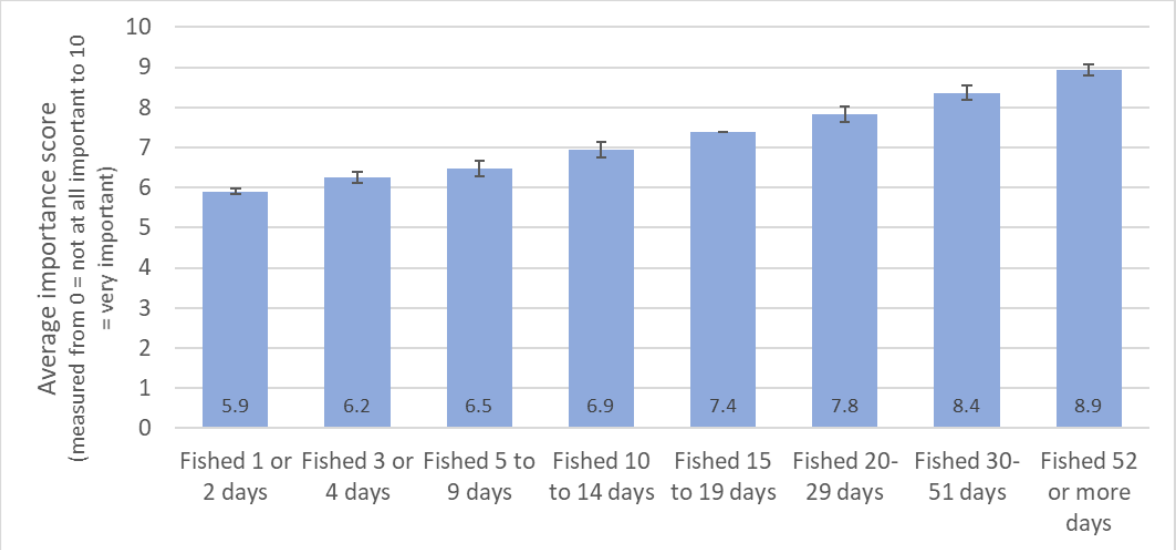


Figure 4.16 Average rating of importance of fishing to a person's life, by days fished in 2018-19 (unweighted NRFS Stage 2 data)

However, the relationship between fishing avidity and importance is not always as linear as indicated in Figure 4.22. It differs depending on where a person lives, their age and gender, and their life circumstances.

For example, Victorian residents rate fishing as only slightly less important to their lives on average than other Australians, despite having much lower fishing avidity on average (Figure 4.23). This suggests that fishing is highly important to many of those Victorians who fish a relatively small number of days, and somewhat less important to some of those living in NSW or Queensland who fish a larger number of days.

Urban residents overall rate fishing as more important to their lives than people living in regional areas, despite their much lower fishing avidity (Figure 4.24). This highlights that while many urban people may fish less than their regional counterparts, they do not value fishing less.

[11] Figure 4.21 uses unweighted data from the Stage 2 survey. This is done as fishing days form a key part of the weighting criteria; using unweighted data ensures the overall association is identified without adjustment for other factors. Weighted data give similar results.

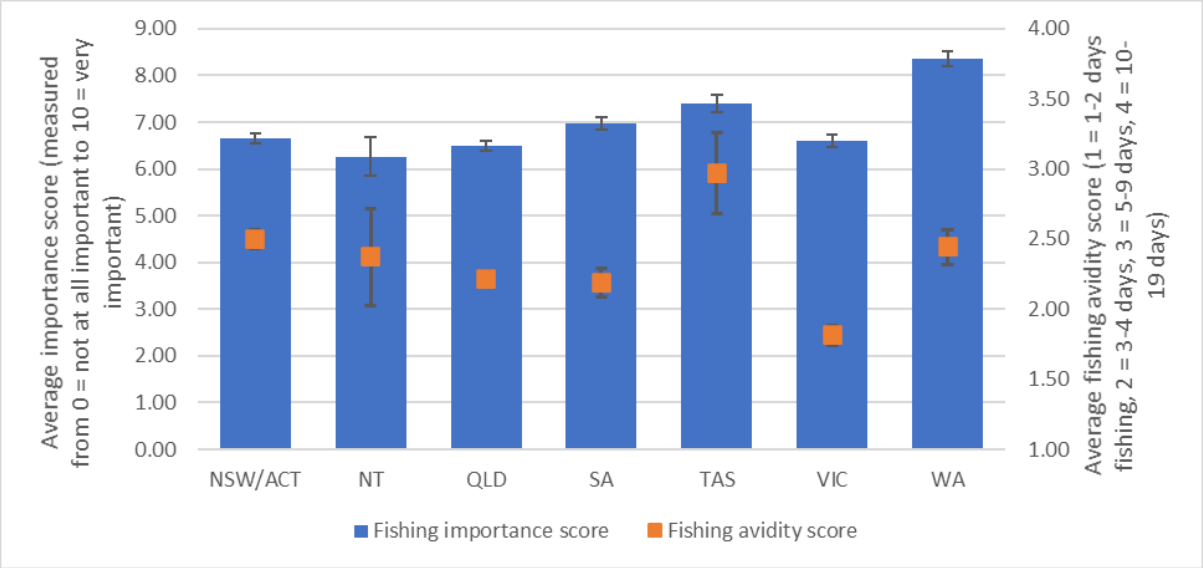


Figure 4.17 Average fishing importance compared to average fishing avidity, by State/Territory, adult fishers, 2018-19, NRFS Stage 2 data

In addition, as shown in Figure 4.24, the reported importance of fishing varied depending on a person's gender, age, cultural background, marital status, work and caring duties:

- Gender: Women typically consider fishing somewhat less important to their lives than men, consistent with their overall lower fishing avidity
- Age: Those aged 30-44 consider fishing more important to their lives than any other age group, despite being less avid fishers than those aged 45 and older; those aged 65 and older rate fishing as less important to their lives than those aged 30 to 64, despite going fishing more often than people aged 30 to 64.
- Those born overseas in non-English speaking countries on average consider fishing to be somewhat less important to their lives than those born in Australia, although the difference is small despite the much lower fishing avidity of those born in non-English speaking countries
- Despite fishing less often, those who work part-time are more likely than those who work full-time to consider fishing to be important to their lives
- Those with caring duties typically consider fishing less important to their lives than other fishers, consistent with their lower fishing avidity
- Those who are retired typically consider fishing less important to their lives than those who are not retired, despite being more avid fishers.

4.6.4 Understanding participation, avidity and importance of fishing

These findings highlight a complex relationship between fishing participation, fishing effort (avidity) and the importance of recreational fishing to the lives of those who take part in it. All three of these measures provide important insight into recreational fishing in Australia, particularly when seeking to evaluate the social and economic contributions of fishing. Understanding total effort is particularly critical for assessing ecological aspects of fishing but is not as central to understanding many of the social and economic aspects of recreational fishing. For example, a person who considers fishing very important to their life may achieve greater total social benefit from their fishing than someone who considers fishing less important, even if they fish fewer days than the person who finds fishing less important. There is a need to further explore how to measure and understand the importance of recreational fishing to the lives of those who do it. Importance is a complex psycho-social concept that has many dimensions and cannot be independently observed, unlike catch and effort. For example, two people who gave a similar rating of the importance of fishing to their lives in this study may have very different reasons for giving this rating that are not comparable.

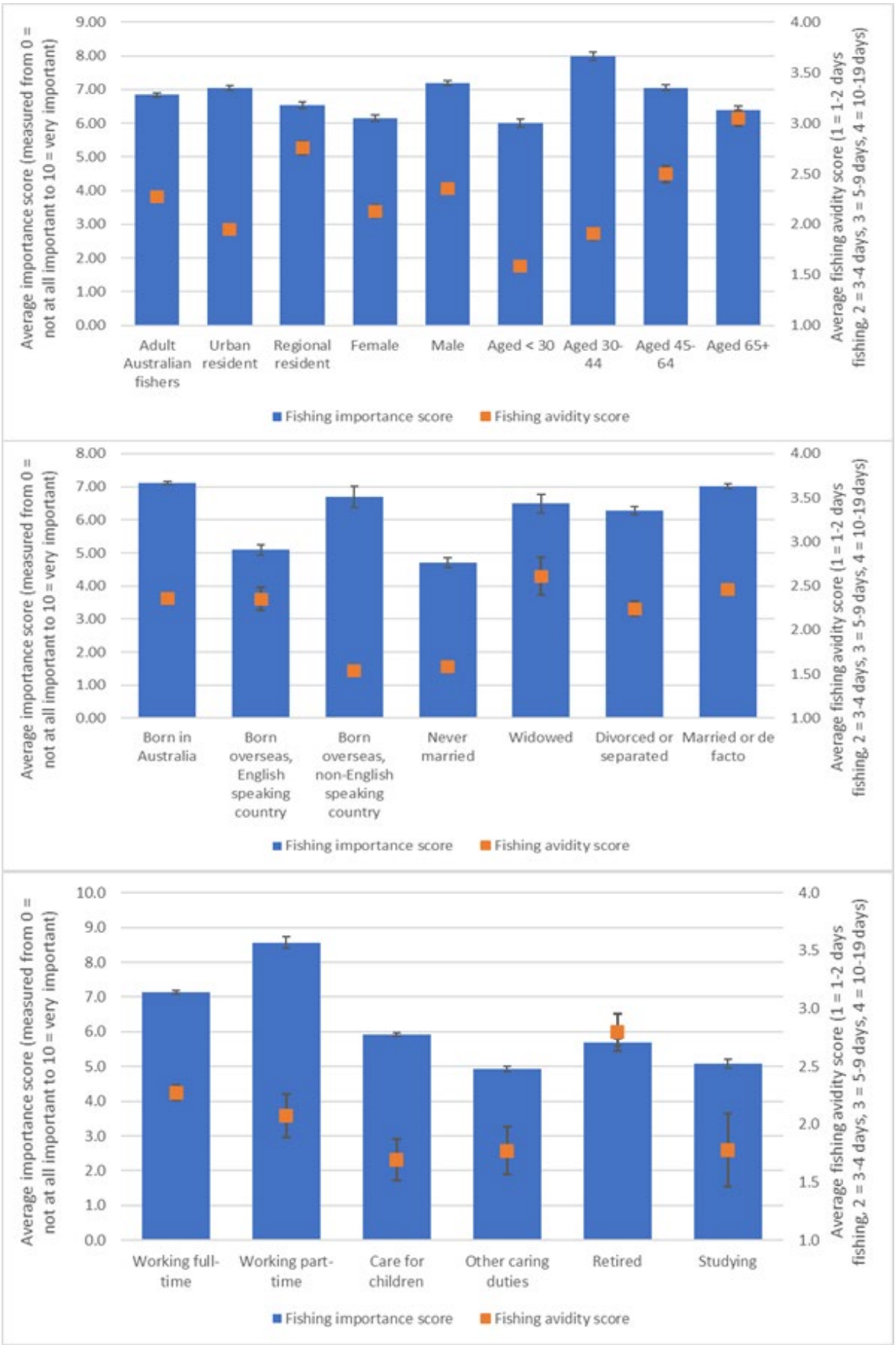


Figure 4.18 Average fishing importance compared to fishing avidity, by socio-demographic group, adult Australian fishers 2018-19, NRFS Stage 2 data

4.7 Changing participation: what factors predict whether a person fishes less or more in a given year?

Not all fishers get to fish as often as they want to. In any given year, some will fish less than they did the previous year and others more, with these changes influenced by many factors. The Stage 2 survey asked fishers if they had fished more, about the same or less in the past 12 months (2018-19) than the previous year. They were also asked if they had fished less than they wanted to, about the right amount, or more than they wanted to in the previous 12 months. Those who indicated fishing less or more (either in terms of total fishing days, or the amount they wished to fish) were then asked if any of a number of factors contributed to them fishing less or more. These questions were then repeated in the Stage 3 wash-up survey conducted in late 2021.

4.7.1 How many recreational fishers are able to go fishing as much as they want to?

In 2018-19 a significant proportion of fishers – 42.4% – reported that they fished more days in the last year compared to the previous year (Figure 4.25), while 38.4% fished about the same amount as the previous year, and only 19.1% fished less than the previous year. At the end of 2021, after almost two years of the COVID-19 pandemic, findings were quite different: 31.4% of fishers reported fishing less in the past 12 months compared to the year before, and only 20.2% reported fishing more.

When asked if they had fished as much as they *wanted* to in the past year, findings were quite different. In 2018-19, 61.9% of recreational fishers said they went fishing less than they wanted to, and only 8.4% had gone fishing more than they wanted. In 2021, a similar proportion reported fishing less than desired, with very few fishing more than they wanted to (Figure 4.26). Even amongst those who had fished more in the past 12 months compared to the previous year, 58.2% reported they had fished less than they wanted to (Figure 4.27).

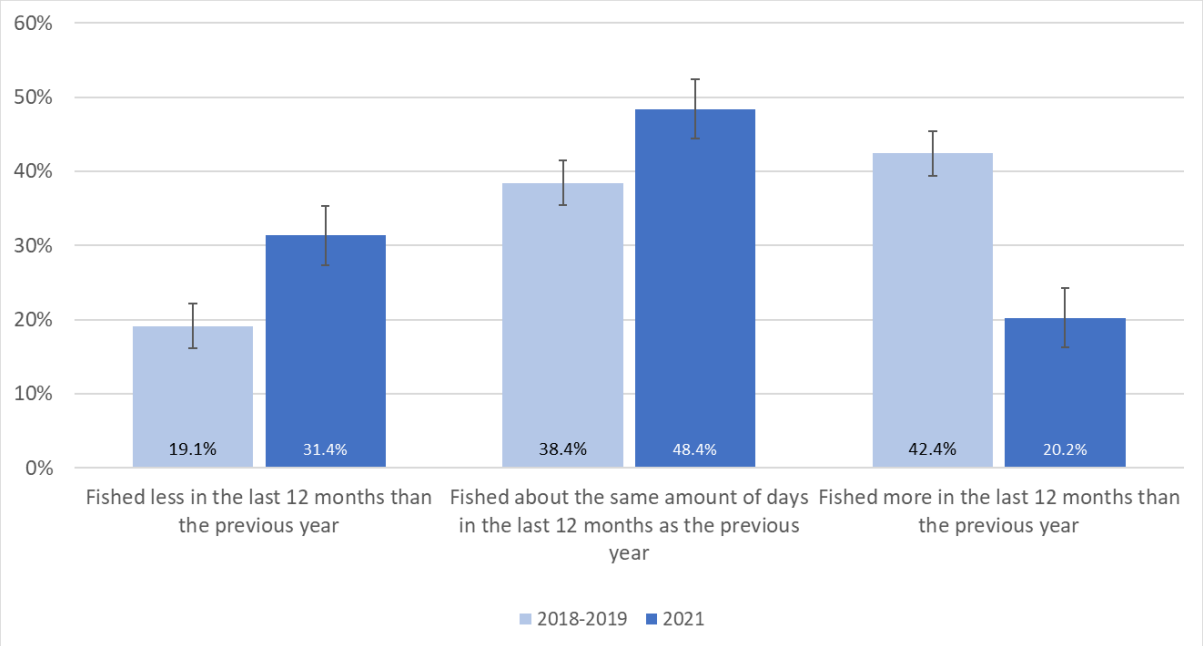


Figure 4.19 Amount of time spent fishing in last 12 months compared to previous year, 2018-19 and 2021

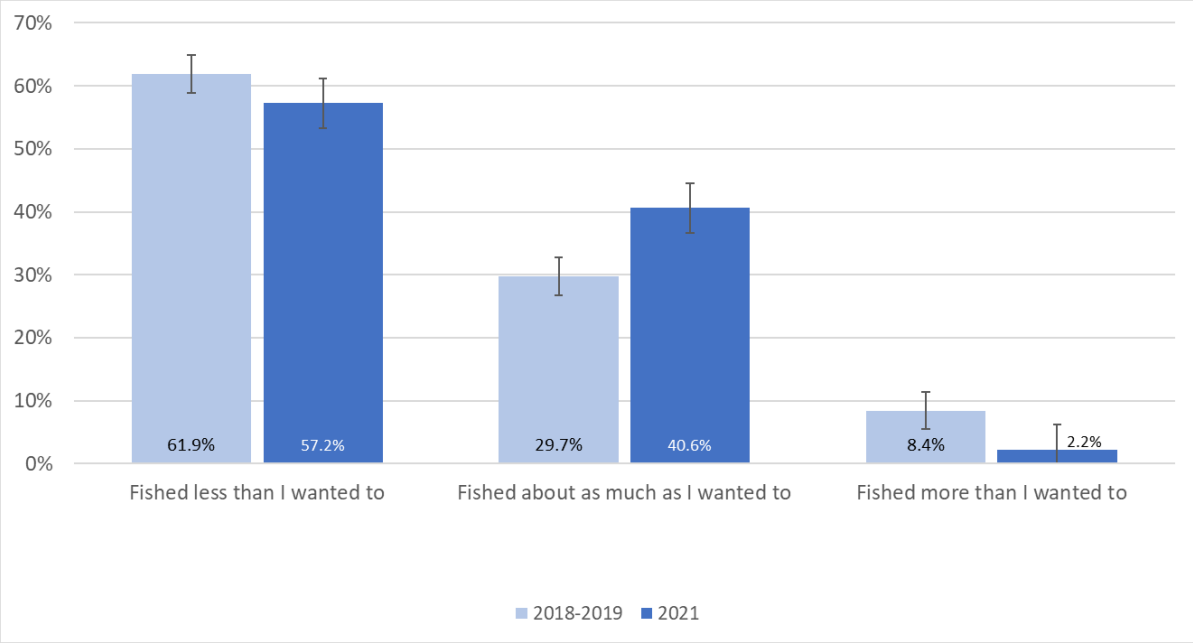


Figure 4.20 Satisfaction with amount of time spent fishing in the last 12 months, 2018-19 (Stage 2 data) and 2021 (Stage 3 wash-up survey)

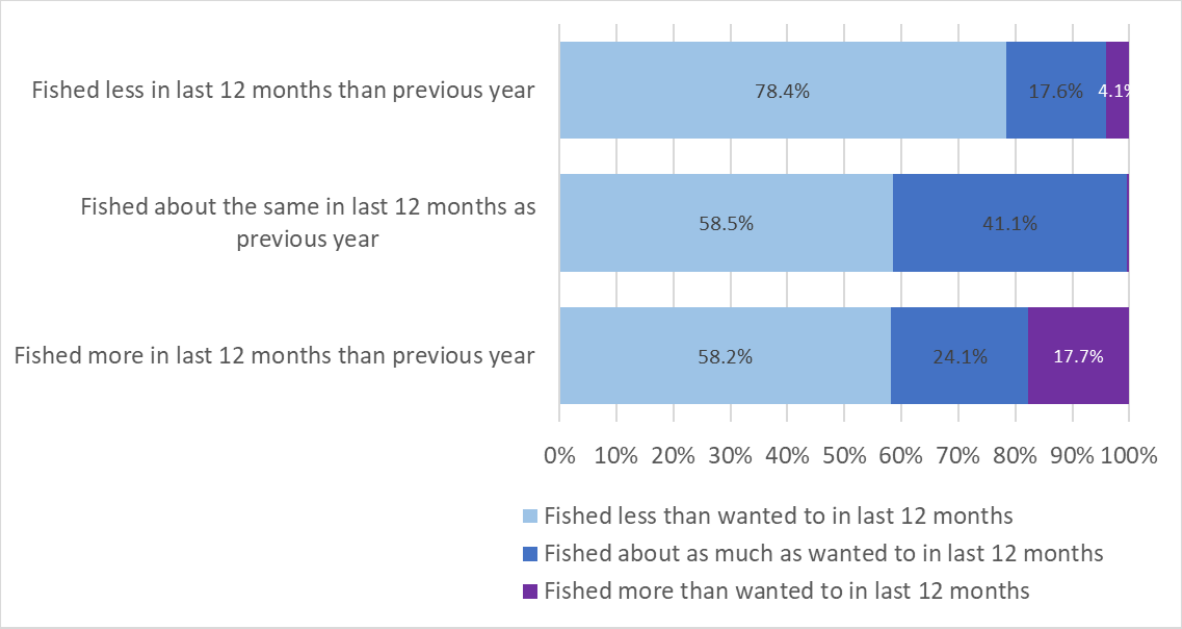


Figure 4.21 Amount of time spent fishing in previous year, by level of satisfaction with amount of fishing done in last 12 months, 2018-19 (NRFS Stage 2 data)

4.7.2 Who gets to go fishing as much as they want to?

Recreational fishers were more likely to have increased their fishing compared to the previous year (Table 4.4) if they were male, younger (aged under 30), were financially well off, had fished a greater number of days, and had spent a larger amount on their fishing. They were more likely to have reduced their fishing less in the past 12 months if they were aged 45 to 64 (32.4%), or 65 or older (33.3%).

Recreational fishers were most likely to report fishing less than they wanted to if they were aged 65 or older (81.4%) or 30 to 44 (79.6%), and if they were male (67.0%, compared to 56.5% of women).

Table 4.4 Who went fished as much as they wanted to in 2018-19? Findings for different groups of fishers (NRFS Stage 2 data)

	% of group who, in the last 12 months:			% of group who, in the last 12 months:		
	Fished more than previous year	Fished about same	Fished less than previous year	Fished less than wanted to	Fished about as much as wanted to	Fished more than wanted to
Female[1]	33.9%	37.0%	29.1%	56.5%	26.2%	17.3%
Male[1]	41.3%	45.3%	13.4%	67.0%	30.5%	2.5%
Aged <30[1]	55.0%	29.7%	15.3%	43.8%	30.9%	25.3%
Aged 30-44[1]	43.9%	43.2%	13.0%	79.6%	14.5%	5.9%
Aged 45-64[1]	22.0%	45.7%	32.4%	43.2%	56.6%	0.2%
Aged 65+[1]	33.3%	50.5%	16.2%	81.4%	18.4%	0.2%
Lives in urban area[1]	42.1%	43.1%	14.8%	60.4%	28.2%	11.5%
Lives in regional area[1]	34.0%	41.3%	24.8%	68.0%	30.3%	1.7%
Australian-born[2]	29.0%	51.1%	19.9%	68.9%	25.7%	5.4%
Born English speaking country[2]	28.8%	48.0%	23.2%	67.2%	27.3%	5.5%
Born non-English speaking country[2]	27.5%	44.8%	27.7%	59.0%	32.7%	8.2%
Aboriginal/Torres Strait Islander[2]	35.9%	45.4%	18.8%	68.4%	26.3%	5.3%
NSW/ACT[2]	29.4%	49.3%	21.3%	67.5%	25.9%	6.5%
VIC[2]	32.8%	48.3%	18.9%	69.6%	27.4%	3.0%
QLD[2]	30.0%	49.2%	20.8%	69.5%	24.7%	5.8%
SA[2]	23.6%	54.6%	21.8%	67.3%	28.6%	4.2%
WA[2]	31.4%	52.8%	15.8%	67.7%	27.3%	5.1%
TAS[2]	30.7%	50.2%	19.1%	62.2%	32.3%	5.5%
NT[2]	28.2%	50.2%	21.6%	68.9%	25.9%	5.2%
Poor/very poor[2]	27.2%	43.2%	29.5%	70.0%	22.7%	7.2%
Just getting along[2]	25.5%	50.4%	24.2%	70.3%	25.4%	4.3%
Comfortable[2]	29.8%	51.5%	18.7%	68.8%	26.3%	5.0%
Very comfortable/ prosperous[2]	34.0%	49.2%	16.9%	61.6%	28.7%	9.8%
Fished <5 days[2]	23.2%	47.2%	29.5%	66.6%	28.4%	5.1%
Fished 5-9 days[2]	24.0%	48.3%	27.6%	74.0%	22.1%	3.9%
Fished 10-19 days[2]	28.5%	51.6%	19.9%	76.5%	19.4%	4.1%
Fished 20+ days[2]	34.1%	55.6%	10.3%	63.3%	29.9%	6.9%
Fishing expenditure <$1,000[2]	22.8%	48.2%	29.0%	66.9%	28.4%	4.7%
Fishing exp. $1,000-$4,999[2]	31.7%	52.1%	16.1%	70.7%	23.9%	5.4%
Fishing exp.$5,000-$9,999[2]	34.6%	52.8%	12.6%	70.0%	23.6%	6.4%
Fishing exp. $10,000+[2]	37.7%	52.0%	10.3%	61.8%	29.5%	8.8%

[1] Data have been weighted to be representative. Weighted data are used as they correct for known biases and there is a large sample from each group, enabling high confidence in weighted data.
[2] Data are not weighted, as the sample size for one or more groups was relatively small, and this meant weighted data had very high rates of potential error. This means unweighted data provide a more accurate estimate: however, the unweighted data will over-represent avid fishers, and those living in States/Territories with smaller populations.

4.7.3 Common reasons for fishing less or more

The Stage 2 survey explored the reasons fishers went fishing less or more often, and the quality of their fishing experience. The most common reason for fishing less than desired or fishing less days in general compared to the previous year, was a person's work commitments: of those who fished less, 69.4% reported that their work commitments were either the main reason (26.7%) or one of the reasons (42.7%) they fished less (Figure 4.28). This was followed by poor weather conditions on fishing days (56.3%), a change in home commitments such as having a baby or doing renovations (46.6%), lack of availability of fishing companions (32.1%), and poor environmental conditions (31.5%). Between 20% and 29% experienced issues related to catch rate or quality, reduced access to fishing areas, difficulty affording fishing, health problems (including reduced mobility associated with old-age related frailty), or difficulties getting to fishing spots.

Relatively few people fished less due to switching to a different hobby or sport – 12.3% said this was one of the reasons they fished less, and only 2% that it was the main reason. This suggests that, for the majority of people who fish less, the change is not due to the person actively seeking to reduce fishing but is more commonly driven by other factors.

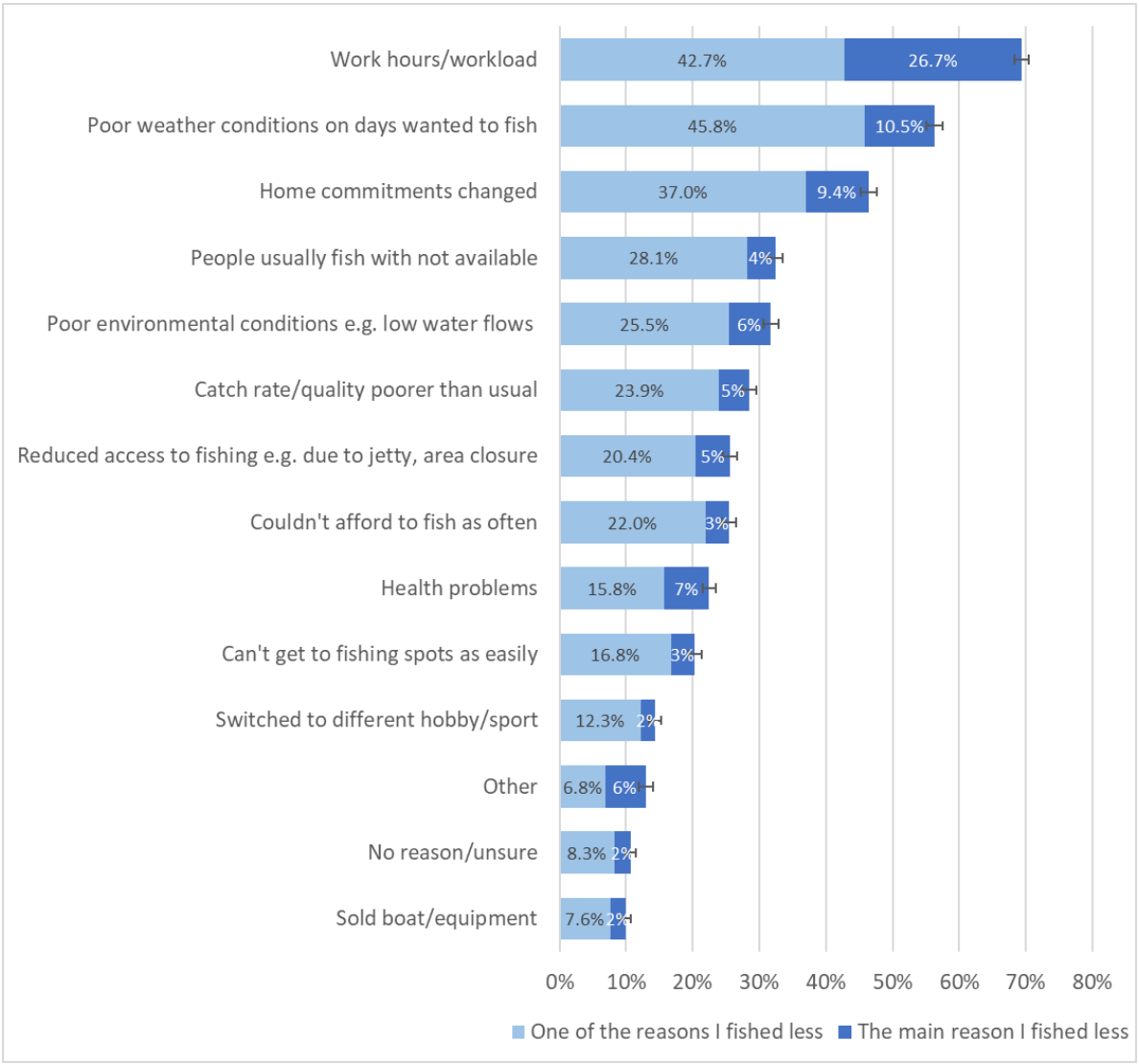


Figure 4.22 Reasons for fishing less in the past 12 months, 2018-19, reported by fishers who had fished less in the past 12 months compared to the previous year and/or fished less than desired in the past 12 months (unweighted data, NRFS Stage 2)

Fishers who reported fishing more often than they had the previous year were asked what factors contributed to them fishing more (Figure 4.29). The most common factors that contributed to a person going fishing more often were that they began doing new/different types of fishing e.g. using different gear or targeting new species (66.1%), people they went fishing with were available more often (47.9%), they found new people to go fishing with (46.3%), there were good weather conditions (43.7%), or they had a reduction in home commitments (40.8%). Between 30% and 39% fished more because they bought new equipment, fishing opportunities improved, they reduced or changed work hours, their finances improved, or their health or fitness improved.

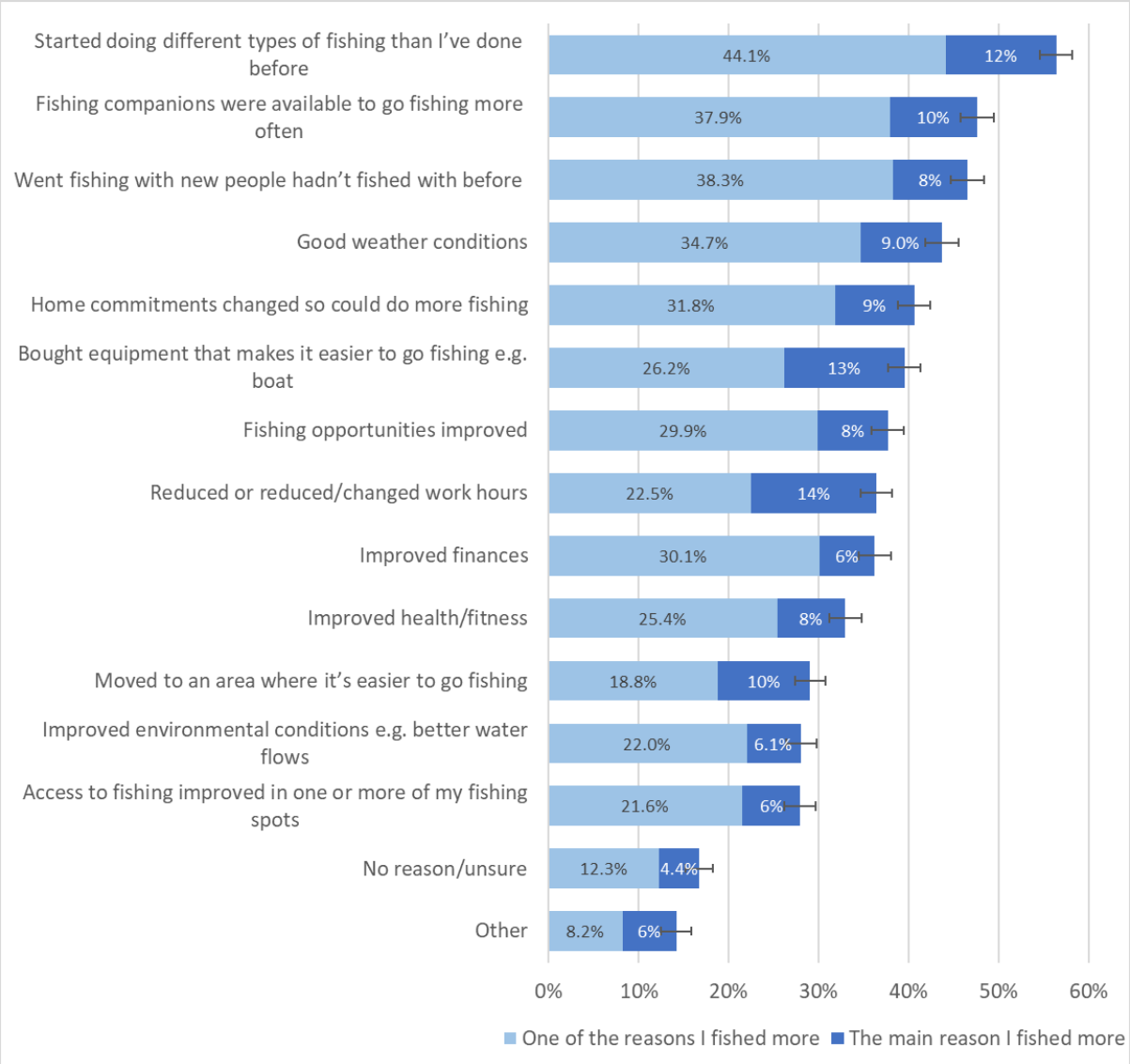


Figure 4.23 Reasons for fishing more in the past 12 months, 2018-19, reported by fishers who had fished more in the past 12 months compared to the previous year (unweighted data, NRFS Stage 2)

4.7.4 Quality of fishing experiences

In addition to asking fishers whether the amount of fishing they did had changed over the past year, those who participated in the Stage 2 survey were asked about the quality of their fishing experiences over the past year (Figure 4.30). The most common negative fishing experience reported was poor weather conditions, experienced sometimes or regularly by 52.0% of fishers. This was followed by undersize catch (58.0%), difficulty catching target species (53.3%), difficulty catching anything (43.8%), and drought (35.7%), with many parts of Australia experiencing drought during the 2018-19 Stage 2 survey period. Overcrowding of fishing areas was sometimes or regularly an issue for 30.9% of fishers. Between 20% and 30% sometimes or regularly experienced lack of fish cleaning and

disposal facilities, other fishers behaving poorly, long queues at boat ramps, poor environmental health, or high volumes of rubbish in the areas they were fishing. Fewer reported being worried about risk of crime, lack of toilet facilities, affordability of fishing, difficulty getting boats down ramps, or difficulty getting advice in gear/tackle shops.

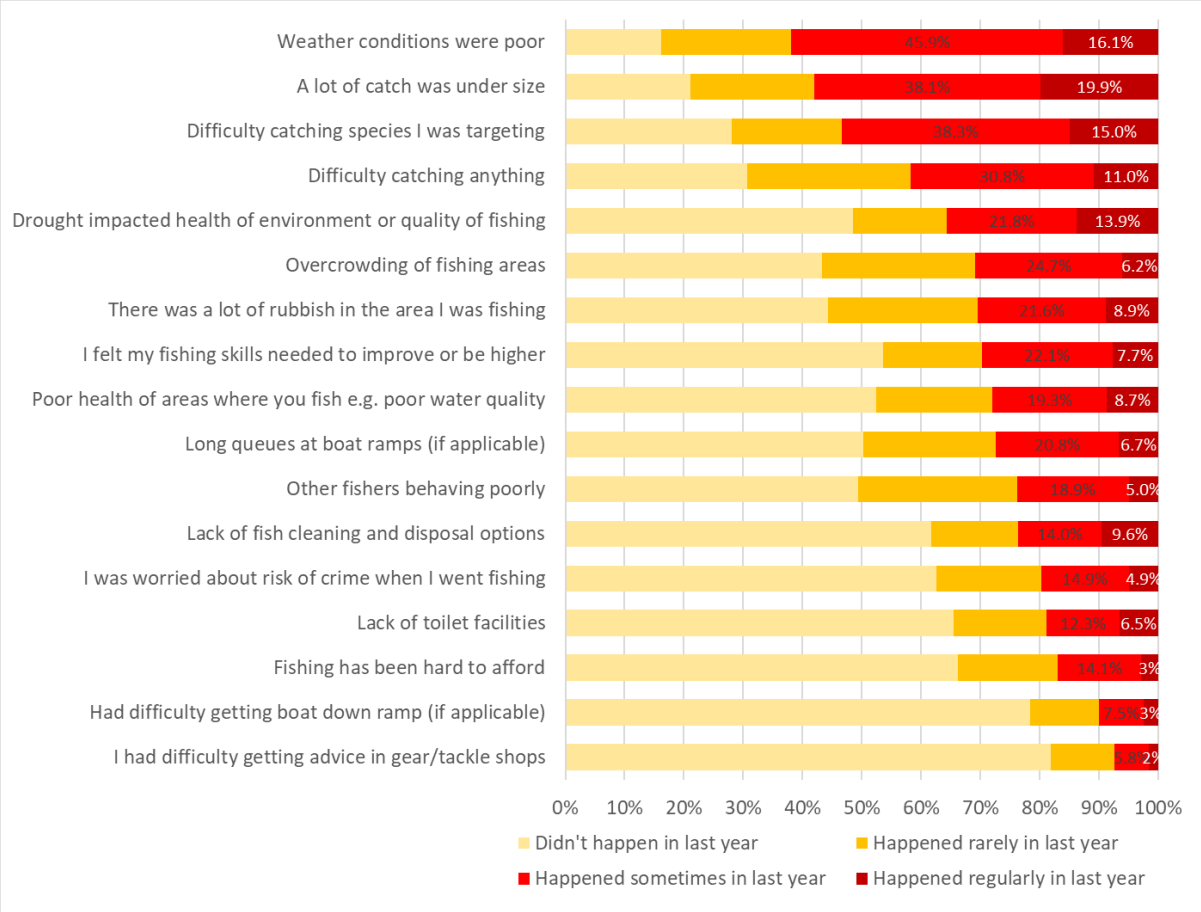


Figure 4.24 Incidence of unpleasant or negative fishing experiences, 2018-19 (NRFS Stage 2 data)

Fishers were asked if any of these negative fishing experiences resulted in them fishing less often than they otherwise would have (Figure 4.31). Of all the factors asked about, experiencing overcrowding was the most likely to trigger a reduction in fishing activity: of the 30.9% of fishers who experienced overcrowding sometimes or regularly, just over half (51.4%) reported that they did less fishing as a result of experiencing overcrowding. Additionally, one-third of those who found fishing hard to afford reporting this led to them fishing less (35.6%), as did one third of those who had difficulty getting a boat down a ramp (33.8%). A reduction in fishing was also reported by between 15% and 25% of those who experienced difficulty getting advice (23.9%), long queues at boat ramps (23.6%), concern about risk of crime when fishing (18.0%) or concern about poor environmental health of the areas they fished in (15.5%).

These findings suggest that any increase in overcrowding of fishing areas is likely to result in some decline in fishing participation. This has implications for those seeking to increase fishing participation: if strategies to increase fishing participation lead to growth in experience of overcrowding, they are unlikely to be effective in the long-term as it is likely the resulting overcrowding will lead some fishers to reduce their fishing trips.

To a lesser extent, the findings suggest that factors related to skills sometimes trigger people to fish less often, particularly those who found it difficult to obtain advice or get a boat down a ramp. This

suggests that for some fishers, encouragement of participation in fishing will be more effective is accompanied by support to learn key skills.

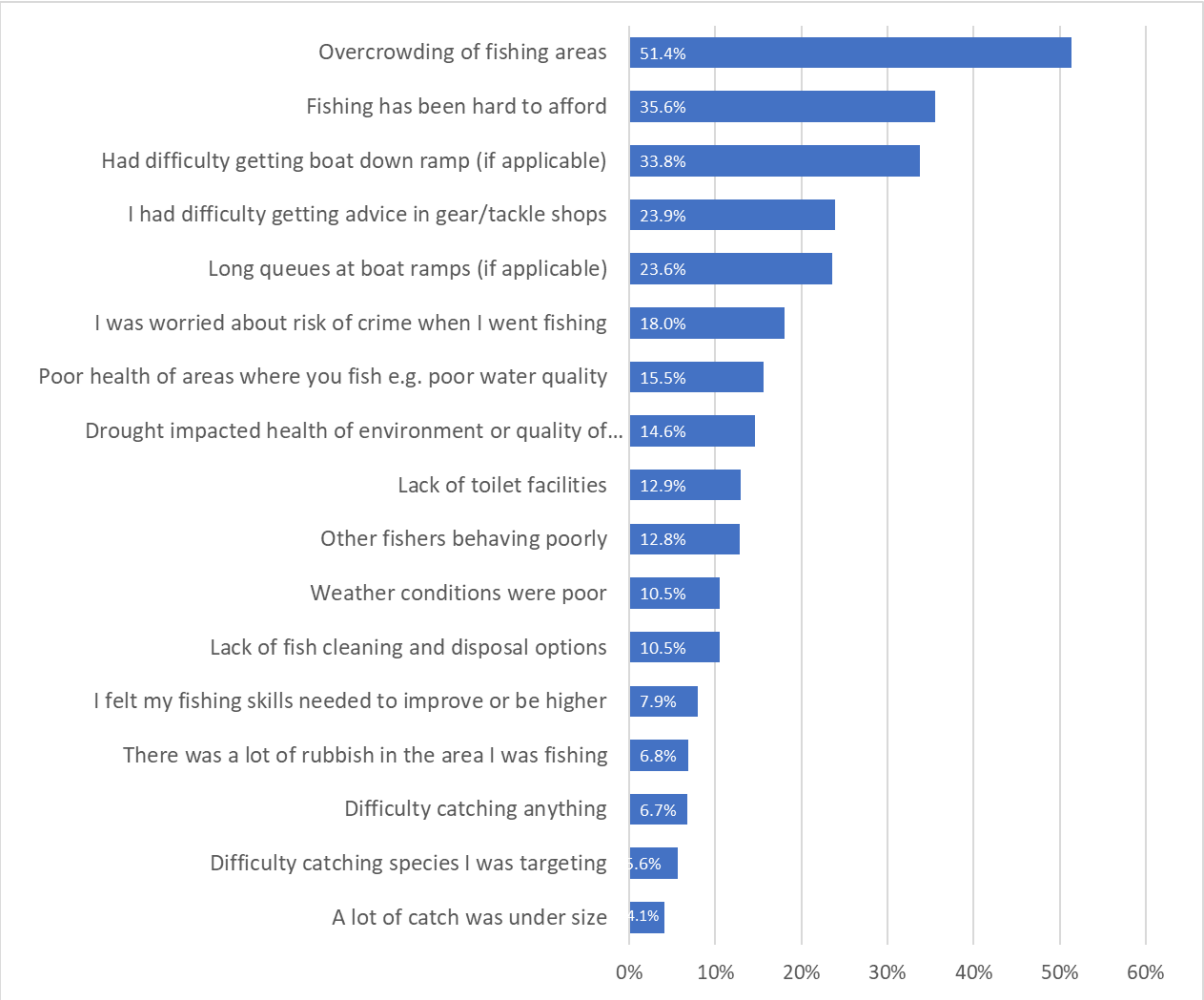


Figure 4.25 Proportion of fishers who said that negative fishing experiences resulted in them reducing the amount of fishing they did, 2018-19 (NRFS Stage 2 data)

4.8 Why don't people try fishing?

Many people never try fishing (non-fishers) or drop out of fishing after having done it (past fishers). The previous section examined reasons for shorter-term change in participation in fishing. This section examines factors that act as barriers to trying fishing, and that contribute to people stopping fishing completely for several years.

The NRFS Stage 2 survey asked those who had never fished, and those who had fished at some point in their life but not in the past five years, whether any of the following applied to them:

- Lack of interest in fishing
- Having few or no people to fish with
- Having other priorities/being busy
- Finding it hard to learn skills, or lacking skills such as swimming
- Disliking aspects of fishing such as touching fish
- Having concerns about cost/affordability/gear
- Other issues such as health or physical limitations.

These issues were asked about as they have been identified in past studies as potential barriers to engaging in fishing. This section examines which of these factors are significant predictors of either not trying fishing, or of ceasing to fish for more than five years. It is important to note that it is likely that other factors are also barriers to trying fishing. For example, it is possible that concern about being able to understand and comply with regulations (e.g. catch size for different species) acts as a barrier. However, given the need to constrain questions asked of non-fishers to a relatively short survey, in order to increase completion rates, only barriers commonly identified in previous work were asked about.

Perhaps the most obvious reason a person might not go fishing is because they aren't interested in recreational fishing. Past and non-fishers were asked to rate their level of interest in fishing from 0 (not at all interested) to 10 (very interested). Amongst those who had never fished, 72.7% reported having zero interest in fishing (Figure 4.32). Amongst past fishers, only 27.6% reported having zero interest in fishing. At the other end of the scale, only 7.3% of non-fishers and 21.9% of past fishers reported having a high level of interest in fishing; 20.0% of non-fishers and 50% of past fishers had moderate interest in fishing. Appendix 3.2 provides more detailed analysis, which shows that the difference between past fishers and non-fishers were statistically significant.

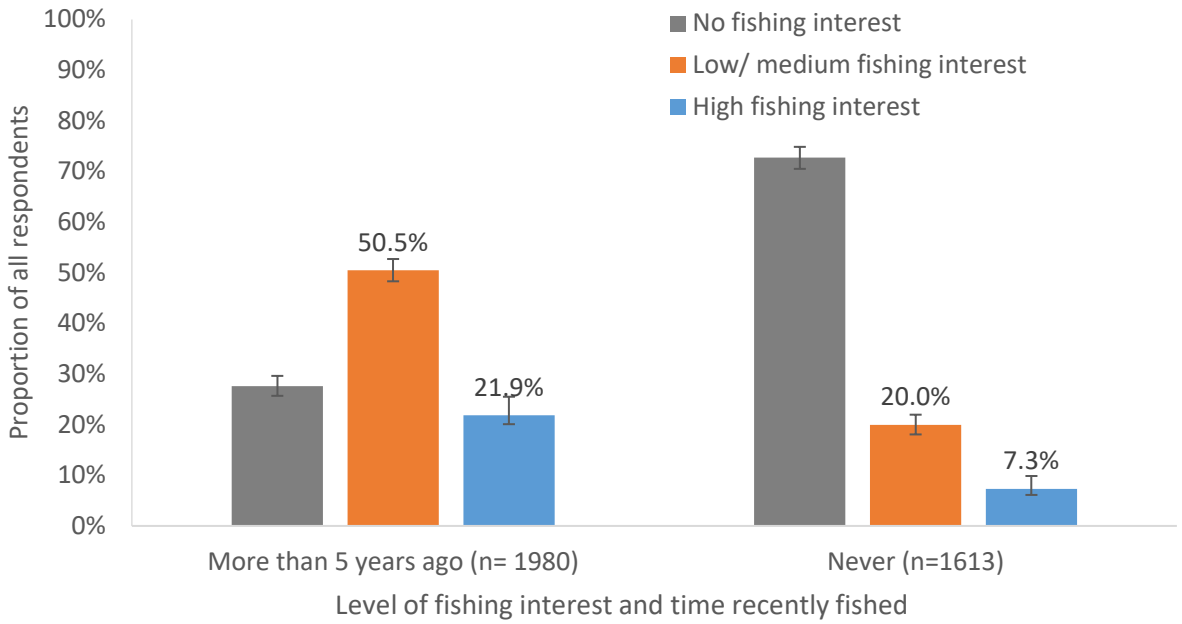


Figure 4.26 Level of interest in fishing reported by past fishers and non-fishers, 2018-2019 (NRFS Stage 2 data)

Level of interest in fishing varied significantly depending on a person's gender and age (see Appendix 3.2 for full data). Female non-fishers were significantly less interested in fishing than male non-fishers, while there were no significant differences between male and female past fishers. Amongst those who had never fished, younger people were significantly more likely to report having a moderate or high interest in fishing than older people, with 46.2% of those aged 18-35 having moderate to high interest in fishing, compared to 28.6% of those aged 36-50, 18.5% of those aged 51-65, and 14.0% of those aged 66 or older.

Beyond level of interest in fishing, a number of other factors may reduce the likelihood of a person choosing to go fishing, ranging from a dislike of specific aspects of fishing, to having few or no people to go fishing with and learn fishing skills from. When asked about these different barriers (Figures 4.33 and 4.34), six barriers to engaging in fishing were identified. These were, in descending order of prevalence:

- Lack of social connection to other fishers
- Lack of time to go fishing

- Aversion to or concerns about some aspects of fishing
- Cost of fishing and gear/equipment
- Reputation of fishers
- Concern about risk of injury, accident, or own physical health.

Social connection: The most common barrier to going fishing, for both non-fishers and recent fishers, was a lack of connection to people they could go fishing with, and/or who could teach them fishing skills. Just over 68% of both past and non-fishers had no or few friends and family who went fishing, and 47.3% of both groups had no-one they could go fishing with. Just over half of non-fishers (53.7%) and 36.6% of past fishers had no-one who could teach them to fish. In addition to lacking people who can teach them, 35.3% of non-fishers and 22.9% of past fishers felt it was hard to learn the skills needed to go fishing.

These findings suggest that, for many, the most significant barrier to engaging in fishing is finding people to go fishing with and to learn fishing skills from. It also suggests that for many, learning fishing skills primarily occurs through contact with family or friends who fish. Those who do not have people in their social circle who go fishing are less likely to feel able to build fishing skills.

Lack of time: The second most common barrier to fishing was a lack of time. Amongst past fishers, 46.3% reported that they were interested in fishing but that other things were a higher priority, while 23.3% of non-fishers reported this. Amongst non-fishers, 43.6% reported being too busy to take up fishing (many of these had little interest in fishing, hence did not suggest that their lack of engagement was due to being interested but having other priorities).

Aversion to aspects of fishing: Amongst non-fishers, dislike of some aspects of fishing was somewhat common: 49.7% did not like touching fish, 39.2% said concern about fish welfare meant they wouldn't take up fishing, and 30.0% did not like eating fish. Amongst past fishers, fewer reported these views, with 31.1% disliking touching fish, 29.5% having concerns about fish welfare and 22.4% disliking eating fish.

Perceived cost: Difficulty affording fishing was reported by 38.0% of non-fishers and 32.0% of past fishers, suggesting cost is a barrier to participating in fishing for a significant minority of both groups. Interestingly, 37.3% of past fishers and 23.3% of non-fishers reported 'I'd go fishing but don't want to have to buy fishing gear/equipment', suggesting that accessing equipment is a significant barrier for some as well as overall cost.

Reputation of fishers: While not a common issue, 27.1% of non-fishers and 22.7% of past fishers felt that the behaviour or reputation of recreational fishers stopped them wanting to fish.

Injury, accident or health concerns: The final type of barriers, reported less commonly than the first four, but with similar frequency to concerns about the behaviour of fishers, was concern about risk of harm or injury from fishing, or about a person's physical capacity to go fishing. Amongst those who had never gone fishing, 27.8% didn't know how to swim, 22.0% said that risk of injury or accident stopped them wanting to fish, and 19.7% felt their health was too poor to go fishing. Amongst past fishers, 25.0% reported poor health, 20.3% didn't know how to swim, and 19.1% were concerned about the risk of injury or accident.

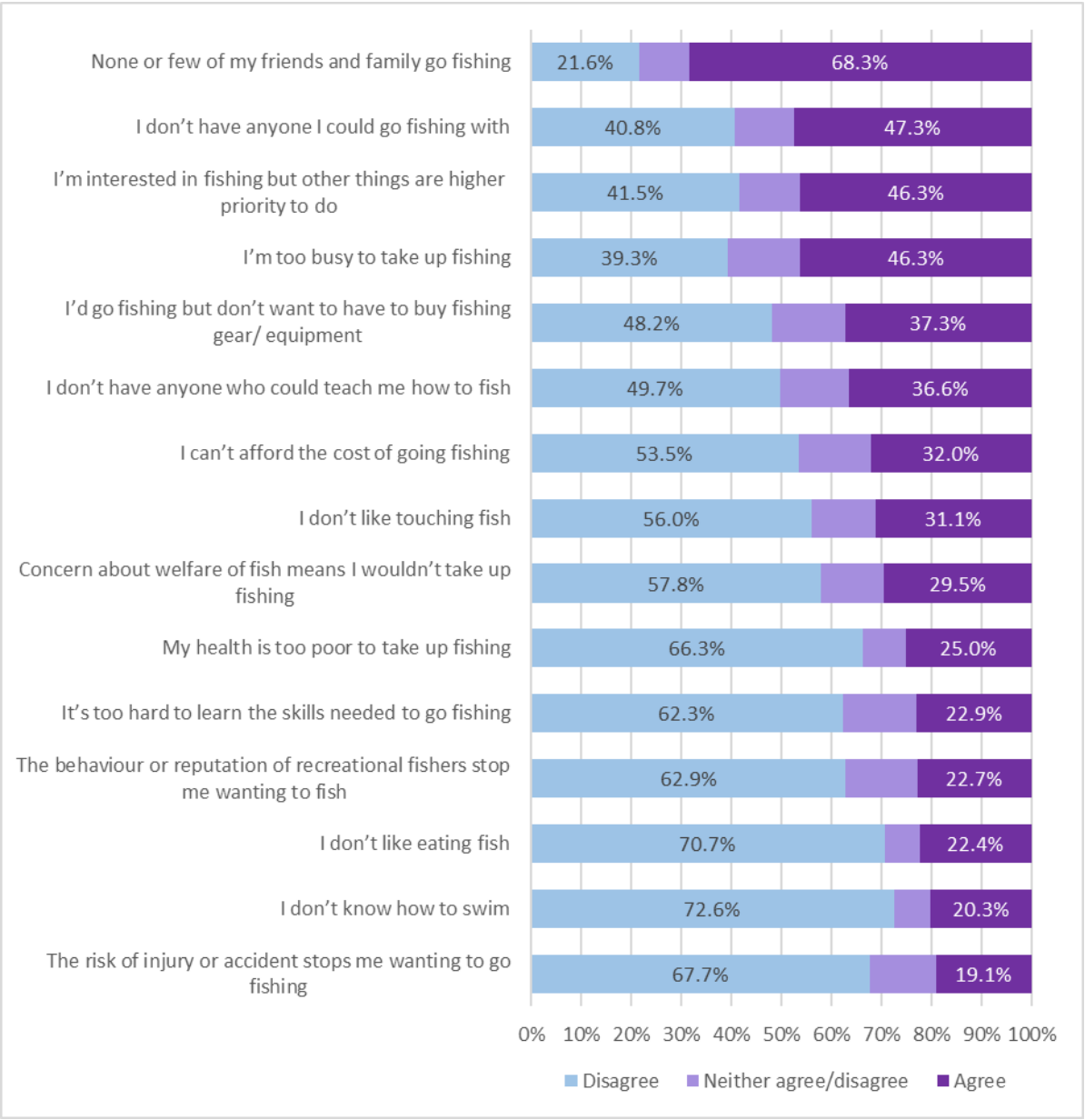


Figure 4.27 Views about barriers to going fishing – past fishers (last fished more than five years ago), 2018-19 (NRFS Stage 2 data)

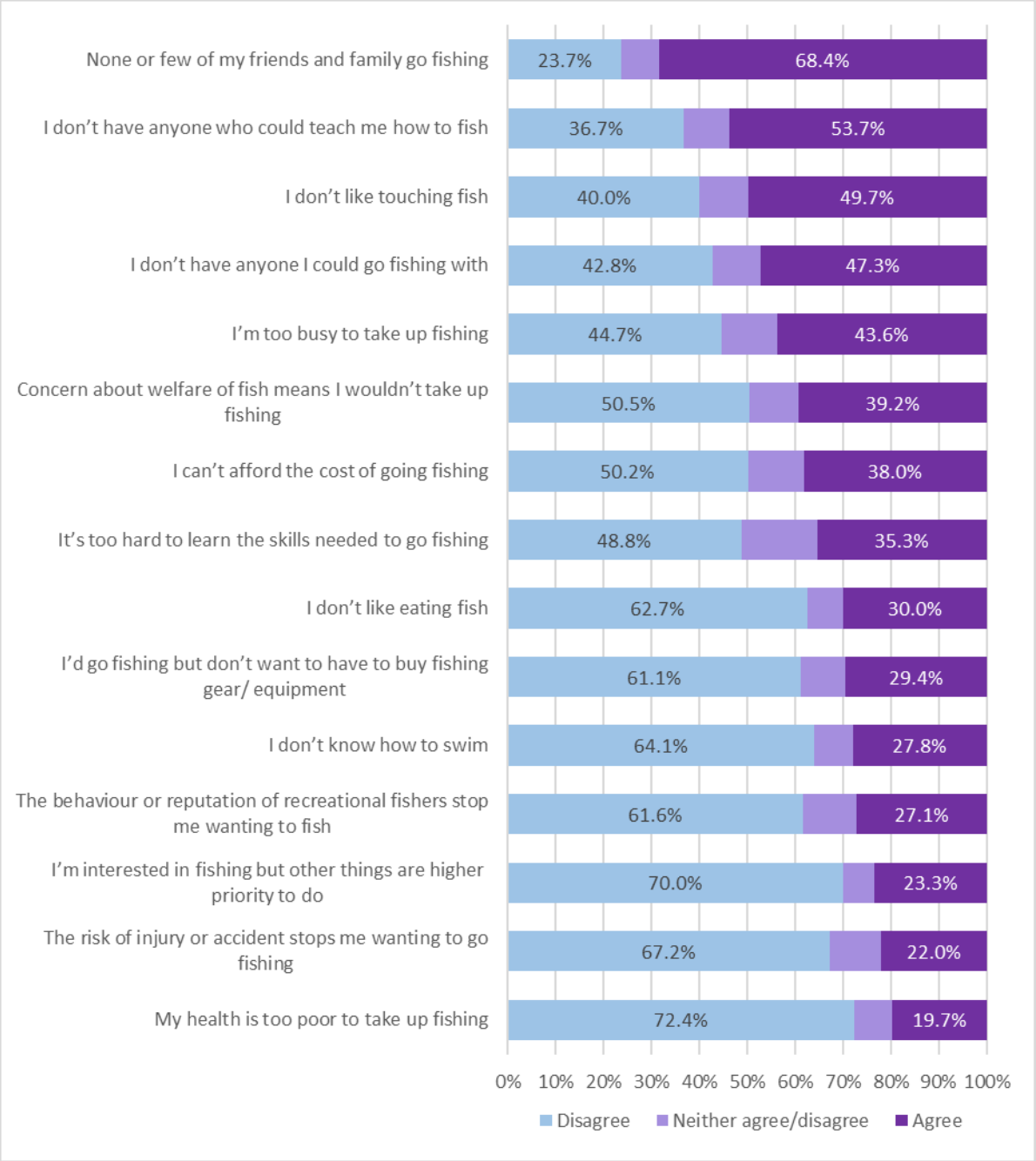


Figure 4.28 Views about barriers to going fishing – non-fishers (those who have never gone fishing), 2018-19 (NRFS Stage 2 data)

Those with higher interests in fishing were more likely to report that they experienced the following barriers to going fishing: being busy, having poor health, difficulty affording fishing, and concerns about the reputation of fishers, or risk of injury/accident. This group was *less* likely than those with no/low interest to have concerns about fish welfare, touching fish or eating fish (see Appendix 3.2 for detailed data).

Having other higher priorities, concerns about fish welfare, and a dislike of touching or eating fish, were all more common amongst female than male past and non-fishers (Appendix 3.2).

Younger past and non-fishers were more likely to experience almost all barriers to fishing compared to those aged 36 and older. In particular, younger people were more likely than older people to report being too busy to go fishing, having no-one to teach them fishing skills, finding fishing unaffordable,

concerns about the behaviour/reputation of fishers, concerns about injury/accident risk, and concerns about fish welfare or touching or eating fish. They were also more likely to report that they lacked swimming skills.

Exploratory factor analysis (detailed in Appendix 3.2) was used to identify whether some barriers to fishing formed common clusters. This analysis identified three common clusters of barriers that typically occur together, and suggested three distinct groups of past/non-fishers, each with a different cluster of reasons for not participating in fishing:

- **Priority/risk aversion:** This group report having other priorities more important than fishing, together with a relatively high level of concern about the risk of injury or accident associated with fishing and/or having poor health. Men, those aged 18-35, and those aged 66 and over, were somewhat more likely than women and those aged 36-65 to be in this group.
- **Fishing aversion:** This group often held concerns about a range of aspects of the fishing experience, particularly fisher behaviour/reputation, safety when fishing, fish welfare, and touching and eating fish. They rarely reported having other priorities that took precedence over going fishing, with their barriers centred on aversion to aspects of the activity of fishing itself. Women and younger fishers were more likely than others to be in this group.
- **Lack of social contact with recreational fishers:** This group did not have an aversion to fishing (whether related to perceived risk or other factors): instead, they typically lacked people to go fishing with. The primary factor preventing them going fishing was that their social networks did not include people they could go fishing with. Lack of social contact with fishers was also relatively common in the other two groups, however in this group it was the strongest factor preventing participation in fishing. Younger fishers were most likely to be in this group.

4.9 Conclusions

The findings presented in this chapter show that recreational fishing continues to be a fairly common activity amongst Australians, with around one in five going fishing in a typical year, and a further one in five having fished within the last five years, but not in the last 12 months. While less common than swimming, bushwalking or walking outdoors, it is similarly common to cycling and camping. The findings also suggest that the overall rate of participation in recreational fishing did not decline between 1999-00 and 2018, although there are limitations to the comparability of these figures. The data suggest there has been an increase in participation of women in recreational fishing, and a slight decline in participation of men. In total, an estimated 4.38 million adult Australian fishers – 21.4% of the adult population - took part in recreational fishing in 2018. Adult Australians took part in an estimated 28.59 million fishing events (a day in which a person spent time fishing) during 2018-19.

Fishing avidity is often, but not always, a predictor of how important recreational fishing is to a person's life. Many of those who fish less often find fishing just as – or in some cases, more – important to their life as those who fish more frequently. This suggests that fishing may have important social benefits even for those who fish relatively infrequently: someone who fishes fewer days, but for whom fishing days provide a key means of connecting with friends or family, or spending time in nature, may achieve significant social benefit from their fishing days.

Limited historical data on participation in fishing means that little is known about how much participation changes in either the shorter or the longer term. The findings in this chapter highlight that short term changes in fishing frequency are often associated with factors such as changes in weather conditions, a person's caring and work responsibilities, and availability of fishing companions. The decline in fishing observed amongst those aged 30 to 44 years between the end of 2018 and the end of 2020, for example, may be a result of the impacts of the COVID-19 pandemic on caring responsibilities amongst this age group, with other studies showing that parents (who make up

a larger proportion of this age group than others) experienced an increase in time demands during this period (see for example Freisthler et al. 2021).

The findings suggest that long-term change in recreational fishing will occur if there is (i) a change in those taking up fishing, and/or (ii) a change in the rate at which fishers stop doing recreational fishing. Both of these are affected by factors such as the availability of people to go fishing with and learn fishing skills from, identified as important in both this study and others (e.g. Holmen and Furukawa 2002, Sasidharan et al. 2006, Sutton et al. 2009, Luo et al. 2012). Lack of interest in fishing is also a key driver, identified both in this study and others (e.g. Sutton et al. 2009), although it is not known whether the proportion of people with an interest in fishing has grown or declined over time. The findings presented in this chapter also highlight that other barriers to fishing are important for some, particularly barriers related to cost, aversion to aspects of fishing, and concerns about risk of accident or injury.

5.0 Impacts of natural disasters and COVID-19 on recreational fishing

Chapter authors: Gavin Hinten, Krystle Keller, Jacki Schirmer and Andy Moore

5.1 Key points

- Recreational fishers in Victoria and New South Wales (including the Australian Capital Territory), where bushfires were most widespread, were more likely to report fishing less during the Black Summer bushfire period
- A large proportion of respondents fished less during the first year of the COVID-19 pandemic and during subsequent lockdowns in the following year, when compared to the same time of year, 12 months before
- The lowest level of recreational fishing activity was reported in March and April 2020 when nation-wide restrictions on movement and non-essential services, and a ban on recreational fishing in Victoria, were in place in response to the COVID-19 pandemic
- Prior to the Black Summer bushfires and COVID-19, in 2018-19 the most common reasons causing people to fish less were work commitments (69.4%), weather conditions (56.3%), home commitments (46.6%), and lack of availability of fishing companions (32.1%)Results presented in this chapter are not weighted to be representative of the population of recreational fishers; as such the results better reflect impacts of events on the fishing activity of more avid fishers, who are over-represented in the Stage 3 survey sample analysed.

5.2 Introduction

This survey was conducted during a period which included a severe drought, the Black Summer bushfires, a worldwide COVID-19 pandemic and regional flooding. Chapter 4 identified that little is known about how and why recreational fishing activity changes, both in the short-term and the long-term. This chapter examines whether natural disasters and other extreme events impact how often people go recreational fishing. This is an important topic to explore in Australia: every year it is likely that recreational fishing activities in at least some parts of Australia are affected by extreme weather events such as drought, fire, floods, and storms. When these events occur on a large scale and impact a significant number of Australians, they have the potential to change overall recreational fishing effort. However, the effect of these events on fishing effort has not generally been examined in recreational fishing studies.

This NRFS was not originally intended to examine the impacts of these types of events. However, the data collected in Stage 1 of the NRFS were collected when much of Australia was experiencing drought; data were collected in Stage 2 as the Black Summer bushfires affected multiple states and territories; Stage 3 data were collected through the COVID-19 pandemic and associated lockdowns and movement restrictions, and as several regions were impacted by severe storms and floods. This provided an opportunity to better understand the impacts of extreme events on recreational fishing activity.

This chapter explores the impact of two extreme events that affected a significant proportion of Australians - COVID-19, and the Black Summer bushfires - on recreational fishing activity between December 2019 and June 2021. It then examines data collected in the final Stage 3 wash-up survey to identify how recreational fishing changed due to COVID-19.

5.3 Extreme events occurring during NRFS data collection

Drought, bushfire, COVID-19 and floods all affected large parts of Australia during the period of time in which data were collected for the second NRFS. This section briefly summarises the timing and scale of the three most widespread events that occurred during data collection for the NRFS: drought, bushfire, and the COVID-19 pandemic.

5.3.1 Drought

Between 2016 and 2020, much of Australia was impacted by a drought that was, in terms of its extent and intensity, one of the worst on record. Stage 1 NRFS data were collected at the end of 2018, just before Australia entered the warmest and driest year on record for the country in 2019. The 2019 spring was also the driest on record nationally, while the 2019-20 summer went on to be the second warmest on record Australia-wide, including the driest December on record, with rainfall below average nationwide apart from western Tasmania and parts of Western Australia (Bureau of Meteorology, 2020). Beginning 12 December 2019, a series of extreme heat events spread across Australia breaking numerous records on individual days and in January 2020 extending as far south as Tasmania. A significant heatwave affected south-eastern Australia at the end of January and start of February 2020, while February was consistently hot across some parts of northern Australia, with some records set (Bureau of Meteorology, 2020).

5.3.2 Black Summer bushfires

The drought of 2016-2020 was the catalyst for the Black Summer bushfires, one of the worst bushfire seasons on record. Despite their 'summer' name, the Black Summer bushfires actually started in late winter of 2019 and extended over an eight-month period to February 2020. Fires occurred in every state and territory, but with particular concentration on the eastern seaboard and areas inland from this across Queensland, New South Wales, Victoria and parts of South Australia. The fires burnt over 24 million hectares of land, destroyed more than 3,000 homes and caused significant death, injury and displacement (Australian Government, 2020). Amongst the impacts of the fires were significant impacts on the agriculture, forestry and tourism industries (Whittaker et al. 2021). Many of the coastal and inland areas in which the Black Summer bushfires occurred are traditionally a focal point for recreational fishing activities over the summer period, meaning that recreational fishing was amongst the many recreational and tourism activities disrupted by the fires.

The bushfire season and the drought ended in February 2020 with a period of intense rain along the eastern seaboard, causing localised storms and flooding and spikes in poor water quality as ash and sediment washed down river systems (Australian Government, 2020).

5.3.3 COVID-19 pandemic

The first confirmed case of COVID-19 in Australia was recorded on 25 January 2020 (Department of Health, 2020). As the initial number of cases grew, the Australian Government responded with a range of measures including closing Australian borders to all non-residents on 20 March 2020 (Prime Minister of Australia, 2020a), introducing social movement restrictions and shutting down many non-essential services. Many of these restrictions were implemented from late March 2020 (Prime Minister of Australia, 2020b,c), when National Cabinet provided strong guidance to all Australians to stay home for all except essential purposes such as shopping for necessary supplies, medical treatment, and limited outdoor exercise time.

Australia was initially successful in flattening the growth of COVID-19 cases and deaths at a national level, however localised outbreaks occurred regularly. Throughout the period data were collected for the NRFS, movement restrictions of various types applied across different parts of Australia. Interstate travel was often restricted, while lockdowns were implemented at various points in time by different states and territories, in which residents were restricted from travelling outside their home other than for essential purposes. The lengthiest lockdowns occurred in the most populous states – Victoria and New South Wales. Figure 5.1 shows (i) daily COVID-19 cases in Australia and (ii) the

COVID-19 Stringency Index for Australia (Hale et al. 2021), a composite measure that indicates the severity of restrictions in place on movement of residents at different points in time, from 0 (no restrictions on movement) to 100 (high levels of restriction on movement). Where sub-national policies varied, as they typically did across Australia, the index indicates the strictest measures in place.

These restrictions had varying effects on ability to go recreational fishing. While recreational fishing was allowed in almost all jurisdictions during COVID-19 lockdowns – with the exception of Victoria during March to April 2020 (VRFish 2020a) – travel and movement restrictions significantly constrained the ability of many to go fishing. In particular, travelling across state and territory borders to go recreational fishing was often restricted. Within states and territories, ability to go fishing was at various times affected by restrictions placed on movement, with the effects likely to vary depending on the distance a person lived from potential fishing locations. During, March and April 2020, the Victorian government instituted a total ban on recreational fishing as part of COVID-19 related restrictions on movement (VRFish 2020a); this lasted only a short period before being amended to allow fishing within permitted travel distances from the home.

5.4 Methods

Data analysed in this chapter were collected in Stage 3 of the NRFS, via (i) a series of surveys of the same group of recreational fishers, asking about their fishing activities over an 18-month period from December 2019 to June 2021 and (ii) a final survey conducted at the end of 2021 which included both the longitudinal participants and a new sample of fishers recruited via the Regional Wellbeing Survey (see Chapter 3 for detail).

Survey participants in Stage 3 were asked to report the number of day and overnight fishing trips they participated in during each month. They were also asked to compare their level of fishing activity in a given month to their fishing activity in the same month one year earlier. The number of day trips fishers reported was analysed to identify change over time.

Microsoft Excel and the Statistical Package for Social Sciences (SPSS) Version 26 were used for all data analyses.

As detailed in Chapter 3, not all fishers invited to participate completed every survey conducted in Stage 3. The sample achieved for the individual surveys conducted in Stage 3 (in which data were collected via a survey conducted every two to three months) varied from 517 to 1066. As the sample size for each individual state and territory was not always large enough to report findings for individual jurisdictions, state/territory data were combined when response sample numbers were low. Although sample numbers were relatively low for Tasmania, given its unique isolation compared to other jurisdictions it was not paired with any other jurisdiction.

Results presented in this chapter are unweighted – they were not adjusted to be representative of the population of recreational fishers. As noted in Chapter 12, the Stage 3 longitudinal sample was biased to avid fishers, and as such the results in this chapter identify impacts of events on fishing activity by more avid fishers. This insight is useful because, as noted in Chapter 3 (Section 3.5.2), avid fishers represent the majority of recreational fishing effort (e.g. Henry and Lyle 2003).

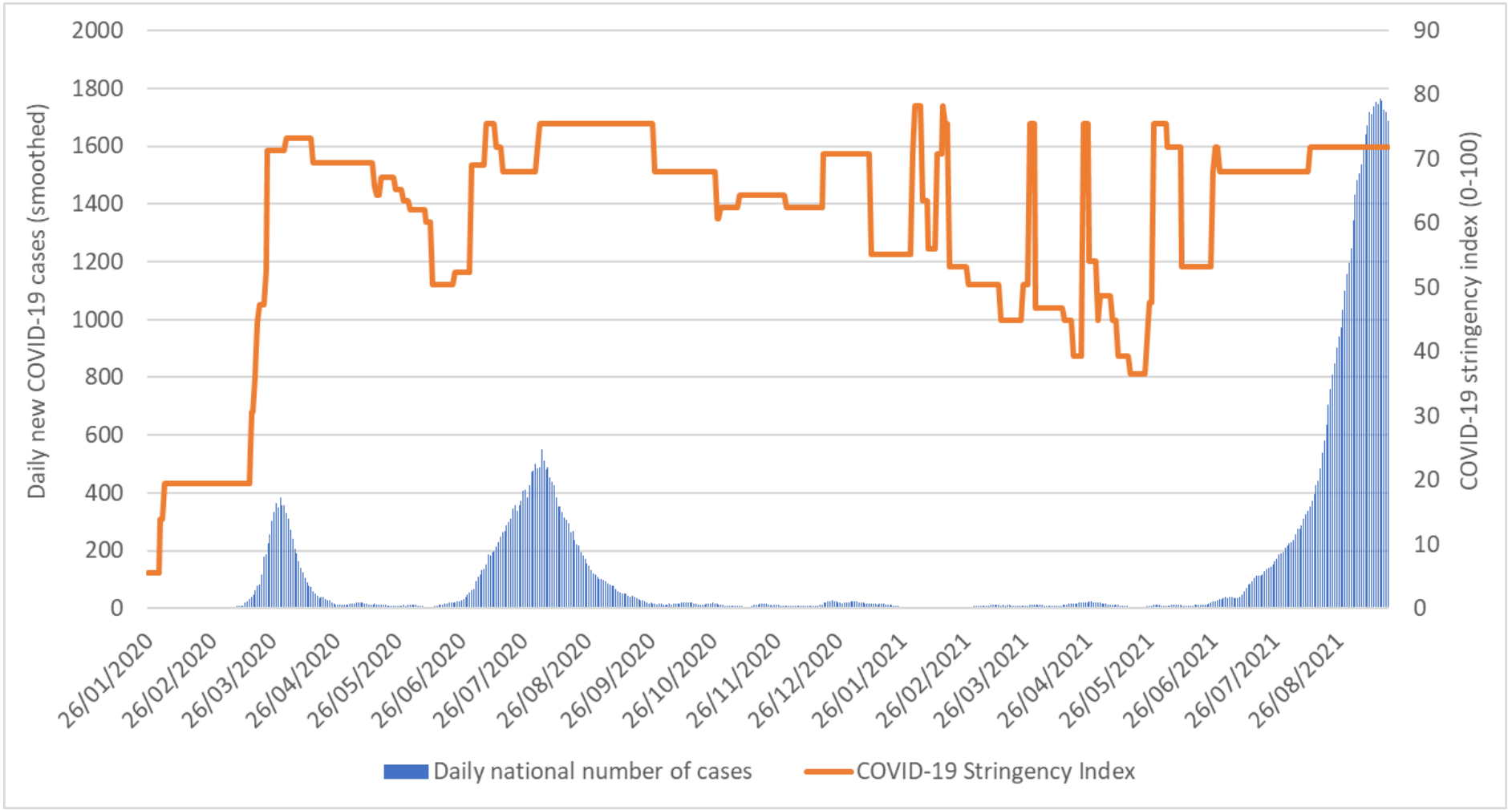


Figure 5.1 National record of new daily cases of COVID-19 in Australia and the COVID-19 Government Response Stringency Index (CGRI) for Australia, from 1 March 2020 to 30 June 2021

5.5 Results: Recreational fishing in the first 18 months of COVID-19

Recreational fishing activity typically varies across the year, with the summer and easter periods being peak periods for recreational fishing. To identify the likely effects of COVID-19 on recreational fishing activity, the average number of fishing trips reported by Stage 3 participants by month was compared (Figure 5.2), as was their estimates of their relative levels of fishing activity in each month compared to the same period 12 months earlier (Figure 5.3). This provided the opportunity to distinguish, to some extent, short term fluctuations from medium term variability. Additionally, comparisons to 12 months earlier are less subject to seasonal effects (such as increased fishing during summer months due to factors including both weather conditions and summer holidays being taken by many Australians), as they compare to the same season in the previous year.

The impacts of COVID-19 on the number of recreational fishing trips are evident from Figure 5.2. The proportion of fishers who reported having no fishing trips in a given month was highest at three points in time when COVID-19 lockdowns were in place across relatively large parts of Australia: (i) during the initial 2020 lockdown (March to April 2020), (ii) during July to September 2020 when a strict lockdown was in place in Victoria, and (iii) in February to March and May to June 2021 when widespread lockdowns or significant movement restrictions were in place in multiple states and territories.

From Figure 5.3, it is possible to see that during the first year of the pandemic, from March 2020 onwards, in every month more than 50% of recreational fishers reported going fishing less often compared to a year earlier. Fewer reported this as the pandemic extended into its second year, a time when most fishers were comparing their fishing to a previous year in which their fishing was also likely to have been restricted.

It is useful to analyse the impacts of extreme events on recreational fishing participation in four distinct time periods, each of which were characterised by comparatively different combinations of extreme events that had potential to affect participation in recreational fishing:

1. December 2019 – February 2020: Black Summer
2. March 2020 – November 2020: COVID-19 year 1 (excluding summer)
3. December 2020 – February 2021: COVID-19 year 1 (summer)
4. March 2021 – June 2021: COVID-19 year 2 (first three months).

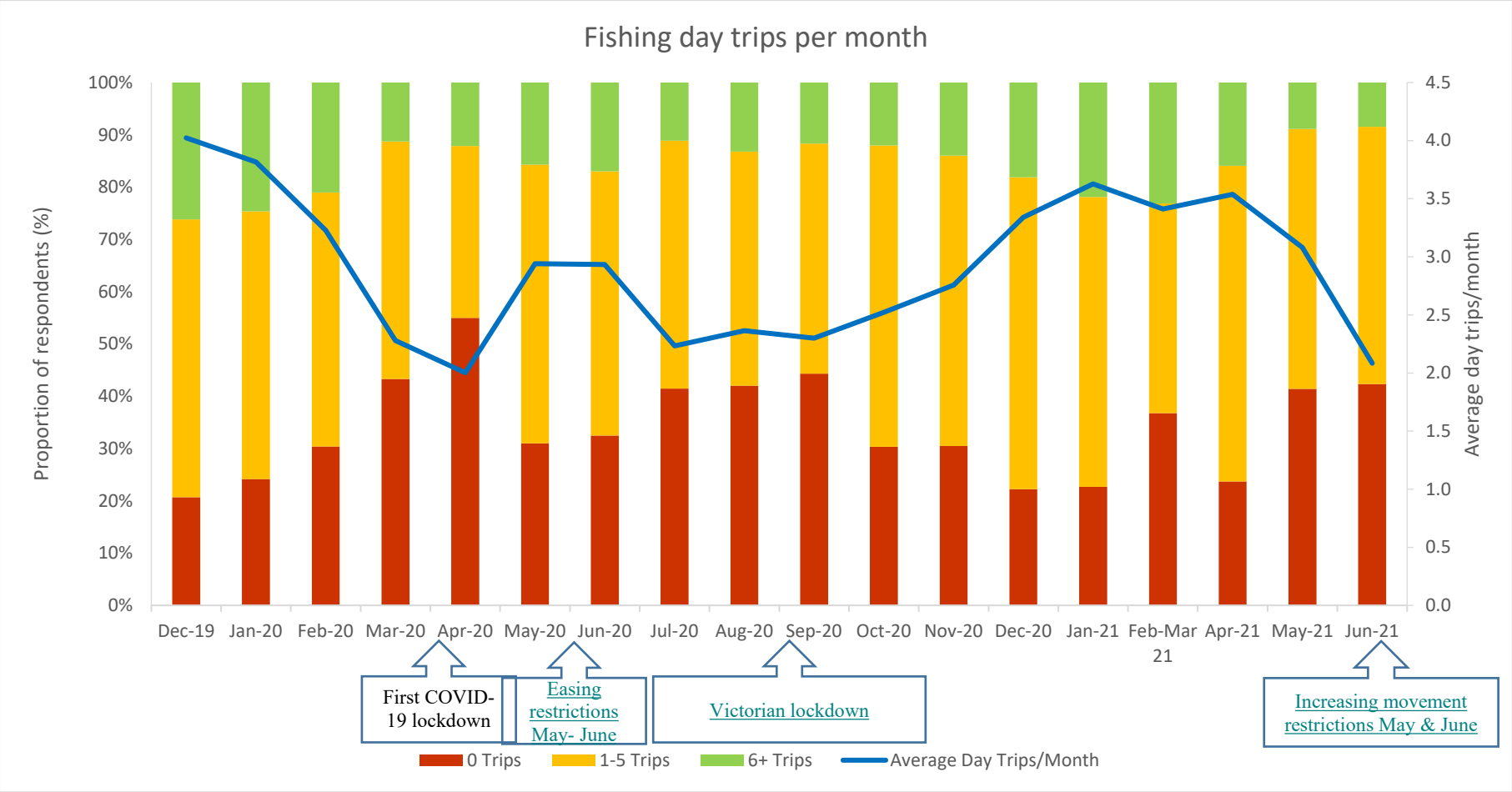


Figure 5.2 Number of recreational fishing day trips undertaken each month by respondents, Stage 3 monthly survey data

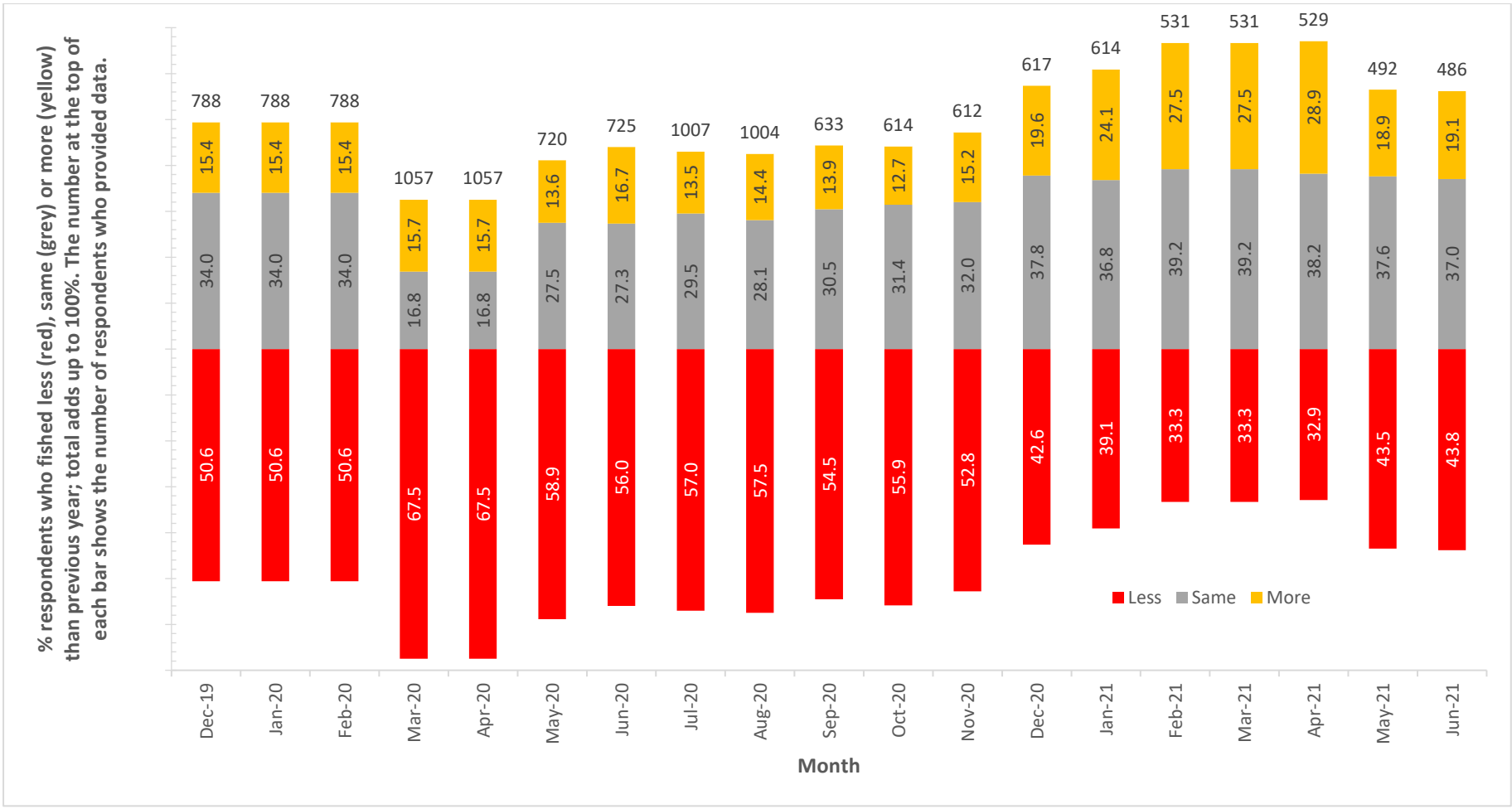


Figure 5.3 Proportion of fishers who in a given month fished less, the same amount, or more than in the same month a year earlier, NRFS Stage 3 monthly survey data

5.5.1 Black Summer: December 2019 – February 2020

In December 2019 and January 2019, fishing activity was the highest recorded through the Stage 3 data collection, with respondents going on an average of 4.0 and 3.8 day fishing trips in these months, respectively (Figure 5.2). A day fishing trip means a day on which the person went fishing, irrespective of how long they went fishing for, or whether they fished at more than one location during the day. Fishing participation then declined in February 2020, falling to an average of 3.2 day trips for the month.

However, just over half of respondents reported that they fished less often during December 2019, January 2020 and February 2020 compared to the previous summer (Figure 5.3), while only 15.4% reported fishing more than at the same time the previous years. This suggests that the Black Summer bushfires may have impacted fishing participation, something explored further in Section 5.7.

5.5.2 COVID-19 year 1, excluding summer (March 2020 – November 2020)

The introduction of social and travel restrictions across Australia in response to COVID-19 was associated with a significant decline in recreational fishing activity during March and April 2020, with national participation levels dropping to an average of 2.3 and 2.0 day trips per month, respectively (Figure 5.2). A high proportion of survey respondents reported they did not fish at all at this time - 43% and 55% of respondents in March and April 2020, respectively (Figure 5.2). The lowest level of recreational fishing days across the entire period of December 2019 to June 2021 occurred during April 2020. Some decline in fishing days may be normal at the end of summer, due to holidays finishing and weather becoming cooler (although temporal variation in effort will vary depending on the species being targeted, and the Easter holiday period is often associated with high recreational fishing effort)., However, the decline in fishing activity was unusually high, with (67%) of fishers reporting that they fished less compared to the same time one year earlier. Only 15.7% that they fished more, suggesting a majority of fishers engaged in less fishing than was typical for them during autumn (Figure 5.3).

Australian governments began to ease social and travel restrictions in May 2020 and this coincided with a brief and partial rebound in recreational fishing participation in May and June, to an average of 2.9 day trips per month (Figure 5.2). The increase in fishing activity in these months was characterised by many fishers reporting they went on between one-to-five-day fishing trips in a month, with very few reporting going on six or more day trips. While fishing activity was greater than in March and April, it was still low compared to the previous year, with around 60% of respondents reporting they fished less during May and June 2020 than they had in the same months the previous year (Figure 5.3). Therefore the level of activity represented a partial recovery of some fishing activity, but not a return to ‘normal’ levels of recreational fishing activity.

This brief rebound was followed by a return to lower levels of recreational fishing activity during July to September 2020, the period in which the second COVID-19 wave and associated lockdowns occurred in Australia.

During October and November 2020, as COVID-19 related restrictions were lifted gradually across many Australian states and territories, there was an increase in the recreational fishing participation rate, reaching an average of 2.8 day trips per month in November, slightly below that of May and June 2020 (Figure 5.2), but higher than during the July to September lockdown period. While greater than the recreational fishing activity that occurred during the period of greater movement restrictions, more than half of fishers still reported that they went fishing less in October and November 2020 compared to the same months in 2019.

5.5.3 COVID-19 year 1 – summer (December 2020 – February 2021)

Between December 2020 and February 2021 fewer COVID-19 related movement restrictions were in place across Australia compared to much of 2020. Travel was permitted within and between almost

all states and territories during most of this period. This, together with the typical increase in recreational fishing activity occurring during the summer holiday period in Australia, was associated with an increase in fishing days, peaking in January 2021 at an average of 3.6 day trips per fisher for the month. There was growth in both the proportion who went on between one and five day fishing trips, and in those reporting six or more fishing trips a month, and a decline in the number of respondents who reported zero day fishing trips (Figure 5.2).

Further evidence of increased recreational fishing activity over this period can be seen in comparison to the same period 12 months earlier, during the Black Summer bushfires. The proportion of fishers reporting they more in January 2021 compared to the previous January was 24.1% (compared to 15.4% in January 2020). The proportion who fished less declined, to a lot of 33.3% in February 2021. This highlights that one in three fishers still fished less in February 2021 compared to the previous year. This may partly reflect effects of COVID-19 on movement, but equally could be reflecting common patterns of change in fishing effort. Further studies would be needed, conducted in a time in which a pandemic was not affecting travel, to understand what proportion of fishers report fishing less in a more 'typical' year.

5.5.4 COVID-19 year 2 – initial months (March 2021 - June 2021)

During March to June 2021, restrictions on movements increased across Australia in response to the emergence and spread of the Delta variant of COVID-19. Following a brief lockdown in February 2021, Victoria re-entered lockdown in May 2021; in June, movement restrictions were put in place in parts of Sydney. More generally, there were restrictions on movement between most states and territories.

These increases in COVID-19 related restrictions are reflected in spikes in the proportion of recreational fishers reporting they did not go fishing at all during February to March, May and June 2021 (Figure 5.2). In May and June 2021, more than 40% reported that they fished less compared to the previous year – despite that previous year also being impacted by COVID-19. However, almost 20% reported fishing more than the previous year during the same months, highlighting that many factors were affecting ability to go fishing, possibly including the varied locations of COVID-19 related restrictions.

5.6 Changes in recreational fishing activity by gender, age and jurisdiction

Different groups of people may have different patterns of fishing activity. For example, Chapter 4 identified that women fish less frequently than men on average, while younger fishers go fishing fewer days in a year compared to older fishers. A statistically significant decline in the proportion of people aged 30 to 44 who went recreational fishing at least once was also identified between 2018 and 2020 when Stage 1 NRFS data were analysed (Chapter 4), suggesting that it is possible COVID-19 and/or other factors led to different types of changes in fishing behaviour amongst fishers of different ages.

Data from the Stage 3 longitudinal sample were analysed to identify whether the types of changes in fishing activity observed between December 2019 and June 2021 differed depending on the gender or age of recreational fishers, or on the state/territory they lived in. Figure 5.4 shows the average number of day fishing trips undertaken per month during this period by these groups. More detailed data are provided in Appendix 4.1. These data suggest that, for the most part, fishing activity changed in similar ways for most recreational fishers between 2019 and 2021, irrespective of their gender, age or the place they lived. Recreational fishing activity declined most during the first COVID-19 lockdown in March and April 2020, and again during subsequent lockdowns. However, there were also some differences. For example, during the 2020-21 summer, fishing activity increased more amongst male than female fishers.

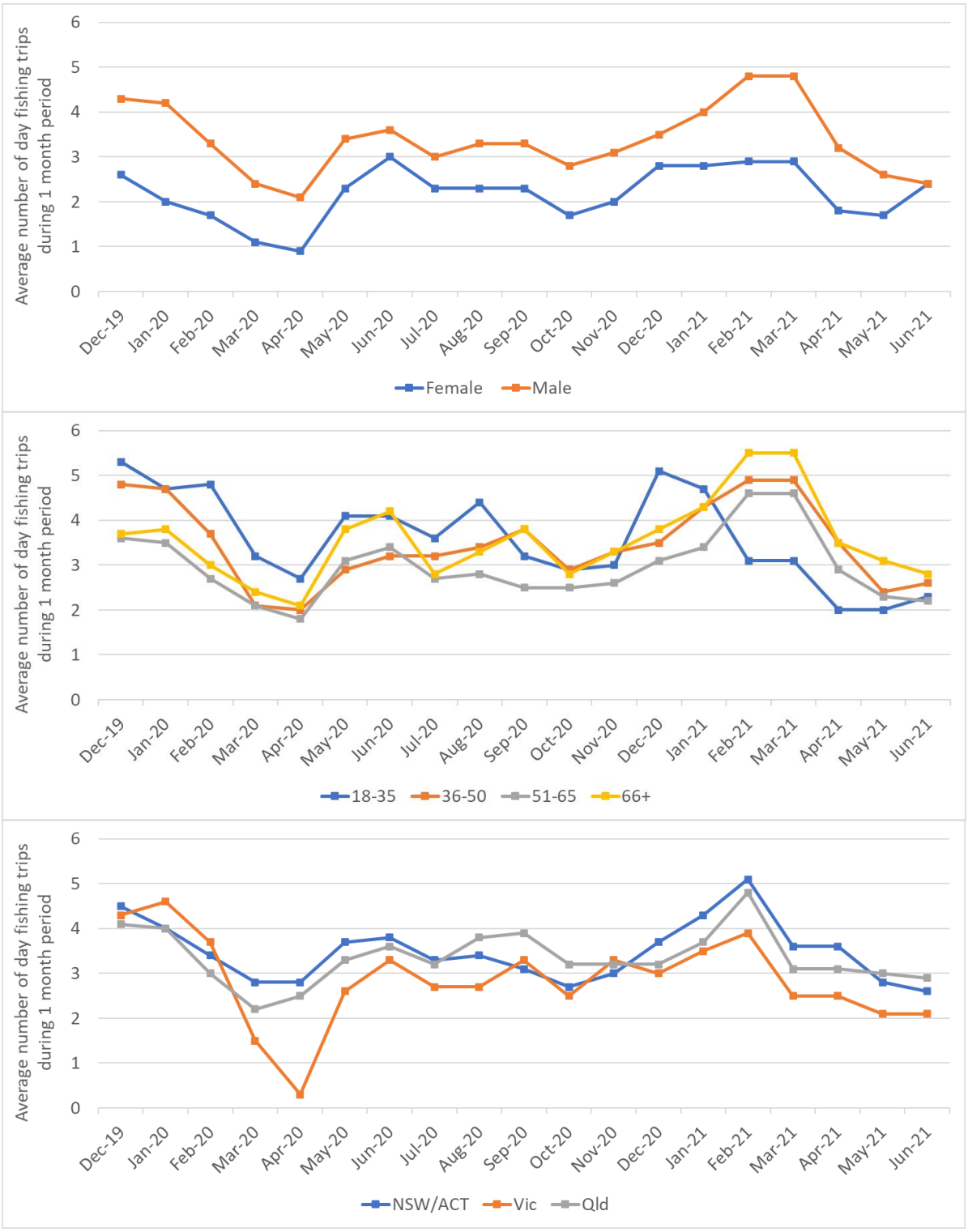


Figure 5.4 Average number of day fishing trips per month, by gender, age group and jurisdiction, December 2019 to June 2021, NRFS Stage 3 monthly survey data

While most of these differences are relatively small, one difference stands out: fishing activity declined much more in Victoria than other jurisdictions during March and April 2020. This is consistent with differences in activities permitted in different states and territories during this time: during March and April 2020, the Victorian government instituted a total ban on recreational fishing as part of COVID-19 related restrictions on movement (VRFish 2020a). Other states and territories permitted recreational fishing as long as it did not breach social distancing and travel restrictions that

were in place. Reflecting this difference, during this period Victoria had the lowest average number of day trips of any jurisdiction, with an average of 1.5 day trips in March and just 0.3 day trips in April. The restriction on recreational fishing was lifted by the Victorian government in mid-May 2020 (VRFish 2020b), and this was associated with the average number of fishing day trips amongst Victorian fishers returning to levels comparable to those in other states and territories (Figure 5.4). The restriction on fishing was not reintroduced in subsequent lockdowns.

5.7 Reasons for fishing less: how significant were bushfires and COVID-19?

While COVID-19 and the Black Summer bushfires were both significant events with the potential to impact recreational fishing activity, many other factors can also cause a decline in fishing activity beyond normal seasonal variation. It is normal for a proportion of fishers to reduce fishing activity in any year, due to factors such as change in their work or caring responsibilities, availability of people to fish with, or variable weather conditions. As reported in Chapter 4, the Stage 2 survey asked those who reported a decline in their fishing activity in 2018-19 why this decline had occurred. The most common factors were work commitments (69.4%), poor weather conditions (56.3%), changing commitments at home (46.6%), and lack of availability of fishing companions (32.1%).

In Stage 3, in addition to other factors potentially causing a decline in fishing, fishers were asked whether the Black Summer bushfires or COVID-19 contributed to any decline they reported in fishing activity compared to the previous year. This meant fishers could select from both the drivers examined in the Stage 2 survey (work commitments, poor weather etc), as well as identify bushfire/bushfire smoke, COVID-19, and drought as factors. Fishers could identify more than one factor that had contributed to them fishing less than usual, and many did so.

Figure 5.5 shows the top reasons reported for fishing less during the summer of 2019-20 compared to the summer of 2018-19: bushfire/smoke (45.6% of respondents), poor weather (40.6%), work commitments, (37.2%), COVID-19 (31.2%), drought (22.2%) and lack of availability of fishing companions (20.4%). This suggests that both bushfires and drought contributed significantly to a reduction in fishing activity for many during this period – and that other factors such as work commitments remained significant contributors. The high proportion reporting COVID-19 restricting fishing may reflect some response bias, with specific restrictions on movements only introduced in March 2020, rather than during the summer months. However, it may also reflect some fishers making decisions to cancel plans for fishing trips, or to postpone booking trips, due to concern about the emerging pandemic and the expectation that restrictions were going to be introduced on travel at some point.

Figure 5.6 shows the proportion of respondents from Australia's largest three jurisdictions – NSW/ACT, Victoria and Queensland – who identified bushfires/smoke, drought, rain/flood/storm, or COVID-19 as reasons for fishing less during the 2019-20 summer. As noted earlier in this chapter, the Black Summer bushfires were most widespread in the NSW/ACT and Victorian jurisdictions. This is reflected in the large proportion of NSW/ACT and Victorian residents who reported that the bushfires contributed to them fishing less: more than three quarters of those who fished less in these areas identified the bushfires as a contributing factor. While significant bushfires also occurred in other states and territories, they were typically affected a smaller proportion of these jurisdictions. Drought, meanwhile, impacted a large proportion of Queensland, NSW/ACT, and Victoria in the 2019-20 summer, and was a factor contributing to decline in fishing for between 26% and 41% of fishers living in these regions. The proportion reporting COVID-19 contributed to a decline in fishing was similar across all regions, while rain, floods and storms were a more common contributor to fishing less for those living in NSW/ACT and Queensland, and less in Victoria.

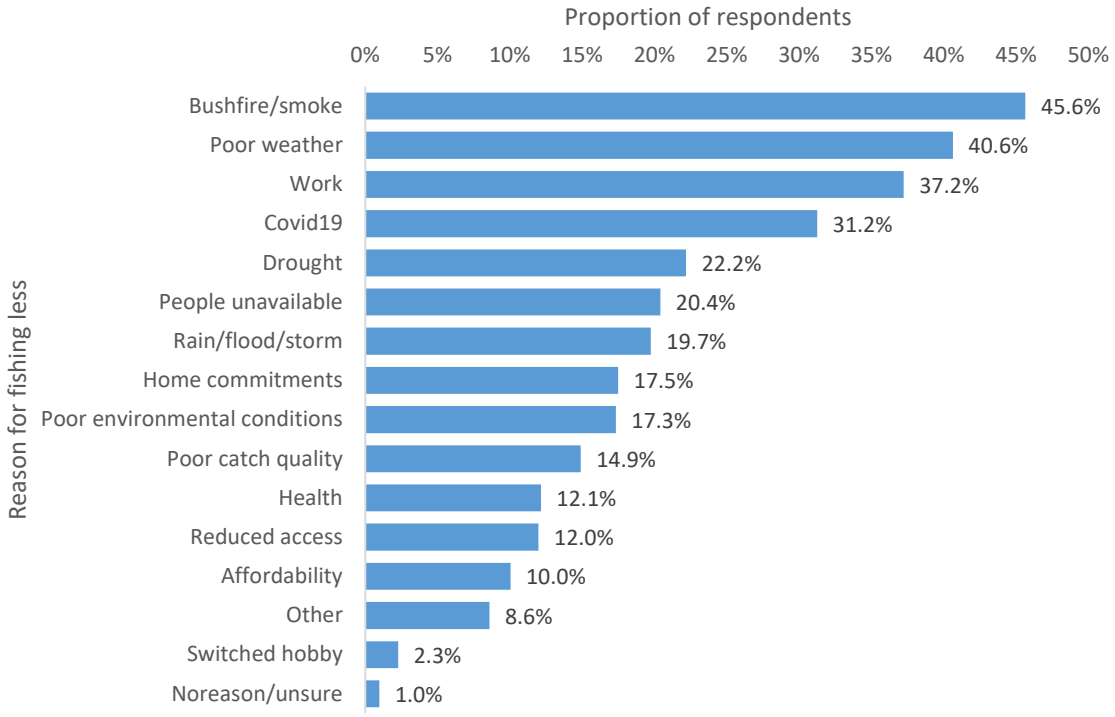


Figure 5.5 Reasons for fishing less in summer 2019-20 compared to summer 2018-19, NRFS Stage 3 monthly survey data

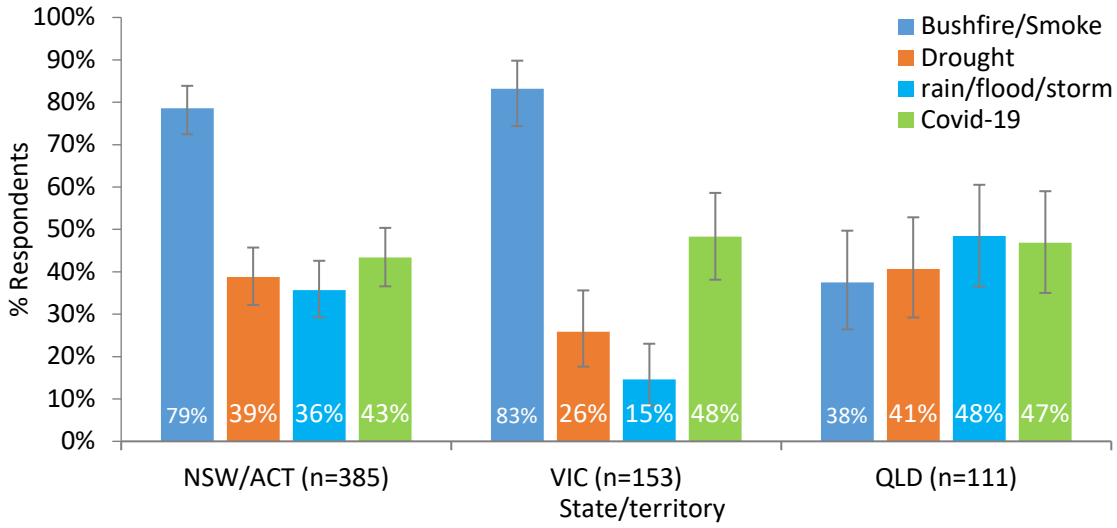


Figure 5.6 Extreme climatic events and COVID-19 as reasons for fishing less during the 2019-20 summer, by jurisdiction, NRFS Stage 3 monthly survey data

Detailed questions about reasons for fishing less were not asked in all Stage 3 surveys. However, in every survey those who reported fishing less were asked if this was due in part or whole to the impacts of COVID-19 and associated restrictions on travel and activities, or other reasons. From March 2020 to August 2020, the majority of respondents identified COVID-19 as the main reason or one reason for fishing less, although that proportion steadily declined over time (Figure 5.7). By September 2020, half of respondents identified COVID-19 as a reason for fishing less, while half stated that it wasn't a reason for fishing less in that month. The proportion of respondents who stated that COVID-19 was a reason for fishing less then continued to decrease until May 2021, when once again the majority of respondents identified COVID-19 as one reason or the main reason they did less fishing. This increase in May and June 2021 was associated with the increasing restrictions on travel and activities outside the home implemented in many parts of Australia at that time.

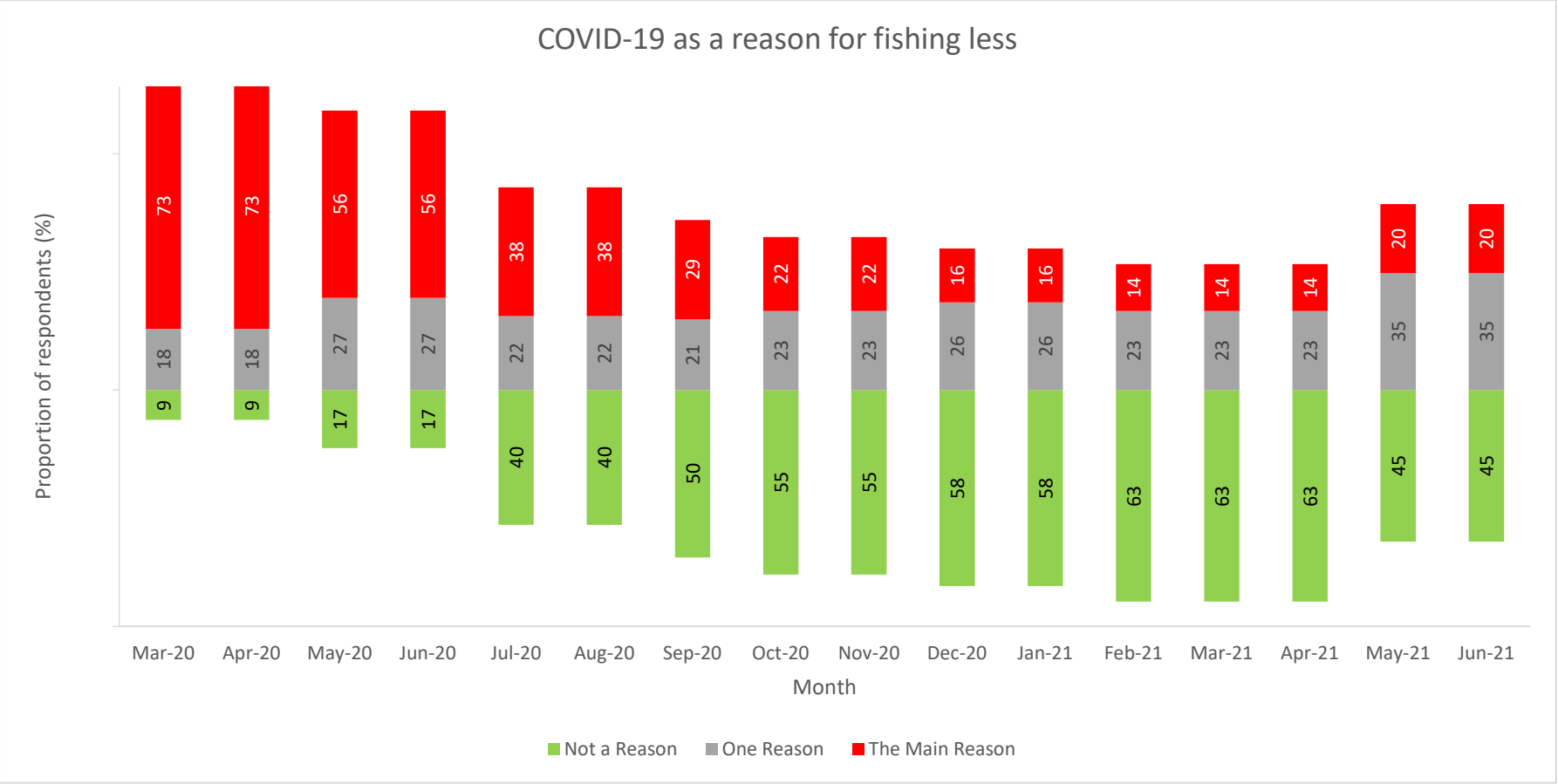


Figure 5.7 Proportion of respondents who identified COVID-19 as a reason for fishing less, NRFS Stage 3 monthly survey data

5.8 Did COVID-19 change fishing habits?

While COVID-19 restrictions led to a reduction in the amount of fishing many recreational fishers could do, most continued to do at least some recreational fishing, and many did so at a significant level. For some, the types of fishing they could do changed due to restrictions on their ability to travel, resulting in change in fishing sites accessed or timing of fishing trips.

This is similar to findings of other studies, which show a range of impacts of COVID-19, including both reduction in fishing for some people and at some fishing locations, and increases for other people/places (see for example Howarth et al. 2021, Ryan et al. 2021, Audziionyte et al. 2022). Depending on the timing and nature of restrictions affecting fishing activity, effort declined for some recreational fisheries (Philipp et al. 2023). However, some studies have found evidence of an overall increase in recreational fishing activity during the pandemic, particularly in the USA and parts of Europe (e.g. Midway et al. 2021, Trudeau et al. 2022). This suggests that factors such as the different types of travel restrictions imposed in different countries in response to COVID-19 may have resulted in differing types of impacts of the pandemic on recreational fishing activity.

The Stage 3 wash-up survey, conducted at the end of 2021, asked recreational fishers whether a number of aspects of their fishing had changed since COVID-19 first impacted Australia. This section examines the changes reported, focusing on changes in fishing methods, fishing locations, timing of fishing trips, or the overall quality of a person's fishing experience.

Fishers were asked whether they experienced any of a number of changes or outcomes from their fishing as a consequence of COVID-19 and associated movement restrictions. These ranged from asking whether going fishing helped them cope with COVID-19 restrictions, to whether they experienced stress or crowding of fishing spots (Figure 5.8).

The most common experience reported was that going fishing helped 43% of recreational fishers to cope with COVID-19 restrictions (although a similar proportion - 41% - reported that fishing was not something that helped them cope with these restrictions). One in three fishers (33.0%) experienced a lot of unfamiliar people out fishing, while almost one in four (23.9%) reported that fishing sometimes felt more stressful than usual due to COVID-19 restrictions, and 22.4% experienced more crowding at fishing spots than usual. Seventeen per cent sometimes experienced concern that they might be criticised for fishing even if meeting social distancing requirements. Very few reported changes in fishing platform or species targeting, with 13.5% fishing more from shore than usual, 10.6% targeting different species than usual, and 9.1% fishing from a boat more than usual.

The experience of overcrowding can appear contradictory: on the one hand, overall fishing activity fell when COVID-19 related movement restrictions were in place, but on the other hand, 22.4% of fishers reported their fishing spots were more crowded than usual. This may reflect that movement restrictions meant there was an increase in the number of people seeking to fish in the locations they could reach within their permitted travel restrictions. In some areas, this is likely to have resulted in an increase in popularity of some fishing spots, particularly in densely populated areas where movement restrictions meant that local residents were not able to travel to fishing spots a longer distance away as they may otherwise have done.

Different groups of fishers were compared to identify whether some were more likely to report particular experiences of fishing during the COVID-19 pandemic compared to others. The detailed analysis is provided in Appendix 4.2, with a summary of the findings provided here.

Those who fished fewer days were significantly less likely than more avid fishers to report changing their fishing by changing targeted species, or fishing from shore or boat more often. They were also less likely to report finding fishing spots more crowded than usual or seeing new

people going fishing. Avid fishers were more likely to report these things and were also more likely to report that going fishing had helped them cope with COVID-19 restrictions. Similar differences were identified amongst those who found fishing more or less important: those for whom fishing was important were more likely to find that going fishing helped them cope with COVID-19 restrictions. They were also more likely to report increased crowding at their usual fishing spots and targeting different species to usual.

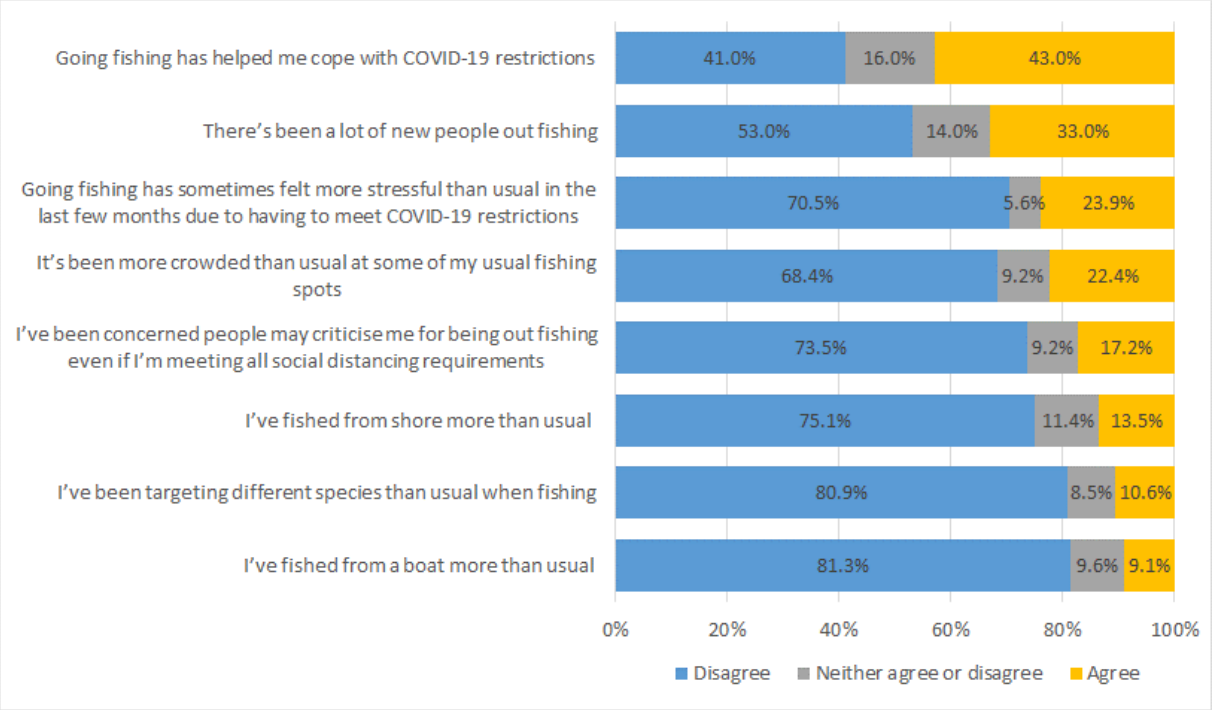


Figure 5.8 Proportion of fishers who reported change in fishing location, methods, or experience during the COVID-19 pandemic, Stage 3 wash-up survey

Younger fishers (particularly those aged 18-29) were more likely than older fishers to report targeting different species than usual when fishing. They were also more likely than older fishers to worry that people would criticise them for being out fishing while social distancing restrictions were in place, and to feel stressed due to having to meet COVID-19 related restrictions when fishing. There were no significant differences between male and female fishers.

While there were few differences in the experiences of fishers living in different states and territories, those living in Victoria were much more likely to report that going fishing had helped them cope with COVID-19 restrictions than those living in other states and territories. Those living in Western Australia and Tasmania were significantly less likely to. This may reflect that the longest and strictest lockdowns occurred in Victoria compared to other states.

5.9 Conclusions

Events such as the Black Summer bushfires and the COVID-19 pandemic have been associated with a decline in recreational fishing activity. While a relatively small proportion of fishers were able to increase their fishing activity when COVID-19 lockdowns occurred, it was more common for fishers to report that their fishing activity reduced due to lockdowns. This was not only due to recreational fishing being banned – something that only occurred for two months in one jurisdiction. Instead, it occurred in relation to restrictions on movement more generally, put in place to reduce risk of spread of COVID-19. However, this did not represent a long-term

cessation of fishing: while many fishers reported one or two months with no fishing trips, or going on fewer fishing trips than usual, for most the number of fishing trips increased again once travel restrictions eased.

Amongst those who did continue fishing during COVID-19 (the majority of fishers, albeit often fishing less frequently than before the pandemic), many found that going fishing helped them cope with lockdowns. This was particularly the case for more avid fishers, and those for whom fishing was a more important activity. However, more than one in five of those who fished during COVID-19 experienced some negative changes when fishing, such as increased overcrowding, or stress when fishing.

6.0 Substitutability of recreational fishing and other activities

Chapter authors: Jacki Schirmer

6.1 Key points

- This survey found that nearly all of those who fished recreationally also participated in one or more other activities, and were equally or more likely to choose one of these activities over fishing if asked to choose between activities on a nice weekend
- Camping, outdoor picnics/barbeques, four-wheel driving and kayaking were common substitutes for recreational fishing
- Camping, four-wheel driving, and kayaking/canoeing were identified as being activities likely to be 'complementary' (undertaken together with) recreational fishing One third of fishers considered recreational fishing to be more important than any of their other outdoor recreational activities
- Recreational fishers were less likely to identify substitutable activities if they were male, over 60 years old, or spent more time fishing
- The monthly surveys conducted during COVID-19 restrictions in April to June 2020 identified that while some fishers went fishing instead of engaging in other activities that were now restricted, it was more common for fishers to report that they had to find alternative activities to engage in instead of being able to go fishing
- Common substitute activities undertaken instead of recreational fishing during COVID-19 restrictions were chores around the home, cycling, swimming, walking, gardening and home entertainment.

6.2 Introduction

People may achieve a diverse range of benefits as a result of recreational fishing. Some keep friendships strong by going fishing with mates, some use fishing as a way of staying physically active, while others go fishing to relax and 'get away from it all'(see for example Birdsong et al. 2021, Young et al. 2016). Chapter 9 discusses these potential benefits in more detail. However, fishing is not necessarily the *only* way to achieve these benefits. It is well recognised that many people are able to substitute different outdoor recreational activities for each other and achieve similar benefits (e.g. Lovelock et al. 2018). This suggests that, if unable to go fishing, many fishers would be able to achieve similar benefits – connecting with friends, physical fitness or relaxation – through engaging in alternative activities. Similarly, when considering economic contributions, it is possible that a person who spent $100 on fishing in a regional town may still have spent that $100 in the town even if they didn't go fishing, just on an alternative activity (although it is equally possible that they would have spent that $100 in a different location).

This report – particularly Chapters 7 to 11 - examines the social and economic contributions that occur when a person chooses to engage in recreational fishing. It does not attempt to answer the question 'would the same social benefit/outcome have occurred in the absence of recreational fishing?', as the focus is on understanding the extent to which the active choice to go fishing resulted in these contributions.

While those who have gone fishing have chosen to do this as their preferred way of spending time and/or money, fishing is not the only activity that can provide social and economic benefit to fishers and to communities in which fishing occurs. However, some people are likely to find

it easier to substitute other activities for fishing compared to others. It is useful to examine which fishers find it easier or harder to substitute fishing for other activities. Understanding this can help identify whether there are particular cohorts of fishers who are at greater risk of losing the benefits they typically achieve via fishing if they are unable to fish. It also enables identification of which types of fishers find it relatively easy to swap between different activities with minimal disruption to their ability to achieve outcomes such as social connections, physical fitness, or relaxation.

Studies on substitutability of recreational activities often examine the extent to which a person can substitute one activity for another (activity substitution), change the methods or mode of activity, for example by changing locations, using different gear or targeting different fish species (resource substitution), or change the timing of their activity (temporal substitution) (Hestetune 2020). This chapter focuses primarily on activity substitution, as understanding this can assist with interpreting estimates of economic and social contributions examined in other chapters of this report. In particular, understanding how easily fishers can substitute non-fishing activities for recreational fishing provides insight into the extent to which the economic and social benefits documented in other chapters are likely to be unique to fishing, versus being readily substituted by other activities if fishing is not available.

This chapter also examines whether data from the NRFS suggests the presence of 'complementarity' in which fishing and other outdoor recreation activities tend to occur together. For example, a person may go on a fishing trip in which they also go bushwalking, camp for several nights, or spend some time swimming. Would the bushwalking, camping and swimming still occur if the person did not go fishing – or was fishing the catalyst for all these activities? The question of complementarity has rarely been examined in relation to recreational fishing. More broadly there is relatively little work examining how engaging in one recreational activity may support a person taking part in a wider cluster of associated recreation activities.

Substitutability and complementarity are examined through:

- Reviewing what has been learned from previous studies (Section 6.2)
- Describing the analysis methods used to examine substitutability (Section 6.3)
- Examining whether recreational fishers engage in clusters of recreational activity suggestive of complementarity (Section 6.4)
- Exploring the extent to which fishers are highly 'specialised' to fishing (Section 6.5)
- Identifying how many, and which types, of recreational fishers feel they could easily substitute another activity for fishing on a day when conditions were equally good for both? (Section 6.6)
- Identifying whether fishers substituted fishing and other activities during the first March-May 2020 COVID-19 lockdown (Section 6.7)

6.2 Understanding substitutability and key related concepts

6.2.1 Defining substitutability and specialisation

The substitutability of recreational activities has been a field of research since the 1970s. Appendix 5.1 reviews the development of this field of research, key evolutions in thinking and understanding, and key implications for the approach to examining substitutability presented in this chapter. Broadly, research examining the substitutability of recreational activities has shifted away from an early assumption that all activities a person engages in are likely to be substitutable, to an understanding that in many cases the different activities a person engages in are not necessarily substitutes for each other. For example, Shelby (1984) found that many salmon fishers did not consider other outdoor activities they took part in to be equivalent substitutes for their salmon fishing, as they didn't provide similar benefits and satisfaction. This

recognition led to development of a more complex field of research into the substitutability of outdoor recreation activities, that has developed more specific definitions of substitutability and associated concepts such as specialisation.

In this study, the definition of 'recreational substitutability' proposed by Brunson and Shelby (2004, p. 69) is used:

> *The term recreation substitutability refers to the interchangeability of recreation experiences such that acceptably equivalent outcomes can be achieved by varying one or more of the following: the timing of the experience, the means of gaining access, the setting, and the activity.*

This definition focuses on people being able to achieve 'acceptably equivalent outcomes'. This means that a person may substitute activities that have differing benefits or qualities, if they provide equivalent outcomes. Most define an acceptably equivalent activity as being one that provides a similar level – but not necessarily the same type – of satisfaction and benefits as the activity being replaced (Gentner and Sutton 2008, cited in Lovelock et al. 2018).

People may substitute one activity for another because they have to – 'forced substitution' – or because they choose to – 'voluntary substitution'. In recreational fishing, an example of forced substitution would be a person substituting another activity for fishing if their main fishing area was closed to fishing, while voluntary substitution might involve a person becoming interested in, and taking up, an activity such as bushwalking that they choose to do instead of fishing. In this chapter, the focus is on voluntary substitution of activities by recreational fishers. This is because the objective of examining substitutability was to shed light on the extent to which the social and economic benefits documented in other chapters of this report may be specific to fishing, versus being readily achieved by substituting another activity.

People who are 'specialised' to an activity are often argued to be less able to find activity substitutes that provide equivalent outcomes (see Appendix 5.1 for detail). Specialisation in an activity means the extent to which a person is invested in specifically undertaking a given activity, through either investing in developing specialised skills, investing in equipment, or engaging in the activity frequently and developing social networks specialised to the activity. Those who are more specialised in an activity may find it more difficult to achieve equivalent outcomes from other activities – in other words, to have fewer options for substitutable activities.

6.2.2 Substitutability of recreational fishing: findings of previous studies

Several past studies have examined the substitutability of recreational fishing. These studies are varied and typically not comparable, having used a range of methods, and studied different countries and regions, types of fishing (e.g. freshwater, saltwater, shore-based or boat-based fishing), and target species. Some studies examined all fishing in a given location, while others focused on a specific target species such as salmon and trout.

These studies have found that, when asked to identify activities that could provide similar levels of benefit and/or satisfaction to recreational fishing, the activities most commonly nominated include camping, hunting, golf and other sports, boating, SCUBA diving, hiking, surfing, water skiing, and swimming. However, even these most commonly nominated activities are often considered acceptable substitutes for fishing by only a small proportion of recreational fishers (Ditton and Sutton 2004, Gentner and Sutton 2008). In most studies, a significant proportion of fishers – between 40% and 80%, depending on the study – have been unable to identify any substitute activities that they feel have acceptably equivalent outcomes to fishing.

However, the small number of studies that have examined actual substitution behaviour, rather than beliefs about likely substitutability, suggest higher ability to substitute activities. In a study

examining whether lapsed fishers took up other activities after stopping fishing, Sutton et al. (2009) found that 28% of lapsed fishers in Queensland reported a decrease in leisure satisfaction after ceasing fishing, and 27% a decrease in overall leisure activity. The remainder increased their participation in other activities in response to reduction in their fishing activity. This suggests a potentially higher rate of substitutability, of up to 72%, depending on whether overall leisure satisfaction is considered a measure of 'acceptable equivalence'.

Willingness to substitute other activities for fishing has been found to vary depending on factors including age, gender, length of time since stopping fishing, and fishing specialisation (Sutton et al. 2009). While the extent of specialisation amongst recreational fishers is not well studied, past studies suggest that older fishers with lower levels of formal education and highly activity-specific motivations are more likely to be specialised, while younger fishers with higher levels of formal education may be less likely to be specialised (Ditton and Sutton 2004). Greater specialisation to fishing sites, target species, or to consumptive aspects of fishing such as catching large numbers of fish have been associated with lower willingness to substitute amongst Texan anglers in the USA (Oh et al. 2013).

Some studies have examined resource substitution amongst fishers, with varying findings. For example, high willingness to substitute target species was found amongst women, younger fishers, more educated fishers, and those who are motivated to fish for 'trophy' catches, in studies of saltwater anglers in Florida and Texas in the USA (Sutton and Ditton 2005). Willingness to substitute sites has been found to vary depending on level of connection to specific fishing sites, reasons for that connection, age, gender, income, boat ownership and importance of fishing (Hammit et al. 2004, Tseng and Ditton 2007).

Overall, the available evidence from past studies on substitutability of recreational fishing suggest that a significant cohort of recreational fishers may have few or no readily available substitute activities. However, the evidence is relatively limited, being based on a small number of studies that have used varying methods and examined diverse contexts.

6.3 Methods

This chapter draws on data collected in Stage 2 and 3 of the NRFS. Overall methods for Stage 2 and 3 are described in Chapter 3. This section examines the specific decisions made regarding measuring and analysing data on substitutability.

6.3.1 Stage 2 sample

The Stage 2 questionnaire included questions examining the types of recreational activities a person took part in, how important the person found each activity, and their views about the substitutability of recreational fishing and other activities they engaged in. Substitutability was examined by asking the person which activity they would choose to do if given the option of either going fishing or another of the activities they already participated in.

Rather than ask survey participants to list all recreational activities they took part in, they were asked to select from a pre-set list (see Table 6.1). Using a pre-set list ensured that survey participants answered for activities they found less important as well as those they found more important, whereas the alternative approach of using an open-ended question that asked participants to list activities would likely have biased the data to more important activities. This approach was taken in response to Gentner and Sutton's (2008) argument that it is important to not just examine which activities are considered substitutable, but to better understand the attributes that influence this. In the case of fishing, they argued that this included how important the person finds fishing versus other activities that may be considered substitutes. Asking about a pre-set list of activities enabled comparison of the relative importance of different activities, with survey participants asked to rate how important each activity they did was to them.

Table 6.1 Stage 2 survey questions used to examine substitutability and complementarity

	Activities asked about	Response options	Purpose of measure
Do you do any of the following hobbies/sporting activities?[1]	Bushwalking or hiking; jogging or running; cycling (road riding or mountain biking); playing game stations/online games; swimming; surfing; playing sports with others e.g. tennis, football; going to gym or exercise classes; camping; horse riding; kayaking or canoeing; four-wheel driving; clothes shopping[2]; attending sports games or events as a spectator, e.g. football games; recreational shooting or hunting (other than fishing), playing golf, other outdoor or sports activities (please describe).	• I don't do this • I do this and as a sport/hobby it is… Not at all important to me (0), 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (Very important to me)	Documenting participation in recreational activities that may be substitutes for fishing. Measuring specialisation through examining level of importance.
If given the following options on a nice weekend, at the same cost, which would you choose to do? Imagine you have to choose between them and can't do them at the same time on this particular weekend (we know many of these things are sometimes done at the same time).	HUNTING or fishing? CAMPING or fishing? BUSHWALKING or fishing? FOUR WHEEL DRIVING or fishing? OUTDOOR PICNIC/BBQ or fishing? CLOTHES SHOPPING[2] or fishing? ONLINE GAMES/GAME STATION or fishing? GO TO SPORTS GAME (e.g. AFL, rugby, other game you follow) or fishing? GYM/EXERCISE CLASS or fishing? BIKE RIDING or fishing? SWIMMING or fishing? SURFING or fishing? KAYAKING/CANOEING or fishing? GOLF or fishing?	• I'd do the first activity • I'd find it hard to choose (I like both equally) • I'd go fishing.	Documenting substitutability preferences in a situation in which the only constraint is one of opportunity, with the person unable to choose to do both at the same time but otherwise equally able to participate in both activities.

[1] This question was preceded with the explanatory text 'Many people have multiple hobbies, and recreational fishing will be just one of them. The next questions ask about the different hobbies and sports you get involved in – and which one you would choose to do on a nice weekend if you had to make a choice between fishing and another activity.'

[2]As clothes shopping is an unusual type of activity to include in questions such as this, the item 'clothes shopping' was accompanied by a note in brackets 'no, we're not kidding and yes, there's a reason we're asking'.

The list of pre-defined activities asked about was selected based on activities found to be common substitutes for fishing in previous studies, and on the overall popularity of a range of recreational activities amongst Australians. Bushwalking/hiking, jogging/running, camping, cycling, going to gym or exercise classes, playing sports with others, playing golf and horse riding were included as they are common recreational activities in Australia. Kayaking/ canoeing and four-wheel driving were included as activities that previous studies identified as being common amongst fishers. Attending sports games or events as a spectator, and outdoor picnics/BBQs were asked about as they may provide a substitute for social interactions that are an important part of the fishing experience for many people. As picnics/BBQs are engaged in by large numbers of people and not typically considered a specific recreational pursuit, this item's importance was not asked about, but its substitutability for fishing was. Additionally, survey

participants were asked whether they were involved in playing games stations/online games. This was done as Steering Committee members who reviewed the initial questionnaire draft reported anecdotal evidence that many recreational fishers engage in this recreational activity. Finally, clothes shopping was included as an activity that is different in almost every attribute from recreational fishing, providing a 'contrast' activity.

When asking about participation in these activities, rather than specify participation over a specific time period, survey participants were simply asked 'Do you do any of the following hobbies/sporting activities?' This was done deliberately as it focused on whether a person self-identifies as a participant even if they have not actively taken part in the activity within the last 12 months.

When asking about substitutability of fishing for other activities a person engaged in, a key decision was identifying the situation in which the person was being asked to consider substituting activities. In particular, it was important to specify whether it was a forced situation in which fishing was no longer possible, or a voluntary substitution, in which the fisher was simply choosing between fishing and another activity on a day when they could do either. The decision made was to examine voluntary substitution. This was done as the findings of previous studies indicated that people may be less willing to substitute activities if they feel they are being forced out of one of those activities without having a choice in the matter. To ask about a relatively unconstrained situation, fishers were asked whether, if they had to choose between two activities (one fishing and one non-fishing) on a given day, each of which was equally possible and cost the same, they would prefer fishing, the other activity, or would find it hard to choose as they like both equally. This represented a short-term substitution choice rather than a longer term one.

Participants who answered questions about 10 or more of the 17 listed outdoor activities were considered valid participants for the purposes of analysing substitutability. In total, 9,109 survey participants provided valid answers to questions about their recreational activities, and this sample is analysed in this chapter. Of these, 4,745 answered for all 17 items, while 2,504 answered for 16 of the 17 items (most of these not providing an answer to the final item 'other outdoor sports activities'), while 979 answered 15 items, 436 answered 14 items, 197 answered 13 items, 115 answered 12 items, 59 answered 11 items and 74 answered 10 items. Of those who answered 10 to 16 items, the most common issue gap in data completion was that they answered which activities they *did* participate in, but did not identify which activities they did not participate in. Five participants who had not provided a complete answer were emailed to ask why they did not complete some items: four of the five responded and indicated the activities for which they selected no answers were all activities they did not participate in. The fifth did not respond. This response, together with the patterning of answers, was used to justify imputing missing items to indicate they had not been undertaken by the participant. This was done only for those who had answered for at least 10 of the 17 activities asked about; a further 840 respondents who answered 9 or fewer were excluded from the dataset as invalid responses.

Some participants indicated they did not do an activity, but still rated how important it was to them. Where this was the case, they were recorded as not having done the activity and their importance rating removed from the dataset. Of those who selected both options, the majority (74%) indicated they had not done the activity in the last 12 months and that its level of importance to them was '0 – not at all important to me'.

6.3.2 Stage 3 sample

Two surveys undertaken as part of Stage 3 data collection asked fishers whether their fishing activities changed due to COVID-19: the July 2020 survey, and the wash-up survey. These surveys examined whether fishers changed not only the amount of fishing they did due to COVID-19, but also whether they substituted other activities for fishing (activity substitution),

or changed how they undertook their fishing (strategic, resource or temporal substitution). : Fishers were also asked if they experienced any of a number of constraints that could reduce their ability to engage in fishing during COVID-19, including being able to source good quality bait, targeting different species, experiencing crowding, being concerned about criticism from others when fishing during a COVID-19 lockdown, or experiencing stress when fishing.

6.3.3 Data analysis and weighting

Confidence intervals were calculated to identify whether differences between groups were significant at the 95% confidence level. In some cases, other statistical tests of significance were conducted: these are described in the results sections when presented to enable easy identification of which tests were used for which analyses.

Where data are presented for current fishers, both weighted data (weighted using the processes described in Chapter 3 to correct for known bias in the sample towards more avid fishers and other factors) and unweighted data are presented. Data for recent, past and non-fishers are not weighted. This is because the process of statistical weighting involves benchmarking the survey sample achieved against known characteristics of the population the sample was drawn from. For current fishers, a specific benchmark population was developed for this project, which drew on a number of studies in the last 20 years to identify the characteristics of current fishers. There is no comparable information available enabling identification of benchmark population characteristics for recent, past and non-fishers. This meant it was not feasible to develop statistical weighting for these groups.

Almost all recent, past and non-fishers were recruited in the Stage 2 survey as part of an online panel sample which used quota sampling to be representative of the adult Australian population (see Chapter 3). Ensuring the overall online panel sample had similar socio-demographic characteristics to the adult Australian population was done to minimise likely bias in responses. This means it is likely – but cannot be confirmed – that the sample of recent, past and non-fishers is reasonably representative of these groups across Australia. The sample of current fishers, in contrast, was recruited using a range of methods, some of which deliberately over-sampled more avid fishers. Given this, weighted data better represent Australian fishers than unweighted data. However, unweighted data are also presented for current fishers, given that data for other groups are unweighted.

6.4 Results: Recreational activity clusters

The types of recreational activities that fishers and non-fishers typically participate in were identified and compared. As noted earlier in this chapter, the fact a fisher participates in a given activity (e.g. cycling, or swimming) does not automatically mean that the activity is a substitute for fishing, as the non-fishing activity may or may not provide equivalent benefits to fishing.

Table 6.2 compares the most common recreational activities other than fishing undertaken by current fishers (who had fished in the last 12 months), recent fishers (last fished two to five years previously), past fishers (last fished more than five years ago), and non-fishers (those who had never done fishing). Current fishers typically engage in a different cluster of recreational activities compared to recent, past and non-fishers. Most current fishers reported that they participate in camping (79.7%), swimming (68.8%), attending sports games as a spectator (62.7%), four-wheel driving (59.1%), and bushwalking (57.9%). Clothes shopping was not necessarily a desired activity but was also done by most current fishers (59.6%).

Current fishers were significantly more likely to go camping, four-wheel driving, and kayaking/canoeing compared to all other groups (Table 6.2). This may indicate that these activities are often complementary with fishing. Complementary activities are, broadly speaking, activities that 'go well together' and, hence, are often undertaken together. Many fishing trips involve camping, four-wheel driving, and/or kayaking/canoeing. The lower levels of participation in these potentially complementary activities by those who have not participated in fishing for even a short period of time is consistent with the hypothesis that they are complementary activities to fishing. However, other explanations are also possible. For example, it is possible the factors causing a person to stop fishing for a short or long time also impact their ability to participate in activities such as camping or kayaking/canoeing, resulting in a fall in participation across a cluster of activities.

Recent fishers were more likely than current fishers to go clothes shopping, play online games, and go horse riding. Past fishers were less likely than current fishers to go camping, be a spectator at sports matches, go four-wheel driving, go bushwalking, play sports with others, go hunting, play golf, cycle, jog, or go kayaking/canoeing. They were more likely to play online games, go clothes shopping, and go horse riding. Non-fishers were less likely than current fishers to do all activities asked about except five: clothes shopping, gaming, going to gym/exercise classes, jogging/running and horse riding.

The differences observed between current fishers and those who had never fished or last fished some time ago may be due to a range of factors. Some of these may relate to fishing: for example, camping appears strongly associated with fishing trips, and so it is perhaps not surprising that a person who hasn't fished in the last year or two is also less likely to have gone camping. However, it is likely that some of the differences reflect demographic differences in those who have and haven't fished (described in Chapter 4). For example, women make up a greater proportion of those who have never fished than they do of current fishers. Given this, some of the differing patterns of activities may reflect gender-based differences, rather than being a direct consequence of whether a person has fished in the past 12 months.

As noted earlier, participating in an activity does not necessarily mean it is a substitute for fishing (Gentner and Sutton 2008). For example, a majority of fishers who participated in the Stage 2 survey reported that they go clothes shopping sometimes: it is questionable whether many would find clothes shopping provides 'acceptably equivalent' benefits to fishing. This was confirmed in the importance ratings given to different activities (Table 6.3). Whereas the average importance given to fishing by current fishers was 7.0 out of a possible 10, clothes shopping was rated 3.9 on average (weighted data). This highlights that a person will attach differing levels of importance to the various activities they are engaging in at a given point in time.

Table 6.2 Most common recreational activities undertaken by fishers and non-fishers, Stage 2 NRFS data

Grey highlighting indicates a statistically significant difference between current fishers and the group highlighted, using unweighted data. Appendix 5.2 provides confidence interval data used to assess differences.	**Fished in past 12 months – weighted[2] (n=5241)**	***Fished in past 12 months – not weighted[2,3] (n=5241)***	**Fished 2-5 years ago – not weighted[2] (n=293)**	**Fished more than 5 years ago – not weighted[2] (n=1961)**	**Never fished – not weighted[2] (n=1587)**
Maximum. 95% CI[1]	±1.7%	*±1.4%*	±5.7%	±2.2%	±2.5%
Camping	79.7%	*78.3%*	58.4%[3]	42.5%	31.8%
Swimming	68.8%	*60.1%*	61.8%	57.4%	46.3%
Attending sports games/ events as spectator (e.g. football game)	62.7%	*61.5%*	56.3%	52.4%	42.3%
Clothes shopping	59.6%	*57.2%*	71.3%	80.1%	70.7%
Four-wheel driving	59.1%	*62.4%*	42.3%	34.8%	27.3%
Bushwalking or hiking	57.9%	*64.6%*	64.2%	55.9%	45.0%
Playing sports with others (e.g., tennis, football)	50.1%	*46.1%*	43.0%	40.4%	32.3%
Playing game stations/online games	49.4%	*49.6%*	60.4%	57.3%	46.9%
Recreational shooting or hunting (exc. fishing)	46.2%	*44.3%*	38.6%	27.9%	21.9%
Playing golf	45.3%	*36.9%*	37.2%	31.4%	23.6%
Going to gym or exercise classes	40.3%	*45.5%*	51.9%	47.3%	41.8%
Cycling (road riding/ mtn biking)	39.8%	*47.9%*	47.4%	41.6%	35.6%
Kayaking or canoeing	39.2%	*49.5%*	41.0%	31.8%	25.5%
Surfing	38.8%	*36.0%*	37.5%	33.7%	28.5%
Jogging or running	38.6%	*47.2%*	48.1%	44.8%	41.1%
Horse riding	36.5%	*26.7%*	34.1%	30.4%	24.6%
Other outdoor or sports activities	32.2%	*28.7%*	35.8%	27.8%	21.2%

[1] Appendix 5.2 provides full confidence interval data. While the 95% confidence interval was similar for different items e.g. bushwalking versus camping, it did vary by up to 0.5% depending on the item. The confidence interval shown is the most conservative (i.e. largest) across all items.

[2] Weighted means the data have been adjusted to be representative of Australia's adult recreational fishers, while unweighted data (also called not weighted data) are based on the sample without this adjustment, and are biased to more avid fishers, older fishers, and overrepresent fishers living in states and territories with smaller populations. See Chapter 3 and Section 6.3 of this chapter for explanation of the weighting approach used. It was not possible to identify an appropriate statistical weighting for these comparison groups due to a lack of available benchmark data: therefore unweighted data were used to compared these groups to current fishers.

[3] As noted in section 6.3.3, weighted data for current fishers should be compared to unweighted data from other groups. Unweighted data for current fishers are provided to enable identification of the effect of weighting - which addresses the known bias to more avid fishers in the current fisher sample – on findings.

Table 6.3 compares the average importance rating given to different activities by those who did them, for current, recent, past and non-fishers. The findings suggest current fishers have differing views to recent, past and non-fishers about the importance of a number of the recreational activities they engage in. Overall, current fishers are more likely than recent fishers to say that fishing, camping, four-wheel driving, hunting and kayaking/canoeing are important to them. For example, current fishers who go camping consider camping a more important activity (average importance rating of 7.0 in the weighted sample and 6.8 in the unweighted) compared to recent fishers (5.6), past fishers (4.1) and non-fishers (3.4) who spend time camping.

Of all the recreational activities they took part in, the two most commonly considered highly important by current fishers were fishing and camping. These two activities were on average rated 7 out of 10 in importance by current fishers (weighted data), while the average score for all other activities was 5.8 or less. Activities typically considered moderately important were four-wheel driving, bushwalking, swimming, and attending games as a spectator (all having an average importance score of between 4 and 6.9). The other recreational activities they engaged in were usually of relatively low importance to current fishers.

Amongst recent fishers (those who last fished 2-5 years ago), fishing was typically considered moderately important (average importance score of 4.5). No single activity was considered more important than others by a majority of this group, with average importance scores across all activities falling between 3.8 and 5.5. This likely reflects high diversity in which activities were considered more and less important amongst this group.

Amongst past and non-fishers, the activities with the highest average importance were bushwalking, gym/exercise classes, and clothes shopping. This group was more likely than current fishers to say that swimming, horse riding, gaming and gym/exercise classes were important to them, and less likely than current and recent fishers to report that camping, four-wheel driving, hunting and kayaking/canoeing activities were an important part of their life.

Table 6.4 ranks recreational activities by their average importance. Amongst current fishers, the activities considered of highest importance were fishing, camping, four-wheel driving and bushwalking. Amongst recent fishers, camping, bushwalking, and four-wheel driving remained some of the most important activities, but gym/exercise classes were most important (amongst those who participated in them). Amongst past fishers and non-fishers, bushwalking, clothes shopping, gym/exercise classes and online games were the top four rated activities in terms of importance. The only activity that was in the top five important activities for all four groups (current, recent, past and non-fishers) was bushwalking/hiking.

Overall, these findings show that camping, four-wheel driving, bushwalking/hiking and kayaking/canoeing are all activities commonly undertaken by current fishers, and typically considered moderately to highly important by them. Of these, only bushwalking/hiking remains at similar levels of participation and importance amongst recent fishers, while participation in the other activities is lower amongst recent fishers than current fishers. These findings are consistent with camping, four-wheel driving, and kayaking/canoeing being complementary activities to fishing, that may be undertaken as clusters of activities that typically occur together. While these findings cannot answer the question of whether stopping fishing (or one of the complementary activities) is associated with decline in participation in all of these complementary activities, they are consistent with this hypothesis.

Table 6.3 Self-rated importance of different recreational activities, by those who reported participating in them, Stage 2 NRFS data

Grey highlighting indicates a statistically significant difference between current fishers (those who fished in the last 12 months) and the group highlighted, using unweighted data. See Appendix 5.2 for full data.	n	**Current fishers (fished past 12 months) - weighted** [b]		***Current fishers (fished past 12 months) – not weighted*** [b]		**Recent fishers (last fished 2-5 years ago) – not weighted** [b]		**Past fishers (last fished more than 5 years ago) – not weighted** [b]		**Non-fishers (have never fished) – not weighted** [b]	
		Mean importance score[a]	**95% CI**	***Mean importance score***[1]	***95% CI***	**Mean importance score**[1]	**95% CI**	**Mean importance score**[1]	**95% CI**	**Mean importance score**[1]	**95% CI**
Fishing	10470	7.0	0.05	*7.5*	*0.05*	4.5	0.2	N/A		N/A	
Camping	5529	7.0	0.1	*6.8*	*0.1*	5.6	0.5	4.1	0.2	3.4	0.3
Four-wheel driving	4385	5.8	0.1	*5.4*	*0.1*	5.0	0.6	3.4	0.2	2.9	0.3
Bushwalking or hiking	5123	5.1	0.1	*5.1*	*0.1*	5.5	0.5	5.2	0.2	5.1	0.2
Swimming	5222	4.8	0.1	*4.1*	*0.1*	4.9	0.4	4.5	0.2	4.2	0.2
Other outdoor or sports activities	2296	4.8	0.2	*4.3*	*0.2*	4.6	0.7	4.3	0.3	3.4	0.4
Attending sports games/events as spectator	5302	4.7	0.1	*4.3*	*0.1*	4.8	0.5	4.5	0.2	4.1	0.2
Recreational shooting or hunting (exc. fishing)	3229	3.9	0.2	*4.8*	*0.2*	4.4	0.6	3.0	0.3	2.0	0.3
Clothes shopping	6117	3.9	0.1	*2.7*	*0.1*	4.7	0.4	4.9	0.1	5.2	0.2
Playing sports with others (e.g. tennis, football)	3712	3.8	0.1	*4.2*	*0.1*	4.8	0.6	4.2	0.2	3.6	0.3
Playing games stations/online games	4361	3.5	0.1	*3.1*	*0.1*	4.5	0.5	4.6	0.2	4.4	0.3
Going to gym or exercise classes	3847	3.4	0.2	*4.4*	*0.2*	5.6	0.5	5.0	0.2	5.1	0.3
Kayaking or canoeing	3644	3.3	0.1	*5.0*	*0.1*	4.6	0.6	3.0	0.2	2.7	0.3
Cycling (road riding/ mtn biking)	3711	3.2	0.1	*3.9*	*0.1*	4.8	0.5	3.8	0.2	3.7	0.3
Jogging or running	3866	3.1	0.1	*3.6*	*0.1*	4.3	0.5	4.2	0.2	4.3	0.3
Playing golf	3008	3.0	0.1	*3.4*	*0.1*	4.2	0.6	3.2	0.3	2.7	0.4
Surfing	2759	1.7	0.2	*3.0*	*0.2*	3.8	0.6	2.9	0.2	2.3	0.3
Horse riding	2168	1.3	0.2	*2.1*	*0.2*	3.9	0.7	3.0	0.3	2.3	0.3

[a] Importance was rated on a scale from 0 (not at all important to me) to 10 (very important to me).

[b] Weighted means the data have been adjusted to be representative of Australia's adult recreational fishers, while unweighted data (also called not weighted data) is based on the sample without this adjustment, and is biased to more avid fishers, older fishers, and overrepresents fishers living in states and territories with smaller populations. See Chapter 3 and Section 6.3 of this chapter for explanation of the weighting approach used. As noted in section 6.3.3, weighted data for current fishers should be compared to unweighted data from other groups. Unweighted data for current fishers are provided to enable identification of the effect of weighting -which addresses the known bias to more avid fishers in the current fisher sample – on findings.

Table 6.4 Recreational activities, ranked by average importance score given to them by those who participate in them, Stage 2 NRFS data

Importance ranking	Current fishers (fished past 12 months) - weighted [a]	*Current fishers (fished past 12 months) - unweighted* [a]	Recent fishers (last fished 2-5 years ago) – not weighted [a]	Past fishers (last fished more than 5 years ago) – not weighted [a]	Non-fishers (have never fished) – not weighted [a]
1 (most important)	Fishing	*Fishing*	Going to gym or exercise classes	Bushwalking or hiking	Clothes shopping
2	Camping	*Camping*	Camping	Going to gym or exercise classes	Going to gym or exercise classes
3	Four-wheel driving	*Four-wheel driving*	Bushwalking or hiking	Clothes shopping	Bushwalking or hiking
4	Bushwalking or hiking	*Bushwalking or hiking*	Four-wheel driving	Playing game stations/online games	Playing game stations/online games
5	Swimming	*Kayaking or canoeing*	Swimming	Attending games/events as spectator	Jogging or running
6	Other outdoor or sports activities	*Recreational shooting or hunting (exc. fishing)*	Cycling (road riding/mtn biking)	Swimming	Swimming
7	Attending games/events as spectator	*Going to gym or exercise classes*	Playing sports with others	Other outdoor or sports activities	Attending games/ events as spectator
8	Recreational shooting or hunting	*Other outdoor or sports activities*	Attending sports games/ events as spectator	Playing sports with others (e.g., tennis, football)	Cycling (road riding/mtn biking)
9	Playing sports with others	*Attending games/events as spectator*	Clothes shopping	Jogging or running	Playing sports with others
10 (less important)	Kayaking or canoeing	*Playing sports with others*	Other outdoor or sports activities	Camping	Other outdoor or sports activities

[a] Weighted means the data have been adjusted to be representative of Australia's adult recreational fishers, while 'not weighted' (also called unweighted) means the data is based on the sample without this adjustment, and is biased to more avid fishers, older fishers, and overrepresents fishers living in states and territories with smaller populations. See Chapter 3 and Section 6.3 of this chapter for explanation of the weighting approach used. As noted in section 6.3.3, weighted data for current fishers should be compared to unweighted data from other groups. Unweighted data for current fishers are provided to enable identification of the effect of weighting -which addresses the known bias to more avid fishers in the current fisher sample – on findings.

6.5 'Specialisation' amongst recreational fishers

Multiple past studies suggest that a person who is more 'specialised' to a particular activity will find it harder to substitute other activities for it (see Appendix 6.1). Specialisation here means the extent to which a person uniquely focuses on one activity, for example by learning skills specific to that activity, investing in activity specific gear, joining organisations focused on the activity, or simply being highly focused on or dedicated to that activity. This section examines those who are more and less 'specialised' to recreational fishing as an activity. These measures of specialisations are then analysed further in Section 6.6, to identify whether those who are more specialised to fishing are less likely to identify other activities as being substitutable for fishing.

Three measures of specialisation were examined:

- Concentration: The proportion of recreation focused on a single activity. The higher the proportion of recreation focused on a single activity, the greater the level of specialisation. Specialisation was defined as being high if a person reported engaging on no or one recreational activity other than fishing; as moderate if they participated in 2 to 4 activities other than fishing; and as not specialised to fishing if they engaged in five or more recreational activities other than fishing.
- Importance: Those who are specialised will rate the activity they specialise in as being more important than other recreational activities they engage in. Specialised fishers were defined as those who rated fishing as more important than all other recreational activities they engaged in. Non-specialised fishers were defined as those who identified one or more other activities they engaged in as being just as or more important than fishing.
- Overall specialisation: This combines the measures of the concentration of activity and the relative importance of activities. A specialised fisher was defined as a person who is moderately or highly specialised in terms of concentration *and* rates fishing as more important than other recreational activities.

Table 6.5 shows the proportion of current fishers identified as being 'specialised' to fishing as a recreational activity, using each of these three measures:

- Concentration: 6.4% of fishers were highly specialised, 21.6% moderately specialised, and 72.0% not specialised to fishing.
- Importance: 34.0% of fishers were specialised and 66.0% not specialised.
- Overall specialisation: 14.4% of fishers were highly specialised, 32.9% moderately specialised (some due to lack of diversity of recreation activities outside fishing, and some due to considering fishing more important than their other activities), and 52.7% not specialised to fishing.

Table 6.5 Proportion of current fishers who are considered 'specialised' recreational fishers using three measures of specialisation

Measure (sample size)	Category	% current fishers	Definition
Concentration (n=5,200)	Highly specialised to fishing	6.4%	Person engages in 0 to 1 recreational activities other than fishing
	Moderately specialised to fishing	21.6%	Person engages in 2 to 4 recreational activities other than fishing
	Not specialised to fishing	72.0%	Person engages in 5 or more recreational activities other than fishing
Importance (n=5,113)	Specialised to fishing	34.0%	No other recreational activities rated equally or more important than fishing
	Not specialised to fishing	66.0%	One or more other recreational activities rated as or more important than fishing
Overall specialisation (n=5113)	Highly specialised	14.4%	No other activities as important as fishing and person engages in <5 recreational activities other than fishing
	Moderately specialised – importance	19.6%	Person engages in 5+ activities other than fishing, but none are considered as important as fishing
	Moderately specialised – concentration	13.3%	Person engages in <5 activities other than fishing, at least one other activity rated as important as fishing
	Not specialised to fishing	52.7%	Person engages in 5+ activities other than fishing, at least one of which is equally/more important as fishing

Data were also analysed to identify whether rates of specialisation in fishing vary depending on a fisher's socio-demographic characteristics, including their gender, age, cultural background, formal educational attainment, and whether they live in a major city or in a regional/rural area, as well as their fishing avidity (data are provided in Appendix 5.3). Few significant differences were identified[12], with three key exceptions: men were more likely to be specialised than women based on ratings of importance, younger fishers were less specialised on average than older fishers, and those who fished more frequently were more likely to be specialised.

Female fishers were less likely to be specialised to fishing using the importance measure: 36.2% of male fishers reported no other recreational activity they did was as or more important than fishing, compared to only 20.8% of female fishers (Appendix 5.3). However, male and female fishers did not differ in their concentration of activity on fishing, being just as likely as each other to engage in a diverse array of recreational activities. With regards to age, fishers aged 18-29 and 30-44 were less likely to be specialised, and those aged 60 or older more likely to be specialised, across all three measures of specialisation. For example, 26.5% of fishers aged 18-29 were specialised to fishing using the Importance measure, compared to 41.0% of those aged 60 and older. Consistent with this, those with lower levels of formal educational attainment (who are also more likely to be in older age groups) were more likely to be specialised. Those who fished 20 days or more in a year were more likely to be specialised based on the Importance measure (40.0%), and those who fished less than 20 days a year were less specialised (23.5% to 29.5% depending on the number of days fished).

Levels of specialisation did not differ significantly amongst current fishers with different cultural backgrounds (born in Australia or overseas, born in an English speaking or non-English speaking country, or identifying as Aboriginal and/or Torres Strait Islander), or between fishers living in major cities versus rural/regional areas.

6.6 Substitutability of recreational fishing and other activities

This section examines self-reported substitutability of fishing and other activities. Current and recent fishers were asked whether, if given the option of fishing versus another activity on a nice weekend at the same cost, they would fish, do the other activity, or find it hard to choose between the two. A survey participant was only asked about their preference for fishing versus other activities they had indicated they engage in, with one exception: all were also asked to identify if they would choose to do an 'outdoor picnic/BBQ' or fishing if asked to choose between them. The 'outdoor picnic/BBQ' option was included to ensure that any fishers who had not identified doing an activity other than fishing were asked at least one question about substitutability.

In total, 88.6% of current fishers and 90.3% of recent fishers identified at least one non-fishing activity they would be as likely or more likely to do than fishing, if asked to choose between them on a nice weekend (Table 6.6). This suggests that most fishers (likely including many specialised fishers) have at least one activity they can reasonably readily substitute for fishing. However, some identified few potentially substitutable activities. Amongst current fishers, 29.3% identified only one activity they would be as or more likely to do than fishing, while 35.8% had two or three. Only 23.6% had four or more activities considered similar to or preferable to fishing. Amongst recent fishers (unweighted data), in contrast, 53.1% identified four or more activities considered similar to or preferable to fishing.

[12] 95% confidence intervals were used to identify whether differences between groups were significant, with data for confidence intervals provided in Appendix A5.3.

Table 6.6 Number of recent recreational activities fishers reported they were as or more likely to do than fishing if asked to make a choice on a nice weekend

Number of activities person would be as or more likely to do than fishing if asked to choose	Current fishers (weighted)[a]	Current fishers (unweighted)[a]	Recent fishers (unweighted)[a]
No activities	11.4%	22.5%	9.7%
1 activity	29.3%	16.4%	13.2%
2-3 activities	35.8%	25.2%	33.9%
4-5 activities	15.4%	16.7%	20.1%
6 or more activities	8.2%	19.1%	33.0%

[a] Weighted means the data have been adjusted to be representative of Australia's adult recreational fishers, while unweighted data is based on the sample without this adjustment, and is biased to more avid fishers, older fishers, and overrepresents fishers living in states and territories with smaller populations. See Chapter 3 and Section 6.3 of this chapter for explanation of the weighting approach used.

Data were analysed to identify whether the likelihood of substitutability varied depending on a fisher's socio-demographic characteristics, including their gender, age, cultural background, formal educational attainment, and whether they live in a major city or in a regional/rural area (data are provided in Appendix 5.4, including confidence intervals). Current fishers were less likely to identify one or more activities that were substitutable for fishing if they:

- Were more highly specialised to fishing, particularly if fishing was rated as more important than all the other activities they were involved in
- Reported higher levels of expenditure on fishing in the last 12 months
- Fished a greater number of days in the last 12 months
- Were male.

Fishers were more likely to identify substitutable activities if they were less specialised to fishing, spent less on fishing, fished fewer days, or were female.

A fisher's age, cultural background, and formal educational attainment were not predictors of their likelihood of identifying one or more activities as being substitutable for fishing.

Fishers who lived in urban areas were slightly more likely to identify substitute activities for fishing than those living in regional and rural areas, although this was not consistent across both weighted and unweighted data. Hence, confidence in this result is lower than for the results identified above, all of which were consistent irrespective of whether data were weighted or unweighted.

While many fishers could identify at least one activity that was substitutable for fishing on a nice weekend, the types of activity they found substitutable varied. Figure 6.1 shows the extent to which different activities were considered substitutable for fishing by current fishers, from most to least common. The activities most commonly considered equally or more desirable than fishing (and therefore likely to be substitutable) were camping (66%), outdoor picnics/BBQs (55%), four-wheel driving (40%), kayaking (37%), playing sports with others (29%), swimming (28%) and hunting (27%). For all others, 20% or fewer fishers indicated likely substitutability.

Table 6.7 compares participation in, importance of, and substitutability of the ten activities other than fishing most commonly engaged in by fishers. Camping is highest on all three measures, being the most common activity participated in, highest ranked in importance and the activity most commonly considered substitutable for fishing. However, there is much less consistency in participation, importance and substitutability of other activities. For example, swimming was the second most commonly engaged in activity, but amongst those who went swimming it ranked as the fourth most important activity, and fifth most substitutable activity.

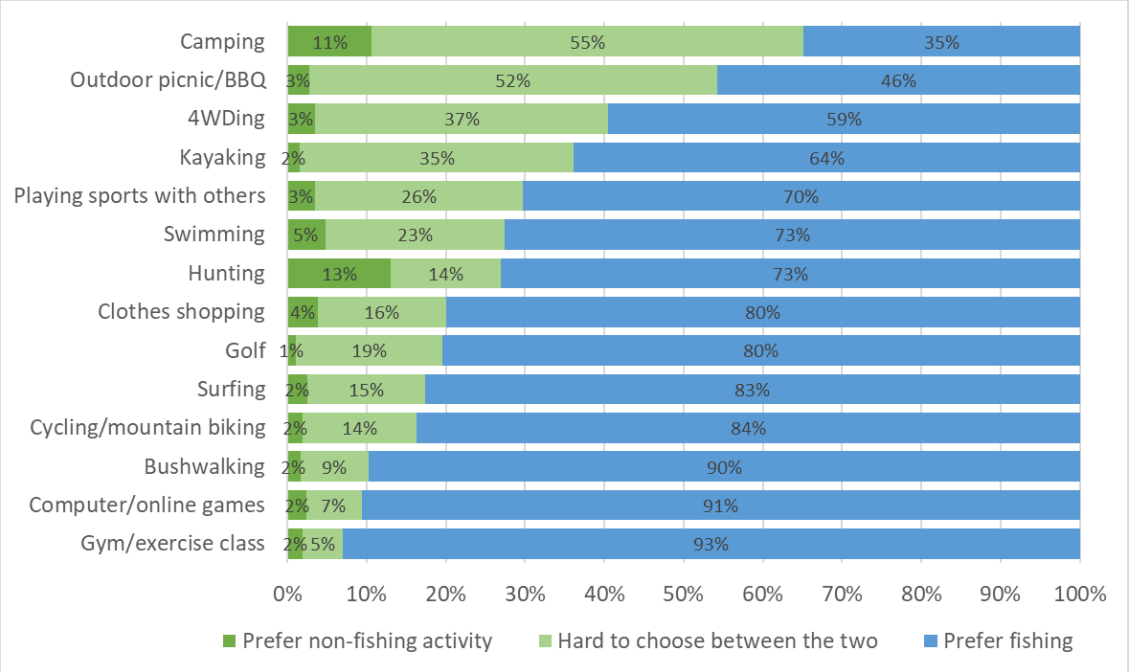


Figure 6.1 Preference for fishing versus other recreational activities engaged in during the past 12 months – current fishers (NRFS Stage 2 weighted data)

Table 6.7 Ten most common activities current fishers participate in, consider important, and consider substitutable for fishing (NRFS Stage 2 weighted data)

Ranking	Participation in activity	Importance of activity (excluding fishing)	Substitutability of activity
1 (most common)	Camping	Camping	Camping (and picnic/BBQ)
2	Swimming	Four-wheel driving	4WDing
3	Attending sports games/ events as spectator	Bushwalking or hiking	Kayaking/canoeing
4	Clothes shopping	Swimming	Playing sports with others
5	Four-wheel driving	Other outdoor or sports activities	Swimming
6	Bushwalking or hiking	Attending games/ events as spectator	Recreational shooting or hunting
7	Playing sports with others	Recreational shooting or hunting	Clothes shopping
8	Playing game stations/online games	Playing sports with others	Golf
9	Recreational shooting or hunting	Kayaking or canoeing	Surfing
10 (less common)	Playing golf	Cycling	Cycling

Recent fishers were much more likely than current fishers to report that other activities were substitutable for fishing. Amongst those who most recently fished two to five years prior to completing the survey (Figure 6.2, unweighted data[13]), 47% or more reported each activity

[13] Data for current fishers presented in Figure 6.1 are weighted, while data presented in Figure 6.2 for non-current fishers the data are unweighted. While weighting did make a different to the list of activities, amongst current fishers the effect of weighting was largely to increase preferences for non-fishing

asked about was substitutable for fishing. Fishing was – just – the preferred activity for more than half of recent fishers when compared to surfing, hunting, and golf. However, among recent fishers, fishing was preferred to camping by only 25%, to picnics/BBQs by 31%, to swimming by 33%, and to bushwalking by 34%.

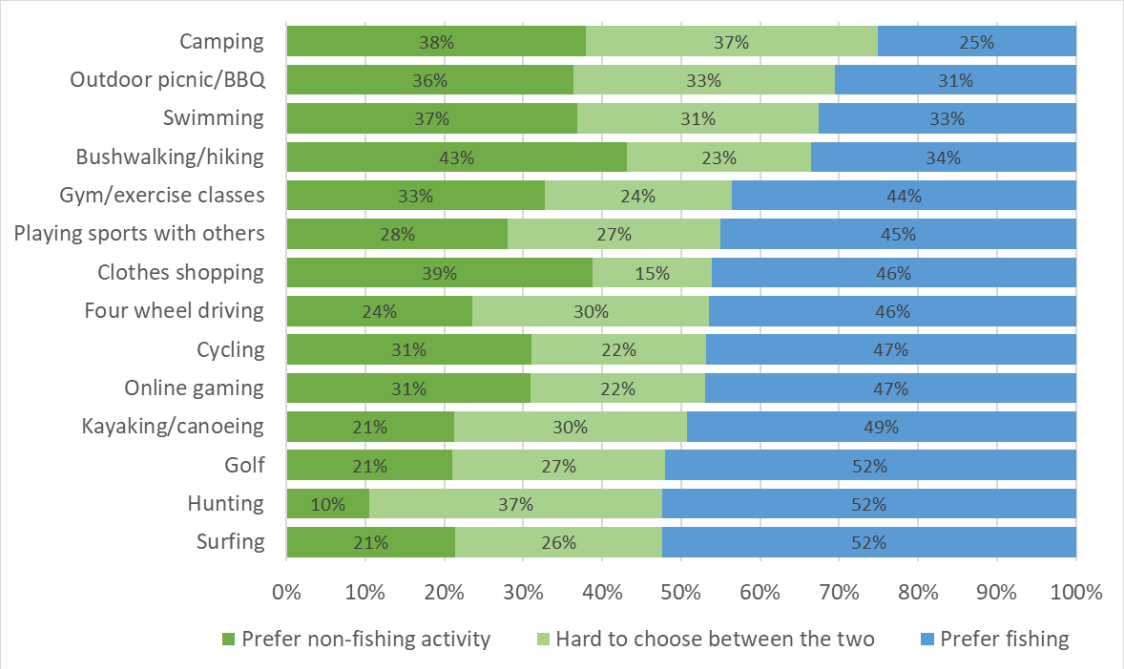


Figure 6.2 Preference for fishing versus other recreational activities engaged in during the past 12 months – recent fishers (most recently fished 2-5 years prior to survey, NRFS Stage 2 unweighted data)

The findings on substitutability suggests that many fishers engage in at least one activity that is potentially substitutable for fishing on a nice weekend. Whether these would be substitutable for fishing over a longer period is not known, however previous studies suggest that placing greater constraints on the substitution – such as needing to substitute an activity for a longer period of time – is likely to be associated with lower willingness to substitute.

Those who fish more often, spend more on fishing, and are more specialised to fishing, are less likely to find other recreational activities they do substitutable for fishing. This is important, as a large proportion of the expenditure on recreational fishing reported in Chapter 7 is generated by those who fish more often and who spend more on fishing. This means that even if many people substituted other activities for fishing, it is likely that more avid fishers would continue fishing in preference to other activities. This in turn would reduce the extent to which substitution of activities affected total expenditure on fishing and, as a result, the contribution of fishing to the economy.

activities. It is likely that if weighted, data for recent fishers would also result in a higher proportion indicating a preference for non-fishing activities, as it is likely recent fishers who participated in the survey may be biased to those with a greater, rather than lesser, interest in fishing. Comparison of unweighted data for both groups confirms that current fishers are more likely than recent fishers to prefer fishing, across all comparison activities asked about.

6.7 Substitution strategies during COVID-19: did fishers substitute other activities for fishing or vice versa?

In July 2020, current fishers participating in regular surveys as part of Stage 3 of NRFS data collection were asked whether they changed their recreational activities during April to June 2020 as a result of the first COVID-19 lockdown. The sample of 1,491 fishers who participated in the survey included an over-representation of avid fishers. The data presented in this section have not been weighted to correct for this over-representation. They therefore are most likely to indicate the extent to which more avid fishers – who were less likely to find other activities substitutable for fishing – engaged in substituting other activities for fishing during COVID-19 lockdown.

As noted in Chapter 5, COVID-19 related restrictions varied depending on the state and region of a state a person lived in, but typically involved some limitation on travel. These movement restrictions often reduced a person's ability to take part in some or all of their usual recreational activities, such as fishing. More than half of fishers reported that they fished less in May and June 2020 compared to a year earlier, and relatively few reported that they fished more often than usual (Figure 6.3). An even larger proportion – more than three-quarters – reported that they fished less than they wanted to during May and June 2020 (Figure 6.4). Amongst those who reported fishing less, the majority – 83.3% - reported that COVID-19 was either the main reason, or one of the reasons they fished less. Only 16.7% reported that COVID-19 was not one of the reasons they fished less (Figure 6.5).

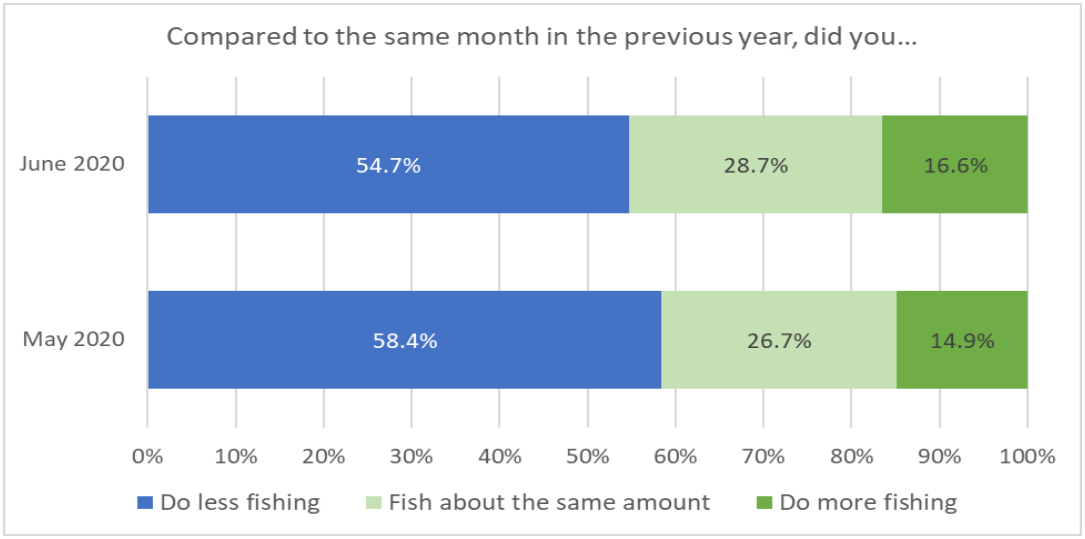


Figure 6.3 Proportion of fishers who fished less, about the same amount, or more than a year previously in May and June 2020, NRFS Stage 3 monthly data

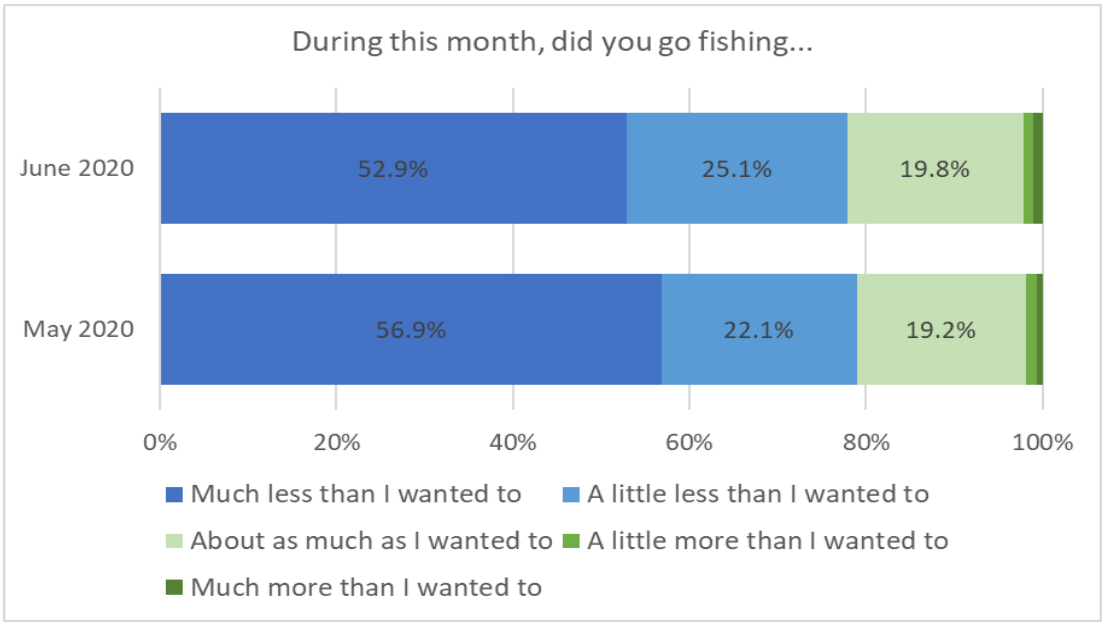


Figure 6.4 Ability to fish as much as desired, May and June 2020, NRFS Stage 3 monthly data

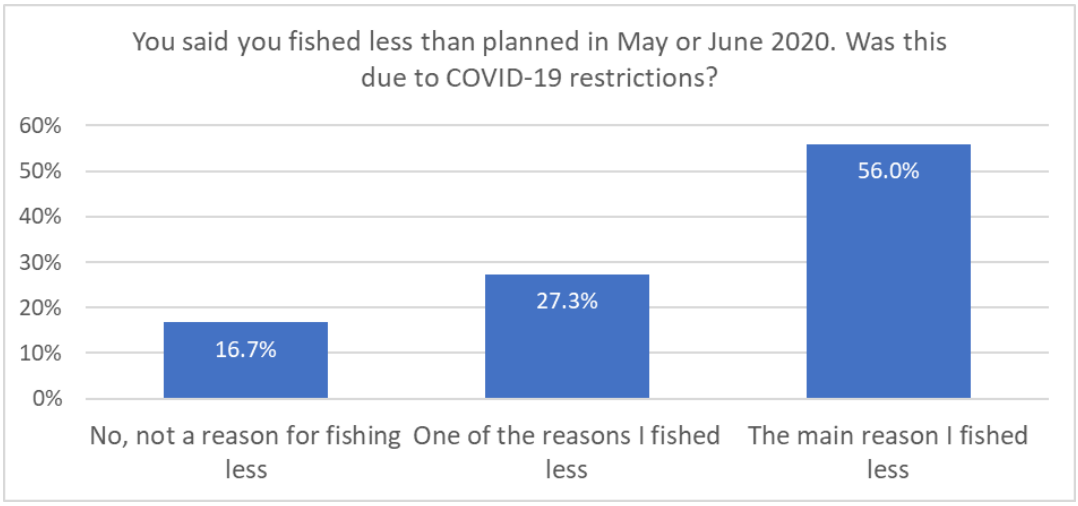


Figure 6.5 Proportion of fishers for whom COVID-19 was a reason for fishing less during May/June 2020, NRFS Stage 3 monthly data

In total, 27% of survey participants reported they had gone fishing instead of doing another activity they would normally have done during the period April-June 2020, while 73% had not done this. Meanwhile, 47% reported that they had done another activity instead of fishing during this time (Figure 6.6). The COVID-19 lockdown was an unusual context for examining activity substitution: the same factors that reduced a person's ability to go fishing also often reduced their ability to engage in other recreational activities. This means that the findings do not indicate what activities would be considered substitutes for fishing under unconstrained circumstances. They also do not necessarily indicate true substitute activities: the activities people turned to when unable to go fishing may not necessarily provide equivalent benefits. Similarly, amongst those who went fishing instead of doing other activities they were unable to do due to COVID-19 movement restrictions, fishing may not have provided equivalent benefits to the activity it replaced. Despite this, understanding the activities done instead of fishing, or that fishing replaced, does provide insight into the types of activities exchanged for fishing.

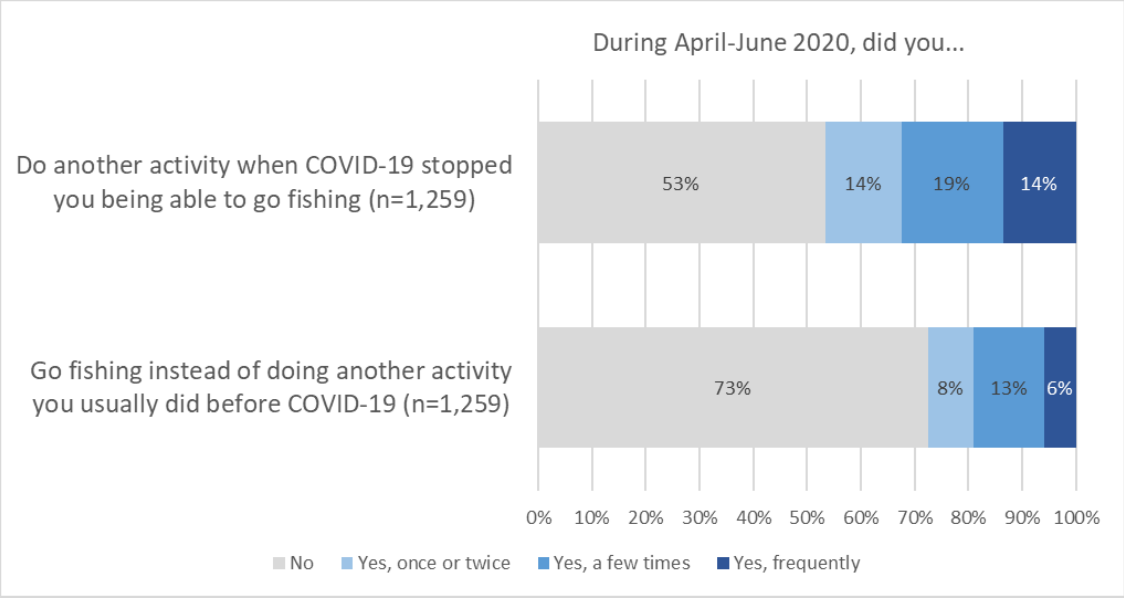


Figure 6.6 Proportion of fishers who reported substituting fishing and other activities during the April-June COVID-19 lockdown period in Australia, NRFS Stage 3 monthly data

Those who reported that they either replaced fishing with another activity, or fished instead of doing another activity, were asked to identify what the non-fishing activities involved were. This was asked as an open-ended question, and participants' responses were then coded into categories. Participants could identify one or several activities that either replaced fishing, or that were replaced by fishing.

Of those who reported that fishing replaced one or more non-fishing activities, a total of 340 participants reported 411 activities that were replaced by fishing. Thirty five per cent reported that fishing replaced some form of sport or exercise that was not nature-related, 33.8% that it replaced social activities, 20.3% that it replaced time spent on hobbies or travel, and 12.6% that it replaced other nature-focused sports or activities (Table 6.8).

Table 6.8 Pre-COVID-19 activities that were replaced by fishing during COVID-19 lockdown in April-June 2020

Previous activity that fishing replaced…	% respondents reporting this type of activity
Sports/exercise (not nature focused) e.g. football, gym, golf, cycling/mountain biking, cricket, lawn bowls, baseball, basketball, hockey tennis	35.0%
Social interaction e.g. seeing friends and family for social occasions	33.8%
Hobbies or travel e.g. woodwork, music groups, vacations or weekends away, motorbike riding, four wheel driving	20.3%
Nature focused sports/activities e.g. camping, hunting, bushwalking, bird watching, surfing, snow sports	12.4%
Paid work, volunteer work, or study	10.6%
Organised children's sports/activities	6.2%

Of those who reported that they did another activity instead of fishing, 574 respondents identified a total of 757 activities. The most common activity that replaced fishing was doing work around the home, in the form of home maintenance, home improvement, or more generally 'chores', reported by 20.7% (Table 6.9). This was followed by exercise such as cycling or swimming (18.3%), walking (17.2%), gardening (16.0%) and increasing home entertainment activities such as watching TV, reading, internet exploration, or online games (15.3%).

Table 6.9 Types of activities that replaced fishing during COVID-19 lockdown in April-June 2020

Types of activities done instead of fishing	% respondents reporting this type of activity
Home maintenance, home improvement, domestic chores	20.7%
Specific exercise/sport e.g. cycling, swimming, shooting, hunting, surfing	18.3%
Walking (usually in local area; for some this involved bushwalking in nearby reserves)	17.2%
Gardening	16.0%
TV, reading, surfing internet/social media, online shopping, podcasts, games (online/electronic)	15.3%
Fishing related activity	11.5%
Hobby	9.8%
Other/unclear	9.4%
Work, study, home schooling, volunteering	4.4%
Home-based exercise, e.g. workout at home, online workout	3.3%
Social activities with family/friends including board games	3.1%
Nature-based activities such as bird watching, walking in nature areas, backyard camping	2.8%

A number of respondents (11.5%) reported that they replaced going fishing with fishing-related activities, such as repairing fishing gear or equipment, making lures, practicing casting, or reading or watching fishing-related material. Fewer – less than 10% - reported replacing fishing with a hobby such as playing a musical instrument or woodworking (9.8%), with work/study/volunteering (4.4%), home-based exercise (3.3%), social activities (3.1%), or nature-based activities other than walking (2.8%). A number of respondents (9.4%) reported activities that were difficult to categorise or were unclear: examples included ‘sulking’, ‘gambling’, and ‘inside activities’.

In addition to replacing some or all of their fishing with other activities (or vice versa), many fishers changed the types of fishing activities they did. As shown in Figure 6.7, around one in three fishers reported watching more fishing shows/videos or spending more time than usual on fishing websites/forums/social media during this period. Meanwhile, 66.7% went away less on overnight trips than usual, and 58.2% did less fishing with people who lived in a different home to them than usual. There was relatively limited evidence of fishers changing one type of fishing for another, although 19.2% reported trying new fishing spots more often than they normally would. It is possible that COVID-19 constraints limited the types of resource substitution (e.g. changing type or location of fishing) that many fishers could use when COVID-19 restrictions impacted their fishing.

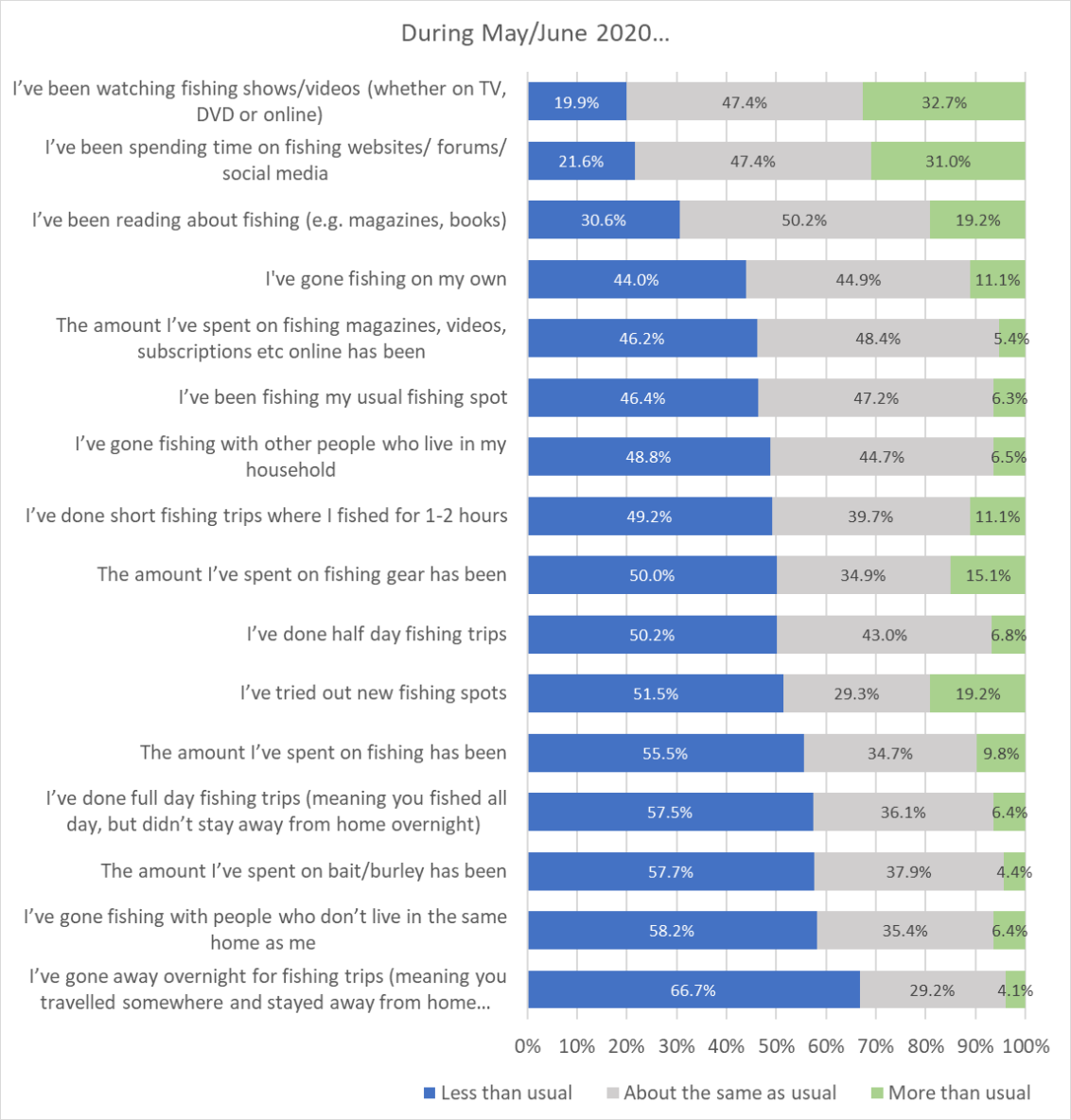


Figure 6.7 Changes in fishing-related activities done during the COVID-19 lockdown, May/June 2020, NRFS Stage 3 monthly data

Overall, the changes in fishing and non-fishing activity during the first COVID-19 lockdown suggest that the activities undertaken in place of fishing were not principally focused on either exercise or nature-based activities. Instead, a complex mix of activities were done instead of fishing, including gardening and home maintenance, walking, specific types of exercise such as cycling, and home entertainment . This, together with earlier evidence regarding substitutability of activities such as picnics/BBQs for fishing under unconstrained circumstances, suggests that it may be important to look beyond outdoor recreation activities and sporting activities when identifying substitute activities for recreational fishing. The choice of combinations of entertainment, exercise, outdoor activity such as gardening, and do-it-yourself jobs suggests that people may be replacing a complex array of benefits they achieve from fishing and doing so with a broad range of alternative activities.

6.8 Conclusions

If a person cannot go fishing, how likely is it that they will instead turn to alternatives that generate equivalent social and economic benefits? This chapter explored this question by examining the types of recreational activities fishers engage in other than fishing, how important these activities are to them compared to their fishing, and whether they would choose to do fishing or another activity if asked to choose between them on a nice weekend. It also identified what types of activities fishers reported they did instead of fishing during the first COVID-19 lockdown in Australia in 2020. These findings cannot quantify how likely it is that fishers will do activities that generate equivalent social and economic benefits. They do, however, provide some insight into likely choices and behaviours of fishers, and the types of activities they may do as a substitute for fishing, albeit in a situation in which they were also constrained in the alternative activities they were able to do.

The topic of substitutability was examined to better identify the extent to which the social and economic benefits derived from recreational fishing, examined in other chapters of this report, may still be achieved in the absence of recreational fishing. With many fishers having at least one other activity they find relatively easy to substitute for fishing, at least in the short-term, it is clear that at least some of the social benefits resulting from fishing can, for many fishers, be achieved either by going fishing, or through substitute activities.

However, this is not the case for all fishers, and particularly not the case for more avid fishers. Much of the economic contribution of recreational fishing (examined in Chapter 7) results from activities of avid fishers. This relatively small proportion of fishers contribute a large proportion of the economic activity generated by fishing, as they spend more on fishing and fish more days compared to non-avid fishers. They are also significantly less likely to be able to identify activities they feel they would choose in place of fishing. In the absence of fishing, many of these fishers are likely to decrease spending on fishing but, at least in the short-term, and possibly the longer term, may not increase engagement in other activities. If this occurred, this group of fishers would also likely experience significant loss of the social benefits they previously derived from fishing, and find it very difficult – or for some, impossible – to achieve equivalent benefits through other activities.

The findings also suggest that future studies examining substitutability should consider a wider range of potential substitute activities for fishing. Previous studies have mostly examined the substitutability of recreational fishing and other outdoor recreation activities, or sometimes sporting activities. This suggests an underlying assumption that the benefits of fishing derive largely from either its outdoor or exercise benefits. The findings of this study suggest that a wider range of activities may be substitutable for fishing, including some that focus on social interaction, some focusing on nature connection, and others that focus on sport/exercise/skills-based activities. Recreational fishing also differs from many of the potential substitute activities examined in this chapter, in that it may be used to provide food for consumption. The relative importance of achieving nutritional benefit versus other benefits should be examined in future studies.

The substitutability of one type of fishing for another (for example, saltwater and freshwater fishing, boat or shore-based fishing, or fishing in different location or for different target species) was not examined in this study. This is an important area for future study. In particular, it would be useful to identify the extent to which fishers are more likely to change the type of fishing they do, versus change from fishing to a non-fishing recreational activity, if unable to continue engaging in the type of fishing they currently prefer.

Future studies interested in substitutability should also examine the role of complementarity. As well as the question ‘would the same benefit be derived from other activities if fishing was not possible’, a second question should be asked: ‘if unable to go fishing, would engagement in

other complementary activities such as camping, kayaking/canoeing, or swimming also decline?'. The findings reported in this chapter suggest this may be a possibility but cannot confirm whether it does in fact occur. Future studies should examine whether and, if so, how engagement in clusters of complementary activities change, and what changes in social and economic contributions may result if a change in access to one activity in turn triggers a change in engagement in the complementary activities that often accompany it.

7.0 Economic contribution of recreational fishing

Chapter authors: Anders Magnusson, Jacki Schirmer and Abbie Dix

7.1 Key points

- Recreational fishing in Australia in 2018-19 contributed an estimated $11.5 billion to Australia's gross domestic product (GDP) and supported over 100,000 full-time equivalent jobs in Australia.
- Several past recreational fishing studies have measured expenditure on recreational fishing but no national study has produced economic contribution estimates such as those in this report.
- The estimates produced in this study differ to other studies. This study included all contributions made by fishers regardless of where the fisher lived and spent money on recreational fishing. Other studies typically have not been able to include all these flows of economic activity.
- Economic contribution analysis is a type of 'footprint' assessment that quantifies the level of activity in an economy that is supported by a particular activity, in this case recreational fishing.
- These economic contribution estimates should not be used as the basis for resource access decisions such as allocation decisions between one sector and another, as they don't show how value might change due to reallocation. An impact analysis is better suited to inform allocation decisions.
- Key results are presented in Summary Table 7.1 and Summary Table 7.2.

Summary Table 7.1: Economic contribution, direct and flow-on effects, 2018-19, Australia

Effect	Gross Domestic Product ($m)	Employment (full-time equivalent)
Direct	3,396	40,483
Flow-on	8,126	60,859
Total	**11,522**	**101,342**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.		

Summary Table 7.2: Economic contribution, total (direct + flow-on), by state/territory, 2018-19, Australia

State/Territory	Gross State Product ($m)	Employment (full-time equivalent)
New South Wales	3,879	32,493
Victoria	2,266	19,737
Queensland	2,515	23,602
South Australia	985	9,434
Western Australia	1,146	9,380
Tasmania	270	2,670
Northern Territory	270	2,523
Australian Capital Territory	190	1,502
National	**11,522**	**101,342**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.		

7.2 Introduction

Recreational fishing, like many other recreational activities, contributes to economic activity in Australia. This is because recreational fishing activity is supported by the spending of fishers, which leads to production and employment in the economy. This chapter examines the economic contribution of recreational fishing to the Australian economy and to the economy of each state and territory.

Economic contribution is estimated for the 2018-19 financial year, the year before COVID-19 impacted engagement in fishing activity. The analysis in this study draws from survey data in which fishers reported their recreational fishing activity and spending. This information was used as an input into an economic model of Australia, which models the activity of each industry as well as the interlinkages between industries and regions across the country, to estimate the contribution of recreational fishing.

Economic contribution can be measured in many ways and differs to other common economic measures. Given this, applied methods and indicators of economic contribution need to be carefully defined, to ensure that they are interpreted appropriately, and that findings can be usefully compared with other studies.

Economic contribution analysis is often described as measuring the 'value added' to the economy by an activity. Economic contribution is the amount of additional dollars and jobs added to economic activity *after* removing transfers between different parts of the economy - thus only the additional value added on top of what already occurred is included. Economic contribution analysis can answer questions such as:

How many jobs were directly and indirectly supported by recreational fishing in Australia in 2018-19?

What proportion of economic activity in non-metropolitan parts of Victoria was supported by recreational fishing in 2018-19?

How much of the economic contribution of recreational fishing to the Queensland economy in 2018-19 was supported by recreational fishers residing outside of Queensland, and how much from those residing within Queensland?

This study defines economic contribution analysis as a type of 'footprint' assessment that estimates the amount of economic activity that is supported by a particular activity during a period of time. This is typically quantified using various indicators of the dollar value of economic activity and the amount of employment supported by the activity. Importantly, it produces a snapshot of the economic activity contributed by recreational fishing (*economic contribution analysis*), not an expected change in economic activity given a change in recreational fishing activity (*economic impact analysis*) (Gretton 2013). Impact analyses would seek to answer questions such as 'What was the net effect on economic activity region X of a 12 month ban on fishing for species Y?'

Economic impact analysis requires both having estimates of economic contribution at a given point in time *and* using behavioural assumptions to model how this would change if a shock occurred. For example, to answer the question posed above, an impact assessment model would need to not only have estimates of the contribution that recreational fishing made to the region prior to the ban, but also of the likely responses of fishers to the ban, including the extent to which fishers would either (i) decrease total fishing and associated expenditure in the region, (ii) target different species without any reduction in overall fishing effort or expenditure in the region, or (iii) reduce fishing and replace it with spending on a different activity within or

outside the region. The extent of the estimated economic impact would depend on the assumed nature and extent of these behaviours. Further, if the associated change in economic activity was relatively large then assumptions about how the regional economy as a whole responds to changes in activity would also be, such as assumptions about migration into and out of the region, changes in prices and movement of resources such as labour and capital between industries and regions over time. Economic contribution analysis does not require any of these assumptions.

Economic value is another concept that should not be confused with economic contribution. While 'value-added' is an indicator of economic contribution, it does not mean the same thing as economic value. For example, it is widely understood that much of the 'value' people receive from undertaking recreational fishing is the value of enjoyment. This is non-monetary as no one pays a ticket price that covers the full value received by a recreational fisher going on a fishing trip. Since no ticket price is paid, the value is not realised as tangible economic activity that could be measured with indicators like employment and GDP[14]. Therefore, the estimates of economic contribution presented in this chapter do not represent a measure of the full economic value generated by recreational fishing. They do however represent the activity that takes place in the economy as a result of the value generated by recreational fishing.

This chapter explains the methods used to estimate economic contribution, presents the findings of our analysis of the national economic contribution of recreational fishing to Australia, and compares the results of our analysis with the findings of previous studies on economic contribution of recreational fishing and of other activities.

7.3 Methods and data

The estimates of economic contribution presented in this report are generated using a multi-region input-output (I-O) model known as RISE-MR (Regional Industry Structure and Employment – Multi-region) developed by BDO EconSearch. The model describes the activity of each industry in Australia as well as the interlinkages between industries and regions with one another and with the rest of the world. This model and approach is similar to that used in the National Fisheries and Aquaculture Industry Contributions Study (FRDC project 2017-210) (BDO EconSearch 2019).

The I-O model requires a *final demand profile* to calculate indicators of economic contribution. In this case, the final demand profile identifies the revenue earned by each industry in each region of Australia during the 2018-19 financial year that was supported by Australian recreational fishing activity. Fishing activity and spending data were collected in the Stage 2 NRFS survey of recreational fishers, and weighted to represent the Australian population using benchmark data on the population of Australian fishers. Expenditure data was then converted from *purchasers' prices* to *basic prices* and allocated to specific industries in each region using external research of each expenditure item - in other words, expenditure data was converted from the amount that fishers paid (purchasers' prices) to the amount that Australian businesses received after accounting for imports, freight costs, margins and taxes (basic prices). This was then input into the I-O model, which estimated direct and flow-on economic contribution to each region using indicators such as contribution to GDP and employment. Figure 7.1 illustrates this process and the remainder of this section describes each stage in detail.

[14] Similarly, when consumers enjoy a meal of seafood produced commercially by the seafood industry, they receive value from the meal of at least as much as the price they paid (otherwise they wouldn't pay for it). However, like the experience value of recreational fishing, this economic value is not fully converted into tangible economic activity that can be measured with indicators like employment and GDP so is not captured by an economic contribution study.

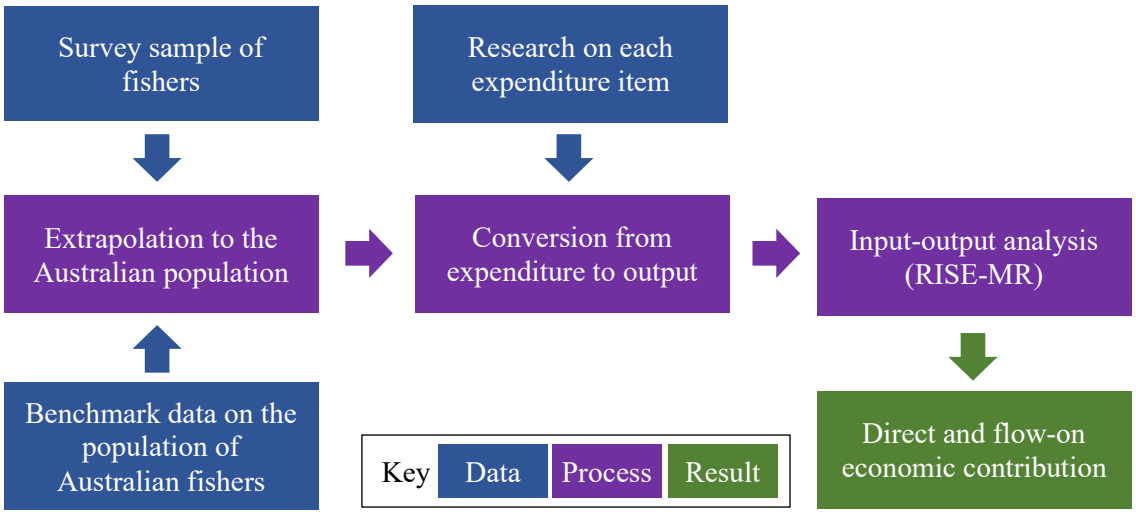


Figure 7.1 Method overview

7.3.1 Indicators of economic contribution

Quantification of economic contribution requires the selection and definition of a set of indicators by which to measure economic activity. Box 7.1 describes the indicators used in this study, which are commonly used for this purpose.

Box 7.1 Indicators of Economic Contribution

Output: value of production by local industry attributable to recreational fishing.

Gross Domestic Product (GDP): the total market value of final goods and services produced in Australia within a given period, after deducting the cost of intermediate goods and services and imports used up in the process of production.

Gross State Product (GSP): the state or territory equivalent of GDP.

Gross Regional Product (GRP): the regional equivalent of GDP.

Household income: income earned by employees of businesses and owner-operators. This is a sub-component of GDP/GSP/GRP that describes how much of the GDP/GSP/GRP is received by households, and is a useful indicator of the welfare of households.

Employment: a measure of the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent jobs. Employment is a key indicator of both economic activity and the welfare of households.

7.3.2 Direct and flow-on economic contribution

Both direct and flow-on economic contribution were modelled in this study. *Direct* contribution means the economic activity supported directly by recreational fishing activity. For example, when a fisher spends money on bait, ice and fuel while on a fishing trip, or on fishing tackle and other equipment in preparation for fishing in the future, economic activity occurs at the businesses that supply these good and services. The activity at those businesses is 'direct' economic activity.

Flow-on contribution is the contribution to the economy that occurs as a result of the activity that 'flows on' from the direct activity. Continuing the example from above, when a bait or tackle shop sells goods or services to a recreational fisher, the shop retains some of the revenue as profit, and spends the rest on wages and its own suppliers (such as businesses that harvest bait or import tackle). Those staff and supplying businesses in turn spend their income in other parts of the economy. For example, staff may spend on groceries, mortgage payments, and car fuel, while supplying businesses may spend on their own suppliers and staff and retain some revenue as profit. This activity supported by recreational fishing in the broader economy, outside of the *direct* activity defined above, is known as *flow-on* activity. Box 7.2 summarises the types of direct and flow-on effects measured.

Box 7.2 Direct and flow-on (indirect) contribution

Direct: activity at businesses that provide goods and services to recreational fishers.

Production induced: activity in the broader economy supported by business to business transactions (purchases from suppliers) associated with recreational fishing.

Consumption induced: activity in the broader economy due to consumption expenditure from household income supported by recreational fishing expenditure.

Flow-on: Production induced contribution + Consumption induced contribution.

Total: Direct + Flow-on.

The terminology used by researchers when describing I-O analysis can be confusing. Our terminology is defined in Box 7.2. When comparing with other studies, the definitions of terms in the comparison study must first be clarified, as the same terms may have different meanings in different reports. Specifically, some studies use the term 'indirect' to refer to what we have termed 'flow-on', while others refer to 'production induced' as 'indirect' and 'consumption induced' as 'induced'.

7.3.3 Input-Output models and their limitations

I-O models describe the direct and flow-on effects of production by capturing, for each industry, the industries it purchases inputs from as well as the industries it sells its product to. A multi-region I-O model categorises the locations of industries as being (i) in the same region as the purchasing industry region, (ii) in other regions within the model, or (iii) imports from outside the model region.

I-O models have important limitations for economic analysis. One of the key limitations of the conventional I-O model is its lack of accounting for market response and regional adjustment for economic impact analysis. Inter-industry models, such as the I-O model, are based on the premise that it is possible to divide all productive activities in an economy into sectors or industries whose inter-relations can be meaningfully expressed as a set of equations. The crucial assumption in the I-O model is that the money value of goods and services delivered by an

industry to other producing sectors is a linear and homogeneous function of the output level of the purchasing industry with supply being infinitely elastic.

This linearity assumption implies a strict proportional relationship between input coefficients and output. For example, income coefficients are average propensities and employment coefficients reflect average labour productivity rates. In impact studies, this property can lead to an overestimation of the flow-on (multiplier) effects, particularly if the direct effects are not marginal. For example, many industries can increase output in the short-term without corresponding proportional increases in wage costs and employment, particularly if there is slack (under-utilised) capacity.

As noted above, contribution analysis is different from impact analysis as it quantifies the existing level of activity and the current linkages that exist within the economy, rather than a change. As such it is appropriate to use an I-O model for the current research.

7.3.4 Calculations

Estimating the economic contribution of recreational fishing required several calculation steps. These steps are described in this section to illustrate how the estimates of economic contribution are derived from the input data.

Creating a final demand profile

The first step in estimating economic contribution was to generate a final demand profile. In this case, this was a profile of revenue earned by each industry in each region of Australia during the 2018-19 financial year supported by Australian recreational fishing activity. This was calculated by applying some transformations to estimates of expenditure by recreational fishers, which were collected in a survey. The transformations involved allocating expenditures to the supplying industries (e.g., manufacturing, restaurants, and accommodation) and converting from *purchasers' prices*[15], into *basic prices*[16]. The conversion from purchasers' prices to basic prices involved identifying the components of expenditures at purchasers' prices that represent net taxes and margins (e.g. retail, wholesale and transport) and allocating these to the relevant industries. The result is referred to as a final demand profile.

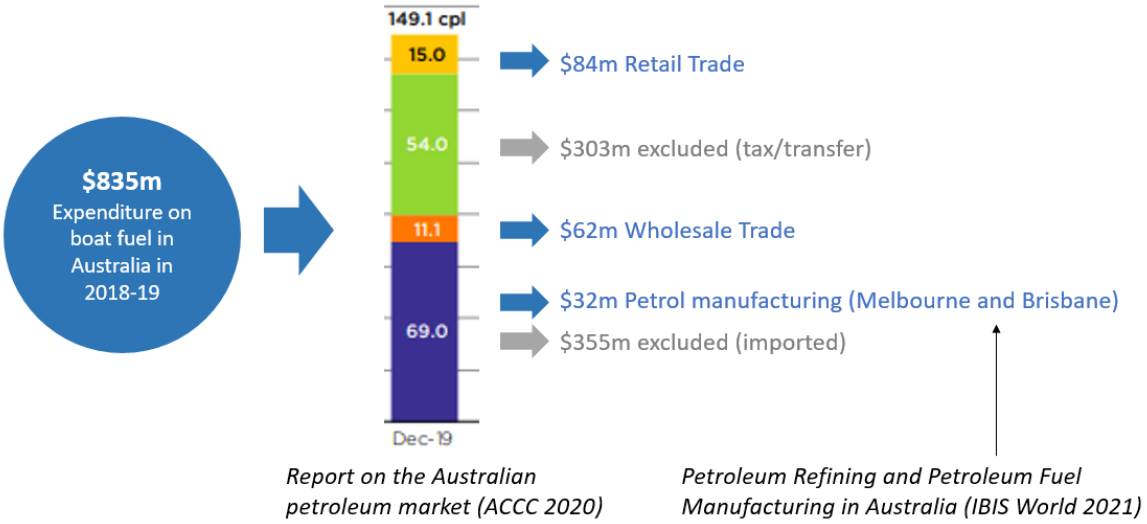
Conversion to basic prices and allocation to industries relied on research collated by BDO EconSearch over time, including data from the RISE-MR model itself and various other sources. There is a lack of consistent quality data to inform this conversion process, so judgement is needed to interpret and reconcile various sources into a coherent set of assumptions. Box 7.3 demonstrates this process using the boat fuel expenditure item as an example. Appendix 6.1 summarises the result for each expenditure item.

[15] The price paid by purchaser/receiver of a good or service: includes price received by the producer/supplier of the good/ service, taxes less subsidies paid and margins (e.g. transport, wholesale) paid to supply the good/service.

[16] The amount received by the producer/supplier from the purchaser for a good/service supplied. It is calculated as the purchaser's price less any tax payable, plus any subsidy receivable and less any margins (transport, wholesale trade) on the good/service supplied as a consequence of its production or sale.

Box 7.3: Conversion from expenditure to output, boat fuel example

The ACCC (2020) regularly publishes a decomposition of petrol price margins. These were used to convert expenditure on petrol to output by local industry. Of the estimated $835 million spent on boat fuel by recreational fishers in Australia in 2018-19, the value of output by local industry was estimated to be $177.9 million, with this expenditure incorporating $84 million of output by the retail trade industry, $62 million by wholesale trade, and $31.9 million by domestic petrol manufacturing. All fuel sold in regions other than Brisbane and Melbourne is assumed to be imported from overseas (IBIS World 2021). As production occurring overseas is not output attributable to the Australian economy, the $355 million of fuel that is manufactured outside Australia is excluded from economic contribution calculations, while the associated wholesale and retail trade generated by the importation and sale of that fuel is included. The $303 million of expenditure that goes to taxes, duties etc. is excluded as it is a transfer of wealth between Australians and the Australian Government, not part of direct output by local industry.



Calculating direct economic contribution

Direct economic contribution is the activity at businesses that provide goods and services to recreational fishers and is measured using indicators of economic activity such as GDP, household income and employment. Figure 7.2 illustrates the calculation of direct economic contribution by recreational fishing in Australia. The actual calculation makes use of the RISE-MR model which produces results for 78 sectors across 15 regions of Australia, while the figure represents a national aggregate. The process begins (on the left) with itemised expenditure associated with recreational fishing in 2018-19 (such as fuel, insurance, accommodation, etc.). This is converted to a final demand profile of direct output as described above, which is output by *industries within regions* (such as retail trade in Melbourne and Personal & Other Services in 'Rest of Victoria'). The final demand profile is input into the I-O model which applies coefficients of economic activity per $1m of output to calculate indicators of direct economic contribution such as GDP, household income (a component of GDP) and employment.

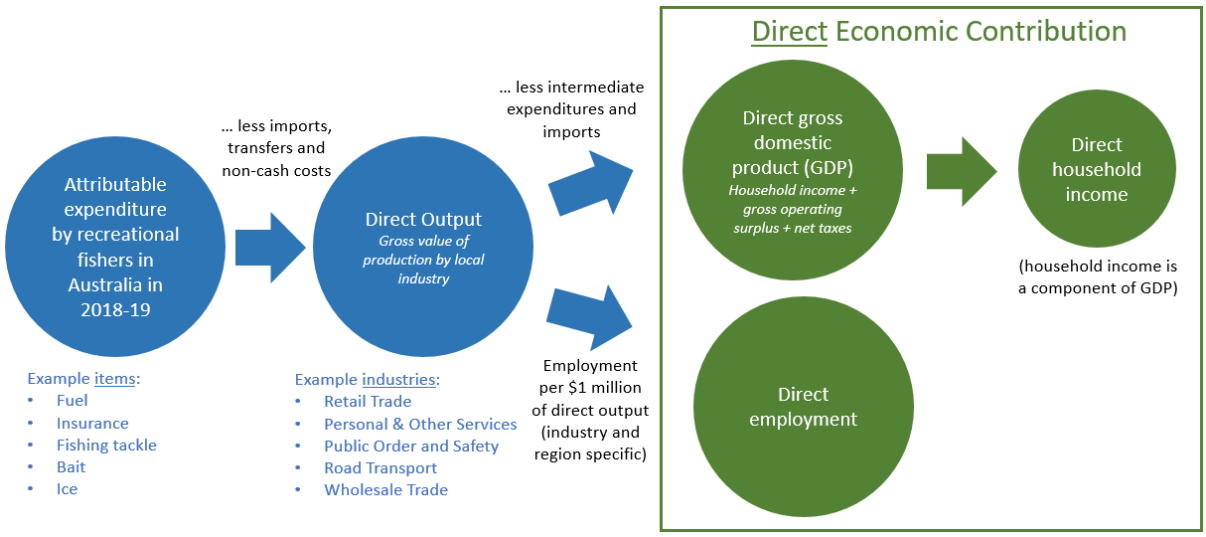


Figure 7.2 Calculating direct economic contribution

Calculating flow-on economic contribution

Flow-on economic contribution is the economic activity supported by recreational fishing in the broader economy, outside of the direct activity described above. Flow-on economic activity was defined in this study as the combination of production induced activity and consumption induced activity.

Production induced flow-on activity results from the successive rounds of business-to-business expenditures along the supply chain that support the final sales to recreational fishers. Figure 7.3 illustrates the calculation of production induced flow-on effects at the national level. Starting in the top-left, direct output produces some GDP, some spending on imports and some business-to-business expenditures within Australia. The business-to-business expenditures support additional activity in the economy as well as further business to business expenditures and further economic activity. Production induced flow-on activity is calculated as the sum of these successive rounds of activity.

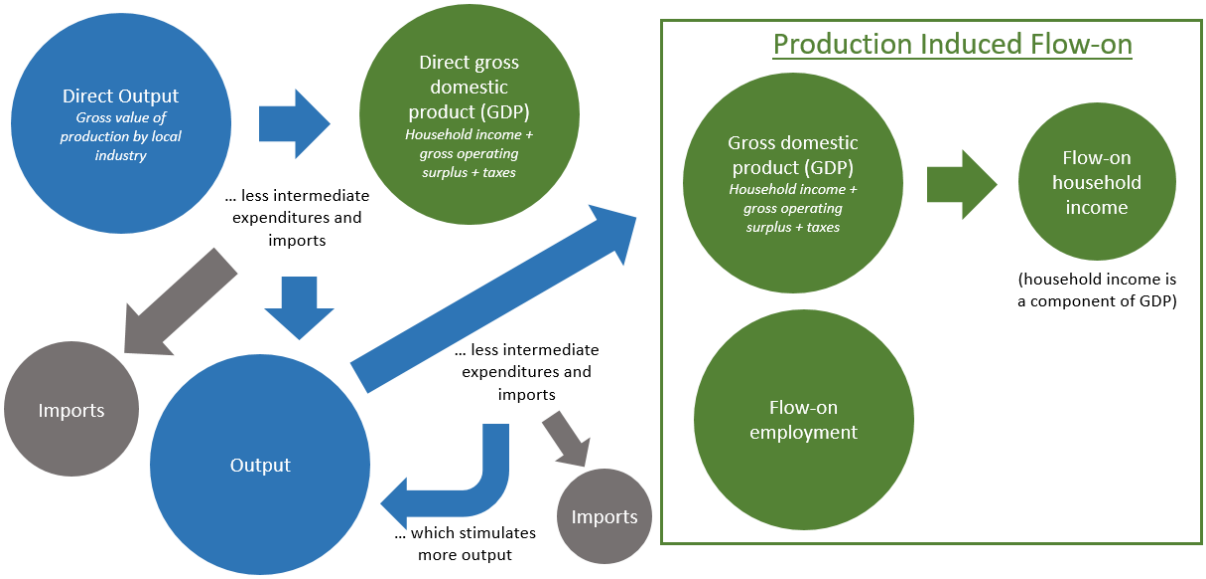


Figure 7.3 Calculating production induced flow-on effects

Consumption induced flow-on activity results from the successive rounds of consumption expenditure along the supply chain as businesses pay wages to their staff and staff spend them on consumption. Figure 7.4 illustrates the calculation of consumption induced flow-on effects at the national level. Beginning on the left, the direct household income (Figure 7.2) and production induced flow-on household income (Figure 7.3) each lead to consumption expenditure by workers. Some of the consumption expenditure is spent into Australian industries, triggering additional successive rounds of wages and consumption expenditures. Consumption induced flow-on activity is calculated as the sum of these successive rounds of activity.

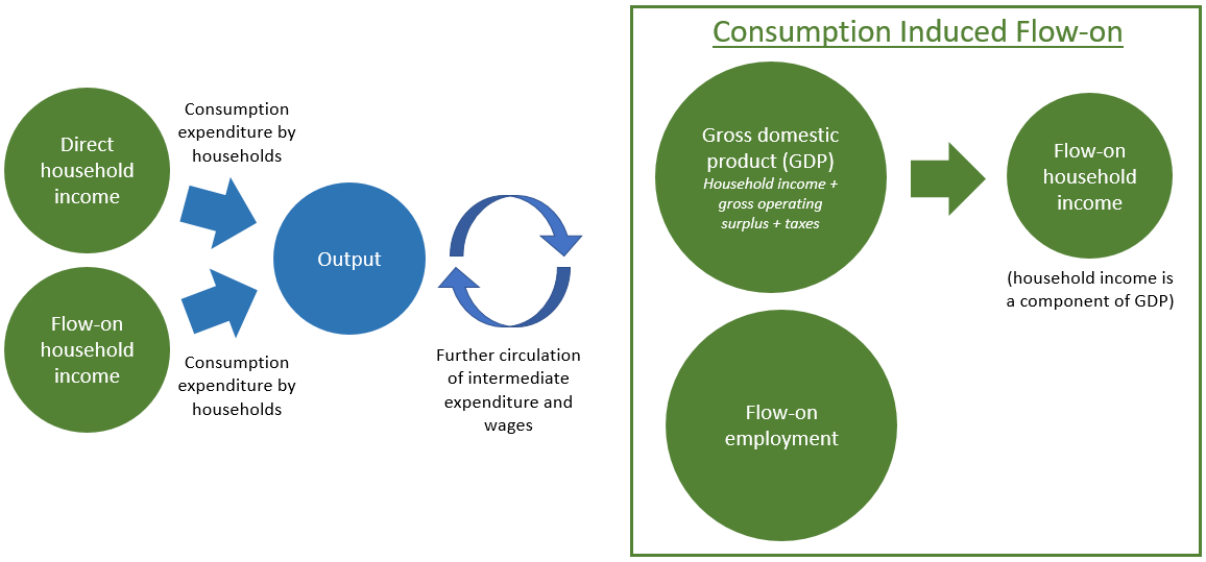


Figure 7.4 Calculating consumption induced flow-on effects

The sum of direct, consumption induced and production induced economic contribution is known as 'total' economic contribution. The results from the analysis are presented in the following section in terms of these three components of economic contribution, and with a regional dimension.

7.3.5 Defining attributable expenditure

Creating a final demand profile, from which to estimate economic contribution, required estimates of the various types and locations of expenditures supported by recreational fishing in Australia. This study used a survey as a starting point for these estimates. Before designing survey questions, it was essential to first define the types of expenditure that should be included. It was then important to identify how to attribute expenditure to recreational fishing for those expenditures that have uses beyond recreational fishing, how to address capital expenditures such as purchases of houses, vessels and motor vehicles, and how to attribute the location of expenditures.

Partial attribution

Recreational fishing involves direct expenditure on items and activities that span multiple economic sectors, including (amongst others):

- Equipment directly used in recreational fishing, such as fishing tackle
- Equipment used by recreational fishers that is sometimes used for fishing, and sometimes for non-fishing purposes, such as boats, kayaks and jet skis
- Services specific to recreational fishing, such as recreational fishing charter trips and fishing guide businesses, and

- Activities occurring due to, but not specific to, recreational fishing, such as spending undertaken as part of a fishing trip on regional accommodation, boat fuel, car fuel, and food and drinks.

This complexity means that to estimate the economic contribution of recreational fishing, it is necessary to collect data that enables identification of expenditure on multiple types of equipment and activities, and that also enables estimation of the proportion of that expenditure that is attributable to a person's recreational fishing activities.

The proportion of an expenditure item used for recreational fishing, rather than other activities, can be used to identify the proportion attributable to recreational fishing. For some items, all expenditure relates to recreational fishing, meaning 100% of the value of these purchases is attributable to recreational fishing. For example, a recreational fisher who purchases a fishing permit, buys fishing tackle, or spends on bait, berley and ice for purposes of recreational fishing trips, is spending that money entirely for the purpose of their recreational fishing. In other cases, expenditure on items occurs partly due to a person going recreational fishing and partly for other reasons. For example, if a person purchases a boat, and around 50% of its use is for recreational fishing while the remaining 50% is for other purposes, only 50% of expenditure on things such as vessel maintenance, registration and insurance should be considered to be expenditure directly related to recreational fishing. Activities occurring due partially to recreational fishing, such as spending undertaken as part of a fishing trip on regional accommodation or food and drinks, should be attributed proportionally based on whether recreational fishing was the main reason for the trip.

Capital items

The economic activity associated with capital expenditure, such as purchases of houses, vessels and motor vehicles in support of recreational fishing activities, was included in this study after important transformations. In many cases capital expenditure involves the transfer of assets between people, rather than new economic production that supports activities such as employment and the earning of wages. This study included the economic activity associated with the transfer of the assets, not the value of the asset itself. For example, when a house is purchased, most of the sale price represents a transfer of wealth in exchange for a valuable asset (which is not economic contribution), however new economic activity is generated for real estate agents in terms of business profits, taxes, wages and employment, each of which represents an economic contribution.

Location of expenditure

Adding to this complexity, recreational fishers are highly mobile, both in terms of where they fish, and in terms of where their fishing-related expenditure occurs. In many regions, a significant proportion of the economic activity generated by recreational fishing is a result of fishing trips by people who do not live there. Ideally, studies of the regional economic contribution of recreational fishing should capture all fishing-related expenditure that occurs in that region and exclude (or appropriately allocate) expenditure not directly undertaken in that region, regardless of where fishers reside and go fishing. Table 7.1 describes the types of spending ideally included and excluded when estimating regional economic contribution; in reality, it is not always possible to include all these aspects when estimating economic contribution.

Table 7.1 Inclusions and exclusions of different spending types in regional economic contribution analysis

Ideally included in regional estimates of economic contribution:	**Ideally excluded from regional estimates of economic contribution:**
On-trip expenditures • Spending within the region by locals while on local fishing trips (e.g., bait, fuel and takeaway food). • Spending within the region by people who do not reside in the region but who visit to go fishing (e.g., bait, fuel, accommodation and takeaway food purchased at the trip destination). Off-trip expenditures • Spending within the region by people who reside in the region, even if they do not fish in their local region (e.g., purchases from local tackle shops). • Spending by people who do not reside in the region, but spend at businesses in the region (e.g., online purchases from tackle shops).	On-trip expenditures • Spending outside the region by locals while on fishing trips to other regions (e.g., bait, fuel, accommodation and takeaway food purchased at the trip destination). • Spending outside the region by people who do not reside in the region but who visit to go fishing (e.g., bait, fuel and groceries purchased at home and brought to the trip destination). Off-trip expenditures • Spending outside the region by locals at businesses that are located outside the region (e.g., online purchases from tackle shops and international imports). • Spending outside the region by people who do not reside in the region, even if they visit the region to go fishing (e.g., purchases from tackle shops outside the region that are brought to the trip destination).

7.3.6 Collecting attributable expenditure data in a survey

To estimate the economic contribution of recreational fishing to the Australian economy, data were collected in the Stage 2 NRFS survey, as detailed in Chapter 3. This section builds from the information in Chapter 3 to provide more detail about the collection and treatment of data on expenditure, focusing on:

- Design of questions asking about expenditure on recreational fishing
- Number of valid survey responses achieved and weighting of expenditure data
- Using survey data to estimate expenditure on recreational fishing.

The economic contribution estimates presented here are for the 2018-19 financial year, as this was the period for which the majority of those completing the Stage 2 survey reported expenditure. A small proportion reported data for the 2019 calendar year, due to the length of time the survey was open. This means that the data can be considered representative of a typical 12 months of fishing occurring at some point between July 2018 and the end of 2019. Importantly, these data are for the period prior to COVID-19 and the 2019-20 bushfires, both of which impacted fishing activity. The estimates produced therefore do not include the effects of COVID-19 related lockdowns on fishing activity and expenditure.

Collecting data on fishing expenditure via surveys has several known challenges. This includes survey participants having difficulty recalling exact amounts spent over a given period of time on fishing activities, being unwilling to spend time answering often the complex questions required to underpin modelling of expenditure across regions, and the risk of strategic bias in which participants may deliberately overstate their expenditure in an attempt to inflate the value of recreational fishing (see Chapter 3 and Appendix 6.2 for detail on strategic bias). The design of survey questions needed to consider these challenges while collecting sufficiently precise data. The key considerations of collecting data on expenditure were to:

- Ensure expenditure was collected in categories designed to align with industry classifications used by the Australian Bureau of Statistics when generating national input-output tables showing flows of economic transactions between different parts of the economy. This was important as it enabled subsequent modelling of flow-on effects of expenditure on fishing through the broader Australian economy.
- Ask for levels of precision in responses that match typical ability to recall expenditure.
- Where a person was unlikely to be able to accurately estimate value of expenditure, ask for information that would allow that value to be independently estimated. In particular, many people drive a vehicle to and from fishing trips. This means that a proportion of spending on things such as car registration and insurance, fuel, repairs and maintenance can be attributed to fishing. However, it is unlikely that a person would be able to accurately estimate what proportion of total vehicle expenditure should be attributed to their recreational fishing trips versus to use of the vehicle for purposes other than fishing trips. What they are able to identify is the distance driven for fishing trips. This information can be combined with regularly used metrics on valuing car use per kilometre to estimate the value of expenditure on vehicle use.
- Enable questions to be answered where possible without requiring significant reference to a person's bank or other financial records of transactions. Many smaller expenditures are of the type that is difficult to identify in financial records even if there is an electronic record – for example, repeated purchases of ice or bait and berley. However, in pilot testing of different options, most fishers could readily calculate the amount spent in a year to a reasonable accuracy as they knew the typical price paid and how many times they had purchased these items.

Based on review of previous surveys collecting data on expenditure, for each type of expenditure, survey participants were asked about realistic categories identified that reflected the range of possible expenditure in a one-year period. For most types of expenditure, survey participants were asked to identify their activity over the 12 months prior to completing the survey. There was one exception: capital items, which tend to be purchased irregularly. Large capital items are often purchased only once every few years. Even with a large survey sample, it is possible a relatively small number of purchases made in the past 12 months will bias findings. Given this, to ensure the full range of purchasing by region was better recognised, survey participants were asked about their spending on large capital items over the past five years, and this value was then adjusted to an average figure for a single year when calculating 12-month expenditure.

Where previous studies and data on the capacity to recall expenditure suggested it was unlikely that a person would be able to accurately estimate precise dollars spent (and that asking them to do so may result in failure to provide any data due to lack of recall), participants were provided pre-set ranges of expenditure to select from, described in Appendix 6.3. These ranges were set based on review of the distribution of expenditure on different items in previous studies: for example, if a previous study identified that the majority of fishers spent less than $100 on an item, but that recall of the exact amount is likely to be poor, they were provided three to five categories under $100 to report on, and fewer categories above $100.

Initial questions on expenditure were pilot tested. Where pilot test participants indicated difficulty answering questions, questions were redesigned until a point was reached where most fishers participating in pilot tests indicated they were able to answer questions. In most cases, this required changing from a more specific question (such as 'what proportion of the spending on this trip can be attributed to fishing') to a more general question that better matches the extent to which an individual can estimate amount and attribution of expenditure (such as 'was the main purpose of this trip (i) fishing, (ii) an activity other than fishing, or (iii) 50/50 on fishing and other activities').

Questions about expenditure focused on household expenditure in all cases, rather than individual expenditure. Other sections of the survey identified how many fishing trips the individual completing the survey had in the past 12 months, the proportion of these trips undertaken with other members of their household, and the number of fishing trips other people in the household took without the person who completed the survey.

7.3.7 Calculating attributable expenditure

The Stage 2 survey sampled recreational fishers who had fished in the past 12 months, as well as those who had last fished more than 12 months ago, and also included a sample of those people who had never gone fishing. Estimates of the economic contribution of recreational fishing were based on expenditure on fishing in the past 12 months, by those who had gone fishing in the last 12 months. Those who had not fished in the past 12 months were not included (despite the fact some of these may have engaged in some expenditure on fishing) to ensure consistency with past studies.

In total, 10,547 respondents met these criteria. However, not all of these responses included sufficient detail of their expenditure on fishing to be analysed for purpose of modelling economic contribution. In total, 9,236 answered sufficient questions on expenditure to be included in the analysis. This means 88.4% of eligible survey respondents answered expenditure questions in sufficient detail to enable analysis. The question of whether the exclusion of the other 11.6% introduced bias was investigated by comparing the weights of those who did provide expenditure data with those who did not. No systematic biases were identified amongst the 11.6%. Average weights were similar for the 88.4% who provided sufficient expenditure data and the 11.6% who provided insufficient expenditure data, as was the distribution of the weighting variables (gender, age, household income, fishing avidity, state/territory, region etc). Given this, no modification was made to the weights used for the purposes of analysing expenditure.

The survey sample was weighted to represent the population using a two-step process. First, the sample was weighted using the method describes in Chapter 3. Second, a multiplier was applied to 'weight up' from the sample to the total estimated population of adult fishers in Australia. The average weight applied was 451, meaning that on average, the activity and spending by each survey respondent was multiplied by 451 to estimate the total activity of all recreational fishers in Australia. The average weight applied ranged from 135 in regional NT and 149 in Darwin – reflecting the relative over-sampling of the Northern Territory compared to its proportion of the Australian population – to a high of 802 in Perth and 604 in Sydney, reflecting the relative under-sampling of major metropolitan areas relative to their proportion of the Australian population. Overall, the weights were generally smaller in areas with smaller samples, and larger in areas in which a larger sample was achieved. This was intended: ideally, weights that are larger should be based on a larger sample, as this reduces the risk of amplifying errors resulting from a bias in the sample responses. Weights are presented by state in Appendix 6.4.

A particularly important part of estimation was ensuring there was no double counting of household spending. Survey participants reported household spending on fishing, but weights were based on individual adult fishers (as discussed in Chapter 3, insufficient household-scale benchmark data are available, meaning weights had to be generated for individuals, rather than households). To prevent double counting of expenditure it was necessary to adjust the household spending reported and attribute it to individual adults in that household. To ensure economic contribution estimates included all fishers, including those aged under 18, when doing this it was important to ensure spending on recreational fishing related to fishers aged under 18 was attributed to adult fishers in their household. Appendix 6.1 details the specific process used to adjust data on household expenditure and attribute it to individuals, which ensured no double counting of household expenditure when using benchmarks based on individual fishing activity.

As the survey did not always ask participants to estimate expenditure to the exact dollar, it was necessary to estimate expenditure based on survey responses. In some cases, values were imputed where sufficient information existed to do so. Key assumptions used to make imputations such as these are described in Table 7.2.

Table 7.2 Key assumptions made to estimate total expenditure on fishing

Survey data	**Method for estimating expenditure (including amount, attributable proportion, location)**
Data in ranges	Mid-point of range used
Data in ranges – top range where person provided value	Used exact value provided
Data in ranges – top range where person didn't provide value	Used specified value e.g., '$2000 or more (please specify)' = $2000 in estimates if person didn't specify the actual value
Kilometres travelled in vehicle for fishing trip	Travel cost of $0.68/km (ATO value for 2019-20)
How many vessels – how do we treat '5+'	Assume '5 or more' = 5
How much household spending is attributable to the individual?	Based on % fishing trips in the last year undertaken with other adults in their household. Note: resulted in an average of 81% household spending attributed to the individual.
Spending related to children	Attributed based on adults e.g., if 80% attributed to Adult 1 in household and 20% to Adult 2, spending on children attributed 80% to Adult 1, 20% to Adult 2.
Trip expenditure estimates where fishing was not the 'main purpose' of the trip	Assume 25% of expenditure relates to fishing i.e., assume that fishing was part of the purpose (applies to non-fishing specific expenditure occurring on trips only).
Imputation where insufficient information provided on expenditure location (or unsure)	Assume person is the same as the average for other people living in the same GCCSA region.
Include capital expenditure?	Yes - % attributable to fishing, based on the % of capital use associated with fishing. Spending over 5 years was divided by 5 to include the average spending in a 12-month period over the previous 5 years. Note that with other methods, depreciation of an asset over a period of time or the asset value may be used, and it would be appropriate to annualise the capital value by dividing by the expected life in years. However, the survey was designed to capture average annual real expenditures during the 5-year period, so the 5 year total expenditure was divided by 5.
Include spending on food, drink?	Yes % attributable to fishing included if fishing was the primary reason for the trip.
Include spending on accommodation?	Yes - when on overnight trips where fishing was the primary reason for the trip include total amount spent on accommodation.
How many adult fishers are there in Australia?	As concluded in Chapter 4, we identified it was most likely that between 18% and 22% of Australians fish at least once in a 12-month period. The midpoint of this range was used for expenditure estimates: 20% of the Australian population aged 18 and over implies 4,162,304 adult fishers in Australia.

7.4 Results

This section presents the findings of economic contribution analysis, using the indicators of economic activity and components of direct and flow-on economic contribution described previously in this chapter. The focus of the findings is on economic contribution to regions and flows of economic contribution between regions.

7.4.1 National contribution

Table 7.3 presents the national scale economic contribution results. In 2018-19, recreational fishing contributed an estimated 101,000 full-time equivalent jobs and $11.5 billion in GDP to the Australian economy, including a direct contribution of $3.4 billion to GDP and 40,000 full-time equivalent jobs, and a flow-on contribution of $8.1 billion to GDP and 61,000 full-time equivalent jobs. The $11.5 billion total contribution to GDP included a household income component of $7.1 billion, indicating that most of the contribution to GDP is received by Australian households as wages and salaries, supporting their livelihoods. The household income share of GDP is high compared to the national make-up of GDP (ABS 2022a) due to the service intensive nature of the industries that recreational fishers tend to spend into.

Table 7.3 Economic contribution, 2018-19, Australia

Effect	Gross Domestic Product ($m)	Household Income ($m)	Employment (full-time equivalent)
Direct	3,396	2,553	40,483
Flow-on	8,126	4,527	60,859
Production Induced	*2,840*	*1,782*	*22,486*
Consumption Induced	*5,286*	*2,746*	*38,373*
Total	**11,522**	**7,080**	**101,342**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.			

7.4.2 Regional contributions

The total economic contribution of recreational fishing to regions of Australia is presented in Table 7.4. Results presented in this table are the 'total' economic contribution (including direct and flow-on effects) of all recreational fishing expenditure in each region (independent of the region of residence and trip). The flow-on effects also include inter-regional flows in the broader economy such as business to business transactions and household expenditures across regional borders.

Regional economic contribution results are further broken down below into components of direct and flow-on effects for employment (Table 7.5) and gross regional product (

Table 7.6). The direct effects are associated with recreational fishing expenditure occurring directly within the region (regardless of the region of residence or trip) and the consumption induced and production induced flow-on effects are those occurring in each region regardless of the region of direct expenditure (they include inter-regional flow-on effects). For example, if a resident of Melbourne purchases tackle online from a shop in 'NSW – Regional' and the tackle shop employs people who spend some of their consumption expenditure in Sydney, the economic contribution results will show direct activity in 'NSW – Regional' (not Melbourne) and flow-on effects will likely occur in 'NSW – Regional', 'NSW – Sydney' and any other region affected by the operations of the tackle shop and its flow-on effects. While most direct economic contribution occurs outside of capital cities, the importance of capital cities in Australia's economy and its flow-on effects means that most of the total (direct + flow-on) contribution occurs in Australia's capital cities.

Table 7.4 Total economic contribution, 2018-19, by region

Region	Gross Regional Product ($m)	Household Income ($m)	Employment (full-time equivalent)
NSW – Sydney	2,410	1,482	18,428
NSW – Regional	1,469	967	14,065
Vic – Melbourne	1,660	982	13,595
Vic – Regional	606	382	6,142
Qld – Brisbane	1,039	643	9,025
Qld – Regional	1,476	914	14,577
SA – Adelaide	593	365	5,301
SA – Regional	392	244	4,133
WA – Perth	709	413	5,387
WA – Regional	437	263	3,993
Tas – Hobart	113	72	1,120
Tas – Regional	157	91	1,550
NT – Darwin	77	30	471
NT – Regional	193	107	2,052
ACT	190	125	1,502
National	**11,522**	**7,080**	**101,342**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.			

Table 7.5 Contribution to employment (full-time equivalent), 2018-19, by region

Region	Direct	Flow-on			**Total**
		Consumption Induced	*Production Induced*	Flow-on sub-total	
NSW – Sydney	4,422	*8,823*	*5,184*	14,007	**18,428**
NSW – Regional	7,227	*4,362*	*2,475*	6,837	**14,065**
Vic – Melbourne	3,156	*6,537*	*3,901*	10,438	**13,595**
Vic – Regional	3,241	*1,937*	*963*	2,900	**6,142**
Qld – Brisbane	3,152	*3,850*	*2,024*	5,874	**9,025**
Qld – Regional	6,990	*4,654*	*2,933*	7,587	**14,577**
SA – Adelaide	1,440	*2,505*	*1,355*	3,860	**5,301**
SA – Regional	2,608	*826*	*699*	1,525	**4,133**
WA – Perth	1,690	*2,416*	*1,281*	3,697	**5,387**
WA – Regional	2,823	*745*	*425*	1,170	**3,993**
Tas – Hobart	444	*451*	*225*	676	**1,120**
Tas – Regional	781	*397*	*372*	769	**1,550**
NT – Darwin	138	*172*	*162*	334	**471**
NT – Regional	1,640	*255*	*157*	412	**2,052**
ACT	729	*443*	*330*	773	**1,502**
National	**40,483**	***38,373***	***22,486***	**60,859**	**101,342**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.					

Table 7.6 Contribution to Gross Regional Production, 2018-19, by region ($m)

Region	Direct	Flow-on			**Total**
		Consumption Induced	*Production Induced*	Flow-on sub-total	
NSW – Sydney	392	*1,323*	*696*	2,019	**2,410**
NSW – Regional	601	*580*	*288*	868	**1,469**
Vic – Melbourne	281	*888*	*491*	1,379	**1,660**
Vic – Regional	258	*243*	*105*	348	**606**
Qld – Brisbane	272	*503*	*265*	768	**1,039**
Qld – Regional	554	*594*	*328*	922	**1,476**
SA – Adelaide	120	*316*	*157*	473	**593**
SA – Regional	201	*112*	*79*	191	**392**
WA – Perth	161	*352*	*196*	548	**709**
WA – Regional	249	*121*	*67*	188	**437**
Tas – Hobart	34	*54*	*25*	79	**113**
Tas – Regional	56	*56*	*46*	102	**157**
NT – Darwin	12	*30*	*35*	65	**77**
NT – Regional	132	*41*	*20*	61	**193**
ACT	76	*73*	*42*	115	**190**
National	**3,396**	***5,286***	***2,840***	**8,126**	**11,522**
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.					

7.4.3 Inter-regional flows

The results presented in Section 7.4.2 are the product of within-region and inter-regional direct and flow-on effects, such as spending by recreational fishers in regions where they do not necessarily live or fish in and spending into other regions by businesses who supply recreational fishers with goods and services. This section examines these inter-regional effects.

Contribution of recreational fishers who are usual residents of a capital city

Despite a higher proportion of rural Australians participating in fishing than urban Australians, the concentration of Australia's population in large cities means that most recreational fishers in Australia live in capital cities. Many urban residents travel to fish in places other than the city they live in, often regional and rural areas, resulting in a substantial amount of recreational fishing activity taking place in locations other than major cities. This suggests a significant contribution to regional Australia by recreational fishing activities of capital city residents. Recreational fishers who live in capital cities are responsible for 59% of the total economic contribution of recreational fishing to Australia. Table 7.7 presents the total economic contribution (direct and flow-on) of recreational fishing expenditure by capital city residents to urban and regional areas of Australia. The component of direct expenditure made in regional areas by urban residents leads to direct and flow-on economic contribution within those regional areas (regional areas subtotal in Table 7.7). Additionally, the expenditure also leads to flow-on economic effects in capital cities through inter-regional flow-on effects as many regional businesses have capital city-based suppliers and regional households spend some of their income in capital cities (urban areas subtotal in Table 7.7).

Table 7.7 Total economic contribution of recreational fishers who are usual residents of a capital city, 2018-19, by region in which contribution occurred

Region	Gross Regional Product ($m)	Household Income ($m)	Employment (full-time equivalent)
NSW – Sydney	1,684	1,055	13,428
NSW – Regional	639	414	6,036
Vic – Melbourne	1,191	715	10,043
Vic – Regional	312	194	3,113
Qld – Brisbane	768	481	6,888
Qld – Regional	489	287	4,598
SA – Adelaide	435	271	3,999
SA – Regional	209	128	2,160
WA – Perth	516	304	4,039
WA – Regional	185	108	1,699
Tas – Hobart	93	60	930
Tas – Regional	68	37	617
NT – Darwin	36	13	210
NT – Regional	42	19	397
ACT	158	105	1,266
National	**6,825**	**4,189**	**59,421**
Urban areas (capital cities) subtotal	***4,881***	***3,004***	***40,802***
Regional areas (rest of states) subtotal	***1,944***	***1,185***	***18,619***
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.			

Detailed inter-regional contribution

Describing in detail the inter-regional flows of economic contribution is difficult as there are many dimensions to consider. Table 7.8 simplifies the dimensions down to total full-time equivalent employment (direct and flow-on) across all industries to illustrate inter-regional flows. This table includes both capital city and regionally based residents and summarises the employment using a heat map. Each row of the table represents the resident population of a region and each column represents the contribution of that resident population to each regional economy. For example, the top row shows the total employment contribution of Sydney residents to each region of Australia. As expected, the largest contribution is usually within the region of residence (the diagonal elements of the table) as most direct expenditure occurs locally. The off-diagonal cells in the table show the economic contribution results from inter-regional direct expenditures and inter-regional flow-on effects. The second most significant contribution for each region is usually the other region within the same state (either the greater capital city or the regional area).

7.4.4 Contribution of different types of expenditure

Error! Reference source not found.7.9 breaks down economic contribution by type of expenditure. The findings show that of the total estimated GDP, $3.3 billion (28%) is related to expenditure on fishing gear and tackle, $2.5 billion (21%) to overnight fishing trips, $2.2 billion (20%) to vessel costs other than capital expenditure (e.g. running costs, registration, maintenance, mooring fees), $1.9 billion (16%) is related to capital expenditure, and $1.7 billion (15%) to day trip travel-related expenditure. This implies that of the expenditure types, expenditure on fishing gear and tackle by recreational fishers generates the largest contribution to the economy, while day trip travel-related activity generates the smallest contribution.

Table 7.8 Flow of contribution to employment from regions of residence to regions of economic contribution, total contribution to employment (full-time equivalent jobs), 2018-19

	Region of contribution (contributed employment of ___ to…)														
Region of residence (fishers who live in…)	NSW – Sydney	NSW – Regional	Vic – Melbourne	Vic – Regional	Qld – Brisbane	Qld – Regional	SA – Adelaide	SA – Regional	WA – Perth	WA – Regional	Tas – Hobart	Tas – Regional	NT – Darwin	NT – Regional	ACT
NSW – Sydney	9Ti649	3060	847	303	419	888	155	111	309	100	63	109	59	224	121
NSW – Regional	3107	6536	436	221	199	501	83	53	145	99	30	47	25	81	87
Vic – Melbourne	1114	791	7120	2088	300	358	169	99	385	163	286	90	29	75	310
Vic – Regional	365	391	1593	2269	89	133	119	180	105	26	12	42	27	14	31
Qld – Brisbane	797	544	667	219	5663	2756	130	50	244	54	23	38	17	12	47
Qld – Regional	781	672	703	263	1613	8856	130	63	227	123	21	63	25	29	56
SA – Adelaide	438	145	422	175	198	170	3284	1709	166	52	16	39	13	15	30
SA – Regional	149	58	180	92	54	85	847	1621	53	13	4	6	8	8	11
WA – Perth	628	274	657	167	188	203	174	147	2815	1271	20	38	20	33	64
WA – Regional	301	153	318	92	90	166	60	29	722	1990	8	20	12	12	23
Tas – Hobart	78	53	64	19	24	57	16	8	22	6	491	267	3	2	5
Tas – Regional	83	71	85	24	26	80	17	6	24	11	111	743	4	2	6
NT – Darwin	17	6	20	4	5	5	3	1	9	16	0	0	53	10	2
NT – Regional	214	147	236	68	66	159	44	21	73	32	5	12	160	1509	22
ACT	705	1164	247	138	91	160	67	35	88	38	30	35	17	25	687
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects															

Table 7.9 Economic contribution associated with each type of expenditure

Estimate	Capital expenditure	Day trip travel-related activity	Fishing gear and tackle	Overnight travel	Vessel costs only (does not include capital expenditure)
GDP ($m) – direct	548	451	1,007	707	683
GDP ($m) – flow-on	1,314	1,267	2,279	1,740	1,527
GDP ($m) – total	1,862	1,718	3,287	2,447	2,209
Employment (full-time equivalent) – direct	6,506	4,990	11,324	9,062	8,602
Employment (full-time equivalent) – flow-on	9,845	9,555	16,849	13,239	11,371
Employment (full-time equivalent) – total	16,351	14,545	28,173	22,301	19,973
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.					

7.4.5 Sensitivity analysis

The sensitivity of the findings to changes in the weighting of survey data was tested. Table 7.10 summarises the findings, with detailed tables of data provided in Appendix 6.5. Activity associated with capital expenditure comprised 16% of the total estimated contribution of recreational fishing (Table 7.9). If capital expenditure is excluded, this reduces the estimate of the total economic contribution to $9.6 billion (direct plus flow-on) and just under 85,000 jobs.

Changing assumptions regarding the proportion of expenditure on multi-activity trips that include fishing makes a relatively small difference to overall estimates. Excluding expenditure on fishing by those whose day trips were not primarily for the purpose of fishing, and reducing the proportion of expenditure attributed to fishing for those for whom 'some but not all' fishing trips were primarily undertaken to fish, reduces estimated economic contribution by approximately 2.5%.

Overall, changing weighting assumptions to the *lowest* possible reduced estimates of economic contribution by 14% while at the *highest* weighting, estimates increased 7%. The greatest effect results from changes in the proportion of Australians estimated to go fishing: for every 1% in the estimated size of the group of Australian recreational fishers, estimates of contribution to GDP, household income and employment change by 1%. Changes in other weighting criteria contribute much less to overall change in estimates of economic contribution.

Table 7.10 Key findings – sensitivity analysis

Estimate	Base case	Case 1: Capital expenditure excluded	Case 2: Alternative attribution of travel costs for multi-activity trips[1]	Case 3: Alternative weights (low)	Case 4: Alternative weights (high)
GDP ($m) – direct	3,396	2,848	3,316	2,907	3,649
GDP ($m) – flow-on	8,126	6,813	7,922	6,965	8,718
GDP ($m) – total	11,522	9,661	11,238	9,872	12,367
Employment (full-time equivalent) – direct	40,483	33,977	39,511	34,655	43,483
Employment (full-time equivalent) – flow-on	60,859	51,014	59,308	52,262	65,173
Employment (full-time equivalent) – total	101,342	84,991	98,818	86,917	108,655

[1] These figures are based on a more conservative estimate of the proportion of a multi-purpose trip that can be attributed to recreational fishing: in this alternative, trips undertaken entirely for recreational fishing are attributed 100% to recreational fishing (identical to the base case), however only 50% of the expenditure of those who reported 'some' trips in which fishing was undertaken were primarily undertaken for fishing, and 0% of the expenditure for those who reported none of their fishing trips were primarily undertaken for purposes of fishing, are included.
Refer to Box 7.1 and Box 7.2 for definitions of indicators and types of flow-on effects.

7.5 Comparison to other studies

This section discusses how the findings of this study compare to other studies and identifies the extent to which comparison is possible and appropriate. Comparisons are made to other studies on recreational fishing, studies on other recreational activities, and a recent study on commercial fishing. In each case, comparisons must consider geographic scope, scope of activities, which indicators were used (and how they were defined), and limitations of the modelling methods used.

Care should also be taken regarding the purpose of comparisons. Comparing the contributions of two different activities is useful for benchmarking, or understanding the relative size of the economic contribution being studied.

Sometimes however, those seeking to compare activities assume that the activities are in some way substitutable – that a decrease in economic contribution on one activity will enable an increase in another. This is a false assumption. For example, assuming recreational and commercial fishing are not mutually exclusive activities for which the economic contribution of one is substitutable for the other. This is because while both sectors rely on the activity of fishing to generate economic contribution, the way each does this is different.

Further, even if the two activities were substitutable, economic contribution is not an appropriate method for estimating the effect of substituting between them. Economic contribution describes the existing level of economic activity, not the effect of change in activity that would occur by re-allocating a fisheries resource, which can be very different (Section 7.2).

7.5.1 Comparison to other studies on recreational fishing

The estimates produced in this study are not directly comparable to any previous Australian study. This is due to the nation-wide focus of this study, which enabled analysis of flows of expenditure across all Australian regions, and the estimation of economic contribution, which has not previously been undertaken at the national level.

This section reviews key Australian studies that have estimated economic contribution of fishing, examining their scope and the types of measures used. It also reviews studies that collected expenditure information as, while not an indicator of economic contribution, they provide useful context. As this chapter focuses on economic contribution analysis, only those recreational fishing studies that have produced data relevant to understanding or measuring economic contribution are reviewed in this section. Studies that estimate economic value, using methods such as willingness to pay, travel cost, contingent valuation, choice modelling and others, are not reviewed.

Between 2000 and 2021, several major studies have produced measures relevant to understanding the economic contribution of recreational fishing in Australia or specific States/Territories of Australia. All of these produced measures of expenditure which, while not itself a measure of economic contribution, is one of the key elements required to conduct economic contribution analysis. Around half produced estimates of economic contribution.

Of the studies that have produced expenditure estimates (and in some cases, assessment of economic contribution), two produced Australia-wide estimates: the NRIFS (Henry and Lyle 2003), and the current study (the second NRFS conducted in Australia). All others produced estimates for individual States or Territories within Australia. In addition to these, several other studies have produced estimates for either specific recreational fisheries, recreational species, and/or specific regions within a State or Territory. Appendix 6.6 summarises previous studies that have produced estimates of expenditure on recreational fishing, and in some cases the economic contribution of recreational fishing, that either examined all of Australia, or all of a State or Territory.

As noted above, around half of the studies reviewed that produced data on direct expenditure on recreational fishing then used this data to estimate economic contribution. In most cases, expenditure data was collected as part of a larger study estimating recreational fishing catch and effort in a specific State/Territory (e.g., West et al. 2012; Lyle et al. 2014, 2019; DPI NSW 2020). Estimating economic contribution was not the main purpose of most of these studies. Not all catch and effort studies have been able to collect data on expenditure, as doing so requires investing additional resources beyond those required for estimating catch and effort[17]. The limited data that are available from past studies therefore often reflect the fact that data on fishing expenditure has primarily been collected when opportunities were present to do so as part of catch and effort surveys, with resources not available to then use this data to support economic contribution analysis.

In addition to the collection of expenditure data as part of catch and effort studies whose primary purpose was not estimating economic contribution, a smaller number of studies have

[17] Expenditure data was not collected in State/Territory studies of catch and effort conducted in South Australia in 2007-08 and 2013-14 (Jones 2009, Giri and Hall 2015), in Tasmania in 2007-08 (Lyle et al. 2009), in Queensland in 2010 and 2013-14 (Taylor et al. 2012, Webley et al. 2015), and in the NSW/ACT in 2013-14 (West et al. 2015).

modelled the economic contribution of recreational fishing. In Victoria, three studies have been conducted specifically to estimate the economic contribution of recreational fishing (Ernst and Young 2009, 2015, 2020). In NSW a study in 2012 sought to update data collected some years previously to produce up-to-date economic contribution estimates (McIlgorm and Pepperell 2013). A 2018 WA study did not produce the measures of economic contribution examined in this chapter, but did examine how to use data on expenditure to produce alternative measures of the contribution of recreational fishing in the absence of sufficient resources to conduct full economic contribution analysis (McLeod and Lindner 2018).

In this study (the NRFS), the economic contribution estimated in any given state or territory includes activity generated by (i) residents of that state who are fishing within the state, (ii) those living in other states who spend some money on recreational fishing in that state, and (iii) visitors who spend time and money fishing in that state. While some economic contribution studies at the state or territory level have been published, the national scope of this study captures a larger volume of economic contribution to any particular region than is possible in most state or territory-based studies. Regional economic contribution patterns are also likely to be different in the present study compared to previous studies due to the assignment of location of expenditure. For example, in the present study, economic contribution in NSW is particularly high due to surveyed fishers from all over Australia indicating that much of their spending on things such as fishing gear was at businesses located in NSW.

The results of previous economic contribution studies cannot be directly compared to the findings of this study as different studies are varied in their timing, location and scope. This makes it difficult to accurately compare and measure economic contribution over time. However, within some States/Territories, consistent methods have been used more than once over time to estimate total value of expenditure on fishing, and this does provide some ability to identify likely patterns of change over time.

Appendix 6.6 reviews previous studies that have either (i) collected data on expenditure on recreational fishing and/or (ii) estimated economic contribution of fishing. Overall, the available evidence suggests it is highly likely that real expenditure on recreational fishing has grown in the past 20 years in Australia, although this may not be the case in every jurisdiction and there is some variability in measurement of expenditure across different studies that reduces comparability. The available evidence is reasonably consistent in suggesting that this growth in reported expenditure is likely to be predominantly a result of an increase in the amount a typical fisher reports spending on recreational fishing, rather than from an increase in the number of people fishing or days spent fishing.

7.5.2 Comparison to sports and outdoor recreation

In Australia there is growing investment in measuring the economic contribution made by outdoor recreational activities such as fishing, as well as by sporting activities more generally. However, the studies produced in this area are often not comparable, as the scope and type of activities they include varies substantially. To identify whether it was possible to compare the estimates in this chapter to other studies, we examined two types of study:

- Studies that have estimated the economic contribution of a number of activities that include recreational fishing
- Studies that have estimated economic contribution of activities other than recreational fishing, using economic contribution analysis methods that have some comparability to those used in this study.

Economic contribution studies examining multiple recreation/sporting activities

A small number of Australian economic contribution studies have examined groups of recreational or sporting activities that include recreational fishing, as have a small number of international studies. Theoretically, these studies might provide an understanding of the total contribution of a range of activities, and of the relative contribution of recreational fishing compared to other activities.

However, these studies have used highly restrictive definitions and measures of recreational fishing that are not comparable to the definition used in this study. For example, KPMG (2020) estimated that the Australian sports industry contributed $14.4 billion and 128,000 full-time equivalent jobs to the Australian economy in 2016-17. While recreational fishing was one of the sports included in the study, it was only included if the recreational fishing involved significant physical exertion. Other recreational fishing, including fishing involving low to moderate physical exertion was excluded. This means the findings are not able to be compared to those from the present study, and do not provide a useful understanding of the relative contribution of recreational fishing compared to a range of sports activities.

In 2018, a study Marsden Jacobs and Associates (2018) (MJA study) examined the economic contribution of a range of outdoor recreational activities in Australia, of which one was recreational fishing. This nationwide study estimated that outdoor recreation contributed $11 billion to Australia's economy as of 2018, or approximately 1% of Australia's GDP, and employed between 16,000 and 30,000 people nationally. Our study estimates the economic contribution of recreational fishing alone as being $3.4 billion directly and $11.5 billion when both direct and flow-on effects are considered. If the two studies were comparable, this would suggest recreational fishing is a significant contributor to overall outdoor recreational economic contribution (and it likely is). However, the two studies are not comparable, as the MJA study based its estimates of recreational fishing activity on data from the Australian Bureau of Statistics *Participation in Sport and Physical Recreation* surveys conducted between 2009 and 2014 – the best available source of data for many outdoor recreational activities, but not for recreational fishing. As noted in Appendix 3, this survey (most recently conducted as the AusPlay survey) substantially under-estimates total Australian participation in fishing. This means that it is highly likely the MJA report significantly underestimates the contribution of recreational fishing as part of outdoor recreational activity. For example, in NSW MJA estimated that the amount of time spent fishing by NSW residents was only twice the amount of time spent on ice and snow sports – something that other studies suggest is a significant underestimate for fishing, which is much more frequently participated in than snow or ski sports (see Chapter 4). Our findings therefore cannot be directly compared to the MJA findings.

Other studies examining outdoor recreation in Australia have similar comparison issues, due to largely relying on data from the AusPlay survey or similar surveys that substantially under-represent participation in recreational fishing. For example, Synergies Economic Consulting (2012) estimated that outdoor recreation contributed at least $2 billion to the economy of Queensland in 2011, but noted that the estimates of participation in fishing used were likely to be a significant underestimate.

Internationally, one study was identified that compared recreational fishing to other activities using a definition similar to that used in this study (Highfill and Franks 2019). In the United States, outdoor recreational activities were estimated to contribute 2.2% of all economic activity in the country between 2012-16, similar in size to the mining and utilities industries (Highfill and Franks 2019). Boating and fishing were the largest contributors to this of any outdoor activities, representing $38.2 billion of economic output, followed by outdoor games such as tennis and golf ($36.3 billion) and recreational vehicle driving ($30.8 billion). This suggests that, when measured using a definition that captures the activity appropriately, recreational fishing is a significant contributor to the overall value of outdoor recreation.

Economic contribution studies examining activities other than fishing

The literature was reviewed to identify economic contribution studies conducted since 2010, that had identified the economic contribution of outdoor recreational activities other than recreational fishing using a methodology similar to that used in this report. In total, four studies were identified that had a reasonable degree of comparability, defined as using a similar modelling approach, examining a national scale, including both direct and flow-on effects, and having a similar approach to attributing expenditure to the activity being studied. However, these studies are not fully comparable to the NRFS, with all using slightly different modelling assumptions and processes (despite being based on a common underlying modelling approach). This means the comparisons made below should be considered qualitative comparisons only, that are likely to provide useful insight into whether recreational fishing is likely to have a larger or smaller economic contribution compared to another activity, but not to estimate the exact difference in level of economic contribution.

Our results suggest that recreational fishing makes a larger contribution to economic activity compared to cycling, recreational hunting and sports shooting, snow sports, mountain biking, and equestrian activities, with the $11.5 billion contribution (direct and flow-on) being higher than:

- $8.5 billion and 34,295 jobs contributed by cycling in 2020 (including both road riding and mountain biking), with an estimated 5.8 million Australians participating in cycling (AusCycling 2021)
- $335 million and 3,300 jobs contributed by recreational hunting and sports shooting as of 2018, with an estimated 642,364 Australians participating in recreational hunting and sport shooting (RMCG 2019)
- $1.822 billion contributed by snow sports in 2012 (Alpine Resorts Coordinating Council 2013)
- $1.413 billion and 6,095 jobs contributed by mountain biking in Australia as of 2020, based on an estimate of 341,900 mountain biking participants across Australia (AusCycling 2021)
- $1.135 billion contributed by equestrian activities (excluding all codes of horse racing, polo, rodeo, western and tent pegging) as of 2016 (Equestrian Australia 2017)

The larger participation base of recreational fishing compared to many of these outdoor activities (with the exception of cycling) is likely to be the principal reason for its relatively larger contribution to economic activity compared to the outdoor activities listed above: a larger number of Australians participate in recreational fishing in any given year than in hunting and shooting, snow sports, mountain biking, or equestrian activities. While cycling is participated in by a large number of Australians, average expenditure per year on cycling ($990) is typically less than that on recreational fishing (the NRFS identified average expenditure of $3,049 per fisher in 2018-19). The higher average spending on fishing compared to cycling is likely to reflect that fishers are more likely than cyclists to spend on travel, accommodation and other trip-related costs, and on boat-related costs, resulting in a higher average spend per participant.

7.5.3 Comparing economic contribution of commercial fishing and recreational fishing

Estimates of the economic contribution of commercial fishing to Australia and its states and territories were published in 2019 (FRDC project 2017-210) (BDO EconSearch 2019). The results of the commercial fishing study can be compared, to a limited degree, to those of recreational fishing as the same modelling framework was used. Both analyses used multi-region input-output models developed by BDO EconSearch, both converted expenditures from purchasers' prices to basic prices (expenditure to output) using a comparable method and data, and both presented comparable indicators of economic activity and components of direct and

flow-on expenditure. It is important to note that data collection in the commercial fishing study was much more limited, meaning that the accuracy of some of the estimates produced may be lower.

The results of the National Fisheries and Aquaculture Industry Contributions Study for the 2017-18 financial year estimated that Australia's commercial fishing and associated processing industries contributed $3.2 billion total gross value added (a similar indicator to GDP) and over 24,000 full-time equivalent jobs to the national economy. However, the scope of the commercial fishing study was more conservative than the recreational fishing study, and the estimates produced would be considerably higher if the scope of included activities was defined more broadly, as it was in the present study. The scope was defined more narrowly due to the difficulty assessing value along the supply-chain after seafood has been produced by a fishing or aquaculture business. Table 7.11 describes the key inclusions and exclusions of the scopes of each study.

Table 7.11 Scope differences between the economic contribution of commercial fishing and recreational fishing

Recreational Fishing Study Scope	Commercial Fishing Study Scope
• Includes all expenditure associated with recreational fishing at any business within Australia and associated flow-on effects.	• Includes fishing activity and estimated processing activity and associated flow-on effects. • Excludes retail, wholesale/distribution/marketing, exporters, transport, food service, boat building and seafood tourism.

As noted at the start of this section, economic contribution analysis does not provide insight into how the economic contribution generated would change if access to a fisheries resource was reallocated from one sector to the other. Consequently, economic contribution analysis is not the right form of economic measurement to compare the commercial and recreational fishing sectors, and it is therefore not appropriate to make inferences about change from this comparison. Given these issues, while it is possible use the two studies to identify the economic contribution of each sector, differences in the unique context of each study should be cautiously considered when making a comparison.

7.6 Conclusions

This chapter examined the economic contribution recreational fishing made to the Australian economy and to the economy of each state and territory, in 2018-19. The analysis found that, in 2018-19, recreational fishing contributed over 100,000 full-time equivalent jobs across Australia, including 40,000 direct jobs and 61,000 flow-on jobs. By state, this included 32,000 jobs in NSW, 24,000 in Queensland, and 20,000 in Victoria. A significant proportion of this employment is generated in rural and regional areas, including 62.5% of the direct employment, and 46% of direct plus flow-on jobs. This highlights the important contribution of recreational fishing to Australia's regional economies.

In 2018-19, recreational fishing contributed $11.5 billion to the Gross Domestic Product (GDP) of the Australian economy, including a direct contribution of $3.4 billion to GDP and a flow-on contribution of $8.1 billion. Fishers living in Australia's capital cities were responsible for 59% of the economic contribution of recreational fishing in 2018-19, and fishers living in other areas were responsible for 41%.

Our results suggest that recreational fishing is likely to make a larger contribution to economic activity compared to several other outdoor activities/sports, such as cycling, recreational hunting and sports shooting, and equestrian activities.

A review of previous studies on fishing found that relatively few studies have modelled economic contribution, and none previously at a national level. The only data available that have some comparability over time are data on expenditure on fishing, which is not an indicator of economic contribution, but an important input for modelling it.

The estimates produced in this study demonstrate the utility of conducting nationwide studies. Given that many fishers cross state and territory borders to go fishing, a national study is better able to capture flows of economic activity across state and territory borders when compared to studies conducted in individual states and territories. The capacity of this study to capture all inter-regional flows allowed the full economic contribution of fishing to be estimated nationally, which has not been achieved previously. This resulted in a higher estimate of economic contribution than has typically been found in individual state and territory studies that do not have the capacity to capture all inter-regional flows of economic activity.

There are several limitations to the estimates produced in this chapter. Notably, they are highly sensitive to change in the proportion of Australians estimated to participate in fishing. As described in Chapter 12, more regular collection of data would allow for these estimates to be updated in the future. As noted, the estimates are based on self-reported expenditure, which relies on the accuracy of recall of survey participants regarding their expenditure. In future, investigation of the potential to include some objective data on expenditure in key categories may provide opportunity to ‘fact check’ the accuracy of this recall, and this could be explored in future studies.

8.0 Physical activity and recreational fishing

Chapter authors: Gavin Hinten and Jacki Schirmer

8.1 Key points

- This study found that in a typical fishing trip of three hours an average of about 100 minutes of moderate physical activity was undertaken. This is more than half of the weekly minimum recommended amount of physical activity for an adult aged 18 to 64 (if fishing is undertaken weekly).
- Shore-based fishers were estimated to exert slightly higher levels of physical activity than boat-based fishers, and male fishers tended to be more physically active than female fishers.
- Given that most recreational fishers fish less than five days a year, fishing represents only a small fraction of the weekly minimum recommended amount of physical activity for most fishers.
- However, fishing contributes over half the recommended annual level of physical activity amongst avid fishers who fish 30 times a year or more. Avid fishers are also less likely to engage in other physical activities; as such, fishing is likely to be a relatively important contributor to achieving minimum recommended physical activity levels amongst this group.
- Fishing may also be a particularly important contributor to the physical activity levels of recreational fishers over 65 years old, as this group is less likely to take part in a range of physically active forms of recreation.

8.2 Introduction

This chapter examines whether and under what circumstances recreational fishing is associated with levels of physical activity that make a significant contribution to the health and wellbeing of fishers. 'Physical activity' is any bodily movement produced by skeletal muscles that requires energy expenditure (WHO 2010). A physically active life promotes both physical and mental health, improving wellbeing and quality of life. Engaging in regular physical activity is critical for maintaining health and wellbeing and is associated with a lower risk of a wide range of physical and mental health conditions through the life span (AIHW 2018).

Engaging in physical activity has a profound impact on a person's health and wellbeing, which has been examined in a large volume of studies. Sabe et al. (2022) identified more than 55,000 studies on the subject of the association between physical activity and different aspects of health and wellbeing, undertaken between 1905 and 2021. This large body of work shows that:

> Physical activity can be considered as medicine and has been used in both the treatment and prevention of a variety of chronic conditions. … Physical activity, and its structured form of exercise, seem to affect the brain and mind, beyond physical health, both as a factor association with poor mental health and quality of life and as a treatment for mental disorders. Indeed, exercise has shown to be efficacious in a number of mental disorders… (Sabe et al. 2022, p. 2).

The minimum level of physical activity sufficient to maintain health and wellbeing varies across the life span. Australia's *Physical Activity and Sedentary Behaviour Guidelines* recommend Australian adults aged 18-64 should accumulate a minimum of 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity each week, ideally including five activity sessions; while older Australians, aged 65 years and older, should accumulate at least 30 minutes of moderate intensity physical activity on most, preferably all, days (Department of Health, 2021).

A significant proportion of Australian adults do not engage in this minimum level of physical activity, and are likely to have poorer health and wellbeing as a consequence. The 2018 *Australia's Health* assessment found that more than half (55%) of adult Australians do not meet physical activity guidelines and almost half (44%) of working-age Australian adults spend much of their workday sitting (AIHW 2018). The Australian Bureau of Statistics found in its 2017-18 *National Health Survey* that just 15% of Australians aged 18-64 and 17.2% of Australians aged 65 years or older met physical activity guidelines (Australian Bureau of Statistics, 2020).

Given the demonstrated importance of physical activity in influencing a person's physical and mental health, and their overall quality of life/wellbeing, it is useful to examine whether recreational fishing can contribute meaningfully to physical activity. In particular, it is useful to examine the extent to which a person's fishing may contribute to them meeting the recommended levels of physical activity. The contribution of fishing to the recommended levels will vary depending on how often a person goes fishing, and the types of activities they do when fishing. For example, a person who goes spear fishing or fishes while kayaking will likely engage in more physical activity compared to a person who mostly fishes from a jetty with their car parked nearby.

This chapter examines the extent to which recreational fishing contributes to physical activity, and through this, to achieving the health and wellbeing benefits of a physically active lifestyle, through:

1) Examining how much physical activity is achieved while fishing
2) Identifying the extent to which this physical activity contributes to meeting *Australia's Physical Activity and Sedentary Behaviour Guidelines* and
3) Given the relative importance of fishing versus other recreational activities, discusses the likely role recreational fishing plays in achieving physical activity targets for different life stages and different types of fishers.

8.3 Methods

The analysis presented in this chapter used data collected in Stage 2 of the NRFS (see Chapter 3 for a detailed description of the data collection methods). As part of the Stage 2 survey, recreational fishers who had gone fishing within the past 12 months were asked how much time they typically spent undertaking activities at various levels of intensity during a three-hour period of fishing, using a modified version of the physical activity measures recommended by AIHW (2003).

To assess the potential physical activity benefits from recreational fishing, the amount of time spent fishing within the past 12 months was assessed. This information was then used to identify the extent to which this activity contributed to meeting the minimum recommended physical activity levels prescribed by AIHW (2003).

A total of 10,547 Stage 2 survey respondents recorded their level of participation in recreational fishing in the past 12 months. The sample that completed these questions included those for which weights were developed to enable analysis that is representative of Australian adult recreational fishers (Chapter 3), with very little missing data. Given this, all findings presented in this chapter have been weighted to be representative of Australia's adult recreational fishers, using the weighting protocol described in Chapter 3.

To better understand whether physical activity preferences align with certain lifestyle choices, we undertook an exploratory factor analysis (EFA) of physical activity preferences. EFA is a statistical technique used to identify whether a number of different survey measures can be combined to form a scale that measures an underlying factor – in this case, types of lifestyles. Principal Axis Factor (PAF) analysis with direct oblimin rotation was conducted to assess the underlying factor structures of the physical activity preference data. Oblimin rotation allows for correlation between factors (see Yong and Pierce 2013 for a discussion of EFA design,

including the use of different forms of rotation). Prior to performing PAF, the suitability of the data for factor analysis were assessed. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.91 for the physical activity preference data (values above 0.6 are considered as evidence of suitability for factor analysis (Kaiser and Rice, 1974) and Bartlett's test for sphericity was rejected ($\chi 2 = 5529$, d.f. = 153, $p = 0.000$). Additionally, post-extraction communalities were above 0.3 for all variables, except clothes shopping (0.27) and fishing (0.13). Together these results suggest the physical activity data was suitable for factor analysis. The Direct Oblimin method was used for oblique (nonorthogonal) rotation since it is most appropriate for any factor with correlation scores above 0.3, as was the case with this data. Eigenvalues higher than one were used as a cut-off to determine the number of factors extracted and a variable was retained if its regression coefficient was 0.3 or above after rotation.

Microsoft Excel and the Statistical Package for Social Sciences (SPSS) Version 26 were used for all data analyses.

8.4 How much physical activity is involved in going fishing?

Recreational fishing can be undertaken in a variety of ways –from shore; from a boat, canoe or kayak; or underwater such as in spearfishing. The level of physical activity associated with different types of fishing can range from relatively sedentary to highly active. As a first step to understanding the relative health benefits of physical activity associated with recreational fishing, the level of physical activity typically associated with different types of fishing was identified.

Survey participants were asked to think about their *most common* and *second most common* types of fishing. This was done as many recreational fishers engage in multiple types of fishing. It was not realistic to ask them to identify the exact physical activity involved in every type of fishing, so instead they were asked how much physical activity would typically occur during three hours spent doing their most and second most common fishing activities. They were asked how much of these three hours would typically be spent:

- Sitting, or equivalent (sedentary activity)
- Standing, squatting or equivalent (light physical activity)
- Walking or paddling with moderate effort, or equivalent (moderate activity)
- Walking or paddling briskly, or equivalent (vigorous activity)

These categories were designed based on the categories recommended for measurement in the Physical Activity Guidelines produced by AIHW (2003). These measurements have been validated in past surveys, which have confirmed their suitability for measuring physical activity levels based on participant recall in a survey (AIHW 2003). They are used to classify physical activity into four categories that correspond to their level of intensity, with the level of impact the activity has on breathing or heart rate used as a rough guide to its intensity:

- *sedentary activity* - being inactive, either sitting or lying down for long periods (except when sleeping).
- *light activity* – such as gentle walking, doing light work around the house or, getting dressed or stretching; breathing rate may be slightly increased compared to resting.
- *moderate activity* – where the person is putting in some effort, but it is not strenuous, such as moderately active bike riding or going for a brisk walk. Moderate activity will make you breathe somewhat harder than normal and slightly increase heart rate
- *vigorous activity* – where you are out of breath and sweating, such as jogging, star jumping or doing sit ups. Vigorous activity will make you breathe much harder than normal and have a greater effect on heart rate.

The amount of time spent in each activity is then transformed into a calculation of the 'moderate activity equivalent'[18]. This figure is used to identify what proportion of the recommended daily physical activity is being achieved. Preliminary analyses revealed no significant differences between the most common and second most common types of fishing. As such, only the most common type of fishing was examined in subsequent analyses.

These measures were used as they have been validated for use in Australia. However, as they were modified to ask about fishing, the modified measure was pilot tested to test two ways of asking about the measure. The first asked a fisher to recall their most recent fishing trip and how much physical activity occurred in three hours of that trip. The second asked a fisher to report on the type of fishing they most often do, and the estimate the typical amount of fishing they would do during three hours of this most typical type of fishing. The first approach gave higher average estimates of physical activity, suggesting that some fishers may be selecting to report about the most physically active part of their most recent trip, or reporting on a recent trip that was particularly active. The second approach – asking a fisher to report on the amount of physical activity occurring during a typical three hours or their most common type of fishing – resulted in more conservative estimates, on average. This approach was used as it was considered more likely to reflect realistic physical activity levels. However, ideally future studies should calibrate the accuracy of this type of self-report assessment of physical activity levels with data from observation of fishing trips.

The typical three hour fishing trip involves around one hour or a little longer of sedentary activity, a little more than an hour of light activity, and around 45 minutes of moderate to vigorous activity. In total the typical fisher aged 18 to 64 achieves an average of 103.4 minutes and older adults (aged 65 and above) 98.5 minutes of moderate physical activity equivalent (Table 8.1). Female fishers are slightly less physically active when fishing, on average, than men, although the difference is not statistically significant.

Table 8.1 Average amount of physical activity achieved in a three hour fishing trip, across all types of fishing, NRFS Stage 2 data

	Adult (18-64)	**Older Adult (65+)**	**Female**	**Male**
Sedentary	59.0 minutes (58.7 - 59.1)	67.2 minutes (66.4 - 68.3)	66.9 minutes (65.9 - 68.1)	58.4 minutes (56.7 - 59.2)
Light Activity	75.1 minutes (74.5 - 75.4)	68 minutes (66.4 - 68.4)	68.9 minutes (68.8 - 69.0)	75.2 minutes (73.9 - 76.0)
Moderate Activity	26 minutes (24.8 - 26.4)	25 minutes (24.0 - 26.0)	23.9 minutes (23.7 - 24.0)	26.4 minutes (24.8 - 27.6)
Vigorous Activity	19.9 minutes (19.7 - 20.1)	19.7 minutes (19.5 - 20.0)	20.2 minutes (19.0 - 21.5)	20.0 minutes (19.2 - 20.8)
Total moderate activity equivalent	**103.4 minutes (101.3 - 104.4)**	**98.5 minutes (96.1 - 100.2)**	**98.8 minutes (96.1 - 101.4)**	**104.0 minutes (100.3 - 107.1)**
Numbers in parentheses show the 95% confidence interval				

As part of answering questions about how much physical activity they did in a typical three hours of fishing, fishers were asked to describe what type of fishing was involved. Table 8.2 compares the physical activity generated on average by shore-based and boat-based fishing in freshwater and saltwater areas.

[18] The estimates of moderate physical activity equivalent are based on the AIHW (2003) measure, in which one minute of vigorous physical activity is equivalent to two minutes of moderate physical activity and two minutes of light physical activity is equivalent to one minute of moderate physical activity.

Table 8.2 Weighted average time spent, in minutes, during a fishing trip of three hours undertaking physical activities at various levels of intensity based on fishing location and fishing platform, NRFS Stage 2 data

Location	Platform	Vigorous (mins)	Moderate (mins)	Light (mins)	Sedentary (mins)	Total moderate activity equivalent (mins)
Freshwater / estuary	Shore	22.5 (21.9 - 22.8)	31.3 (30.7 - 31.7)	70.7 (69.0 - 72.0)	55.5 (54.0 - 57.3)	111.7 (109.9 – 113.3)
	Boat	19.5 (19.4 - 19.6)	23.7 (22.9 - 24.2)	69.2 (67.4 - 69.7)	67.5 (64.2 - 70.3)	97.3 (95.4 – 98.3)
Saltwater	Shore	20.9 (20.8 - 21.4)	28.2 (28.0 - 28.4)	75.9 (74.7 - 77.3)	55.0 (53.6 - 57.2)	108.0 (107.0 – 109.9)
	Boat - Inshore	19.1 (18.8 - 19.2)	22.3 (21.1 - 23.1)	74.0 (73.0 - 74.2)	64.7 (62.5 - 66.4)	97.5 (95.2 – 98.6)
	Boat - Offshore	20.9 (20.6 - 21.4)	22.1 (22.0 - 22.8)	78.0 (76.3 - 79.2)	58.9 (56.9 - 60.4)	102.9 (101.4 – 105.2)
Numbers in parentheses show the 95% confidence interval						

These findings highlight that on any given day a person goes fishing, the physical activity involved will typically make a significant contribution to meeting their weekly minimum recommended levels of physical activity. Shore-based fishing generally involves more physical activity than boat-based fishing, although both shore and boat-based fishing were found to contribute more than 1.5 hours of moderate physical activity per three hours spent fishing.

However, this information needs to be combined with data on the frequency of fishing activity to assess the broader contribution fishing makes to meeting recommended amounts of physical activity. Fishing will be a relatively minor contributor to physical activity for those people who only go fishing once or twice a year, but significant for those who fish regularly. This concept is examined further in the next section.

8.5 Proportion of recommended physical activity achieved through fishing

For some fishers, fishing will constitute a core component of their overall physical activity, while for other fishers, non-fishing activities will make up most of the physical activity they engage in. To better understand the extent to which fishing may contribute to a physically active lifestyle, specifically to meeting recommended levels of physical activity over the course of a year, we assessed the number of day-fishing trips each fisher undertook during the 12 months prior to completing the survey, and used this to calculate what proportion of annual minimum recommended physical activity was achieved through fishing.

We used a conservative approach to calculating the total physical activity a person achieved in a year by going fishing. The number of days a person went fishing was used as the basis for assessing annual physical activity. It was assumed that on each fishing day, the person did three hours of typical fishing. In reality, it is likely many fishers spent more time fishing – and hence achieved a higher level of physical activity – on many of their fishing days. For example, the NRIFS found that Australian residents aged five or older engaged in 102.9 million fishing hours across 23.2 million separate fishing events (trips) during 2000-01, suggesting an average of 4.4 hours per fishing event (Henry and Lyle 2003). This suggests that the average of three hours used in the analysis presented in this chapter (Tables 8.3 and 8.4) is likely to be an underestimate of the amount of physical activity contributed by going fishing.

For older Australians, and for estimation purposes, we based our estimate on four lots of 30 minute sessions of moderate physical activity per week as an approximation of the physical

activity guidelines recommended for older Australians, i.e. 30 minutes of moderate physical activity on most days.

Adult Australian fishers took on average 5.9 day trips over a 12 month period, corresponding to 9.6% of total recommended physical activity for the year (Table 8.3). The distribution of fishing participation is however skewed. Around 70% of adult Australian fishers took four or fewer fishing trips per year: amongst this group, fishing contributes only up to 5% of minimum recommended physical activity in a 12 month period. For the remaining 30% of fishers, fishing contributes a greater proportion of minimum recommended physical activity. For example, for those avid fishers who fish frequently, fishing 30 or more times per year (more than once per fortnight), fishing contributes over half of the recommended annual levels of physical activity. For these individuals, fishing makes a significant contribution to meeting overall recommended levels of physical activity per year.

Older Australians were more frequent fishers, taking on average 6.6 day trips per year, which corresponds to about 11.2% of total recommended levels of physical activity. Around 60% of older Australian fishers went on four or fewer fishing trips for the year. These results suggest that for older Australian fishers, fishing is likely to contribute a higher proportion overall of their total physical activity and is thus more important to a person's overall physical activity level than it is for younger fishers. For those older Australians who fish once per week or more, fishing contributes over 80% of their total recommended levels of physical activity. Amongst this group, fishing may for many be central to their maintaining a physically active lifestyle, particularly as older fishers reported they were less likely to engage in other physically active recreational pastimes (see next section).

These results suggest that for the majority of recreational fishers, going fishing contributes a relatively small amount to achieving minimum recommended levels of physical activity. This is still significant - for the 'average' fisher, fishing contributes up to 10% of recommended amounts of physical activity in a year. The findings also suggest that a small increase in the amount of time spent fishing has the potential to contribute to a significant increase in the proportion of minimum levels of recommended physical activity achieved.

Table 8.3 Estimated proportion of physical activity requirements met through fishing in previous 12 months, by age, NRFS Stage 2 data

Adult Australians (18-64)			**Older Australians (65+)**		
Fishing trips per year	**Proportion of fishers (%)**	**% recommended physical activity guidelines met**	**Fishing trips per year**	**Proportion of fishers (%)**	**% recommended physical activity guidelines met**
1-2 trips	41.0 (39.2 - 44.4)	2.0 (1.9 - 2.0)	1-2 trips	34.6 (32.3 - 38.6)	2.4 (2.3 - 2.4)
3-4 trips	28.6 (26.3 - 32.2)	4.6 (4.5 - 4.7)	3-4 trips	27.8 (25.2 - 31.4)	5.5 (5.4 - 5.6)
5-9 trips	16.4 (15.7 - 16.9)	9.3 (9.1 - 9.4)	5-9 trips	20.3 (19.7 - 22.1)	11.0 (10.8 - 11.2)
10-14 trips	4.9 (2.4 - 5.4)	15.9 (15.6 - 16.1)	10-14 trips	7.2 (3.5 - 8.1)	18.9 (18.5 - 19.3)
15-19 trips	4.4 (2.2 - 4.8)	22.5 (22.1 - 22.8)	15-19 trips	4.5 (2.1 - 5.3)	26.8 (26.2 - 27.3)
20-29 trips	1.6 (0.6 - 2.5)	32.5 (31.8 - 32.8)	20-29 trips	2.0 (0.8 - 3.3)	38.7 (37.7 - 39.3)
30-51 trips	1.7 (0.7 - 2.7)	53.7 (52.6 - 54.2)	30-51 trips	2.0 (0.8 - 3.3)	63.9 (62.4 - 65.0)
52+ trips[1]	1.5 (0.6 - 2.5)	68.9 (67.5 - 69.6)	52+ trips[1]	1.6 (0.7 - 2.8)	82.1 (80.1 - 83.5)

Numbers in parentheses are the lower & upper limits of estimation using the data weighting model.
[1]Estimated at 52 trips

Table 8.4 Estimated proportion of physical activity requirements met through fishing in previous 12 months, by gender, NRFS Stage 2 data

Females			Males		
Fishing trips per year	**Proportion of fishers (%)**	**% recommended physical activity guidelines met**	**Fishing trips per year**	**Proportion of fishers (%)**	**% recommended physical activity guidelines met**
1-2 trips	49.2 (47.2 - 51.7)	1.9 (1.8 - 2.0)	1-2 trips	34.9 (31.8 - 39.6)	2.0 (1.9 - 2.1)
3-4 trips	30.8 (28.8 - 33.1)	4.4 (4.3 - 4.6)	3-4 trips	27.0 (24.0 - 31.3)	4.7 (4.5 - 4.8)
5-9 trips	13.0 (12.2 - 14.5)	8.9 (8.6 - 9.1)	5-9 trips	19.2 (18.9 - 20.6)	9.3 (9.0 - 9.6)
10-14 trips	3.0 (1.4 - 3.6)	15.2 (14.8 - 15.6)	10-14 trips	6.5 (3.2 - 7.4)	16.0 (15.4 - 16.5)
15-19 trips	2.2 (1.0 - 2.8)	21.5 (20.9 - 22.1)	15-19 trips	5.6 (2.7 - 6.5)	22.7 (21.9 - 23.3)
20-29 trips	0.7 (0.2 - 1.2)	31.0 (30.2 - 31.9)	20-29 trips	2.2 (0.8 - 3.7)	32.7 (31.5 - 33.6)
30-51 trips	0.6 (0.2 - 1.0)	51.3 (49.9 - 52.7)	30-51 trips	2.4 (0.9 - 4.1)	54.0 (52.1 - 55.6)
52+ trips[1]	0.5 (0.2 - 0.9)	65.9 (64.1 - 67.6)	52+ trips[1]	2.2 (0.8 - 3.8)	69.3 (66.9 - 71.4)

Numbers in parentheses are the lower and upper limits of estimation using the raked weights of the data weighting model.
[1] Estimated at 52 trips

8.6 Assessing the likely significance of recreational fishing as a contributor to physical activity

The Stage 2 survey did not assess the exact proportion of a person's total physical activity that was achieved by recreational fishing. It did, however, ask what other physical activities they engaged in, and how important these were to their lives. This information can provide qualitative insight into the extent that people engaged in multiple recreational activities involving physical activity, and whether fishing was viewed as one of the more or less important of these.

The findings reported in Chapter 6 suggest that amongst recreational fishers, 34% feel fishing is more important than any of the other physical/recreational activities they do, while for the remaining 66% at least one other activity was considered as important as fishing. Fishers who fished more days per year, as well as fishers aged 60 and older and male fishers, were more likely to consider fishing more important than other activities. This suggests that recreational fishing is likely to contribute a more significant proportion of physical activity requirements amongst more avid and older fishers, and that these are also the groups least likely to be willing to substitute alternative recreational activities for fishing.

The clusters of physical activities engaged in by fishers were correlated both by age ($r=0.89$, $p<0.001$) and gender ($r=0.65$, $p<0.01$). The most popular activities undertaken by fisher, regardless of age or gender, were outdoor nature-based activities including fishing, camping, bushwalking/hiking and four-wheel driving. Horse riding was the least popular activity for both age categories and for males, while for females playing golf and surfing were equally the least popular activities. Females expressed a significantly greater preference than males for seven activities (horse riding, clothes shopping, gym/exercise class, swim, e-games, bushwalking, jogging, camping and attending sports games), while males expressed a significant preference

over females in four activities (fishing, recreational shooting, playing golf and playing team sports) (Mann-Whitney U-tests, $p<0.05$).

Physical activity preference scores declined with age for all activities except two: golf and fishing. The greatest declines were observed in more vigorous activities, such as running and team sports, or more risky activities, such as horse riding and surfing. Less vigorous activities, such as playing golf, fishing and bushwalking, declined the least in preference with age. This finding is consistent with other studies, which have found that as people age, the variety of physically active activities they engage in declines (Spiteri et al. 2019).

These findings suggest that fishing may be relatively more important as a contributor to meeting minimum physical activity guidelines for older fishers compared to younger fishers. As shown in Table 8.5, amongst current fishers aged 18-64, camping, fishing, bushwalking, and four-wheel driving all had an importance rating of 5 or more out of a possible 10 on average amongst those who took part in the activities. In contrast, amongst current fishers aged 65 and older, the only activities with an average importance score above 5 were fishing and camping. This underscores that amongst older fishers there are typically fewer alternative physical activities that are considered important, suggesting fishing is likely to play a more prominent role in contributing to physical activity than it does for younger fishers.

Table 8.5 Average importance of different activities, current fishers (NRFS Stage 2 data)

		Age group		Gender	
Activity	Overall	18-64	65+	Male	Female
Attend sports games	4.4	4.7	3.5	4.4	4.7
Bushwalk/hike	5.2	5.3	4.8	5.0	5.8
Camping	6.2	6.3	5.5	6.1	6.7
Clothes shop	3.3	3.5	2.7	2.7	4.6
Cycle	3.8	3.9	3.5	3.9	3.7
E-games	3.5	3.7	2.4	3.3	4.0
Fishing	6.0	6.0	6.1	6.5	5.2
Four-wheel drive	5.2	5.3	4.5	5.2	5.2
Gym/exercise class	4.7	4.8	4.2	4.3	5.6
Horse riding	2.6	2.9	1.1	2.0	3.9
Jog/run	3.7	4.0	1.6	3.5	3.9
Kayak/canoe	4.4	4.6	3.5	4.4	4.4
Play golf	3.6	3.6	3.8	3.7	3.1
Play other sport	4.4	4.5	4.0	4.4	4.4
Shooting/hunting	4.2	4.4	2.9	4.4	3.6
Surf	2.9	3.1	1.9	2.8	3.1
Swim	4.3	4.4	3.7	4.0	5.1
Team sport	4.1	4.3	2.7	4.2	3.8

In addition to examining age and gender based differences, it is useful to examine whether some fishers engage in clusters of activities that typically involve significant physical exercise (e.g. jogging, gym/exercise class), and others in clusters that typically involve less physical activity (e.g. spectating at sports games, e-games, four wheel driving). This can help better identify whether fishing is likely to be one of a relatively small number of physically active pastimes a person engages in – meaning it is more likely to be a significant contributor to a person's overall level of physical activity – or one of many physically active pastimes the person does, in which case fishing is more likely to make a relatively small contribution to their overall physical activity levels.

Clusters of activities are often defined as forming different types of 'lifestyles': Evans and Rollins (2015) examined the degree to which diverse outdoor recreation activities involve

common clusters of activities that work together to form an overall lifestyle. They identified two common outdoor recreation lifestyles: an interactively oriented recreational lifestyle, which involves spending considerable time in nature, and a visually oriented recreational lifestyle, which involves personal viewing and aesthetic appreciation of nature. Similarly, in a study of young adult immigrants and non-immigrants in the Netherlands, Kloek et al (2015), identified five recreational types: 'Nature lovers', 'Social animals', 'Activity lovers', 'Group-based quiet seekers' and 'Individual quiet seekers' and observed that these recreational types correlated with a range of socio-demographic variables.

Elsewhere, research has shown that traditional gender roles and stereotypes can have a strong influence on physical activity preferences and participation: for example, historically men have been more likely to be encouraged and taught to participate in strenuous, aggressive, competitive team sports and physical activities requiring greater strength, while women have traditionally been steered toward individual-based, non-contact, non-organised and non-competitive sports that require less strength (Wilde, 2007). While these gender-based patterns are sometimes changing rapidly, in part due to recognition of the biases involved, historically this has led to men and women having clusters of activities that often involve different levels of physical activity.

To better understand whether physical activity preferences align with certain lifestyle choices or are just a random collection of activities, we undertook an exploratory factor analysis of physical activity preferences. The analysis is provided in Appendix 7.1. The findings suggested that amongst recreational fishers, there are three common lifestyle clusters (three groups of fishers who typically participate in different clusters of recreational activities):

- 'Physical activity oriented': This type of recreational fisher typically engages in a wide range of physical activities (including gym workouts, team sports), and are often also enthusiastic sports spectators. Amongst this group, fishing is one of many activities, and unlikely to be contributing a large proportion of the person's overall physical activity. Both men and women were equally likely to be part of this group, although with somewhat differing preferences for the specific activities undertaken.
- 'Interactive Outdoor Oriented': This group of fishers is more likely to focus their physical activity on camping, fishing, four-wheel driving, kayaking/canoeing and/or recreational hunting/shooting compared to others, and often undertake a combination of these activities while engaging in relatively few other activities. This group is male dominated, with more men than women preferring this group of activities.
- 'Urban Fitness/Visually Oriented': This group had a preference for bushwalking, camping, cycling, jogging and running, kayaking and canoeing, surfing and swimming, and was somewhat female dominated. Many of the physical activities undertaken by people in this group are associated with an urban fitness setting, suggesting that fitness is a motivator for this lifestyle. However, most also align with the Visually Oriented recreational lifestyle identified by Evans and Rollins (2015), in which personal viewing and aesthetic appreciation of nature is an important driver for undertaking the activity (bushwalking, camping, cycling, kayaking and canoeing, and running).

The differing activity preferences of the three groups suggests that there is one group of fishers for whom fishing is most likely to be a more significant contributor to overall levels of physical activity: the interactive outdoor oriented group. This group typically engages in a smaller range of physical activities, often focused around fishing, and engaged in fewer physical active pastimes other than fishing compared to the other two groups.

8.7 Conclusion

This chapter examined the contribution recreational fishing may make towards physical activity, which in turn contributes significantly to a person's overall health and wellbeing. The results show that a single fishing trip of around three hours duration will contribute substantially to the

recommended weekly recommended physical activity levels for Australian adults, regardless of age, gender, fishing location, or fishing platform.

While this means a single fishing trip will contribute significantly to achieving the minimum level of recommended physical activity in a given week, not all fishers go fishing every week. The longer-term contribution of fishing to meeting minimum physical activity recommendations depend on the number, duration and nature of fishing trips undertaken over a period of time. Most recreational fishers go fishing relatively infrequently, taking a handful of trips per year. For these fishers, fishing makes a relatively small contribution to meeting recommended levels of physical activity over the course of the year.

For those fishers who fish more frequently, fishing contributes substantially to meeting minimum physical activity recommendations over a 12 month period. This is particularly the case for avid and older fishers. Going fishing contributes over half the recommended annual level of physical activity amongst avid fishers who fish 30 times a year or more. For older fishers, the findings are more complex: physical activity preferences change with age, with preference for more vigorous and risky activities typically declining as a person ages. Fishing is an activity that can be engaged in using multiple methods that involve differing levels of physical intensity and risk and thus can be engaged throughout the life span. The results show that older people are more likely to go fishing than to do many other common physical activities asked about. This suggests people are either less likely to stop fishing as they age than they are to stop engaging in other physical activities, or that people continue entering fishing at older ages. In either case, fishing appears to provide a readily accessible activity that can enable older Australians to meet a significant proportion of recommended physical activity guidelines.

The results also suggest that there are distinct groups of fishers who typically engage in different clusters of recreational activities. While fishing is typically one amongst many physical activities undertaken by two of these groups – the ‘physical activity oriented’ and the ‘urban fitness/visually oriented’ – for the third, it is one of a relatively small range of mostly outdoor activities. This ‘interactive outdoor oriented’ group includes many of the most avid fishers, and it is amongst this group that fishing levels represent a large proportion of minimum recommended physical activity guidelines.

The findings in this chapter shows that recreational fishing can make a substantial contribution to meeting physical activity guidelines recommendations for some fishers, particularly avid and older fishers, playing an important role in contributing to a physically active life and hence to deriving the health and wellbeing benefits well established to result from being physically active. It is important to note, however, that contributing to physical activity is just one of the ways going fishing may influence a person’s health and wellbeing – positively or negatively.

9.0 Wellbeing and recreational fishing

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9.1 Key points

- Nature-based outdoor recreational activities such as fishing support wellbeing through 'wellbeing pathways' including positive emotions and experience, relaxation/ restoration, nature connection, strengthening social connections, improved self-efficacy (confidence in ability to achieve desired life outcomes), and physical and mental health
- Those who had gone fishing in the past 12 months were significantly more likely to have healthy levels of wellbeing than those who had not and that this his difference in wellbeing remained after controlling for factors known to be associated with both differing levels of wellbeing and differing likelihood of going fishing (age, gender, and income, and urban/rural location)
- Going fishing may help protect wellbeing during times of stress such as experiencing loss of a loved one, relationship breakdown, job loss or health challenges: wellbeing was significantly higher amongst those who experienced stressful events and continued to go fishing compared to those who experienced stresses and did not go fishing
- Fishing is associated with higher levels of social connection: those who fished in the past 12 months were significantly more likely than those who did not go fishing to report frequently spending time with friends and family and being satisfied with their personal relationships; fishers who reported that going fishing helped them maintain social connections had higher than average wellbeing
- Fishers who valued the nature connection and restorative aspects of fishing were more likely to have healthy levels of wellbeing compared to those who did not find these important aspects of their fishing
- Overall, the findings suggest fishing is one of the many outdoor, nature-based activities that support the wellbeing of those who take part in them. Going fishing may support wellbeing in both good times and bad, but appears particularly important for wellbeing amongst those experiencing stressful life events, and may also be more accessible than some other outdoor based activities for those with poor health or limited mobility.

9.2 Introduction

Does recreational fishing support a person's wellbeing? This seemingly simple question is in reality challenging to answer. Not only do many different things affect a person's wellbeing at any given point in time, but recreational fishing may be one of several types of activity that have potential to confer wellbeing benefits – meaning that a person may achieve similar wellbeing benefits from either going fishing, or from undertaking other activities that have similar characteristics such as enabling social connection, nature connection, relaxation, building sense of achievement (self-efficacy), and/or physical exercise.

This chapter examines whether and under what circumstances engaging in recreational fishing is associated with wellbeing benefits. This is an important area to examine, as activities that support wellbeing have significant benefits for individuals and society as a whole. With spending on health increasing from 8.3% of Australia's GDP in 2000-01 to 10% in 2017-18 (AIHW 2020), there is a clear need to invest in actions that can reduce ill-health and its costs for those who are ill, and more broadly for Australia's society and economy. One of the ways to reduce the costs of poor health, both for the people who experience it and for society more

broadly, is to invest in actions that help people maintain their long-term wellbeing. Studies have identified that those who have higher wellbeing live an average of seven to ten years longer – but with a lower healthcare spend across their lifespan compared to those with poorer wellbeing and shorter lifespan, partly due to being more likely to engage in behaviours that protect their physical and mental health (Veenhoven 2008, Xu and Roberts 2010, Diener and Chan 2011, McDaid and Cooper 2014, Diener et al. 2018).

Reflecting the strong and growing evidence that investing in wellbeing is an effective public health measure, a growing number of organisations are investing in activities and actions intended to support wellbeing; for example, some governments in Australia and elsewhere are using wellbeing budgeting processes to identify which proposed policy areas have the greatest likelihood of increasing wellbeing (ACT Government 2020; What Works Centre for Wellbeing 2021; Jacquiery 2022; Mizen 2022). Associated with this is high demand for evidence that can show 'what works' to support wellbeing.

Recreational fishing is often described as having potential benefits for the health and wellbeing of those who participate in it (McManus et al. 2011). However, there is relatively little empirical evidence to support this assertion. The few studies done have mostly focused on the use of fishing as a specific health intervention to support the health and wellbeing of those who have experienced particular health problems, such as post-traumatic stress disorder. These studies have typically found evidence of positive health and wellbeing outcomes (McManus et al. 2011, Wheeler et al. 2020). A large and rapidly growing body of research is finding that engaging in a wide range of outdoor and nature-based activities has benefits for health and wellbeing (Shanahan et al. 2019). This suggests it is important to examine whether going fishing has the same types of wellbeing benefits that are increasingly well documented amongst a wide range of other nature-based outdoor activities.

This chapter first briefly reviews evolving understandings of wellbeing, how it can be measured and understood, and the pathways by which nature-based outdoor activities have been found to influence wellbeing. It then examines evidence for an association between recreational fishing and wellbeing, by examining:

- Is there is an observable association between recreational fishing and wellbeing?
- Does any association between fishing and wellbeing differ depending on factors such as how often a person fishes and how satisfied they are with their fishing?
- Does going fishing support wellbeing during challenging times?
- Does going fishing have benefits for wellbeing via any of a number of 'pathways' known to influence a person's wellbeing, including their social connectedness, sense of being able to achieve desired outcomes in life (self-efficacy), and nature connection?

It is important to note that in this chapter, the focus is on understanding whether recreational fishing is *an* activity that can contribute positively to wellbeing. This is different to suggesting that recreational fishing is the only activity that may have these characteristics. Recreational fishing is one of many activities that may help support a person's wellbeing; given this, the focus is on examining whether recreational fishing has characteristics that would be expected of an activity that confers wellbeing benefits.

If recreational fishing does have these characteristics, then it is useful to consider how it may compare to other outdoor nature-based activities that have wellbeing benefits. In particular, fishing is an outdoor activity that is relatively accessible to people of a wide range of ages and physical ability, including those with limited physical mobility. This suggests that, if going fishing is identified as an activity associated with positive impacts on wellbeing, it may be able to be used to support positive wellbeing amongst groups of Australians who have lower ability to participate in other outdoor, nature-based activities known to support wellbeing.

9.3 Understanding wellbeing

The term 'wellbeing' is used in many ways by different people. In this study, the term was used to refer to a person's subjective wellbeing. For this study, the definition of wellbeing used was that of the Center for Disease Control, who explain that, overall, there:

> *"… is general agreement that at minimum, well-being includes the presence of positive emotions and moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life, fulfillment and positive functioning. … In simple terms, well-being can be described as judging life positively and feeling good."* (CDC 2018)

This definition focuses on how a person is experiencing their life – which is usually referred to as a person's subjective wellbeing. When people discuss recreational fishing having an effect on wellbeing, they usually describe effects that are related to subjective wellbeing – things such as feeling happier, enjoying life, or finding meaning and challenge in life. Recreational fishing is not usually described as changing things typically associated with 'objective' wellbeing (the things that can be measured without asking a person about their experiences), such as a person's income or wealth (except in potentially reducing wealth through spending on gear and boats). Subjective wellbeing measures were therefore considered more appropriate for the NRFS. From this point, the term 'wellbeing' is only used to refer to subjective wellbeing.

Appendix 8.1 provides a brief review of the concept of subjective wellbeing, including how it differs to objective wellbeing, its relationship to 'illbeing', and types of subjective wellbeing. It also examines the emerging science of wellbeing. This review identified that, based on thousands of studies on subjective wellbeing conducted in recent decades, the following important aspects of wellbeing that should be considered when seeking to measure and understand the effects of an activity on wellbeing:

- Wellbeing and 'illbeing' can coexist: For example, a person who has ongoing physical health problems causing limited mobility may be able to manage these in a way that enables them to still have a high quality of life. This suggests a need to understand whether recreational fishing is associated with changes in both (i) wellbeing and (ii) illbeing.
- A person's wellbeing typically stays within a very small range over time (a phenomenon known as 'homeostasis), except when significant life events occur. Engaging in recreational and leisure activities assists in maintaining wellbeing at this healthy level during normal times.
- When significant events occur, such as a divorce, loss of a loved one, or a health crisis, wellbeing typically declines for a period of time, before returning to previous levels. However, some people experience a long-term lowering of their typical level of wellbeing due to stressful events. Engaging in recreational and leisure activities, and outdoor nature-based activities, are hypothesised to assist in enabling more rapid recovery of wellbeing after stressful events.
- A person's subjective wellbeing can be measured using many validated measures, with a large number of wellbeing measures and tools developed and used worldwide over recent decades. Some measure short-term change in a person's experience of different emotions after engaging in an activity; others measure longer-term measures of satisfaction with life as a whole or aspects of life. Long-term measures were considered more suitable for this study, which focused on understanding whether engaging in recreational fishing over a longer period of time (a year) was associated with a change in wellbeing, rather than whether a single fishing trip triggered positive emotions.
- If recreational fishing has benefits for a person's wellbeing, it will likely do this by changing one or more of the factors known to influence, or 'determine' the level of a

person's wellbeing - determinants of wellbeing. These determinants act as 'pathways' by which an activity may influence a person's overall wellbeing. Determinants known to have a strong effect on a person's overall wellbeing include, amongst others: physical and mental health, standard of living (e.g. income, quality of housing), social capital (e.g. having strong social ties to friends, family and community) and self-efficacy (ability to achieve desired outcomes in life).

There is growing interest in the specific role of outdoor recreation and spending time in nature areas or 'green spaces' on health and wellbeing. This forms part of a broader set of studies examining the role of quality leisure time in supporting a person's wellbeing (e.g. Kuykendall et al. 2020, Pomfret 2021). This area of research has emerged as a result of growing interest in understanding when and how outdoor and nature-based recreation can support wellbeing, as well as concerns about declining time spent exercising or outdoors by the populations of many countries (Pretty et al. 2005).

There is substantial and growing evidence that nature-based leisure has benefits for a person's wellbeing. Nature based activities include spending time in 'green space' (land-based nature) and 'blue space' (in and near water and ocean areas) (see for example Barton et al. 2016, Britton et al. 2018, Gascon et al. 2017, Lovell 2016, Markevych et al. 2017, Twohig-Bennett and Jones 2018 Van den Berg et al. 2015).

However, despite this growing evidence there remains a lack of clear understanding of *how* being in nature supports wellbeing (Brymer et al. 2021). The smaller number of studies examining the pathways to wellbeing, reviewed in detail in Appendix 8.1, suggest the following are key pathways by which engaging in nature-based recreation activities may influence a person's wellbeing:

- Positive emotions and experiences: engaging in outdoor recreational and leisure activities is well documented to increase short term positive emotions, something which can support long-term wellbeing. These positive emotions include not just feeling happy, but often feeling a state of focus or clarity similar to meditation/mindfulness, feeling a sense of sanctuary or respite, and feeling spiritual connection, amongst others.
- Restoration: Spending time in nature can assist in restoring a person's capacity to function, through providing time away from stressful or busy built environments and enabling recharging/restoration of a person's capabilities and psychological functioning.
- Coping with and recovery from ill-health: Some studies have found that specific nature-based interventions – including recreational fishing – can reduce severity of symptoms of some physical and mental illnesses and disabilities and can increase the rapidity of recovery from them.
- Nature contact, nature connection and place connection: These are argued to support higher wellbeing, with evidence consistent with this found in multiple studies; some studies simply examine time spent in nature and its association with wellbeing, while others examine a range of specific aspects, such as the extent to which a person feels connected to nature, or that spending time in nature enables other wellbeing pathways such as restoration or social connection.
- Self-efficacy: Several studies suggest that 'green exercise' or recreating in nature has benefits for a person's self-efficacy – their confidence in their ability to achieve desired outcomes in life and in their capabilities.
- Social connection, sociability, community identification: A growing body of work is finding that spending time in nature promotes healthy social connection and is associated with stronger and more positive social interactions and connections, particularly water-based nature experiences.

- Physical and mental health: Multiple studies have found that physical exercise undertaken in nature areas has relatively greater benefits for physical and mental health compared to the same level and type of exercise undertaken in urban or indoor environments; this effect has been found across differing types of recreation/exercise, and different intensity/duration of recreation/exercise
- Stewardship/improvement in environmental health: Some argue that outdoor recreation and activity may improve wellbeing through promoting greater engagement in pro-environmental behaviours (stewardship) and resulting improvements in environmental health, although few studies have examined this.

While much is known about how engaging in nature-based recreation may support wellbeing, there are also many gaps in knowledge, and challenges in this literature to be addressed; these are reviewed in Appendix 8.1. In particular, studies have focused on a relatively narrow range of people; it is unclear 'how much' nature exposure is required to achieve a benefit from it; and most studies are based on Western cultural views of nature.

Overall, the review of existing knowledge suggested that the most likely ways in which recreational fishing may support wellbeing are through (i) helping a person maintain their normal healthy levels of wellbeing, (ii) reducing the amount of decline in wellbeing experienced during challenging times, and/or (iii) assisting in recovering wellbeing to healthy levels after a decline in wellbeing associated with experiencing significant life events or stressors.

What would this look like across a whole population, such as Australia's adults? Based on the review of homeostasis theory and wellbeing studies presented earlier in this chapter, it was hypothesised that this would appear as a relatively small difference in wellbeing between those who do and don't go fishing, if any. This is because in most cases going fishing would, together with other activities a person engages in, assist in maintaining wellbeing at normal levels. If fishing is not very different to the range of other activities a person engages in to do this, it is likely that no difference would be evident. However, amongst those who have been fishers in the past but have not recently been fishing, there may be the presence of lower than typical wellbeing, due to recent loss of an activity that had previously been supporting wellbeing. This would likely be most apparent in the initial period in which a person stopped fishing, as after some time they may be able to substitute other activities for fishing that provide similar wellbeing benefits. It is also likely that any differences in the wellbeing of those who go fishing compared to those who do not would be more evident in analyses that controlled for some of the factors known to be consistently associated with differences in levels of wellbeing, particularly age and gender. Based on this overall approach, it was hypothesised that if fishing does support wellbeing, this would be evident in different ways in three populations:

- Adult population: In the overall adult population of Australia, effects of fishing on wellbeing may be visible in the form of slightly higher levels of wellbeing amongst those who go fishing compared to those who do not, with the difference in scores, if any, being relatively small due to the long-term stability of wellbeing, and more evident when controlling for known wellbeing co-variates such as age and gender.
- Current versus recent fishers: A larger difference in wellbeing would likely be observable between current and recent fishers than between current fishers and the broader population; this is likely to be observable when a person stops fishing for a period of time due to the loss of engagement in an activity previously used to help maintain their wellbeing at homeostatic levels. This difference would likely decrease over time since a person stopped fishing, as many past fishers would take up alternative activities that support their wellbeing.
- Those who have experienced significant stressful life events in recent times: Amongst this group, those who go fishing would be expected to have significantly higher

wellbeing compared to those who do not, likely evident after controlling for other known wellbeing covariates such as age and gender. This larger difference would reflect the role of fishing in both reducing the decline in wellbeing associated with a significant life event, and in supporting recovery of wellbeing after the event. The difference would be most evident when comparing the following two groups amongst those who self-define as fishers and have experienced a significant life event: those who have and have not gone fishing in the past 12 months.

The review also highlighted the importance of considering the 'pathways' by which going fishing may influence wellbeing. Examining which wellbeing determinants are supported by fishing can assist in identifying the aspects of fishing that are most important to encourage to achieve wellbeing benefits. For example, if people who go fishing typically achieve wellbeing benefits due to having stronger social connections than people who don't go fishing, this suggests that it may be useful to invest in supporting people to connect socially through fishing in order to achieve wellbeing benefits. In addition, pathways should be examined as the effects of going fishing on a single determinant of wellbeing (pathway) may be easier to observe compared to the effects of fishing on wellbeing overall. Given this, data were analysed to identify whether there were statistically significant associations between a person going fishing and their levels of five wellbeing determinants that are well established to be (i) important influences on overall wellbeing and (ii) pathways by which outdoor and nature recreation influence wellbeing:

- Social connection/social capital
- Self-efficacy
- Relaxation/restoration
- Nature connection
- Health.

9.4 Methods

To understand the association between recreational fishing and wellbeing, it was important to carefully consider the measures of wellbeing used. Criteria for selecting measures of wellbeing were that they should:

- Be recognised and commonly used in the academic literature
- Be suitable for use in the general population, and ideally used in existing Australian surveys, demonstrating suitability for use amongst Australian recreational fishers
- Be relatively brief and able to be asked as part of a survey that included questions about multiple topics
- Include a measure of ill-being as well as measures of wellbeing.

Two measures of wellbeing, and one measure of illbeing, were used in this study. The measures of wellbeing used were (i) a single item measure – Global Life Satisfaction, and (ii) short multiple item measure – Personal Wellbeing Index. Each of these uses an evaluative approach to measuring wellbeing, in which a person is asked to evaluate their life overall. The measure of illbeing used was the Kessler 6 psychological distress scale, which measures symptoms of generalised distress:

- Global Life Satisfaction (GLS): This single item wellbeing measure asks a person to rate their overall satisfaction with their life, using the question 'how satisfied are you with your life as a whole?". While having the limitation of being a single item measure, the GLS has been used in a large number of studies and found to be highly correlated with other longer measures assessing wellbeing, as well as to predict significant life outcomes (Cheung & Lucas, 2014). The GLS measure is easy to include in a survey,

and lets every person evaluate their satisfaction with their life based on the aspects of life that matter most to them (Cummins, 2018). It is used in multiple long-term surveys in Australia.

- Personal Wellbeing Index (PWI): The PWI measures satisfaction with seven domains of life: (1) standard of living, (2) health, (3) achievement in life, (4) personal relationships, (5) safety, (6) community connectedness and (7) future security (The International Well Being Group, 2013). These domains were selected as each loaded independently onto a person's overall life satisfaction. The PWI is widely used in Australia and internationally. In some international applications, an eighth domain is also measured, examining spirituality; this is not included in all countries and typically not when using the measure in Australia. The average score across the different domains is used to create an overall index of wellbeing that weights each domain equally (Cummins et al., 2003). The PWI is measured in several Australian surveys.
- Kessler 6 Psychological Distress scale (K6): This measure is widely used, and its use described in multiple references (Andrews and Slade 2001). This measure asks 'In the last four weeks, how often have you felt (i) Nervous (ii) Hopeless (iii) Restless or fidgety (iv) So sad that nothing could cheer you up (v) That everything was an effort (vi) Worthless'. Response options for each statement are: None of the time (1), A little of the time (2), Some of the time (3), Most of the time (4), All of the time (5). The scores of the 6 items are summed, resulting in a score from 5-30. The K6 measure (or the related K10, which includes the K6 as six of its ten items) is used in a wide range of Australian and international surveys: usage in Australia includes the Regional Wellbeing Survey, the ABS National Health Survey, and the Household Income and Labour Dynamics in Australia (HILDA) survey, amongst others.

While representing only a small subset of the possible wellbeing (or illbeing) measures that can be examined, these three measures are all well validated, widely used, and their scoring and meaning well established. They are also relatively short, meaning they can be relatively easily incorporated into survey instruments that contain questions about multiple topics, of which wellbeing is only one – a key requirement for this project.

Data collected in all three phases of the NRFS were analysed to examine association between recreational fishing and wellbeing.

All of these phases included the wellbeing measures described in section 9.4.3, as well as measuring known common covariates of wellbeing including experience of significant life events in the last one to two years, age, and gender.

The Stage 1 surveys (the 2018 and 2020 RWS) did not examine a large number of aspects of a person's fishing. They could be analysed to identify overall associations between engagement in fishing, fishing avidity, and wellbeing, while controlling for key factors other than recreational fishing likely to be influencing a person's wellbeing, such as their experience of significant stressful life events in recent times. Most importantly, the 2018 and 2020 RWS provided datasets that included large numbers of non-fishers as well as fishers. This enabled modelling that compared fishers and non-fishers while controlling for factors known to differ between these populations. For example, given that a higher proportion of fishers are male compared to the general population, gender was included as a control variable in modelling comparing the two populations. This enabled examination of the effect of fishing on wellbeing after controlling for gender differences between the fishing and non-fishing population. The Stage 3 wash up survey included these questions, but also asked about social connections when fishing, enabling a more detailed examination of the potential role of fishing in supporting positive social connections.

The Stage 2 survey, meanwhile, also had a sample of non-fishers that enabled some comparison of fishers and non-fishers. It also included detailed questions regarding factors such as motivations for fishing related to different hypothesised wellbeing pathways, and questions

about the extent to which fishing was a way of achieving social connection, self-efficacy, relaxation and other outcomes potentially associated with higher levels of wellbeing.

As a range of analysis techniques were used, the specific methods used to analyse data collected in each stage are described as they are presented in the findings.

Data presented in this chapter were weighted when examining wellbeing across the entire population. When comparing average wellbeing of different subpopulation, data were not weighted unless otherwise specified in the results: this was done as for some subpopulations, such as past fishers in the Stage 2 survey, a lack of weighting benchmark data meant weighting was not feasible. Regression models that involved controlling for known differences between fishers and non-fishers were not weighted, as this risked bias to the mean given the same factors used to weight data were being controlled for in the model.

9.5 Findings: Recreational fishing and wellbeing

This section examines:

- Is going fishing associated with higher levels of subjective wellbeing, both in general and after controlling for known co-variates of wellbeing (Section 9.5.1)?
- Are some types of fishing, or groups of fishers, more likely to have a positive association between going fishing and wellbeing than others (Section 9.5.2)?
- Does recreational fishing contribute to maintaining and recovering wellbeing when a person experiences stressful life events (Section 9.5.3)?
- Is going fishing associated with differences in five wellbeing determinants that past studies suggest may be influenced by outdoor and nature-based recreation: social connection, sense of self-efficacy, connection to nature, relaxation, or health (Section 9.5.4)?

9.5.1 Recreational fishing and wellbeing – population-wide analysis

The first question examined was whether recreational fishers have, on average, higher levels of subjective wellbeing compared to non-fishers. As noted in the introduction to this chapter, even if recreational fishing has benefits for wellbeing, this will not necessarily be observable by comparing the 'average' level of wellbeing a fisher has compared to others, due to the many factors that influence wellbeing making it difficult to observe effects, and because non-fishers may use other strategies to achieve similar levels of wellbeing. Additionally, finding an association does not necessarily mean going fishing caused the higher wellbeing. However, identifying whether there is an association, and whether it is consistently present across data collected at different times and from different samples of people, is an important first step in understanding whether fishing is one of the many activities that can contribute positively to a person's wellbeing.

Do people who have fished in recent months have higher wellbeing?

The typical wellbeing levels of those who have and have not fished in the past 12 months were compared, using three different sets of data – data from the Stage 1 2018 RWS, the Stage 1 2020 RWS, and the Stage 2 survey. This was done first with no controls, and then controlling for co-variates of wellbeing such as age and gender (as discussed further subsequently, across many countries including Australia, subjective wellbeing increases with age, while rates of high psychological distress decrease with age). ,

Current fishers were slightly but significantly more likely to have healthy levels of wellbeing, and less likely to have low levels of wellbeing, compared to those who had not gone fishing in the past 12 months (Figures 9.1 and 9.2). This was the case in all three surveys examined[19]. In the 2018 Regional Wellbeing Survey, 75.3% of current fishers had healthy levels of wellbeing, compared to 69.1% of those who hadn't fished in the past 12 months; in the 2020 Regional Wellbeing Survey, 79.4% of current fishers had healthy wellbeing compared to 71.7% of those who hadn't fished. However, current fishers did not have consistently lower rates of psychological distress across the three surveys (Figure 9.3).

Overall, a person who had not gone fishing in the past 12 months was 1.25 to 1.36 times more likely to have low levels of wellbeing as a person who had gone fishing, based on data from the 2018 and 2020 RWS surveys. Data from the NRFS survey – which deliberately oversampled avid fishers – suggested fishers who last fished 2-5 years ago were 2.1 times as likely to have low wellbeing as a person who went fishing in the past 12 months. Subsequent parts of this section examine whether this difference is likely to be due to fishing affecting wellbeing, or to a person's wellbeing affecting their likelihood of going fishing.

The difference in wellbeing is relatively small, which is consistent with wellbeing homeostasis theory: across a whole population, fishing may be contributing to either (i) helping maintain a healthy level of wellbeing amongst those fishers for whom fishing has this function, and (ii) to reducing the decline in wellbeing occurring during or after a time of significant stress. This would be expected to result in a slightly higher proportion of those who have gone fishing having healthy levels of wellbeing – which is the case in Figures 9.1 and 9.2.

[19] As described in the methods section, more than one data source was examined when exploring associations between fishing and wellbeing. Specifically, the average wellbeing of current fishers was compared to those who had not fished during the previous 12 months using data from the Stage 1 2018 and 2020 RWS, and the Stage 2 survey. These different sources provide differing insights: most importantly, as the Stage 2 NRFS survey was specifically promoted as measuring the potential social and economic contributions, it had a risk of strategic bias in responses. In contrast, the 2018 RWS and 2020 RWS did not have this risk of strategic bias, with the surveys not principally collecting data on recreational fishing, and questions about fishing forming a very small part of a large omnibus survey that examined multiple topics. This means that comparing findings across these different surveys enables identification of whether there is a likelihood that strategic bias affected findings of the Stage 2 NRFS survey.

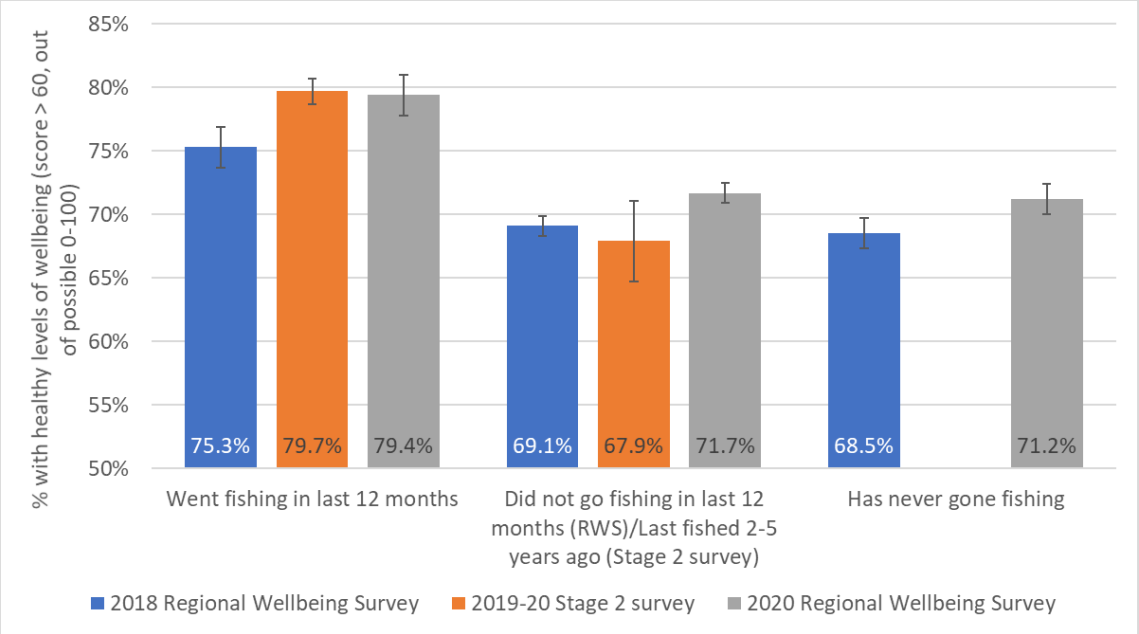


Figure 9.1 Proportion of the population with healthy levels of wellbeing, Personal Wellbeing Index – comparing current, recent and non-fishers

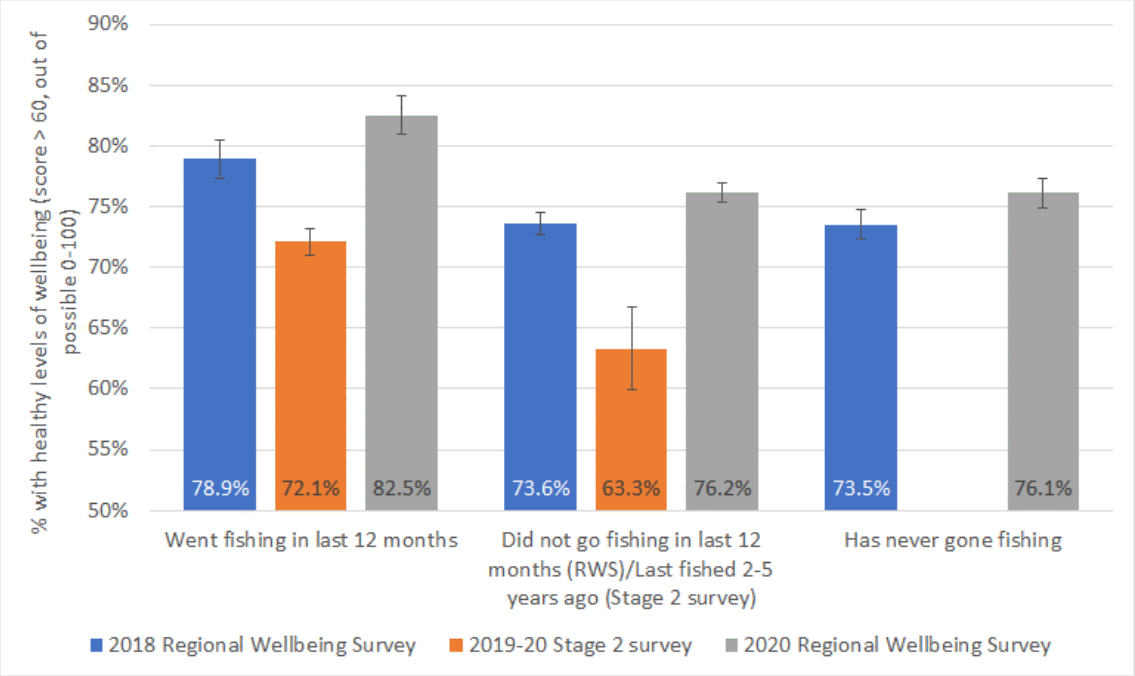


Figure 9.2 Proportion of the population with healthy levels of wellbeing, Global Life Satisfaction measure – comparing current, recent and non-fishers

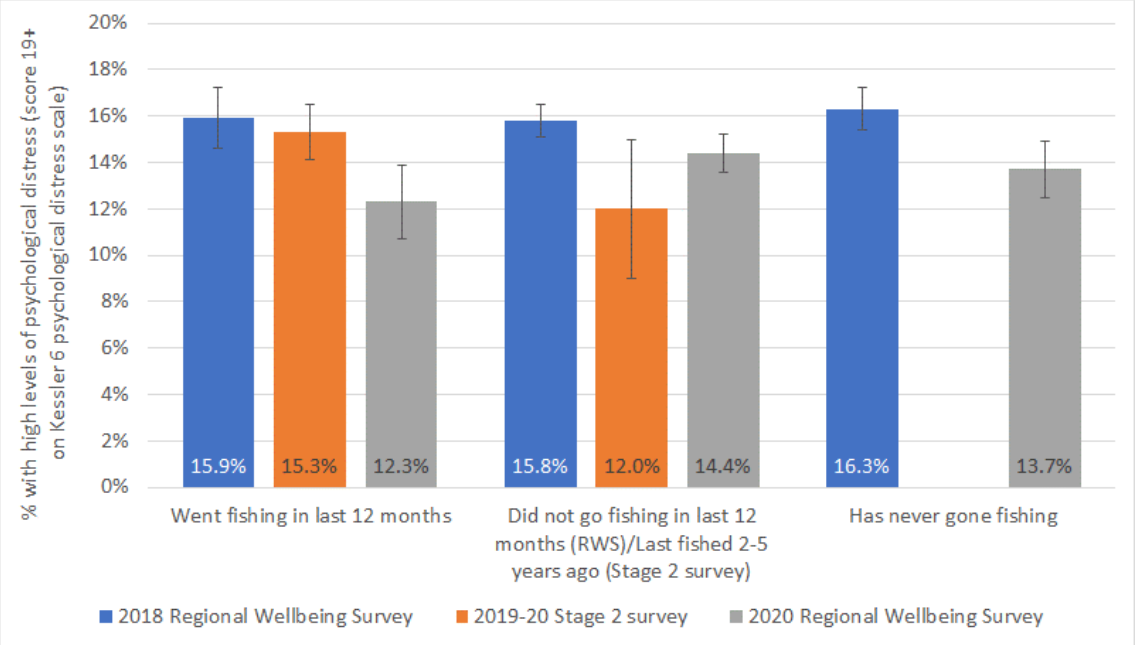


Figure 9.3 Proportion of the population with high levels of psychological distress – comparing current, recent and non-fishers

Does going fishing improve wellbeing – or do other factors explain the higher wellbeing of current fishers?

While the findings of the previous section show a statistically significant association between going fishing in the past 12 months and a higher likelihood of having healthy levels of wellbeing, participating in fishing may not be the cause of the higher rates of wellbeing observed amongst current fishers. There are many possible explanations for this association, including:

- The same factors that are causing high wellbeing are also associated with a greater likelihood of going fishing
- Higher wellbeing causes a higher likelihood of going fishing, and as a result, those who fish are more likely to have healthy levels of wellbeing, or
- Going fishing causes higher wellbeing – the hypothesis that is suggested by studies examining the influence of outdoor recreation and nature connection and wellbeing.

It is important to note that it is possible for more than one of these to be true at the same time: causal associations are not generally simple and one-way, but instead tend to form cycles of wellbeing gain and loss. In other words, it is unlikely that there is a simple unidirectional causal relationship in which doing a particular activity – fishing – causes an increase in wellbeing. It is more likely that going fishing (together with many other factors) positively influences wellbeing, which in turn provides positive feedback to a person that encourages further engagement in fishing activity, due to its benefits. In this type of bidirectional or 'causal loop' relationship, going fishing may support wellbeing and this in turn may encourage more fishing. This can be thought of as a 'gain cycle' in which a person who builds some positive resources – in this case, wellbeing – as a result has greater capacity to further build that resource, and does this through continued or increased engagement in activities that increase their levels of the resource. Evidence for the presence of 'gain cycles' in which a positive change in a person's life triggers a positive spiral of growth in wellbeing has been identified predominantly in studies of wellbeing in the workplace, including in studies examining whether engaging in some types of 'wellbeing' intervention trigger gain cycles related to work productivity (e.g. Kim et al. 2015), and whether changing workplace practices in agriculture in specific ways can trigger gain cycles

of improved self-efficacy and wellbeing (Brown et al. 2022). There is little work examining gain cycles related to outdoor recreation and wellbeing. If a gain cycle such as this was present in fishing, it would mean that going fishing may trigger an increase in a determinant of wellbeing, such as social connection or self-efficacy, and this in turn would trigger growth in wellbeing, which would then encourage further engagement in fishing.

While any causal association between fishing and wellbeing is likely to be complex, it is useful to examine whether the first two possibilities listed above explain a large amount of the higher wellbeing amongst fishers: if they do, then this suggests there is limited scope for presence of a gain cycle. If they do not, then it is more likely that a positive gain cycle is present.

Are some factors associated with both high wellbeing AND a higher likelihood of going fishing?

One possible explanation for the association between fishing and higher wellbeing is that participation in fishing is more common amongst groups who have higher wellbeing. This was examined by testing whether the association between fishing and wellbeing held after controlling for four factors that are known to vary between fishers and non-fishers, and to be predictors of higher or lower wellbeing; age, gender, household income, and whether a person lives in a city or a rural area. A person's likelihood of being a fisher varies based on all these things (discussed in Chapter 4). In addition, all are associated with known differences in incidence of healthy levels of wellbeing.

Wellbeing changes through the lifespan, and is also consistently different between those living in urban and rural areas. Broadly speaking, in English speaking countries younger adult and older adults typically have higher levels of wellbeing than those in their 'middle age' decades, although the same pattern is not identified in other cultures (Steptoe et al. 2015). Those living in rural areas on average have higher levels of wellbeing compared to those living in large cities (Cummins et al. 2003); those with higher incomes have higher wellbeing, although this is only up to a point, with little increase in wellbeing when a person already on a high income experiences income growth, and considerable increase in wellbeing when a person goes from having low income to moderate income (Cummins 2000; Headey and Wooden 2004). Some studies, although not all, also find differences in the wellbeing of those who identify as male and female, although the associations between gender and wellbeing are complex (Western and Tomaszewski 2016). Together, these factors – age, gender, income, and place of residence – often explain a significant proportion of variance in a person's overall wellbeing[20].

Chapter 4 found that people who lived in rural areas were more likely to go fishing compared to those living in cities. This suggests that part of the reason for the higher average wellbeing of fishers may simply be that fishers are more likely to live in rural areas. However, older people were less likely to go fishing in a 12 month period than younger fishers, suggesting that the higher wellbeing of older people was unlikely to explain the higher wellbeing of fishers.

The association between recreational fishing and wellbeing, after controlling for known co-variates of wellbeing was examined using linear regression models that had subjective wellbeing as the dependent variable, and independent variables of age, gender, household income, urban/rural residence, and whether a person went fishing in the last 12 months or not.

[20] So do other factors, such as experiencing stressful events, increasing social connection, and increasing physical activity. However, these other factors may be actively modified by going fishing – fishing may help a person cope with stressful events, maintain or increase social interaction, and increase physical activity. Given this, they were not considered factors that should be controlled for in the analysis presented in this section, instead being examined subsequently in this chapter as part if other analyses.

These models were run using data from two data sets collected for Stage 1 – the 2018 and 2020 RWS – as well as the Stage 2 survey. The full regression models are provided in Appendix 8.2.

It is important to note that the goal of the regression analysis was not to seek to explain all variation in wellbeing, or even a large proportion of it: as is increasingly recognised in psychological research, large effect sizes are, if anything, an indicator of an analysis that may be flawed. This is because when examining a complex psychological phenomenon such as wellbeing, it is rare to identify any single intervention/characteristics, or even group of characteristics/interventions, that explain a large proportion of the phenomenon being examined (e.g. Matz et al. 2017, Funder and Ozer 2019, Gotz et al. 2022). There is growing concern about over-emphasis on large effect sizes when seeking to explain real-world complex psychological phenomena, particularly those where a small change in the thing being studied is known to have meaningful impacts on a person's life. In response to this concern, there is increasing recognition that meaningful effects, rather than large effects, should be sought:

> Every social encounter, behaviour, reaction and feeling a person has … will have an effect that could cumulative over time, with important consequences for numerous life outcomes, including … popularity and social success, physical health, financial success, personal relationships, and overall quality of life. (Funder and Ozer 2019, p. 161).

> Traditional social-science research uses small samples … which require large effect sizes to reach statistical significance and be published. …. Focusing exclusively on them [large effect sizes] hinders a nuanced exploration of complex psychological phenomena such as life satisfaction, which are unlikely to be explained by a few strong predictors. (Matz et al. 2017, p. 48)

> Complex psychological phenomena are most likely determined by a multitude of causes and … any individual cause is likely to have only a small effect … a publication culture that continues to demand large effects … overlooks the small affects that are most likely to be real, hindering attempts to identify and understand the actual determinants of complex psychological phenomena. (Gotz et al. 2022)

Given the large range of factors that influence wellbeing, it is not expected that regression models that include only five, six or even 10 of the major factors known to affect wellbeing will explain a large proportion of variance in wellbeing across a population. When a small change in wellbeing is known to be significant for their life outcomes, factors that explain – and hence could result in a change in – a small proportion of wellbeing should be considered significant. This is reflected in published research on wellbeing, where models including a limited number of relevant wellbeing-influencing factors and explaining anywhere from 5% to 20% of variance in subjective wellbeing are commonly published, including in the area of effects of nature connection and outdoor recreation on wellbeing most relevant to the analysis presented in this chapter (see for example Cartwright et al. 2018, Mavoa et al. 2019, Martin et al. 2020, Poortinga et al. 2021, Smith et al. 2021). They are considered significant as they present useful insight into actions and factors that may make a material different to a person's quality of life, given that the homeostasis theory of wellbeing means small changes in wellbeing are often important and meaningful.

This meant that when seeking to identify if the association between fishing and wellbeing was explainable by variation in factors such as age, gender etc, only those factors known to be different between fishers and non-fishers, and to be significant predictors of wellbeing in the general population, were included.

In all models, going fishing in the past 12 months was significantly and positively associated with higher levels of wellbeing, even after controlling for the effects of age, gender, household income, and whether a person lived in an urban or a rural area (Table 9.1). The findings were consistent across both measures of wellbeing examined and all three data sets. Additionally, going fishing was associated with a slight but significant decline in psychological distress.

Homeostasis theory suggests that if fishing supports wellbeing, then the greatest difference in wellbeing between current fishers and those who haven't fished would occur amongst those who used to go fishing but have not done so recently. This is expected as, after ceasing fishing initially, wellbeing loss would likely occur during the period when a person has ceased fishing but not yet found a replacement activity that could contribute in a similar way to supporting wellbeing.

This was consistent with the findings shown in Table 9.1. Analysis of the Stage 2 survey, which had a large sample of recent fishers as well as of current fishers, found current fishers had wellbeing on average 9 points higher than recent fishers after controlling for the effect of gender, age, income, and rural/urban residential location. In contrast, current fishers had wellbeing that was on average 3 to 4 points higher than all those who had not fished in the past 12 months (whether recent, past or non-fishers), based on analysis of data from the 2018 and 2020 Regional Wellbeing Surveys.

Table 9.1 Difference in wellbeing and illbeing scores of fishers compared to others, after controlling for the effects of age, gender, income and rural/urban residence

Year data collected	Data source	Populations compared	Going fishing in the past 12 months was associated with…		
			Wellbeing – Personal Wellbeing Index	Wellbeing – Global Life Satisfaction	Illbeing – Kessler 6 psychological distress scale
Spring 2018	Regional Wellbeing Survey	Current fishers and all others	2.7 point increase in wellbeing ($p<0.000$)	3.1 point increase in wellbeing ($p<0.000$)	0.3 point decrease in psychological distress score ($p=0.011$)
Spring to Summer 2020	2020 Regional Wellbeing Survey	Current fishers and all others	3.7 point increase in wellbeing ($p<0.000$)	3.8 point increase in wellbeing ($p<0.000$)	0.6 point decrease in psychological distress score ($p<0.000$)
Spring 2019 to Autumn 2020	Stage 2 recreational fisher survey	Current fishers and recent fishers	8.6 point increase in wellbeing ($p<0.000$)	9.1 point increase in wellbeing ($p<0.000$)	0.9 point decrease in psychological distress score ($p<0.000$)
These data are drawn from regression models: the full regression modelling data are provided in Appendix 8.2.					

Overall, there was a clear and strong association between going fishing in recent months and a person having higher levels of wellbeing, even after controlling for the known associations between wellbeing and a person's age, gender, income and urban/rural residence. Additionally, after controlling for these factors, going fishing was associated with a slight decline in risk of having high psychological distress.

Does fishing make you happy – or is it just that happier people are more likely to go fishing?

The previous section found that current fishers don't have higher wellbeing simply because they are older, or have higher income, or are more likely to live in rural areas than those who haven't fished in the last 12 months. However, this still leaves the possibility that the higher wellbeing of fishers may be a result of people being more likely to go fishing when they have high wellbeing, and less likely to when they have lower wellbeing. While this might be expected to

occur to some extent as part of a gain cycle in which fishing triggers an increase in wellbeing and this in turn encourages a person to do more fishing, the association would not be strong.

If higher wellbeing causes a higher likelihood of going fishing in the absence of a gain cycle, this should be observable in the data collected. In particular, if this is occurring it would be expected that people who experience events known to reduce wellbeing would be less likely to go fishing and/or fish less often compared to people who do not experience events known to reduce wellbeing during the same period. In other words, do people who have highly stressful life experiences (which are often associated with a decline in wellbeing) tend to go fishing less often?

Both the Stage 1 and Stage 2 surveys asked participants if they experienced any of a number of events known to be associated with a significant loss of personal wellbeing within the previous 1-2 years (the period over which a loss of wellbeing is likely to be most observable for many of these events). The events asked about included experiencing significant person health problems, increased caring responsibilities, losing employment, shifting house, sudden financial stress, separation/divorce, and experiencing the death of a close friend or family member. All of these are typically associated with lower than average wellbeing, and were in the datasets examined. As shown in Appendix 8.3, people who experienced any of these events had significantly poorer wellbeing, on average 8 points lower than those who hadn't experienced stressful life events in recent times.

However, despite those who experienced stressful personal events having, on average, significantly lower wellbeing compared to those who did not experience these stresses, they were not less likely to go fishing, or to fish less often (Figure 9.4). In the 2018 RWS, 24.5% of those who experienced one or more personal stress events went fishing at least once in the previous 12 months, while 20.6% of those who did not experience any major personal stress event went fishing. In the 2020 RWS, 21.4% of those who experienced personal stress events fished while 20.5% of those who did not experience a significant stressful life event went fishing.

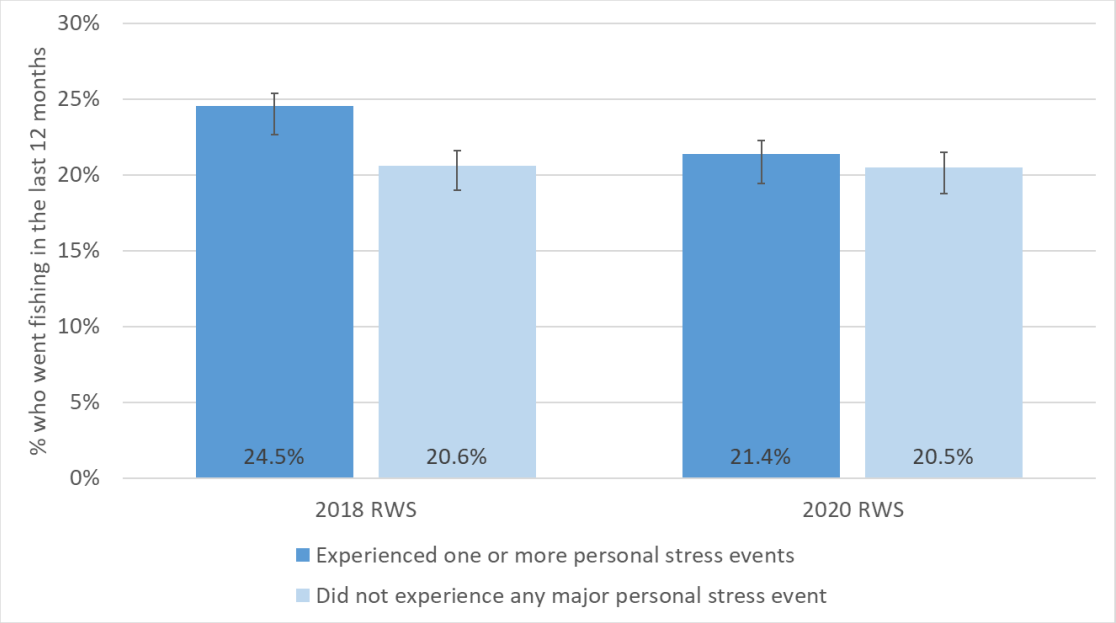


Figure 9.4 Proportion of people who went fishing, by experience of personal stress events, in last 12 months – 2018 and 2020

These findings suggest that people experiencing events associated with a known rapid decrease in wellbeing are just as likely to go fishing as those who have not experienced these events. This

in turn means it is unlikely the wellbeing gap between recreational fishers and others is a result of people being less likely to go fishing when they have poorer wellbeing, or more likely to when they have higher wellbeing. If this was the case, a drop in fishing participation would be expected in association with experience of events known to be associated with a decline in wellbeing.

In fact, some data suggests those experiencing some types of stress events may be slightly *more* likely to go fishing. The data provided in Appendix 8.3 shows that those who experienced significant unexpected financial stress, increased caring responsibilities, a change of employment, or death in the family were *more* likely to go fishing than those who did not experience these things; while those experiencing other types of personal stress (separation/divorce, poor health, or others) were just as likely to go fishing as those who didn't experience them.

9.5.2 Are some types of fishing associated with higher fisher wellbeing than others?

The previous section established that people who have gone fishing within the last 12 months typically have higher levels of subjective wellbeing compared to those who have not, even after controlling for factors such as gender, age and where a person lives. It also showed that this increase in wellbeing is unlikely to be due to people being more likely to go fishing when life is going well compared to when it isn't - people who experience stressful life events typically associated with significant loss of wellbeing go fishing as much as those who do not experience these events.

This section examines whether the association between fishing and wellbeing varies depending on the type of fishing a person does – such as the number of days fished, whether a person is satisfied with their fishing, has had good fishing experiences, or finds fishing important to their life. Specifically, it examines whether levels of wellbeing vary depending on:

- Fishing avidity (days spent fishing in a 12 month period)
- Overall fishing importance
- Overall fishing satisfaction
- Whether a person increased the amount of fishing they did from one year to the next
- Whether a person was able to fish as much as they wanted to
- A combination of these things.

All of these things were asked about in the Stage 2 survey, while only some were asked about in other surveys conducted as part of the NRFS. Table 9.2 shows the average wellbeing score of current fishers with differing fishing avidity, fishing importance, fishing satisfaction, and amount of fishing done compared to previous years or to desired amount.

The data show that fishing more frequently is associated with higher levels of wellbeing. The proportion of fishers with low levels of wellbeing fell as the number of days spent fishing increased, and the proportion with healthy levels of wellbeing increased. The amount of change differed between the surveys. Data from the 2018 RWS showed prevalence of healthy levels of wellbeing increasing by 6% as fishing days increased from less than five to 20 or more in a year. Data from the Stage 2 survey showed prevalence of healthy wellbeing levels increasing by 15% as fishing increased from under 5 to more than 20 days a year. The difference in magnitude suggests that other factors may be interacting to also influence the findings, for example there was also a large difference in wellbeing based on the importance of fishing, with the Stage 2 survey including a greater proportion of respondents for whom fishing was a highly important activity, a factor that is highly correlated with fishing avidity).

The data in Table 9.2 suggest that going fishing more often than in a previous year is *not* consistently associated with higher or lower wellbeing – while going fishing less than in a previous year is associated with lower wellbeing compared to fishing the same amount as the previous year. Fishing less than a person wanted to (as opposed to a decline in actual fishing days) was not associated with a substantially higher risk of low wellbeing, likely reflecting that almost all fishers report they fish less than they want to, even if they have fished many days in the past 12 months. Reporting negative fishing experiences (such as experiencing overcrowding, poor behaviour, long queues at boat ramps, or others) was not associated with significantly higher or lower wellbeing.

Table 9.2 Rate of low wellbeing amongst fishers with differing avidity, importance and change in fishing (proportion with a Personal Wellbeing Index score below 60)

		2018 RWS	2019-20 NRFS Stage 2	2020 RWS
Fishing avidity	Fished <5 days	23.9% ±1.9%	27.0% ±1.9%	Not asked
	Fished 5-19 days	17.9% ±2.7%	18.8% ±1.3%	
	Fished 20+ days	18.0% ±4.2%	12.9% ±0.9%	
Fishing importance	Low	Not asked	32.9% ±2.8%	Not asked
	Moderate		21.6% ±1.3%	
	High		14.4% ±0.9%	
Change in fishing	Fished less than previous year		26.9% ±1.8%	20.3% ±3.1%
	Fished same as previous year		17.2% ±1.0%	14.2% ±2.3%
	Fished more than previous year		16.6% ±1.3%	19.2% ±4.1%
Ability to fish as much as desired	Fished less than wanted to	Not asked	17.6% ±0.8%	Not asked
	Fished as much as wanted to		13.8% ±1.2%	
	Fished more than wanted to		14.8% ±2.6%	
Fishing experience	Fishing experiences in past 12 months almost all positive	Not asked	13.4% ±1.8%	Not asked
	Some negative fishing experiences in past 12 months		11.7% ±1.4%	
	Multiple negative fishing experiences in past 12 months		14.9% ±2.0%	

To further test whether fishing avidity, experience, importance, and change between years were associated with significantly different wellbeing, a linear regression was developed that examined whether these variables were significant predictors of subjective wellbeing levels after controlling for age, gender, and place of residence, using the Personal Wellbeing Index measure. The full regression models are provided in Appendix 8.4. The regression results showed that the various characteristics of fishing examined were all significant predictors of subjective wellbeing levels:

- Going fishing more than the previous year was associated with an increase of 3.4 points (±0.7 points) in the typical wellbeing score of recreational fishers (NRFS Stage 2 survey, $p<0.000$)
- Higher fishing avidity was associated with a small increase in wellbeing: for every increase of 3-5 days fishing, the increase was approximately 0.5 points in wellbeing (±0.14 points). This is not a precise association as the avidity categories asked about were not linear (NRFS Stage 2 survey, $p<0.000$).
- Higher fishing importance was associated with a small increase in wellbeing: for every single point increase in fishing importance (on a scale of 0-10, from not at all important to very important), wellbeing was 0.7 points higher (±0.13 points), (NRFS Stage 2 survey, $p<0.000$).

- Going fishing less than desired was associated with lower wellbeing by an average of 2.5 points (±0.6 points) (NRFS Stage 2 survey, $p<0.000$)
- Having more negative fishing experiences was associated with a small decline in wellbeing of 0.3 points (±0.03 points), (NRFS Stage 2 survey, $p<0.000$).

These findings suggest that the most significant predictors of wellbeing are fishing avidity, and ability to maintain frequency of fishing year to year. It does appear there is some positive association between fishing avidity and wellbeing, with the evidence for this consistent across years and after controlling for age, gender and place of residence (urban or rural).

9.5.3 Pathways to wellbeing: supporting wellbeing during difficult times

Does recreational fishing contribute to maintaining and recovering wellbeing when a person experiences stressful life events? There are many examples of fishing being recommended as a form of therapy for people who are experiencing difficult times, noted earlier in this chapter and in Appendix 8.1. Some studies have found that interventions involving going fishing can help support recovery from and managing of conditions ranging from PTSD to depression, anti-social behaviour to ADHD. This suggests that one area in which fishing may have benefits for wellbeing is in the recovery of wellbeing after some types of stressful events, such as experiencing significant personal stress, or some types of mental or physical illness.

However, studies to date have predominantly examined whether going fishing is beneficial for those with diagnosed medical health disorders. Many people who experience difficult times do not have a diagnosable disorder, however do have a higher likelihood of experiencing a decline in wellbeing levels. It is important to examine whether going fishing may be protective of wellbeing amongst these groups.

To examine this, as noted earlier the Stage 1 and Stage 2 surveys asked participants if they had experienced any of a range of types of stressful life event within the past two years (2018 RWS and Stage 2 survey) or 12 months (2020 RWS). These included poor health, increase in caring duties, job change or loss, shifting house, sudden large financial stress, separation/divorce, or death of a loved one.

A person who experienced one or more of these significant life stresses will be at higher risk of low wellbeing compared to a person who has not experienced these events. If fishing is an effective means of protecting wellbeing when it is threatened by stressful life events, then those who experience stressful events and continue fishing would be expected to have a reduced rate of low wellbeing compared to those who experience stressful events and do not continue to go fishing.

Going fishing in the months after experiencing a stressful life event was associated with higher wellbeing (Figures 9.5, 9.6 and 9.7): those who experienced stressful life events and went fishing had less loss of wellbeing than those who experienced stressful life events and did not go fishing.

When comparing current fishers to all others (whether recent, past, or non-fishers), current fishers who experienced stressful life events were 15% less likely to have low wellbeing in 2018 (measured using the PWI), and 26% less likely to have low wellbeing in 2020 (Figure 9.5).

In 2018, 24.1% of current fishers who experienced stressful life events had low wellbeing, compared to 28.2% of recent, past and non-fishers who experienced one or more stressful life events during the same period. In 2020, 20.8% of current fishers who experienced stressful life events had low wellbeing compared to 28.1% of those who didn't fish. The difference between the two years is likely due to the period of time asked about: the 2018 RWS asked about personally stressful events occurring during the previous two years, while the 2020 RWS asked

only about how many stressful events occurred within the past 12 months. The findings suggest that maintaining fishing may be particularly important close to the time a stressful event occurs.

When comparing just current fishers and recent fishers, the difference in wellbeing was, as predicted by homeostasis theory, much larger, with only 20.5% of current fishers who experienced stressful life events having low wellbeing compared to 38.9% amongst recent fishers.

These results suggest that those who are able to continue fishing when they experience stressful life events experience less loss of wellbeing compared to those who are not able to continue fishing. This is particularly important amongst those who would normally go fishing: recent fishers who did not go fishing after experiencing stressful life events were much more likely to have low wellbeing compared to those who did go fishing. This is consistent with the argument that people whose wellbeing is usually maintained in part by going fishing are at high risk of wellbeing loss in the short term if they stop fishing at a time when they are also experiencing other life stresses.

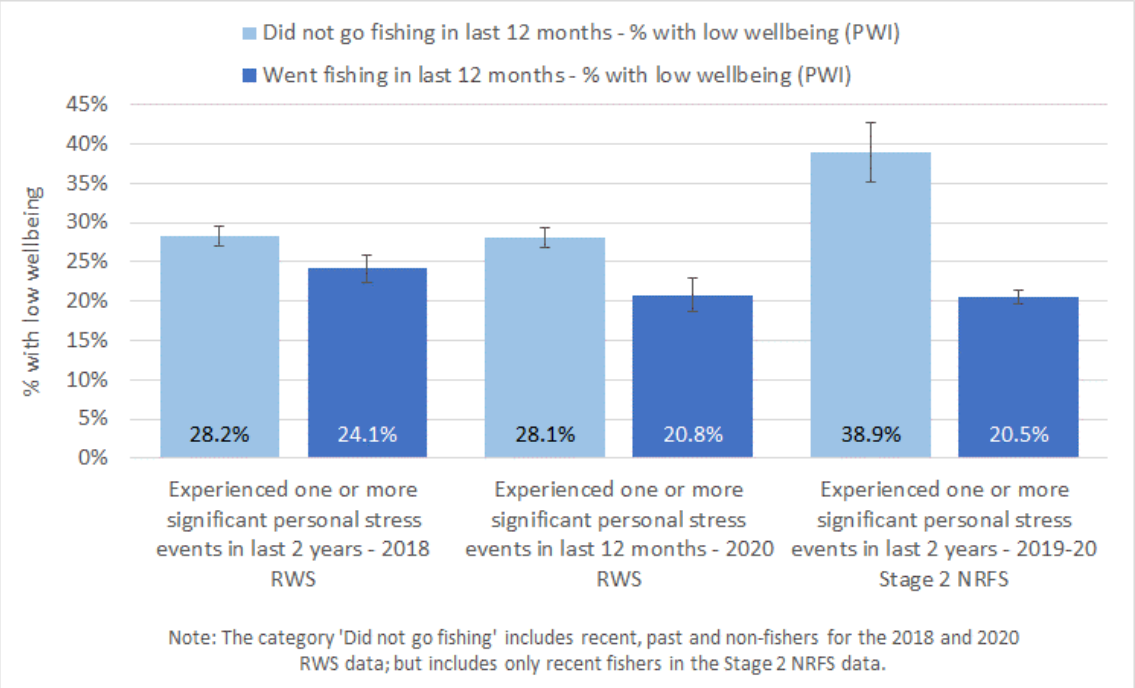


Figure 9.5 Wellbeing of those who experienced stressful life events and did or did not go fishing – Personal Wellbeing Index

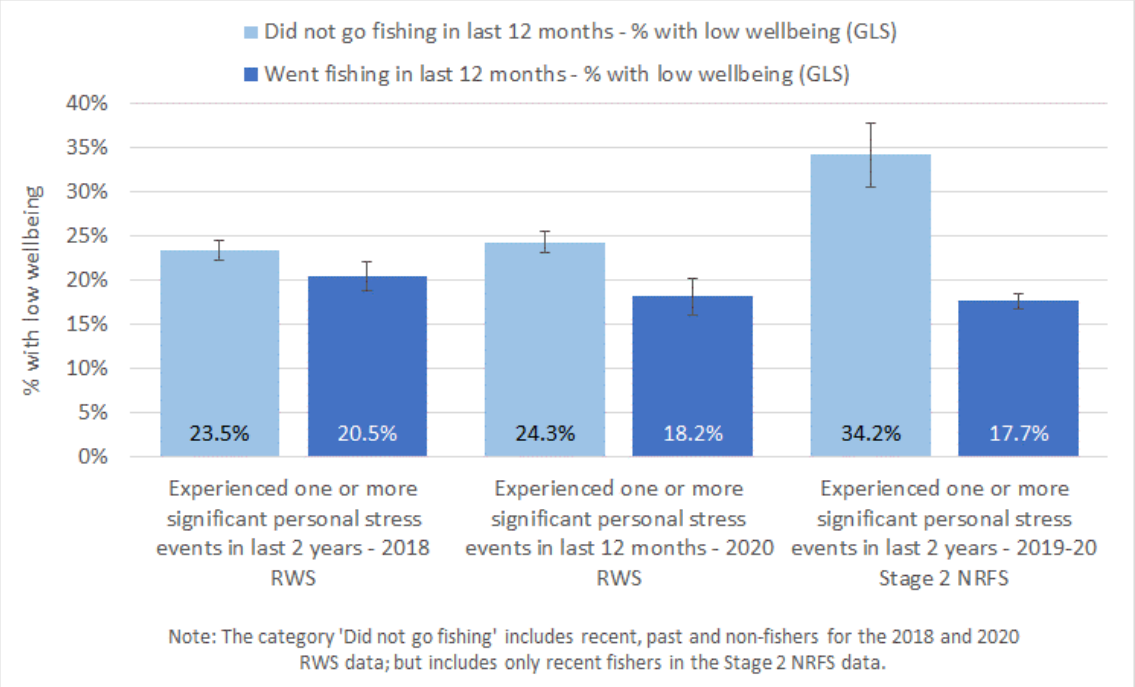


Figure 9.6 Wellbeing of those who experienced stressful life events and did or did not go fishing – Global Life Satisfaction

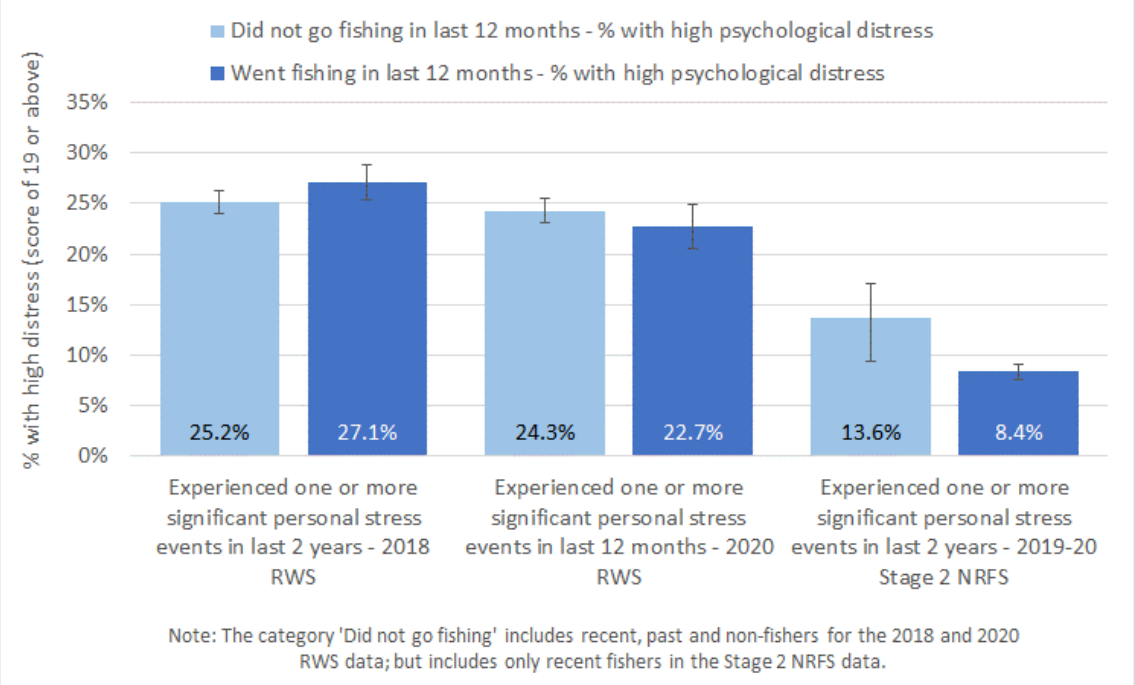


Figure 9.7 Wellbeing of those who experienced stressful life events and did or did not go fishing – Kessler 6 psychological distress scale

However, going fishing was *not* associated with a decrease in psychological distress after experiencing stressful life events (Figure 9.7). This suggests that fishing may act as a protection that reduces the extent of a person's loss of wellbeing when they experience psychological distress associated with stressful life events.

Overall, the data are highly consistent with the hypothesis that fishing is an activity that can assist in helping a person protect their wellbeing when they are experiencing significant stressful life events.

9.5.4 Is going fishing associated with change in determinants of wellbeing?

If going fishing supports wellbeing, it is likely to do so by influencing some of the many factors that influence a person's wellbeing level – the factors that act as determinants of wellbeing, or 'pathways' to wellbeing.

As identified earlier in this chapter, the literature on the wellbeing benefits of outdoor recreational and nature connection suggests that outdoor, nature-based activities are particularly likely to influence wellbeing via having an effect on one or more of a person's: social connection, self-efficacy, relaxation/restoration, nature connection and/or health (physical and mental). Data collected as part of the NRFS was analysed in three ways to explore whether going fishing was associated with significantly higher levels of these different wellbeing determinants. Findings of these three analyses are reported in this section. First, the views of fishers are analysed to identify whether they felt fishing was an important way of achieving different wellbeing determinants. For example, did fishers report that fishing is an important means for them to stay in touch with or spend time with family and friends (social connection), to connect with nature, or to relax? Second, the overall association between going fishing and levels of different wellbeing determinants is examined. This enables identification of whether going fishing is associated with higher levels of those wellbeing determinants that past studies suggest are most likely to be positively influenced by outdoor/nature recreation activities. Third, the role of fishing in helping build or maintain positive social connections is explored, by examining types of social connection happening during fishing (e.g. how many fishing trips involve family and friends), and how important fishers identify their fishing to be as a means of maintaining these social connections.

Social benefits of fishing identified by fishers

Recreational fishing may have a range of social benefits for those who engage in it: previous studies have identified nature connection, social connection, physical exercise, relaxation/restoration, sense of achievement, and achieving nutrition through consuming catch as some of the benefits often associated anecdotally with going fishing (see for example Birdsong et al. 2021, Young et al. 2016).

Many of these benefits are both positive in and of themselves, but also well established 'pathways to wellbeing'. In other words, experiencing one of these benefits or outcomes from fishing is likely to in turn have a positive impact on a person's overall wellbeing. For example, if going fishing helps maintain and strengthen social relationships with the fisher's family or friends, this is a benefit in and of itself. It is also likely to have a positive impact on the fisher's wellbeing, with positive social connections being an influential determinant of wellbeing (Hold-Lunstad 2022).

In both Stage 1 and Stage 2 surveys, fishers were asked about how important different aspects of fishing were to them, including whether social connections were important. This was asked in slightly different ways in each survey.

In Stage 1, fishers were asked to identify whether different outcomes were (i) not at all important, (ii) not very important, (iii) quite important, (iv) very important, or (v) that they were unsure how important they were (Figure 9.8). Using this measure, the outcomes most commonly considered important to fishers were spending time in nature (quite or very important to 79.1% of current fishers), spending time with family (74.8%), spending time outdoors (79.9%), and relaxing/unwinding (73.9%). Between 60% and 70% reported that spending time with friends, getting physically active, learning about nature, and feeling a sense of achievement

were important. Just over half (52.6%) reporting that spending time on their own was an important aspect of fishing. Between 40% and 50% reported that learning new skills, the challenge of catching fish, the enjoyment of catching fish, or catching fresh fish for themselves or others to eat were important to them. Only 10.9% reported that competing in fishing competitions (of any kind) was an important part of fishing for them.

This suggests that, of the potential wellbeing pathways asked about, nature connection, social connection, restoration and physical activity were most commonly valued by fishers as things they achieved via their fishing. Gaining a sense of self-efficacy, through feeling a sense of achievement, learning new skills, experiencing challenge, or participating in fishing competitions was less important, as was consuming catch.

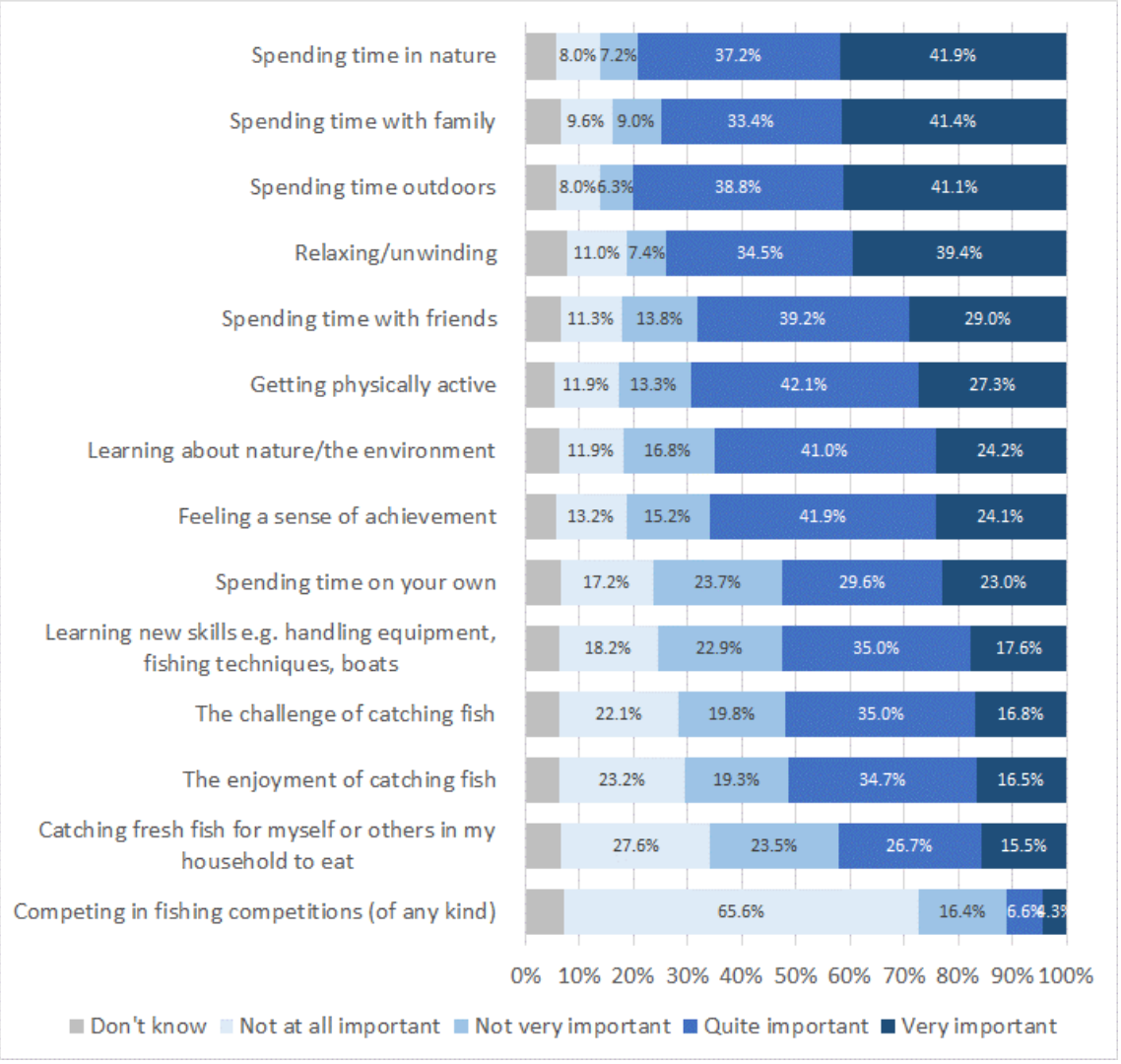


Figure 9.8 Importance of different social/recreational benefits, as rated by current recreational fishers – Stage 1 2018 RWS data

In Stage 2, fishers were asked to rate the importance of different aspects of fishing on a scale from 0 (not at all important) to 10 (very important). When grouped into categories that broadly represent low, moderate and high importance (Figure 9.9), there were very similar findings to those identified in Stage 1: the wellbeing pathways rated most important by recreational fishers were nature connection, restoration, and social connection. Physical activity, building self-efficacy, and consuming catch were less often important, and competing in fishing competition was least likely to be considered important. However, the ability to more clearly distinguish very important aspects of fishing from more moderately important aspects helps better identify

which things were considered more important. In particular, 76.3% reported spending time outdoors/in nature was very important, followed by relaxing/unwinding (69.9%), and spending time with family (61.8%). The idea of restoration was examined by asking how important it was to be able to focus on fishing and not think about other things: 55.4% reported this was highly important, suggesting evidence for restoration as an important benefit of fishing, something not examined in previous Australian recreational fishing studies beyond the idea of relaxing or unwinding.

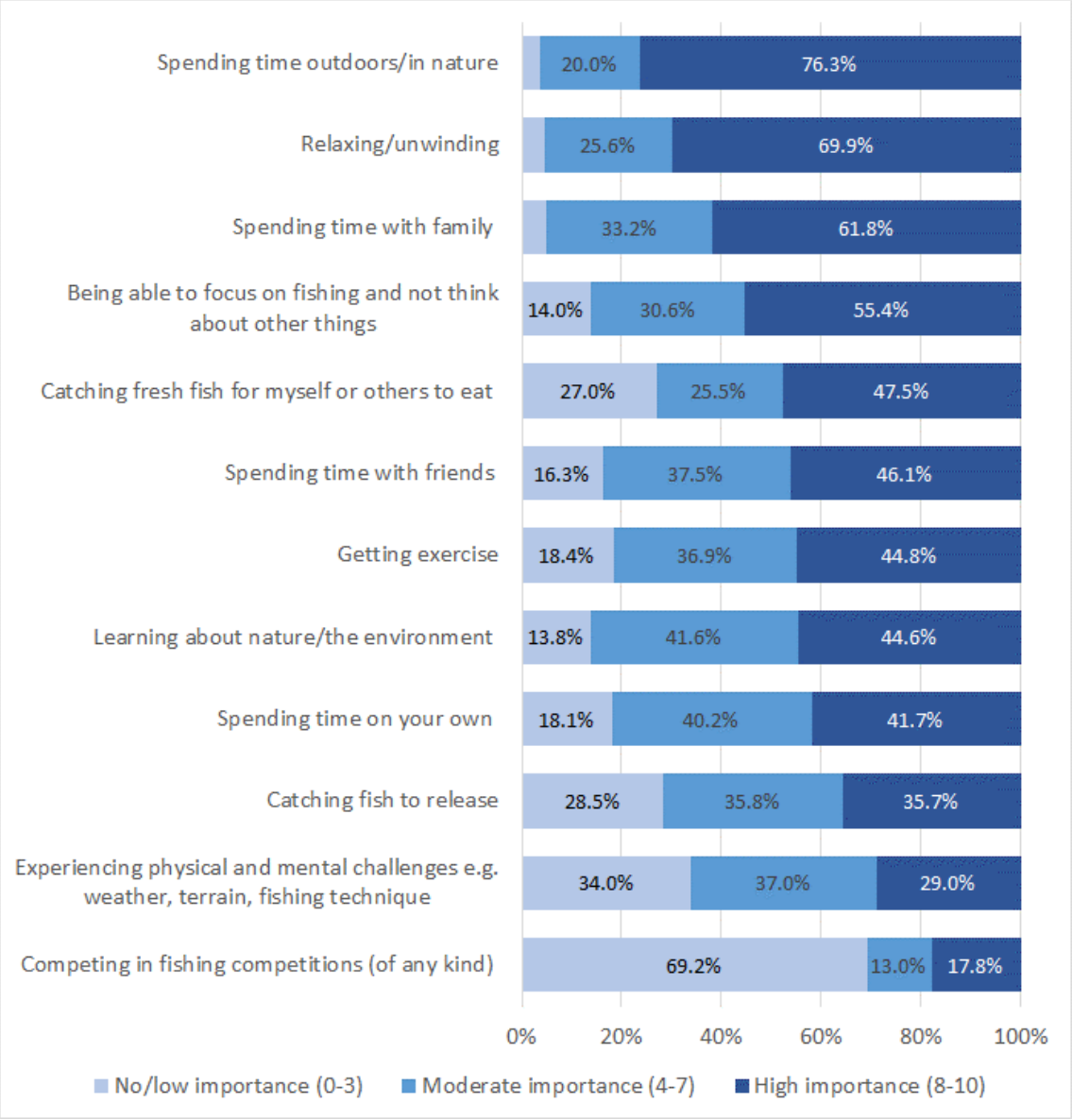


Figure 9.9 Importance of different social/recreational benefits, as rated by current recreational fishers – 2018-19, Stage 2 survey data

Is going fishing associated with higher levels of some wellbeing determinants?

The previous section identified that nature connection, restoration and social connection were the wellbeing determinant fishers most commonly associated with going fishing, with a majority of fishers experiencing these as important outcomes of fishing. Getting physical exercise, and feeling a sense of achievement, were important to fewer fishers.

Of these five wellbeing determinants, three have well established measures: social connection, self-efficacy, and health. Nature connection and restoration do not have well validated measures as a wellbeing determinant: while many measures of short-term restoration exist, there are a lack of measures that identify longer-term restoration. Similarly, most nature connection measures focus on short-term change, for example measuring change before and after time spent in nature, rather than longer-term sense of connection.

This meant that only three of the five wellbeing determinants identified as common outcomes of fishing could be examined in this study, which asked people about experiences over longer timeframes: social connection (examined using three measures), self-efficacy (two measures), and health (two measures) (Figure 10).

As shown in Figure 9.10, those who went fishing were significantly more likely to report they frequently spend time with family members who don't live with them (56.0% of fishers reported doing this compared to 46.0% of those who did not fish in the past 12 months), and with friends who don't live with them (66.2% compared to 60.5%), and are also significantly more likely to be satisfied with their personal relationships (78.0% compared to 70.8%). While it is unlikely that fishing was the sole cause of these differences, it is likely that going fishing was one element that supported and enabled a positive 'gain cycle' that resulted in positive social connections and relationships. In other words, going fishing is likely to have been a positive contributor to improving relationships, which in turn increased the likelihood of other positive interactions outside the fishing context. This, together with the large proportion of fishers who report that fishing is an important contributor to social connection, supports the argument that fishing supports wellbeing through enabling and strengthening the fisher's social connections with family and friends.

The findings also suggest that fishers have higher levels of self-efficacy compared to those who haven't fished recently: 71.7% were satisfied with what they were achieving in life, compared to 64.1% of those who hadn't fished, and 77.5% were confident they could achieve desired outcomes in life (compared to 72.6%). This suggests going fishing may contribute positively to building self-efficacy. However, as noted earlier, not all fishers report that increasing self-efficacy is an important aspect of fishing to them.

There were fewer differences between the health of fishers and those who hadn't fished: there was no significant difference in levels of satisfaction with health, although current fishers were significantly more likely to report that their health was very good or excellent (45.2% compared to 41.0%) (Figure 9.10).

Overall, these results suggest that going fishing may contribute positively to wellbeing through having a positive influence on a fisher's social connections and self-efficacy, while evidence for a difference in health is less clear. These data do not prove a causal connection, but do suggest the presence of associations consistent with the hypothesis that fishing has a positive influence on wellbeing via improved social connection and self-efficacy.

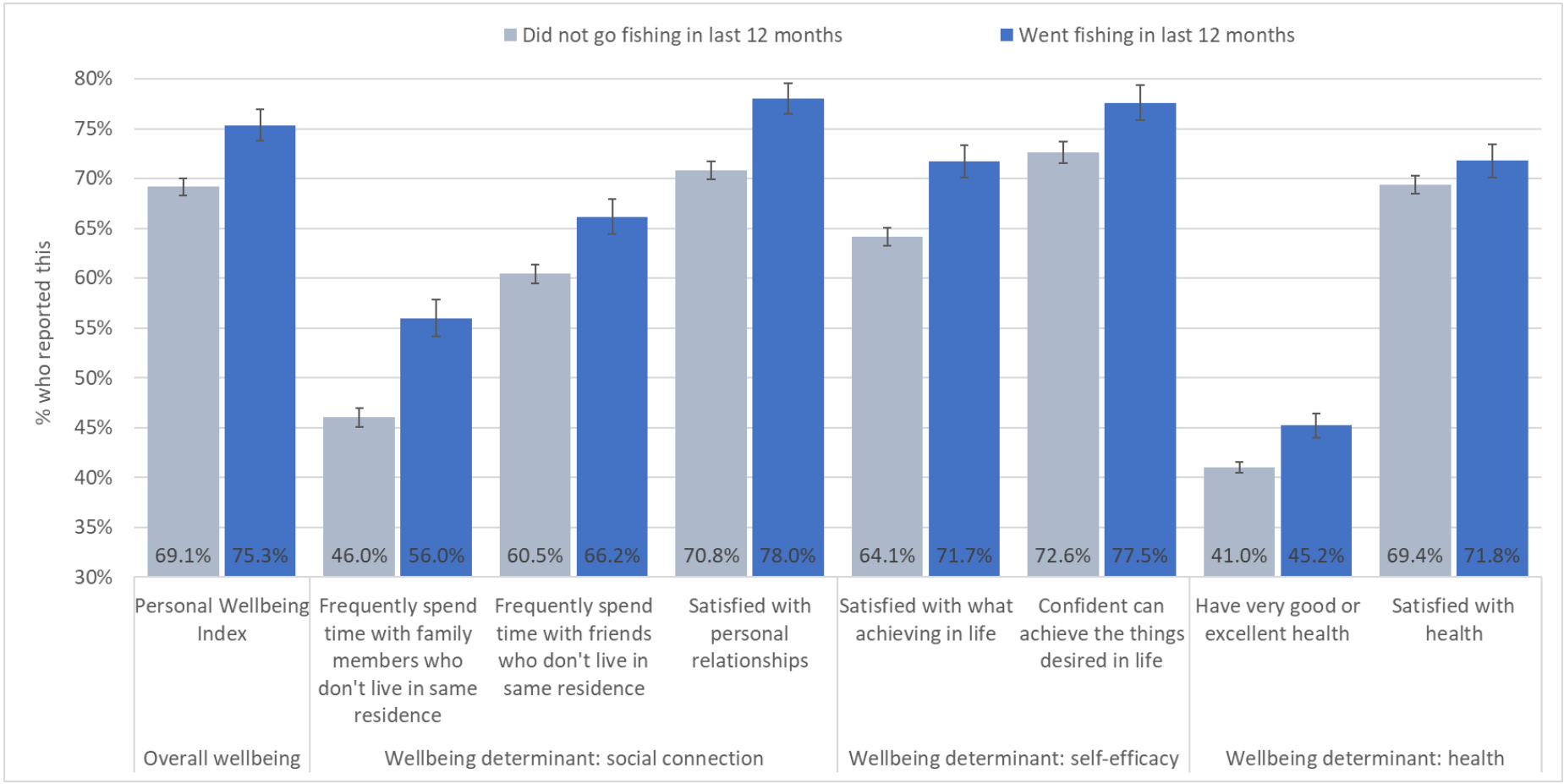


Figure 9.10 Proportion of recreational fishers and non-fishers with healthy levels of different wellbeing determinants, 2018 RWS data

The previous section suggested that while most fishers value fishing for social connection, nature connection and restoration, fewer report that fishing is an important way of achieving self-efficacy or physical exercise. One of the complexities of wellbeing is that a person can – consciously and unconsciously – achieve wellbeing determinants in different ways. For example, one person may use fishing as one way of maintaining important social connections: that person will also use other ways, such as having a backyard BBQ, or going out for a meal with a friend or family member. Another person may value fishing for solitude, and not use it as a way of supporting their social connections.

The idea that people choose how they achieve higher levels of wellbeing determinants suggests that fishing may only have a positive impact on a given wellbeing determinant *if the fisher seeks to achieve, or values, fishing for its impact on that determinant.* This is complicated by the possibility that some fishers may not be consciously aware that fishing has benefits for some determinants of their wellbeing. However, it is likely that even amongst this group, there would be some level of awareness that fishing is important for achieving a given wellbeing determinant if prompted to consider this.

This was first explored for the wellbeing determinant of social connection. Figure 9.11 compares the proportion of fishers with healthy wellbeing, for those who reported fishing was or was not an important way of (i) spending time with family, (ii) spending time with friends, or (iii) spending time on their own.

Fishers were significantly more likely to have healthy levels of wellbeing if they found fishing an important means of spending time with family or friends – but not more likely to have high levels of wellbeing if they said fishing was unimportant for social connection, or that they valued spending time alone when fishing (Figure 9.11).

This is consistent with the idea that fishing can support wellbeing through strengthened social connection. It also suggests that this increase in wellbeing is more likely to be seen amongst those fishers who actively value and utilise fishing as a way of making and maintaining positive social connections with others.

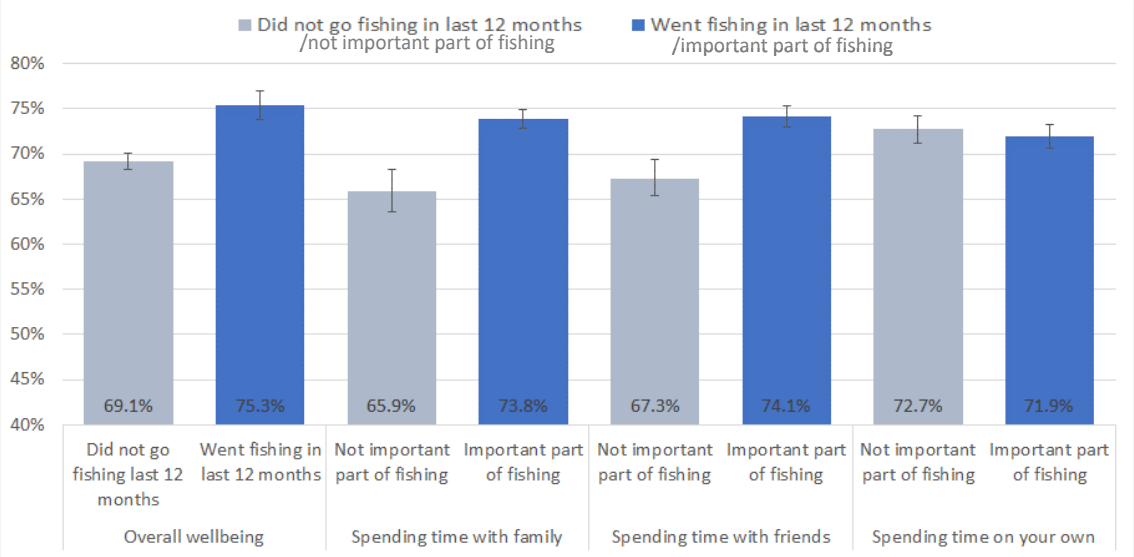


Figure 9.11 Pathways to wellbeing – do fishers who value fishing for social connection have higher wellbeing compared to those who don't use fishing as a way to connect socially? (2018 RWS)

Similarly, fishers who valued the nature connection aspects of fishing were more likely to have healthy levels of wellbeing compared to those who did not report finding spending time outdoors/in nature or learning about nature to be important aspects of their fishing (Figure 9.12).

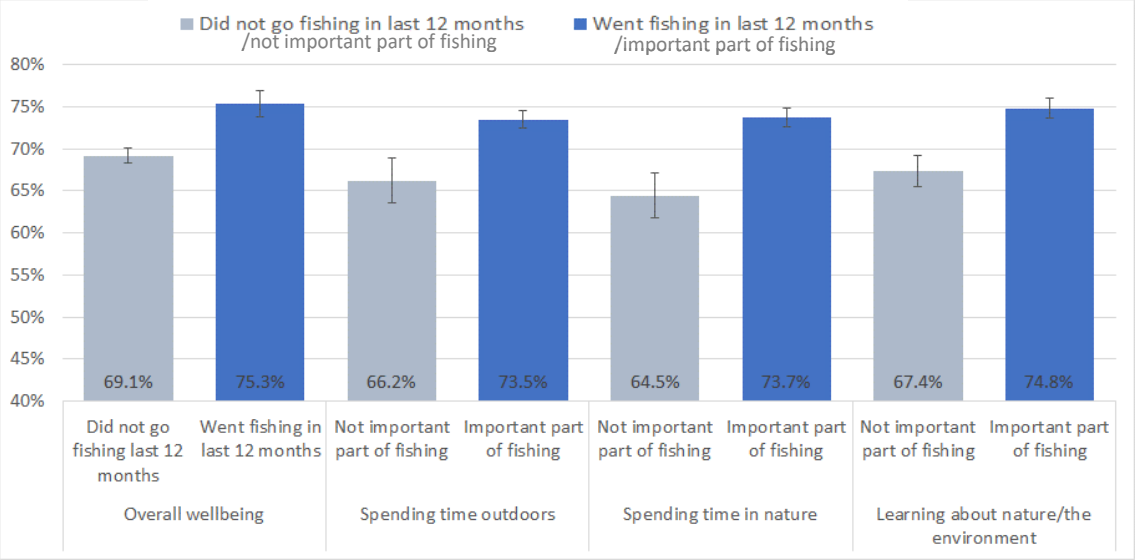


Figure 9.12 Pathways to wellbeing – do fishers who value fishing for nature connection have higher wellbeing compared to those who don't find nature connection an important part of fishing? (2018 RWS)

Fishers who reported valuing fishing for relaxing or unwinding had higher wellbeing compared to those who didn't find relaxing/unwinding to be an important part of their fishing (Figure 9.13). Considering enjoyment an important part of fishing was not associated with significantly higher wellbeing. This suggests both that restoration is likely to be a pathway to wellbeing – and that a wider set of restoration measures should be developed in future to enable more in-depth exploration of this pathway to wellbeing and how it operates amongst recreational fishers.

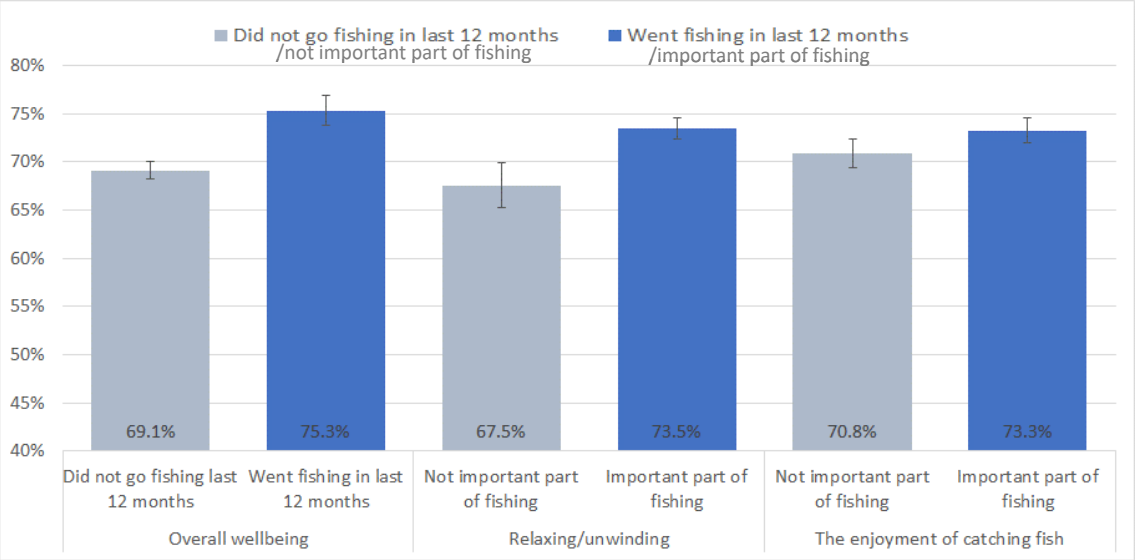


Figure 9.13 Pathways to wellbeing – do fishers who value fishing for restoration/enjoyment have higher wellbeing compared to those who don't find this an important part of fishing? (2018 RWS)

There is less consistent evidence for the role of fishing in achieving self-efficacy and, via this, improving wellbeing. Three different measures, examining self-efficacy in different ways, were examined (Figure 9.14). Fishers who found the challenge of catching fish to be an important part of their fishing had slightly higher wellbeing compared to those who did not find this to be

important, while there was very little difference in wellbeing of fishers who did and did not find fishing important for learning new skills or feeling a sense of achievement. This suggests that self-efficacy may be a less important wellbeing pathway compared to social connection, nature connection and restoration.

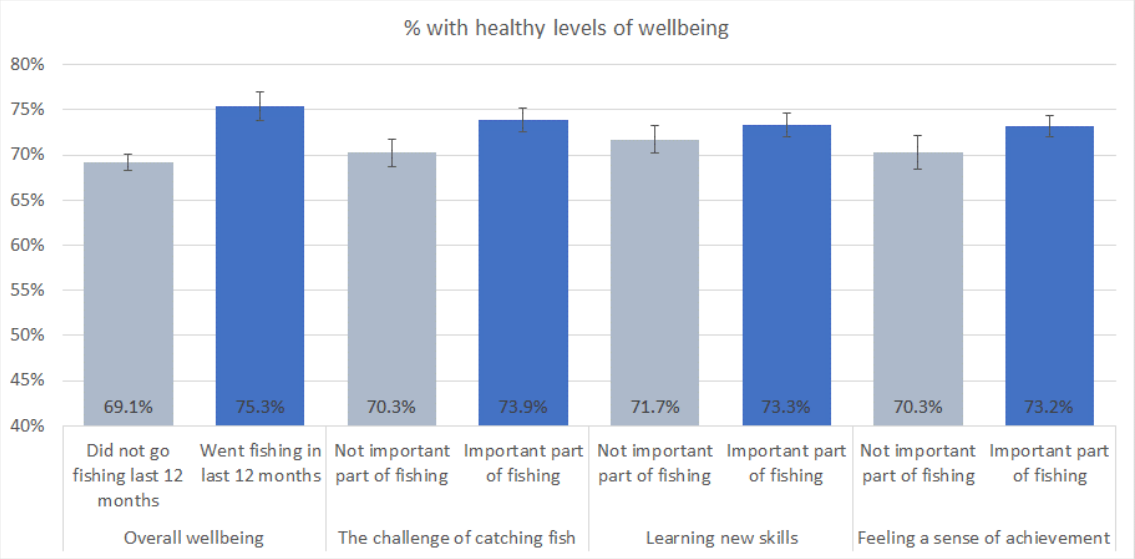


Figure 9.14 Pathways to wellbeing – do fishers who value fishing for restoration/enjoyment have higher wellbeing compared to those who don't find this an important part of fishing? (2018 RWS)

Similar to self-efficacy, there was a relatively weak link between finding being physically active an important part of fishing and a person's overall wellbeing (Figure 9.15), although catching and eating fresh fish was associated with slightly higher wellbeing.

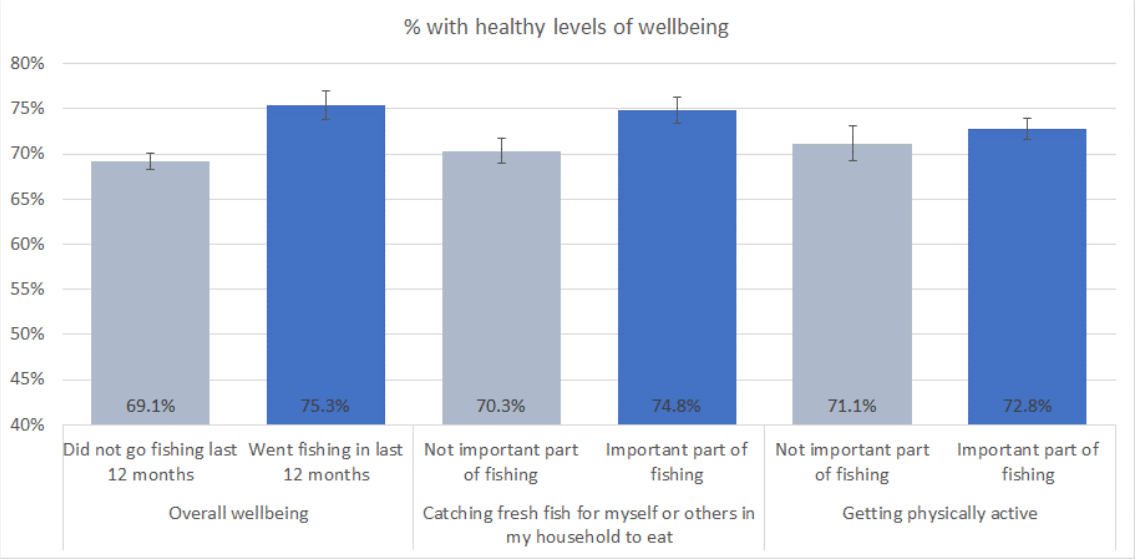


Figure 9.15 Pathways to wellbeing – do fishers who value fishing for source of nutrition/physical activity have higher wellbeing compared to those who don't find this an important part of fishing? (2018 RWS)

Overall, the findings are consistent with the argument that fishing is likely to influence wellbeing most strongly through three wellbeing pathways: social connection, nature connection, and restoration. However, the associations identified, while consistent, do not prove a causal relationship. The role of social connection was explored in more depth as part of Stage 2 and is examined in the next section.

Understanding the role of fishing in maintaining positive social connections

The previous sections identified that fishing may contribute to wellbeing is through supporting social connection. Given the likely importance of social connection as a pathway to wellbeing, in Stage 2 its role was explored further. Fishers were asked how often they fished on their own versus with family and friends over the previous 12 months, and how important fishing was as a means of connecting with family and friends.

The social connections made when fishing were found to largely focus on a person's close friends and family (Figure 9.16), suggesting that fishing is primarily used as a way of maintaining close social relationships, rather than as a way of broadening or widening circles of acquaintances.

Almost all fishers – 94.9% - went fishing with other people at least once during the previous 12 months; only 5.1% reported that all their fishing trips in the last year were done as solo trips. Over half of fishers reported they either never fished on their own (27.5%), or that solo fishing trips made up less than half of their fishing trips in the last 12 months (27.6%). Another 16.4% reported around half their fishing trips were solo trips, while they went fishing with other people on around half their trips, while 23.4% did most fishing trips alone.

Amongst those who go fishing with others, it is most common to go fishing with close friends, with 43.2% of fishers going fishing with close friends on half or more of their fishing trips. This was followed by fishing with others who live in the same household (whether children, a partner, or housemates), with 42.9% reporting that half or more of their fishing trips involved others in their household. Thirty per cent regularly fished with their partner (spouse, girlfriend, boyfriend etc), 30.8% with children, 18.7% with family members they don't live with, and 13.1% with their wider circle of friends.

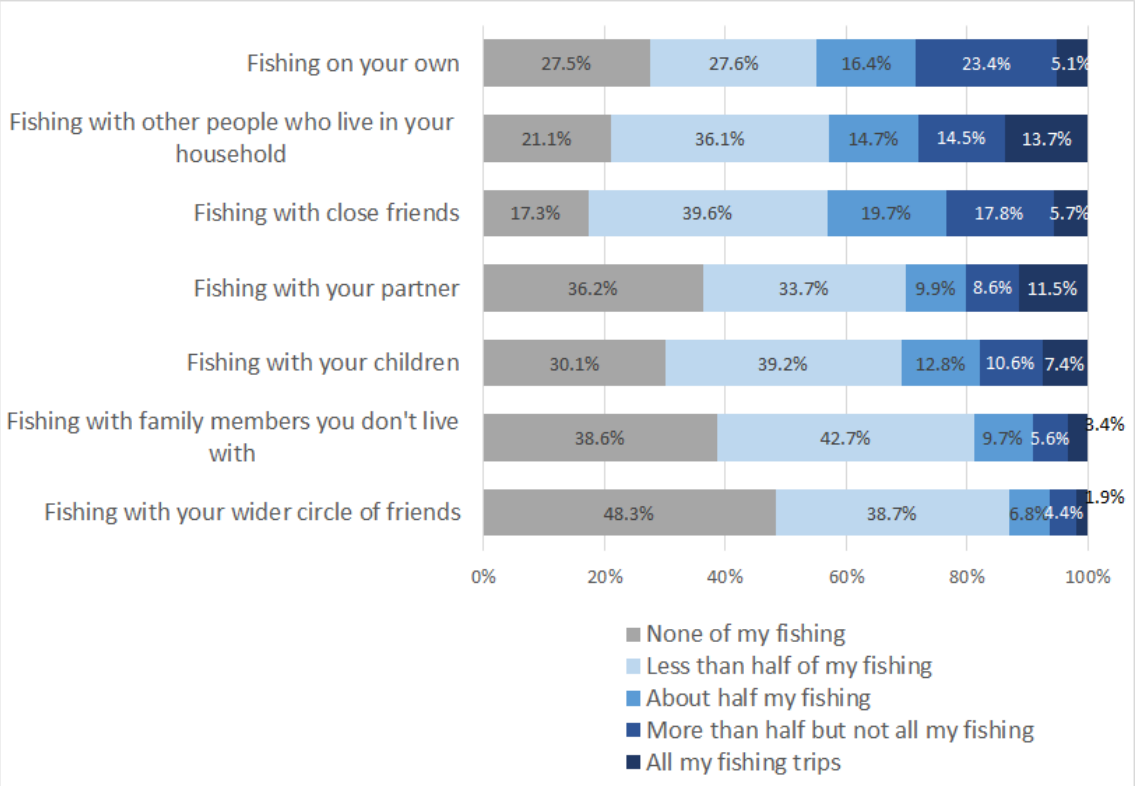


Figure 9.16 Who did people go fishing with in the last 12 months?, Stage 2 data

Reinforcing this, fishers were most likely to report that fishing was highly important as a way of spending time and connecting with their children (46.0%), closest friends (42.3%), partner/spouse (39.2%) and others who lived in their household (35.7%) (Figure 9.17). Fewer reported fishing was an important way of connecting with their wider circle of friends (26.7%).

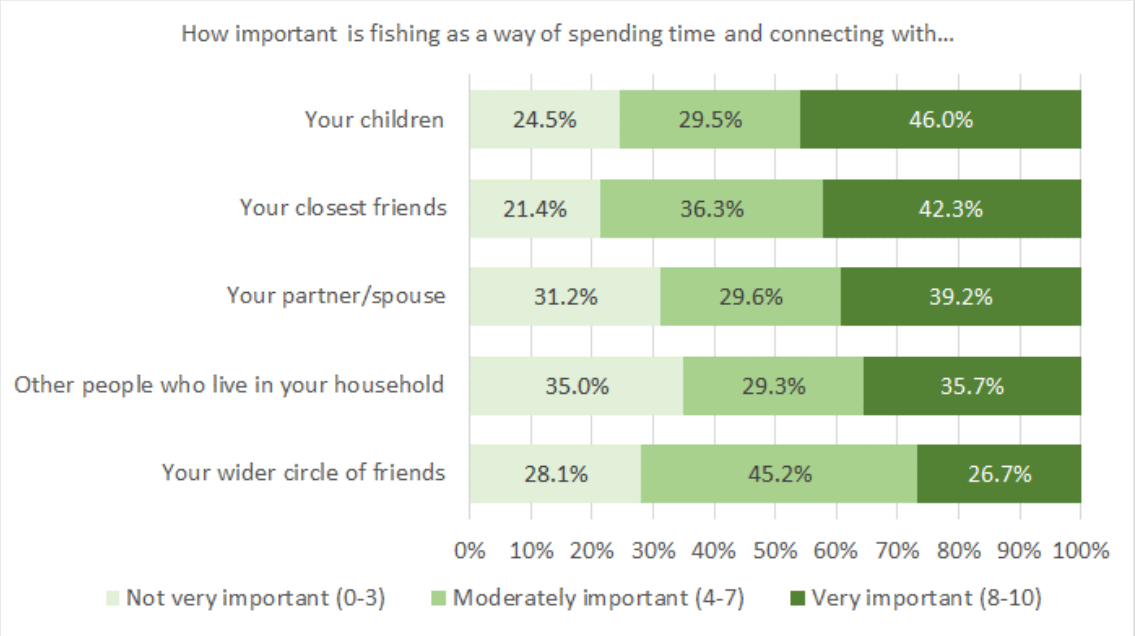


Figure 9.17 Importance of fishing as a way of spending time and connecting with family and friends, Stage 2 data

Those who reported that they did all their fishing trip on their own in the last 12 months were significantly more likely to have low levels of wellbeing compared to those who undertook some or all of their trips with others (Figure 9.18). This is consistent with the argument that fishing is more likely to have benefits for wellbeing when it involves social connection – which it does for the large majority of fishers.

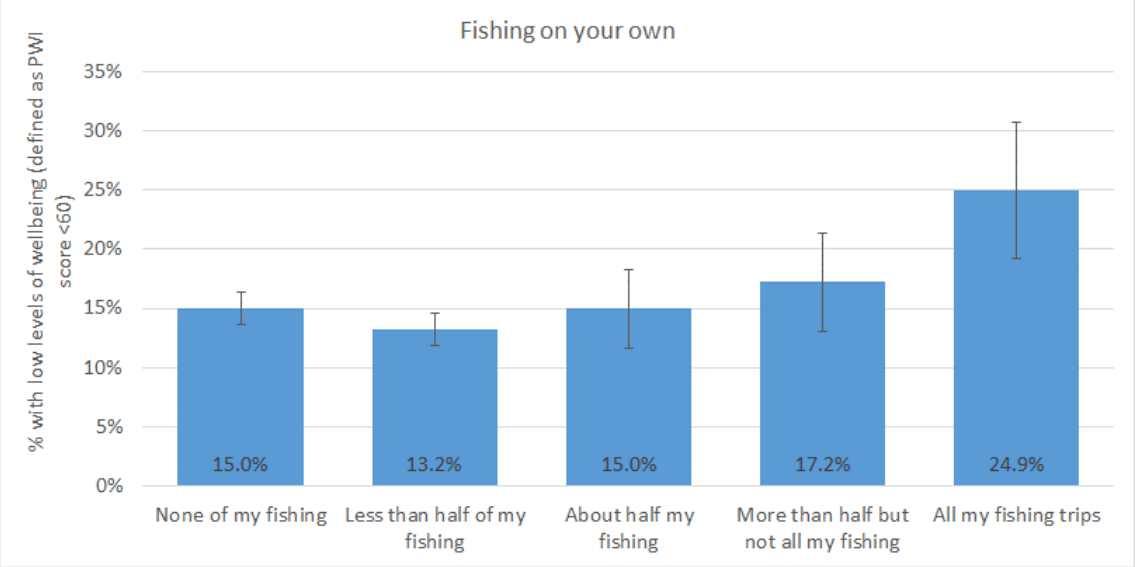


Figure 9.18 Social connection – are people who fish on their own more likely to have low wellbeing?, Stage 2 data

9.8 Conclusions

While it is often claimed that recreational fishing can have a positive impact on a person's wellbeing, few studies have examined whether empirical data supports this claim. However, many studies in recent years have established a growing body of evidence that spending time engaged in nature-based outdoor recreation has benefits for wellbeing. The findings in this chapter show that those who have gone fishing in the past 12 months have slightly but significantly higher levels of wellbeing compared to those who have not fished in the last year (a group that includes those who have never fished, and those who have fished before, but not in the past 12 months). While small, this finding does indicate the presence of a difference, given that relatively small changes in wellbeing are often meaningful. The findings also show that the 'wellbeing gap' is larger when comparing current fishers to those who used to fish but haven't done so in the past 12 months. This is consistent with the homeostasis theory of wellbeing, which argues that during normal times wellbeing is highly stable, and that activities like fishing will act to maintain a person's wellbeing at a healthy level. The small but significant increase in wellbeing found amongst fishers is consistent with this theory, suggesting that going fishing may be assisting fishers to maintain healthy levels of wellbeing.

Going fishing was also found to be protective of wellbeing amongst those experiencing significant life stresses. People who experienced significant life stresses within recent times were more likely to have low wellbeing if they didn't go fishing, while those who were able to go fishing experienced significantly less loss of wellbeing. This suggests that the common practice of encouraging people who are experiencing stressful times to go fishing to help their wellbeing is supported by evidence.

When seeking to understand *how* fishing influences wellbeing, there are many possibilities: fishing may support wellbeing through helping a person maintain and strengthen social connections, providing opportunities for nature connection, being restorative and thus helping reduce the effect of day-to-day stresses on mood and cognitive ability, building a person's sense of self-efficacy, or providing a means of maintaining physical health through physical activity.

The findings are consistent with the argument that going fishing can benefit wellbeing through supporting positive social connections: a large majority of fishers report that going fishing is an important way of building and maintaining connections with family and friends, and those who report fishing with family and friends have higher wellbeing compared to those who fish alone. The data also suggest that nature connection and restoration may be key pathways by which going fishing supports wellbeing. There was less consistent evidence supporting self-efficacy or physical health as pathways to wellbeing. However, the examination of wellbeing pathways in this dataset represents only a limited set of insights, with considerable scope to examine each potential wellbeing pathway in more depth in future studies.

Fishing is one of many activities a person may engage in to support positive wellbeing. The findings suggest that amongst those who choose to go fishing, it is an effective mechanism for supporting positive wellbeing. However, many would be able to achieve similar wellbeing benefits from other activities – as identified in Chapter 6, many fishers have at least one activity they might choose to substitute for fishing, and many undertake fishing as part of a cluster of outdoor activities that also include camping, bushwalking, kayaking/canoeing and other activities. This means that the findings in this chapter may to some extent reflect the outcomes of a person engaging in these clusters of outdoor activities, with fishing being one of them.

However, fishing is likely to be an important wellbeing determinant in its own right for at least some fishers, rather than simply one of many substitutable activities of equal utility. Chapter 6 identified that some fishers are unlikely to find other activities substitutable for fishing: fishing is highly important to them, and they are relatively specialised to fishing. Amongst this group, it is less likely that alternative activities would provide a ready substitute for the wellbeing benefits of fishing. In

contrast, amongst those who fish once or twice a year and engage in a wide range of activities, it is highly likely that other activities are highly substitutable for fishing and can readily provide similar wellbeing benefits.

Fishing is also somewhat unique in that it is an outdoor, nature-based activity that people are relatively likely to continue engaging in as they age or when they experience physical mobility limitations. Whereas engagement in many outdoor nature-based activities declines with age or physical mobility, engagement in fishing is more likely to be maintained (see Chapter 4). In other words, fishing is a highly accessible activity compared to many other outdoor recreational activities, with those who have physical mobility limitations able to participate in fishing when they may be unable to participate in others such as bushwalking. This means that fishing may provide opportunities for supporting wellbeing amongst those who are not able to participate in other activities, thus having a somewhat unique potential to support positive wellbeing across a wider range of adults compared to other activities.

10.0 Social licence of recreational fishing

Chapter authors: Jacki Schirmer and Andy Moore

10.1 Key points

- Continued access to public resources used by recreational fishing may depend on how acceptable the general public find the activity or whether it has a social licence to operate.
- This study found that most adult Australians find recreational fishing highly or somewhat acceptable rather than unacceptable or being unsure.
- Recreational fishing was among the most acceptable of activities using natural resources including recreational hunting and operations involved in bushfire control, renewable energy, forestry, agriculture and mining.
- The acceptability of recreational fishing was higher among males than females and tended to increase for older age groups.
- Being a recreational fisher or living in a household with other recreational fishers was associated with higher acceptance of this activity.

10.2 Introduction

Increasingly, having support for an activity is described as having a 'social licence' for that activity. Social licence is generally agreed to involve a person, group or community accepting or approving of a particular activity, with levels of acceptance/approval taking forms from tolerance to active support (Mather and Fanning 2019). An 'activity' can be anything from building a new mine to implementing renewable energy, establishing plantations, or engaging in different types of recreational activity.

Maintaining a social licence is important for the long-term future of recreational fishing. Most obviously, having social licence enables the activity of recreational fishing to continue: it supports continued allocation of resources for recreational fishing, and helps ensure the livelihoods of the many businesses that rely on recreational fishing for their income (Joyce & Thompson 2000; Gunningham et al. 2004; Esteves & Vanclay 2009). Conversely, loss of social licence is typically associated with pressure to reduce or stop an activity, higher levels of regulation, and reduction in access and/or increased costs of engaging in the activity (Gunningham et al. 2004; Vanclay 2014).

While the importance of having a social licence to operate is well recognised in the commercial sector, with many studies examining social licence in mining, agriculture, and to a lesser degree forestry and commercial fishing/aquaculture (e.g. Mather and Fanning 2019), relatively few studies have examined social licence related to recreation in and conservation of natural resources. Exceptions include some studies examining social licence for different approaches to environmental management (e.g. Cullen-Knox et al. 2016), including the social acceptability of rules and regulations in marine areas (e.g. Cullen-Knox et al. 2017, Kelly et al. 2017), and of specific actions such as declaration of or zoning changes in Marine Protected Areas (Voyer et al. 2015). However, social licence for activities such as recreational fishing, and for protected areas, is beginning to be examined (e.g. Kelly et al. 2019, Kelly et al. 2020).

In Australia, most fish stocks accessed by recreational fishers are publicly owned resources. This means continued support by the Australian public is important to maintaining access to these resources. The views of the public about recreational fishing may be influenced by many things, including the actions of fishing organisations, of individual fishers, and information they access about fishing. This information may come from friends, family, social media, media or other sources. For

example, social licence for recreational fishing is more likely to be maintained if the general public trust that recreational fishers are responsible when fishing, that they protect and grow fish stocks, and that recreational fishing provides benefit for the broader community. Initiatives such as the National Recreational Fishing Code of Practice, and codes of practice specific to different types of recreational fishing such as game fishing and diving, may help support social licence for fishing by encouraging fishers to comply with agreed codes of conduct for responsible fishing (Smith et al. 2016).

Social licence doesn't always change fast, but it does change. In recent years, concern has been raised about whether the Australian public will continue to support recreational fishing. For example, in 2019 Ross Winstanley raised concern that declining trust by the community in the sustainability of recreational fishing may indicate loss of social licence and called for the Australian recreational fishing sector to invest in maintaining and growing social licence (Winstanley 2019).

It's important to understand levels of social licence in order to understand whether, how and why social licence is changing, to identify whether initiatives aimed at maintaining a social licence are succeeding, and to examine the effects of emerging issues on social licence. However, there remains debate about how best to measure social licence, and what aspects of it are most important to monitor. (Gunningham et al. 2004; Owen and Kemp 2013; Bice 2013), including in the fishing and aquaculture sectors (Mather and Fanning 2019). As part of Stage 1 of the NRFS, there was opportunity to test a simple approach to measuring the extent to which recreational fishing in Australia has a 'social licence'.

10.3 Measuring social licence

Measuring social licence is not simple: different people can have differing levels of social licence for an activity and will have a range of reasons for feeling the way they do. This means that it is important to measure whether the level of social licence for recreational fishing varies across different groups of people – for example, fishers and non-fishers – as well as over time. This provides a picture of not only the overall level of social licence, but also of which groups are more supportive and which are less so.

As a first step, it is important to be able to measure the level of social licence – without a useful measure of the level, it is not possible to meaningfully examine what is driving differences or changes in those levels. Given this, Stage 1 of the NRFS examined a simple measure of social licence levels. As there was space for only a limited number of questions examining fishing in the Stage 1 surveys, this required a simple and short measure of social licence, and it was not possible to include detailed questions examining all the factors that may cause differences in levels of social licence for recreational fishing, such as views about the sustainability of fishing, like or dislike of fishing, trust in those managing fisheries, or whether a person had many friends who went fishing, amongst others.

Social licence is not simply present or absent: there are degrees of social licence. This means that measures of social licence should ideally seek to differentiate between multiple levels of social licence. For example, Thomson and Boutilier (2011) and Boutilier at al. (2015) argue that the degree of social licence given to an activity may include the following levels:

- Withheld/ withdrawn: This means that there is no social licence; if there was once one it is no longer granted.
- Acceptance: There is conditional approval for the activity to occur, but aspects of it may be criticised, and it will be heavily scrutinised.
- Approval: Most people approve of the activity and there is limited criticism of it, with many people actively supporting or facilitating the activity.
- Psychological identification: This occurs where social licence is so strong that stakeholders or communities feel a strong connection to the activity: in recreational fishing, examples might include people identifying as living in a 'fishing community', displaying stickers naming

themselves as connected to or supporting fishing, or wearing clothing promoting how much they like recreational fishing.

The idea that there are multiple degrees of social licence, rather than simply a presence or absence of a social licence, leads to an important question: what level of social licence is sufficient for an activity such as fishing to be considered to have 'enough' social licence?

While important, there is little evidence regarding what is a sufficient level of social licence. Broadly speaking, it is likely that any level above withheld/withdrawn may be sufficient for the ongoing operation of an activity, although at the acceptance level there may be ongoing debate and criticism about aspects of the activity.

While there is agreement that there are differing levels of social licence, there is not agreement on whether a survey should ask multiple questions to test these different levels, or whether a single question may be sufficient. A single question is ideal if it is effective, as it involves limited space on a survey, meaning it can be used as part of larger surveys with relatively low cost. This in turn enables larger samples and better identification of how social licence differs between regions and groups of people. However, if a single question is used, the response options should enable some identification of the level of social licence that is present, ideally corresponding to some degree with differing levels of social licence such as those proposed by Thomson and Boutilier (2011).

Some measures of social licence focus on measuring the factors believed to influence overall levels of social licence, such as the perceived legitimacy and credibility of the activity, and the level of trust in the people undertaking and governing the activity (Thomson and Boutilier 2011, Dare et al. 2014, Moffat and Zhang 2014, Gehman et al. 2017). Rather than use this approach, which required multiple questions, in this study a single 'outcome' question was asked that identified the outcomes of things such as the perceived legitimacy and credibility of recreational fishing – the degree to which a person felt that recreational fishing was an acceptable activity.

10.4 Methods

Social licence was examined as part of Stage 1 of the NRFS (see Chapter 3 for detail).

The single question asked about social licence in the RWS asked respondents 'how acceptable do you find the following activities in your local area'. They were also advised that if the activity didn't currently occur in their local area, they should 'indicate how acceptable you would find them if they did occur'. They were asked to rate the acceptability of each of a number of activities on a scale from 1 (not at all acceptable) to 7 (very acceptable); an option to respond 'don't know' was also provided. The full questionnaire is provided in Appendix 2.1. A similar set of questions has been included in the RWS since 2013 and has shown that ratings of acceptability of different practices remain relatively stable over time, irrespective of the order in which different topics are asked, and the total number and type of topics listed. There is growing use of simple acceptability ratings such as this to examine the acceptability of practices, with this usage relatively common in the health sector (e.g. Healey et al. 2011, Ho et al. 2014), and beginning to emerge when examining acceptability of actions that affect natural resources and the environment (see for example Tam and McDaniels 2013, Perlaviciute et al. 2021, Zawadski et al. 2022)

The question deliberately asked about 'acceptability'. Based on typical practice for interpreting acceptability scales in social acceptability research (e.g. Tam and McDaniels 2013, Perlaviciute et al. 2021, Zawadski et al. 2022), it was considered likely that those who answer 'very acceptable' have a level of social licence that is consistent with the approval and/or psychological identification level of social licence; those who answer in the middle of the scale have some tolerance of/acceptance of the activity but may at the same time have significant concern about or criticism of it; and those who answer 'not at all' acceptable either do not accept that recreational fishing should occur, or have stopped giving it support as an activity. Given this, when analysing responses a score of 6 or 7 was interpreted as 'very acceptable', a score of 3, 4 or 5 as 'somewhat acceptable' and a score of 1 or 2 as 'unacceptable'.

The question also asked people to indicate whether they were uncertain: this is important as not all people will necessarily have an opinion about the acceptability of recreational fishing, and they may have differing characteristics to those who have an opinion.

The question asked specifically about acceptability in a person's local area. This was done as available evidence suggests that some activities are *less* likely to be considered acceptable if occurring near where a person lives compared to if they take place some distance away, although findings vary as to the presence of a difference and, when present, the strength and extent of difference in acceptability (see for example Katranidis et al. 2003, Strazzera et al. 2012). Previous testing undertaken as part of the RWS indicated that for most activities, including recreational fishing, ratings of acceptability were slightly higher if people were asked to rate their views about the activity in general, and slightly lower if asked to rate their views about the activity when or if it occurred in their local area (Schirmer and Mylek 2023).

The other activities asked about were not selected specifically to be comparable to recreational fishing but were issues of relevance to a range of other users of RWS data. This means that there was only one other recreational activity asked about – 'recreational hunting other than fishing' – while other activities mostly involved commercial use of natural resources, or environmental regulation/governance practices. The common theme amongst the questions was that all asked about use of natural resources, including water, agricultural land and livestock, minerals, energy, and natural areas.

All data presented in this chapter are weighted to be representative of the Australian adult population.

10.5 Findings: overall acceptability of recreational fishing in Australia

The findings show that in 2018, recreational fishing was considered highly acceptable by most adult Australians. As shown in Figure 10.1:

- An estimated 61.0% of adult Australians felt that recreational fishing was a very acceptable activity
- 18.1% felt recreational fishing was somewhat acceptable: this group was likely to still feel fishing is an activity that is acceptable to some degree, but may hold some concerns about aspects of fishing, or about fishing occurring in specific locations
- 8.2% found recreational fishing an unacceptable activity
- 12.7% were unsure.

Recreational fishing was considered one of the most acceptable of the different natural resource use activities asked about (Figure 10.2 and 10.3). Recreational fishing was one of a group of four activities considered moderately to highly acceptable by most adult Australians, with few – less than 15% - indicating they found the activity unacceptable, and between 10% and 15% being uncertain. The other activities in this group were controlled burning to reduce bushfire risk, establishment of wind farms, and establishment of solar farms. Of the activities asked about that involved natural resource management, only controlled burning to reduce bushfire risk had higher acceptability[21]. Recreational fishing was viewed quite differently to 'recreational hunting other than fishing', with fewer people finding recreational hunting acceptable compared to recreational fishing.

[21] The difference between views of recreational fishing and controlled burning was also not statistically significant, as shown by the 95% confidence intervals in Figure 10.2.

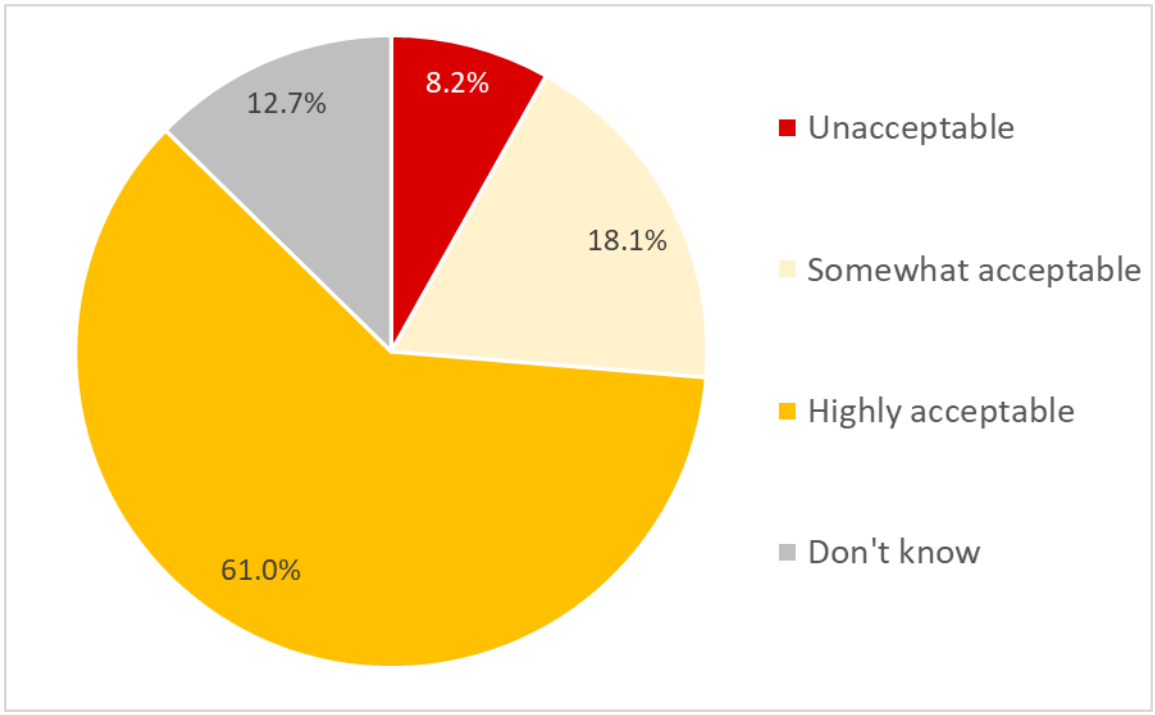


Figure 10.1 Overall views about acceptability of recreational fishing in their local area by adult Australians, Stage 1 2018 RWS data

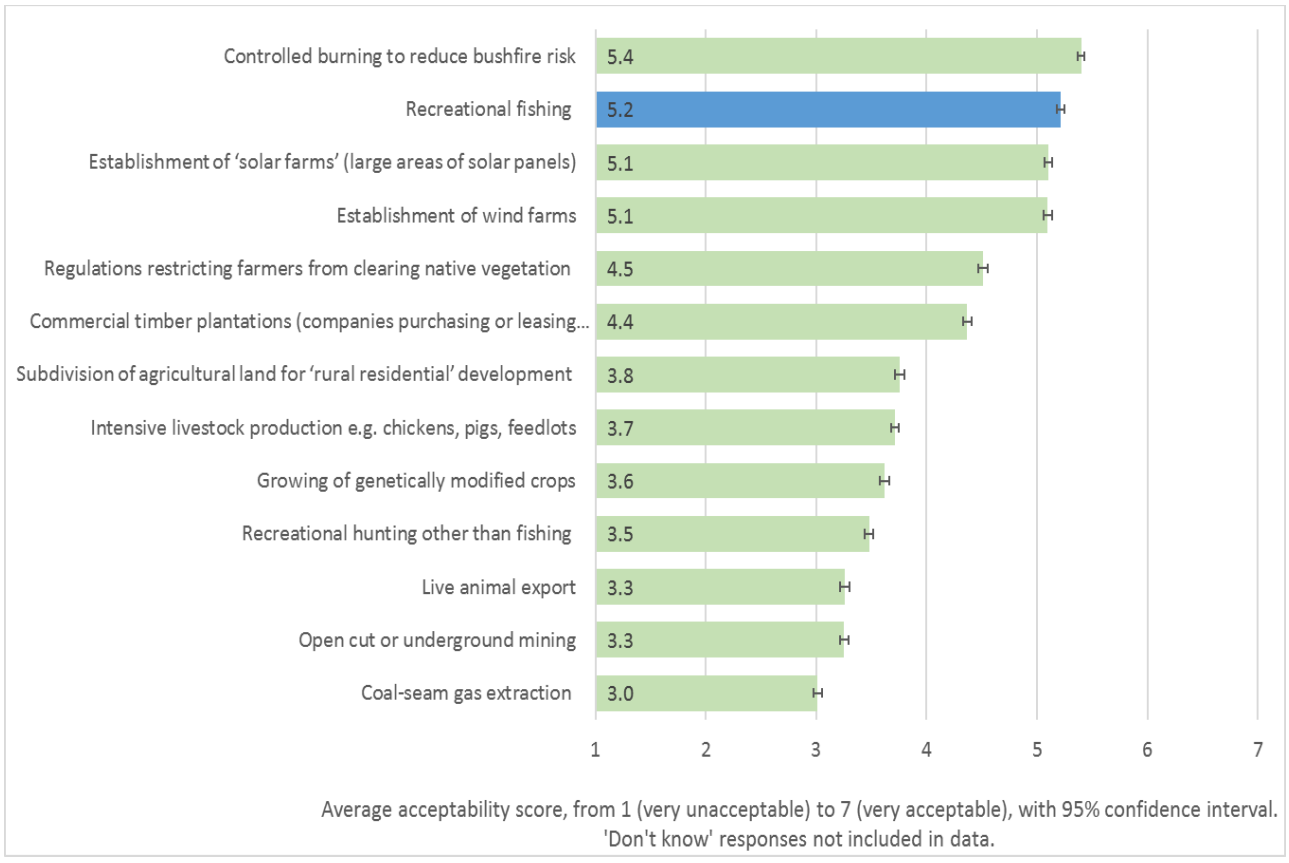


Figure 10.2 Acceptability of recreational fishing in local area compared to other activities: average score (don't know responses not included), Stage 1 2018 RWS data

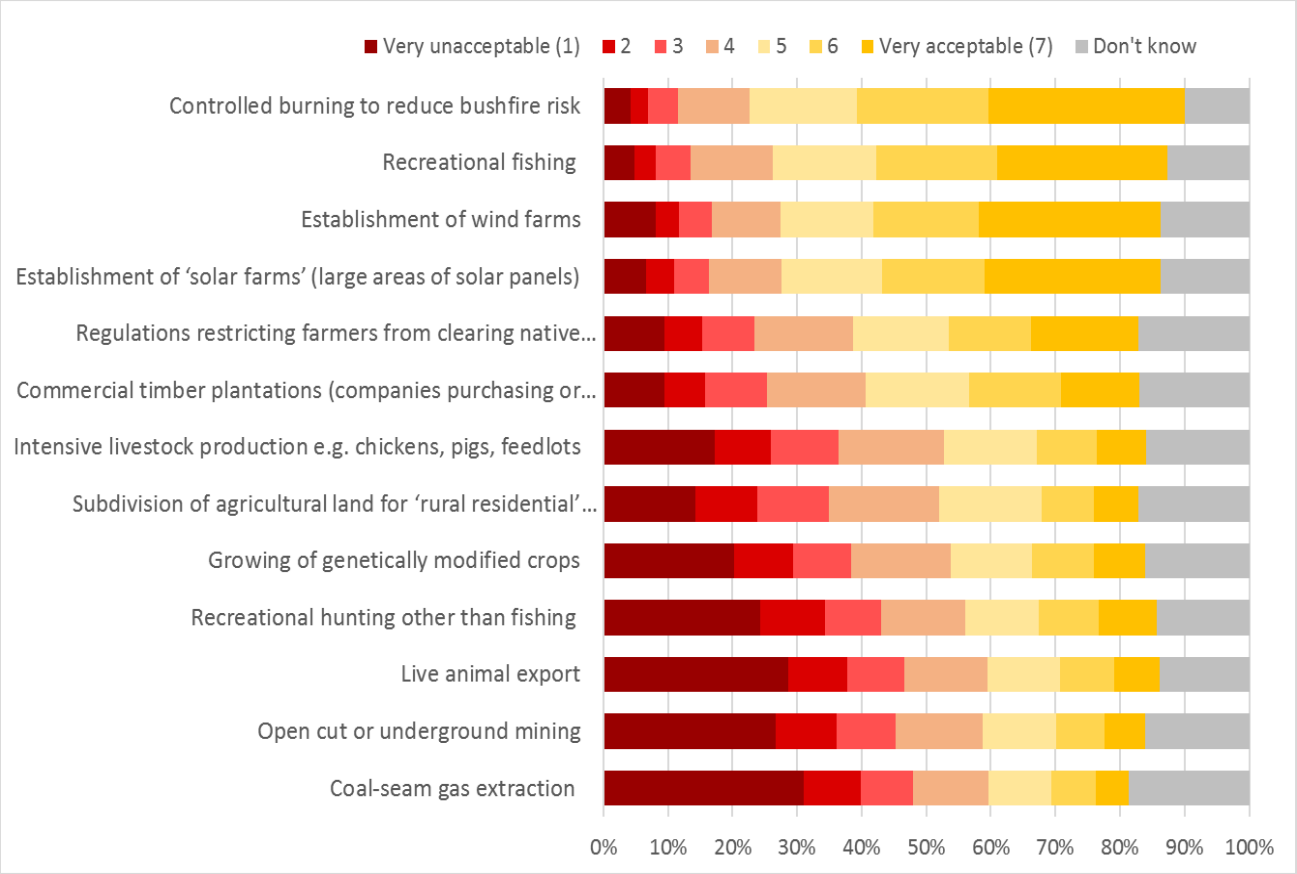


Figure 10.3 Acceptability of recreational fishing in local area compared to other activities: proportion reporting differing levels of acceptability, ordered from most acceptable to least acceptable, Stage 1 2018 RWS data

10.6 Levels of social licence for recreational fishing amongst different groups

Acceptability of recreational fishing was higher amongst those who either fished themselves, or who knew others who were recreational fishers. Those who had never fished in their life, and who lived in a household where no-one fished, were significantly less likely to consider fishing acceptable compared to those who fished themselves, and/or lived in a household where someone else went fishing (Figures 10.4 and 10.5).

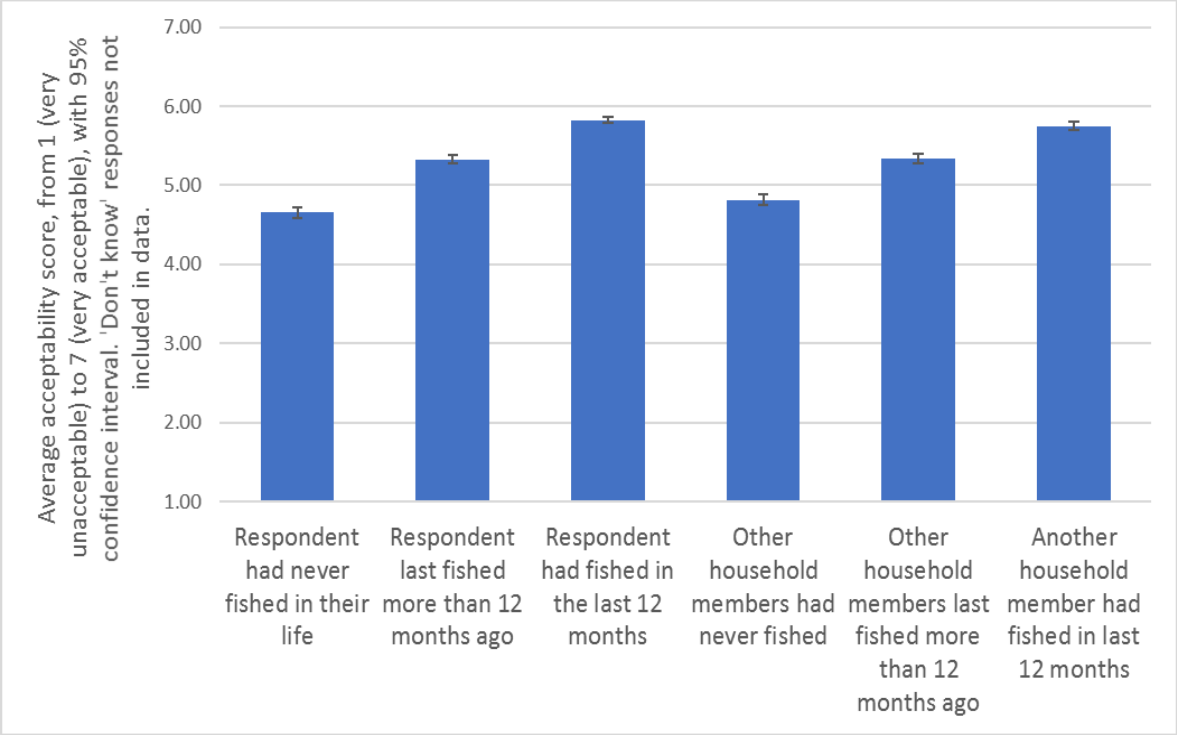


Figure 10.4 Acceptability of recreational fishing amongst fishers and non-fishers: average score (don't know not included), Stage 1 2018 RWS data

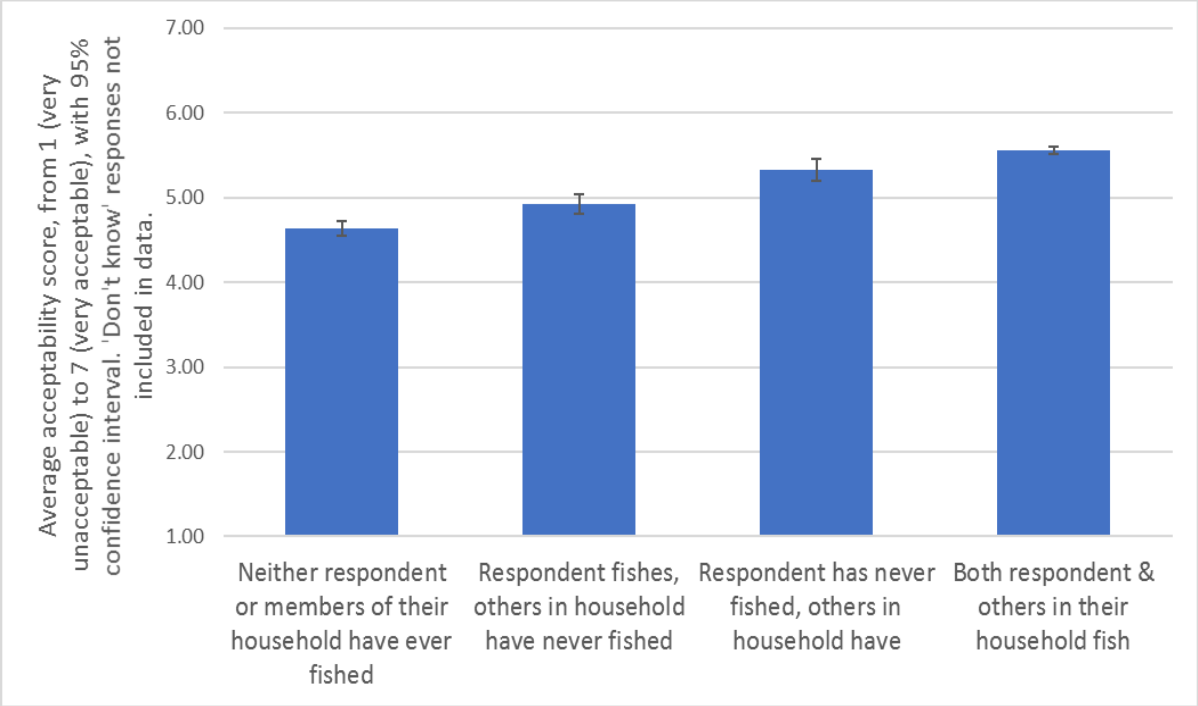


Figure 10.5 Acceptability of recreational fishing by contact with fishing activity: average score (don't know not included), Stage 1 2018 RWS data

The results suggest that both a person's own engagement in fishing *and* that of others in their household are important. Acceptability of fishing was lowest amongst those who had never fished themselves and lived in a household where others never fished, and higher in households where both the respondent and others in their household fished (Figure 10.6). Those who have never fished and live in a household where no-one else goes fishing still showed overall support for recreational

fishing, with 45% indicating they strongly support fishing as an activity and 22% indicating low to moderate support (Figure 10.6). However, this was significantly lower compared to those who fish and live in a household where others fish (in these households 71% strongly support fishing and 15% indicated low to moderate support).

This is consistent with the finding of Arlinghaus et al. (2015) that having a connection to a strong fishing culture is important for fishing participation, and suggests that this connection is important not just for participation in fishing, but may increase the likelihood that a person accepts or approves of recreational fishing as an activity.

The survey results suggest amongst those with little contact with recreational fishing, there is both higher uncertainty about the acceptability of fishing, and a greater likelihood of finding recreational fishing unacceptable (Figure 10.6). The proportion of people who report finding recreational fishing unacceptable is 7.8% higher amongst non-fishers compared to those who fished in the last 12 months (from 5.1% to 12.9%), and the proportion who are uncertain is 11.5% higher (going from 8.9% to 20.4%).

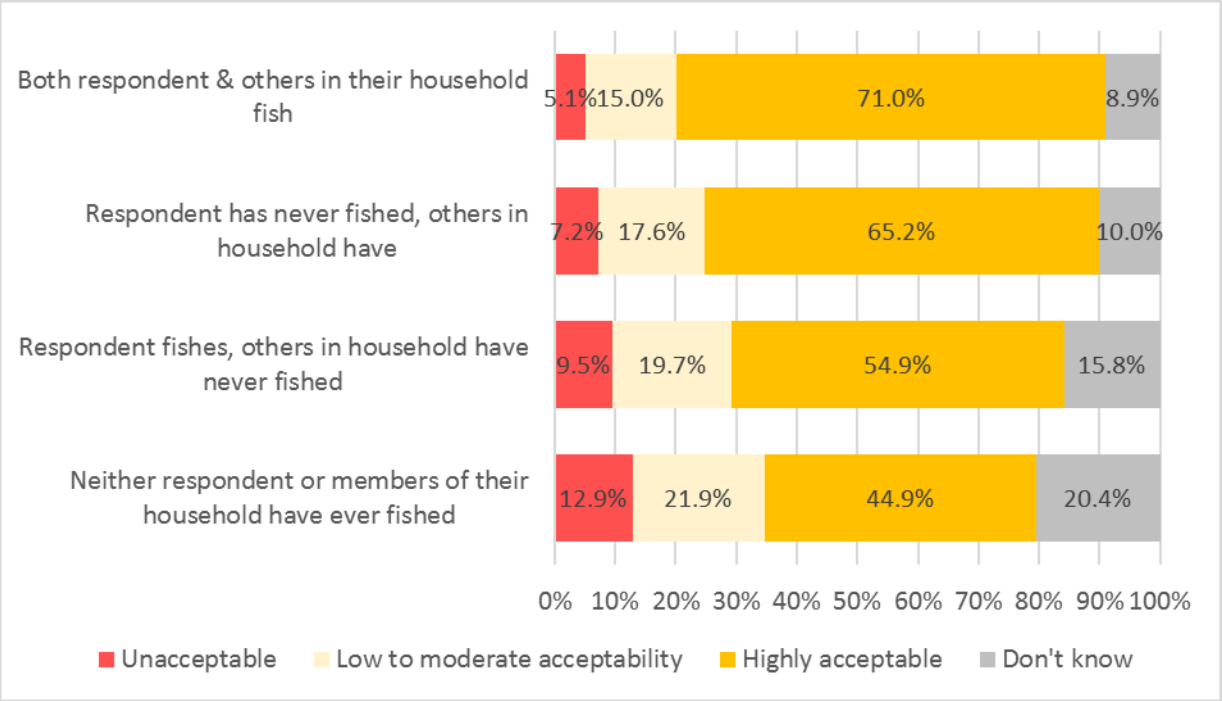


Figure 10.6 Acceptability of recreational fishing amongst fishers and non-fishers: proportion reporting differing levels of acceptability, including 'don't know' responses, Stage 1 2018 RWS data

Acceptability of fishing also varied depending on a person's demographic characteristics: younger Australians were less likely than older people to find recreational fishing acceptable, and women slightly less likely than men.

While a majority of both men and women felt recreational fishing was highly acceptable, women had a slightly (but significantly) lower acceptability score (Figure 10.7). However, the largest difference was between age groups: the younger a person was, the less likely they felt recreational fishing was highly acceptable, increasing from an average of moderate acceptance amongst those aged 18 to 24, to very high acceptance amongst those aged 55 and over (Figure 10.8). Figure 10.8 shows that this difference is driven not by higher uncertainty amongst younger people about the acceptability of fishing, but by lower acceptability ratings. In other words, younger people on average are less likely to find recreational fishing a highly acceptable activity, and more likely than older people to feel it is unacceptable or of low/moderate acceptability.

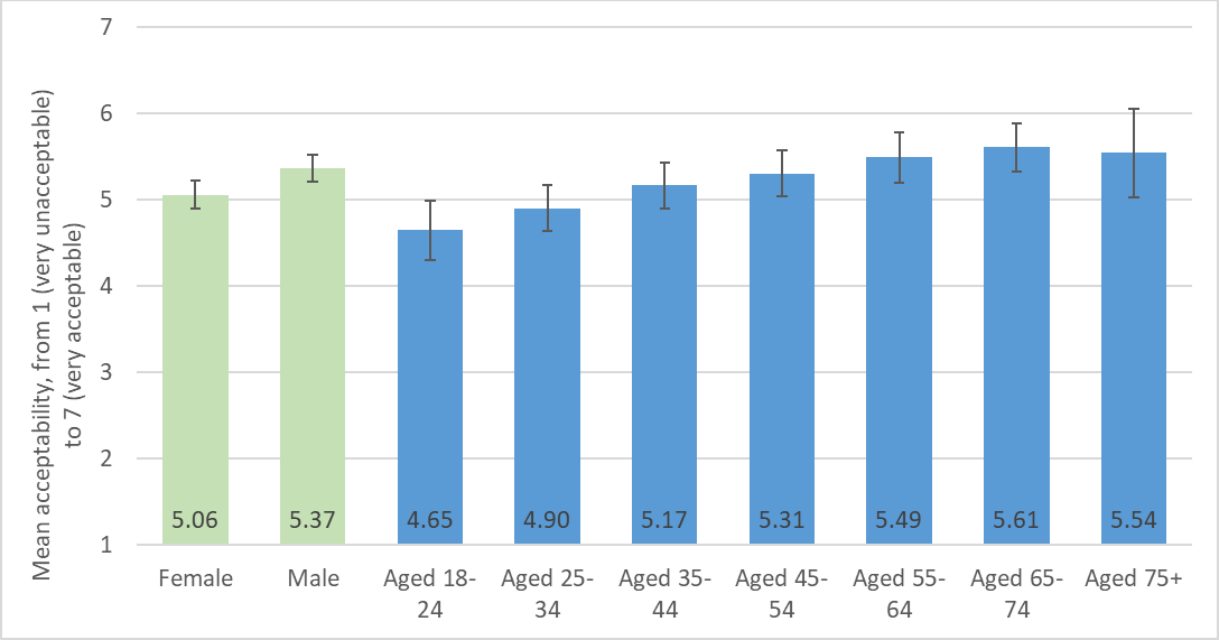


Figure 10.7 Acceptability of recreational fishing by gender and age group: average score (don't know not included), Stage 1 2018 RWS data

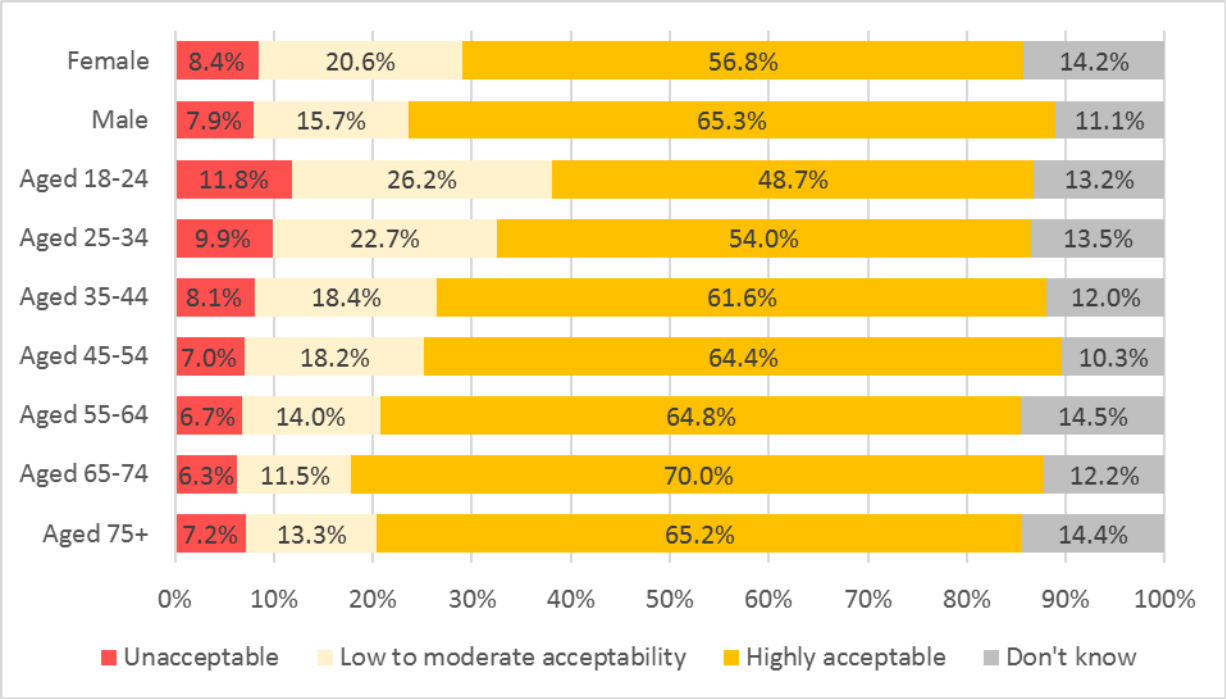


Figure 10.8 Acceptability of recreational fishing by gender and age group: proportion reporting differing levels of acceptability, including 'don't know' responses, Stage 1 2018 RWS data

Views about acceptability of fishing did not vary substantially between people who identified as Aboriginal or Torres Strait Islander, who were born in Australia, and who were born in other countries (Figures 10.9 and 10.10). Those born overseas in non-English speaking countries were slightly (and significantly) less accepting of fishing compared to others, but still on average reported viewing recreational fishing as having moderate to high acceptability.

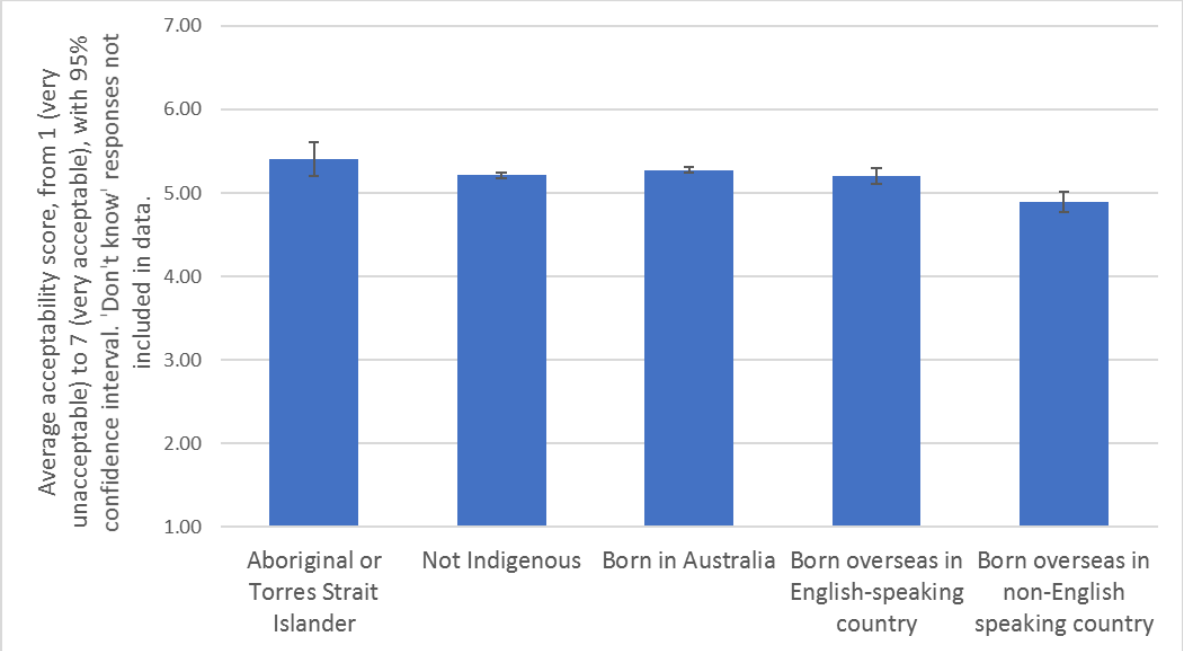


Figure 10.9 Acceptability of recreational fishing by cultural background: average score (don't know not included), Stage 1 2018 RWS data

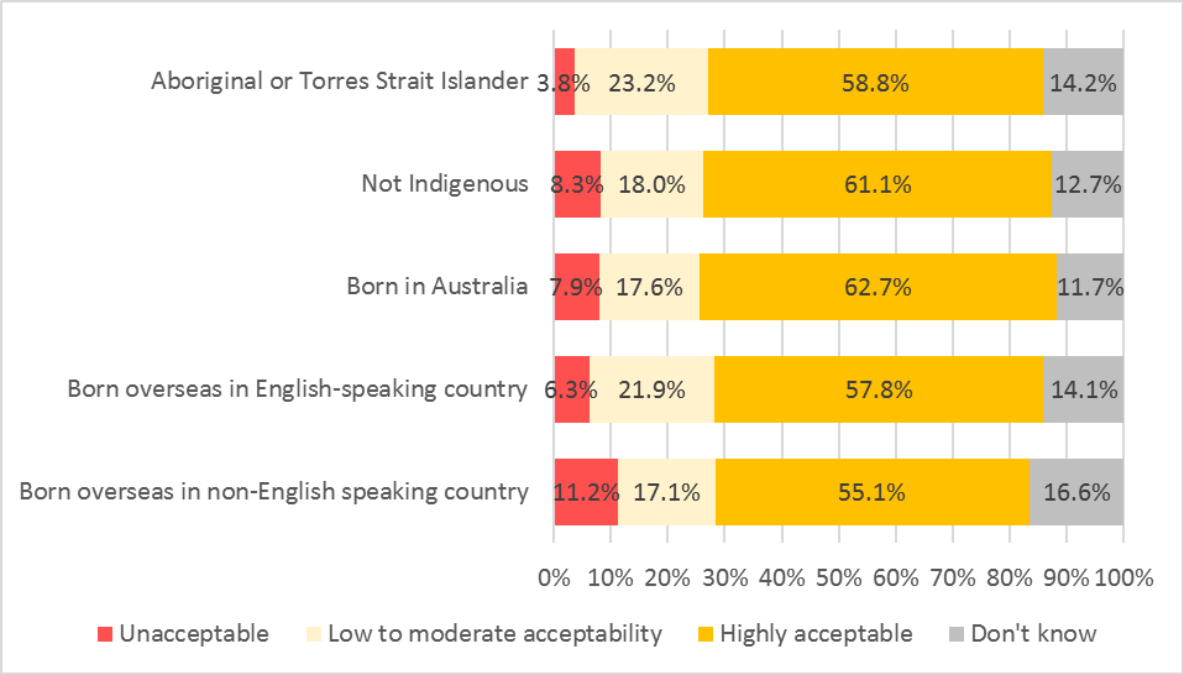


Figure 10.10 Acceptability of recreational fishing by cultural background: proportion reporting differing levels of acceptability, including 'don't know' responses, Stage 1 2018 RWS data

Similarly, there was little difference in views of those who had different levels of household income (Figures 10.11 and 10.12). However, one group was significantly less likely to report finding recreational fishing acceptable: those on very low incomes were less likely to find fishing acceptable. This may in part reflect a degree of confounding with age, as amongst those who are working, incomes are lowest amongst those aged under 25 – the group least likely to find recreational fishing acceptable (ABS 2022b). However, while somewhat more prevalent amongst younger adults, low incomes occur across all age groups, and it is likely that factors beyond age may contribute to the lower acceptability of fishing amongst those on lower incomes. Other studies have, for example, found that there are higher rates of fishing participation amongst those with higher incomes

(Arlinghaus et al. 2015). Other possibilities that warrant exploration include the possibility that those on low income view fishing as an activity associated with higher wealth.

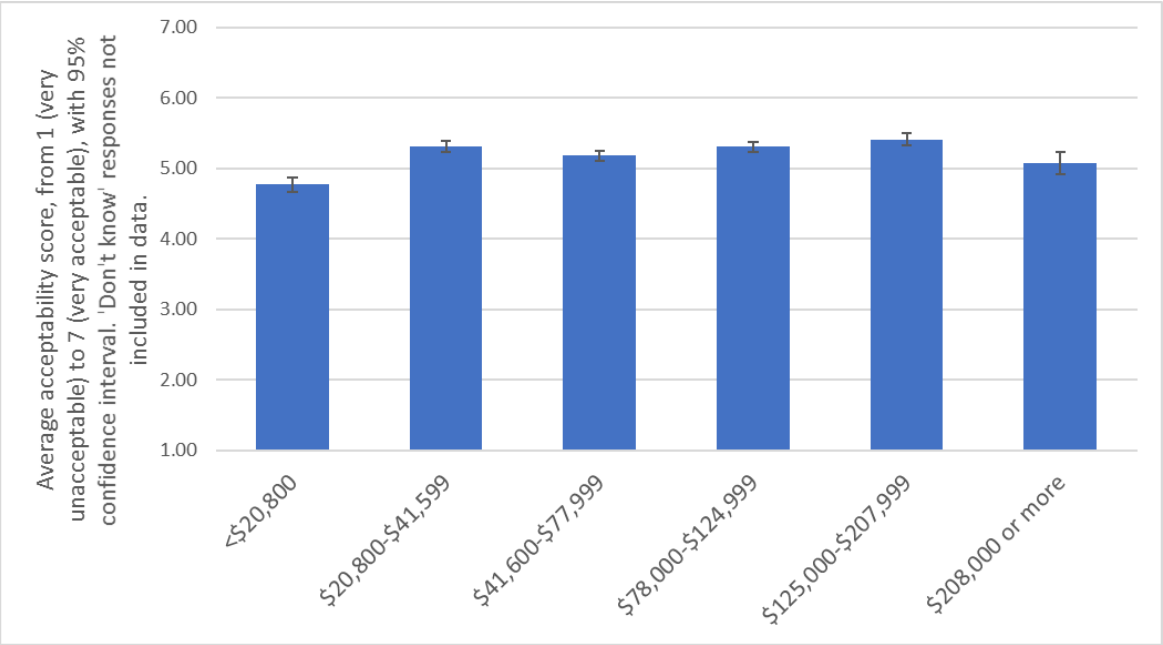


Figure 10.11 Acceptability of recreational fishing by annual household income 2017-18: average score (don't know not included) , Stage 1 2018 RWS data

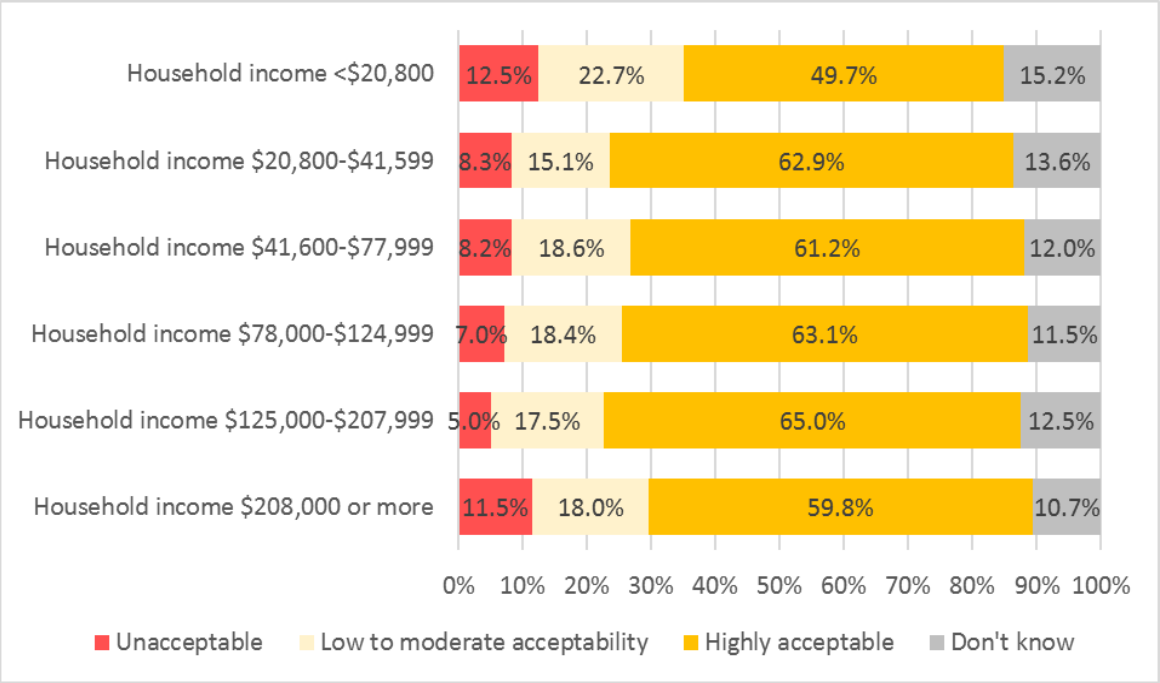


Figure 10.12 Acceptability of recreational fishing by annual household income 2017-18: proportion reporting differing levels of acceptability, including 'don't know' responses, Stage 1 2018 RWS data

Where a person lives is a significant predictor of acceptability of recreational fishing – in particular, whether a person lives in a major city of Australia (defined as the greater cities of Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra), or in what are termed inner regional, outer regional, or remote areas. As described in Chapter 4, inner regional areas are typically within a couple of hours drive of major cities or have a regional city; outer regional areas are a longer drive from key services,

and remote areas are those where residents have a very long drive to get to a significantly sized city (Baxter et al. 2011).

People living in Australia's major cities are significantly less likely to find recreational fishing acceptable than people living in areas outside major cities, with 57% finding recreational fishing highly acceptable, compared to 70% or more of those living in regional, rural and remote areas (Figures 10.13 and 10.14). Those living in major cities were around 6% more likely to be uncertain whether fishing was acceptable, 4% more likely to find it unacceptable, and 4% more likely to feel it has low to moderate acceptability, compared to those living outside major cities. This is likely to reflect a number of factors, including the lower participation in recreational fishing amongst those living in inner city areas identified both in Chapter 4 and in previous studies (e.g. Henry & Lyle 2003), and possibly also the somewhat younger average age of those living in Australia's capital cities (median age of 37.1 as of 2021) compared to rural/remote regions (median age of 41.8) (ABS 2022c).

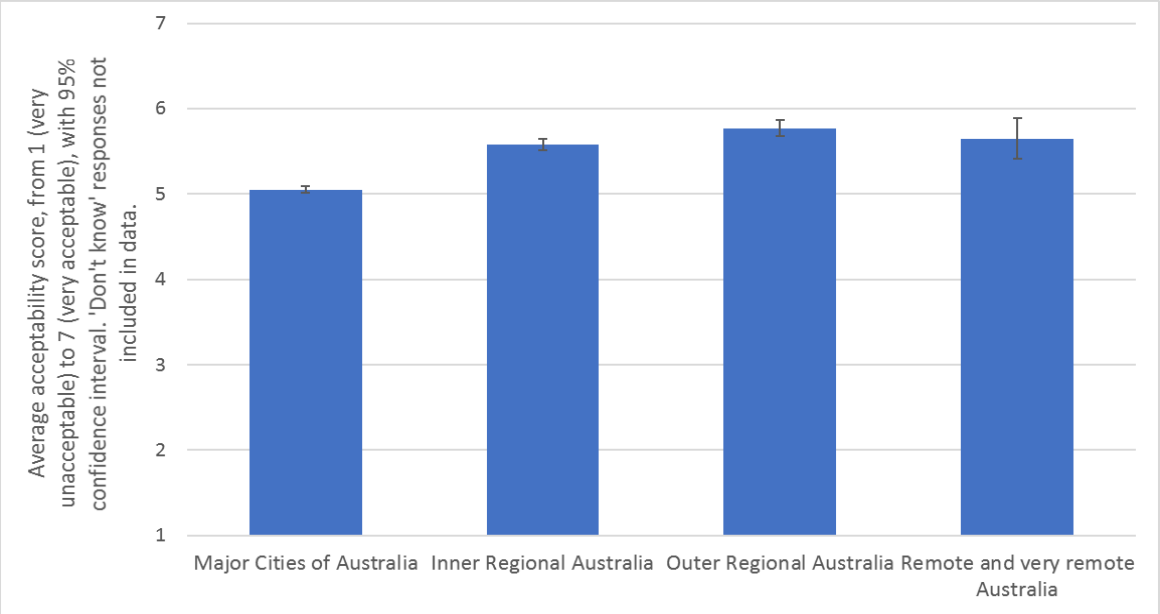


Figure 10.13 Acceptability of recreational fishing in major cities, regional and remote areas of Australia: average score (don't know not included), Stage 1 2018 RWS data

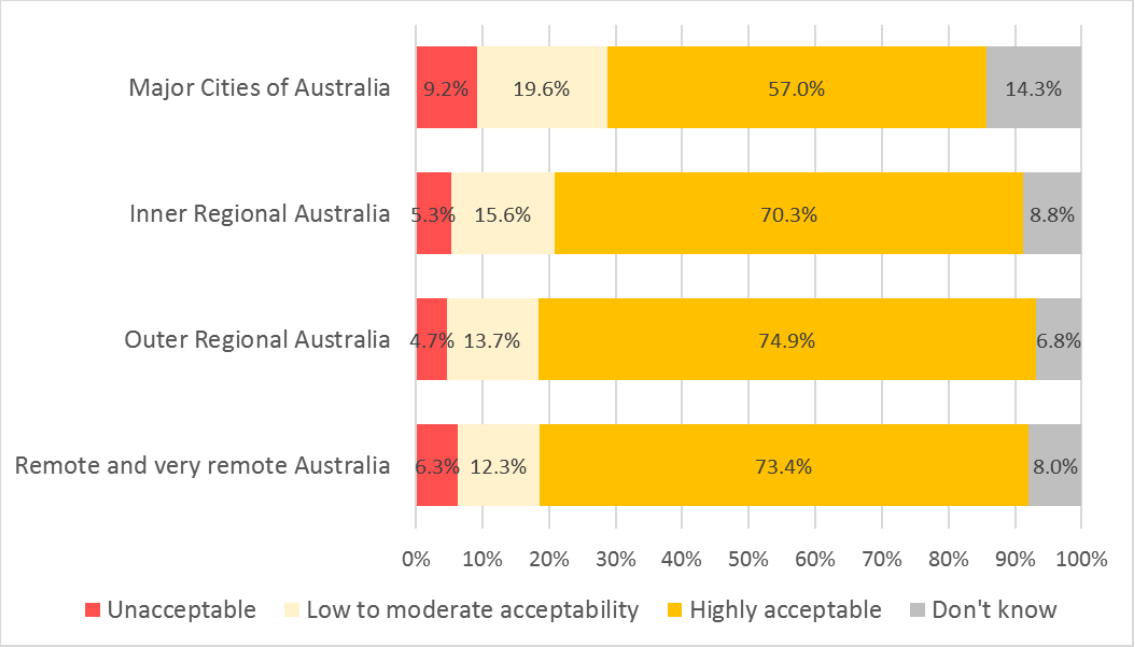


Figure 10.14 Acceptability of recreational fishing in major cities, regional and remote areas of Australia: proportion reporting differing levels of acceptability, including 'don't know' responses, Stage 1 2018 RWS data

10.7 Conclusions

Overall, the findings of this simple measure of social licence suggest recreational fishing currently has positive social licence in the Australian community. Most Australian adults find fishing a highly acceptable activity, and most of the remainder find it moderately acceptable or are uncertain, with less than one in ten feeling recreational fishing is an unacceptable activity. This overall high level of acceptability suggests that for a significant proportion of the Australian adult population, there is either high approval or psychological identification with recreational fishing.

While the measure of social licence used in Stage 1 was useful for identifying overall levels, care is needed in its interpretation. For example, it should not be assumed that a person who finds recreational fishing highly acceptable is supportive of all types of recreational fishing – they may hold concerns about specific types of fishing, or specific aspects of recreational fishing, while also supporting it strongly overall. Similarly, a person who finds recreational fishing unacceptable to some degree should not be assumed to be opposed to all recreational fishing – they may find it acceptable under some circumstances and not others or want to see significant change in aspects of how it is managed.

Some groups were found to be less likely than others to find recreational fishing highly acceptable: younger people, those who live in households that never go fishing, and those living in major cities. It is not possible to identify based on these data whether a person's views about acceptability are likely to change as they age, or whether the views held at a younger age are good predictors of views a person is likely to hold when they are older.

Australia's population has been urbanising over time and is expecting to continue urbanising in coming decades (ABS 2018, Australian Government 2020). Given this, and that younger people are somewhat less likely to have contact with fishing than older people, it is possible that without intervention to support social licence, current high levels of support for recreational fishing will decline over time.

These findings do not mean social licence *will* decline – measurement at a single point in time is not sufficient to identify whether this is the case. Whether social licence changes depends on many

factors, including whether the views of younger people are likely to stay the same as they grow older. The findings do however suggest that there is risk of decline over time and highlight a need to monitor how social licence for recreational fishing is changing, as well as examine it in more depth to better understand the multiple factors that are likely to influence it.

Further work is needed to understand what influences higher and lower levels of acceptance of recreational fishing amongst different groups of people. A range of work has examined the factors influencing social licence more generally (e.g. Thomson and Boutilier 2011, Dare et al. 2014, Moffat and Zhang 2014, Gehman et al. 2017, to name just a few). Additionally, studies that report on the views people hold about different aspects of recreational fishing, including its sustainability, views about catching, handling and eating aquatic species, and other aspects, can shed light. For example, this report, Chapter 4 identifies factors commonly associated with choosing not to fish, which may also influence views about social acceptability.

Further work is also needed to identify the actions that may assist in maintaining or growing social licence. For example, the finding that lack of contact with fishing is a predictor of lower social licence suggests one possible pathway for maintaining social licence of fishing may be investing in programs that provide opportunities for those who live in households that don't fish to try fishing. However, this is one of many possible actions, and further work to identify the wider range of factors that influence acceptability is needed to enable appropriate targeting of investment; as is better understanding of the type of action needed. For example, if lack of contact is an area that can be invested in to address low acceptability, further questions would need to be explored, including how much contact with fishing may be needed to build social licence, and whether programs in which people other than family and friends introduce a person to fishing have similar effects to family and friends encouraging a person into fishing.

The measure of social licence used was a simple, single item measure in which levels of acceptability reported by the survey respondent were assumed to have some degree of correspondence to level of social licence. Future measurement of social licence should seek to use measures that more explicitly identify what high versus low acceptability mean: for example, if a person feels fishing is moderately acceptable, does this mean they support fishing overall but want to feel confident fishing is sustainable, or does it mean they have relatively lower support for the entire activity of recreational fishing compared to someone who finds fishing very acceptable? Accompanying this should be measures that examine in more detail what factors influence how acceptable a person finds recreational fishing.

11.0 Recreational fishing and environmental stewardship

Chapter authors: Jacki Schirmer and Andy Moore

11.1 Key points

- This study found that recreational fishers most commonly contributed to environmental stewardship by picking up rubbish when out fishing, participating in clean-up days, donating to aquatic health organisations, and being part of organised habitat restoration activities.
- A smaller proportion of recreational fishers participated in collecting data that contribute to fisheries or other scientific assessments, such as providing information on fishing activities, reporting sightings of particular species, recording environmental or habitat conditions, tagging or catching fish, or collecting water samples.
- The proportion of recreational fishers willing to be involved in future scientific data collection was larger than those who participated in the previous year.
- Whether recreational fishers can appropriately collect scientific data may depend on their ability to comply with fishing rules and regulations, use best practice fish handling practices and accurately identify the species they catch; recreational fishers had the lowest confidence in the latter of these.
- It is possible that these findings are affected by social desirability bias (the desire to report 'doing the right thing'.

11.2 Introduction

Environmental stewardship is important in all areas of life, and recreational fishing is no exception. Being a good steward of the environment is important for many reasons. First and foremost, for recreational fishing to be sustainable into the future, it is critical that aquatic habitats are in good health. Recreational fishers can contribute to this in many ways, from ensuring their own fishing practices are sustainable, to supporting activities like monitoring environmental health and habitat restoration activities.

Recent years have seen concerns that recreational fishing risks having a 'legitimacy gap' in relation to environmental stewardship. Some argue that recreational fisheries are less regulated compared to commercial fisheries, and have less oversight in terms of actions such as catch reporting, stock assessment and fishing to manage stock levels; or that recreational fishers have fewer incentives to meet responsible fishing standards compared to commercial fishers (McPhee et al. 2002, MacKenzie and Cox 2013). Many factors can contribute to these challenges:

> *'Enforcing compliance with rules and regulations in recreational fisheries has proved difficult due to factors such as the high number of participants and costs of enforcement, the absence of regular monitoring of recreational fishing activity, and the inherent difficulties in accurately determining catch levels. The effectiveness of traditional punitive deterrence is limited, yet current management is heavily reliant on this compliance approach.'* (Mackay et al. 2018, p. 256)

Others, however, argue that recreational fishers are likely to be intrinsically motivated to be good environmental stewards, as they have a vested interest in caring for the resources their fishing activities rely on (Granek et al. 2008). This results in significant voluntary investment in responsible fishing and environmental stewardship activities by recreational fishers.

There are clearly both challenges and opportunities for environmental stewardship in recreational fisheries. Challenges include difficulties in applying regulatory frameworks and reporting approaches used in commercial fisheries into the very different contexts of recreational fishing. Opportunities include the strong motivation of recreational fishers to be good stewards, which may enable and encourage fishers to engage in a range of actions to support environmental health.

Investments that seek to support positive environmental stewardship of recreational fisheries take many forms. They include investing in methods to better estimate recreational take; development and promotion of codes of practice for recreational fishers; development of a wide range of citizen science initiatives that involve recreational fishers; and aquatic habitat restoration and habitat enhancement activities (referred to as habitat restoration activities from this point on), amongst others.

One thing all of these diverse actions have in common is that they rely on the active participation of recreational fishers. For example, estimating recreational catch can be challenging, as the large numbers of recreational fishers, often fishing from multiple locations, and each catching a small amount, make it harder to monitor catch and effort in recreational fishing compared to commercial fishing. Achieving reliable estimates of recreational catch that can inform stock assessments in those fisheries with a large share of recreational effort requires the active participation of recreational fishers. For example, surveys of catch and effort rely on achieving sufficient participation by fishers to accurately estimate sampling error, non-response and recall bias effects, amongst other issues (Ryan et al. 2016), while methods such as harvest tags also rely on recreational fisher compliance for their effectiveness (Jackson et al. 2016).

A key environmental stewardship action implemented in Australia is the use of a code of practice for recreational fishing. A national code of practice for sport and recreational fishing was first introduced in Australia in 1995 by government, recreational fishers and peak bodies representing fishers, and has been updated since (Smith et al. 2016). Internationally, codes of practice for recreational fishing have also been introduced (Arlinghaus et al. 2010). However, there is a lack of information regarding the effectiveness of codes of practice in supporting environmental stewardship, and in how confident recreational fishers feel in their ability to fish responsibly.

As well as investing in improving estimates of recreational catch and effort, and development of codes of practice to support good environmental stewardship, recreational fishers are increasingly encouraged to become engaged in a range of other environmental stewardship activities. These include involvement in citizen science initiatives, in which fishers contribute to collecting the data needed to increase knowledge of environmental health more generally. The types of data collected range from data on water quality to sightings of species (including fish and other aquatic species, birds, and others), and reporting of environmental problems (McPhee 2017). Participation by recreational fishers in habitat restoration activities, habitat enhancement/ creation activities such as development of artificial reefs, and stock enhancement through breeding and release programs, is also commonly encouraged (Gregory and Grant-Smith 2022, McPhee 2017). These types of activities ask fishers to be actively responsible for a wide range of environmental stewardship activities. However, some argue that the growing number of requests for fishers to engage in these types of activities is a type of ‘responsibilisation’ that can mean that ‘recreational fishers are being tasked with shouldering a disproportionate stewardship burden’ (Gregory and Grant-Smith 2022, p. 1).

With many different actions forming part of environmental stewardship of recreational fisheries, it is important to understand the extent to which fishers feel able to participate in different forms of stewardship. This understanding can help inform design of strategies to support engagement in environmental stewardship actions by recreational fishers (Mackay et al. 2018), and ensure they are effective and do not result in unintended biological, social or economic consequences (Arostegui et al. 2021, Haase et al. 2022).

While a complex range of factors may contribute to a fisher being a ‘good steward’ (Feldman 2021), understanding how confident fishers feel in engaging in different aspects of stewardship, they extent

to which they do engage, and their willingness to contribute to a range of stewardship activities in future, can provide useful insight.

11.3 Methods

The survey data examined in this chapter were collected as part of the Stage 3 wash up survey. The Stage 3 survey involved asking question of both fishers who had participated in multiple surveys as part of Stage 3 *and* asking the same questions of a broader range of fishers who took part in the RWS. The sample analysed in this chapter was those responding to the RWS only. This was done as the sample responding to the RWS was not biased to avid fishers, unlike the sample participating in regular surveys during Stage 3, and because there was a somewhat lower risk of social desirability bias in responses of RWS participants (the likelihood of a person answering a question in a way they believe is socially desirable rather than in a way that reflects their actual experiences). In total, 2,400 recreational fishers answered questions about their recreational fishing activities as part of the 2021 RWS. Of these, 641 answered detailed questions about their participation in environmental stewardship activities; this sample is examined in this chapter.

Recreational fishers were asked questions examining (see Appendix 2.9 for full questionnaire):

- Confidence in being able to identify species caught when fishing, identify boundaries where fishing rules change, comply with fishing rules and regulation, access information on stock status, and use best practice fish handling techniques
- Experience of identifying environmental problems or illegal activities when fishing
- Participation in a range of stewardship activities including accessing information, seminars, workshops etc on best practice fish handling, picking up rubbish/litter or clean up days, participation in habitat rehabilitation/protection activities, donating to organisations that seek to protect and improve health of aquatic environments, teaching others about responsible fishing, participating in collecting scientific data, for example by completing catch surveys, tagging fish, reporting species sightings, or collecting samples, and reporting environmental problems or illegal activities
- Willingness to get involved in stewardship activities in future, and
- Views about recreational fishers reporting catch data.

Chapter 3 provides a detailed description of data collection methods. All data presented in this chapter are weighted to be representative of the broader population.

Some care is needed in interpreting the findings presented in this chapter: while based on a sample of fishers recruited as part of the RWS – and hence being less likely to be biased to highly avid fishers than data collected in surveys aimed specifically at recreational fishers – there is a possibility that answers were influenced by social desirability bias. Social desirability bias refers to a person claiming to have done something when asked about it due to believing it is a socially desirable thing to do. Questions about stewardship have a relatively high risk of this type of bias, as they are asking about engagement in practices often viewed as socially desirable. However, it is not known to what extent social desirability bias is likely to have affected answers; some studies have found little to no evidence of the presence of this bias when asking about engaging in activities typically viewed as environmentally friendly (e.g. Cheek 2007). It was not possible to administer a separate set of questions testing for the likelihood of desirability bias. Given this, the findings should be considered to represent the maximum likely level of participation by recreational fishers in the activities asked about, with the true figure potentially being lower than that indicated if social desirability bias affected findings.

11.4 Results: Fishing responsibly

The first aspect of environmental stewardship examined was fishing responsibly. Having the knowledge and skills to fish responsibly is core to ensuring sustainability of fishing over time. Fishers were asked about the extent they felt able to comply with rules, regulations and codes of practice intended to ensure long-term sustainability of target and non-target species.

Fishers were asked how confident they were in their knowledge and skills to fish responsibly, focusing on species identification, ability to comply with fishing rules and regulations, and fish handling practices (Figure 11.1). Most fishers were confident in their ability to comply with fishing rules and regulations (69.6% having high confidence and 19.7% moderate confidence), and to assess whether their catch met size requirements (67.6% and 17.7%). Fewer had high confidence in their ability to use best practice fish handling practices, identify species, identify boundaries where fishing rules change, or access good information on stock status. Almost one in five fishers had low confidence that they were able to use best practice fish handling practices, and one in four had low confidence in identifying the species they caught, and in identifying the boundaries where fishing rules change.

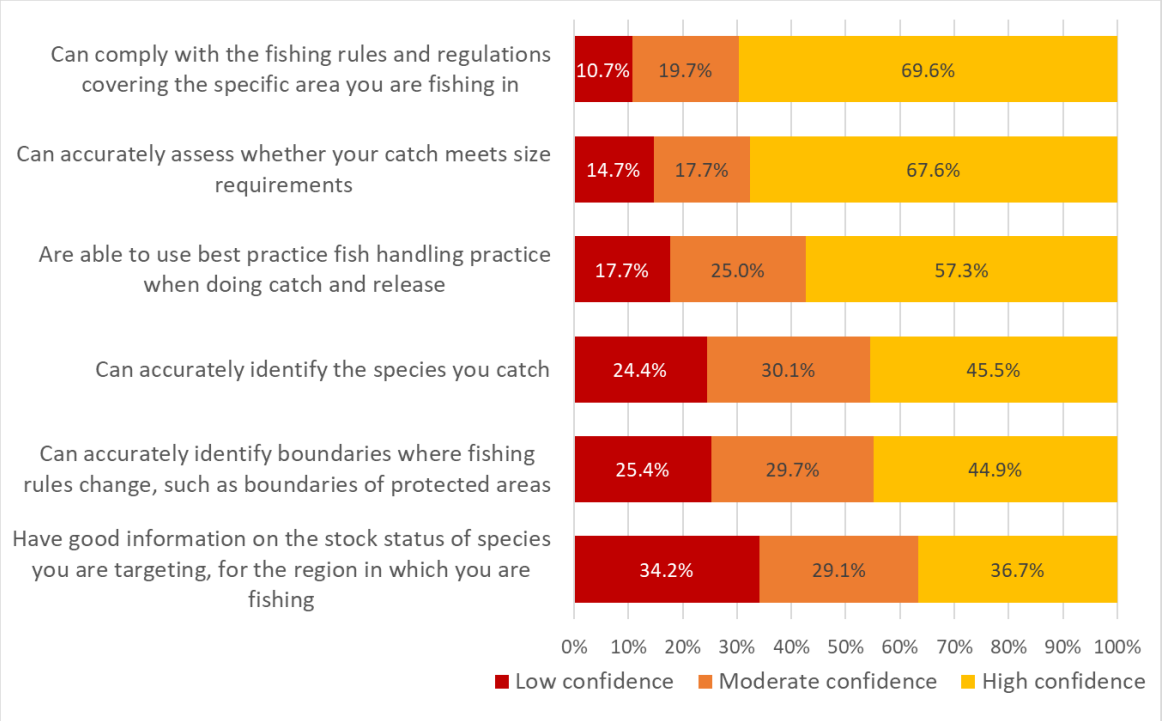


Figure 11.1 Confidence in ability to fish responsibly, Stage 3 2021 RWS data

Younger and female fishers were less confident in key aspects of their ability to fish responsibly, compared to older and male fishers (Figure 11.2). Female fishers were significantly less confident than male fishers in their ability to accurately identify the species they catch, whether catch met size requirements, and the boundaries where fishing rules and regulations change. Fishers aged under 40 were less confident in their ability to identify the species they caught, and those aged under 55 less confident in their ability to assess whether catch met size requirements, identify boundaries of fishing zones, comply with fishing rules and regulations, and use best practice fish handling practices, compared to older fishers.

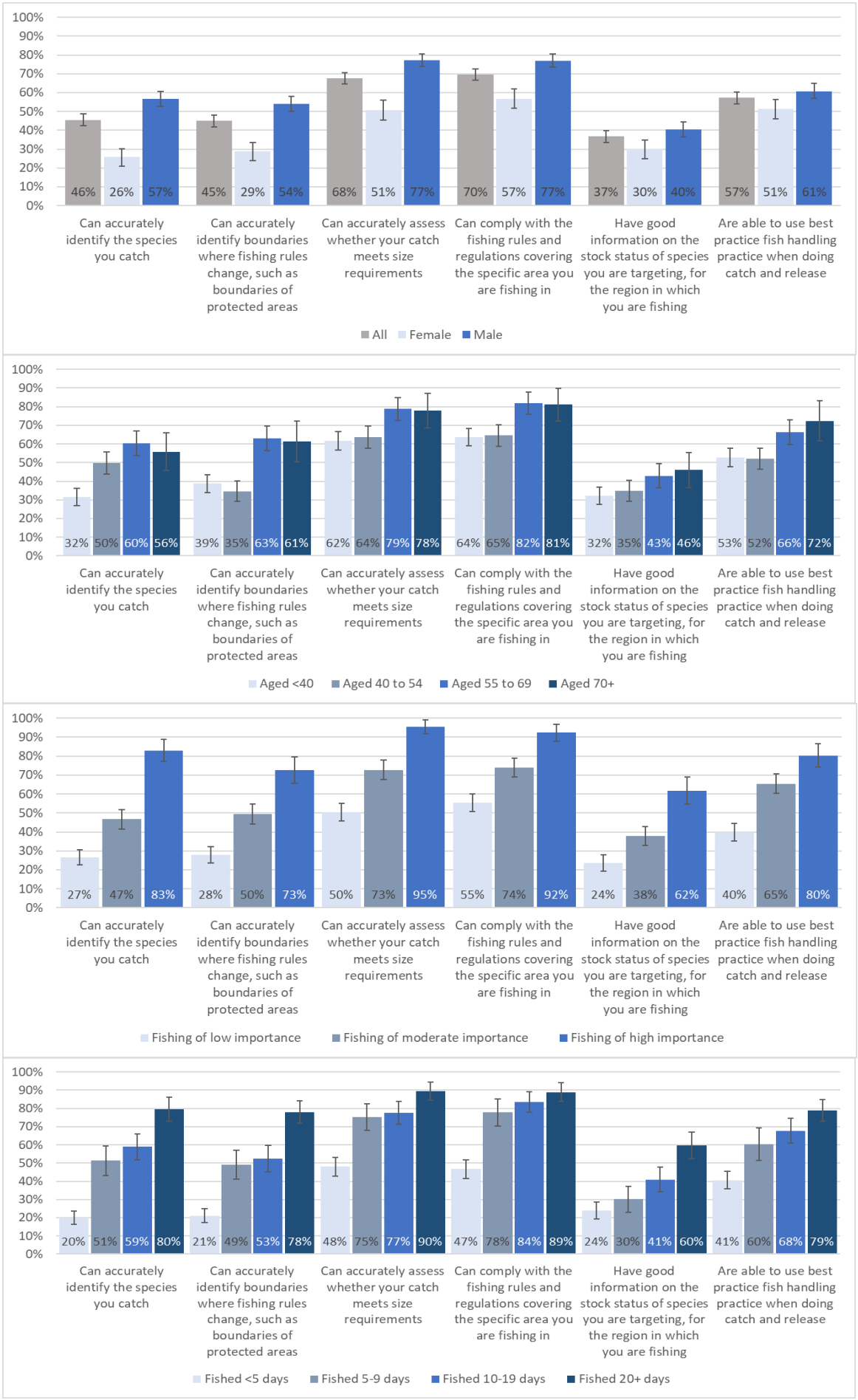


Figure 11.2 Confidence in ability to fish responsibly, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

Confidence in being able to fish responsibly increased with the importance of fishing to a person's life, for all aspects of responsible fishing (Figure 11.2). For example, only 27% of those for whom fishing was of low importance felt confident they could accurately identify the species they caught, compared to 83% of those for whom fishing is highly important. Similarly, those who fished a greater number of days were more confident in their ability to fish responsibly: only 20% of those who fished for five days or less were confident they could accurately identify the species they caught, compared to 80% of those who fished for 20 days or more a year.

The findings suggest that the avid fishers who are responsible for the majority of the recreational fishing catch are more confident in their ability to fish responsibly compared to non-avid fishers who only fish occasionally. They suggest a need to focus on providing information that is easy for both avid and less avid fishers to understand and utilise. Information needs to be easy for avid fishers to understand as they are responsible for the majority of fishing effort, and also important for less avid fishers to understanding to ensure good stewardship amongst those who fish less often. They also suggest a need to focus on providing support to female and younger fishers in particular when seeking to build knowledge and skills in responsible fishing.

A person's confidence in their ability to fish responsibly will reflect many things, including the opportunities they have had to learn fishing skills. Fishers were asked whether they learned about, or helped others learn about, responsible fishing via a range of different activities, including learning from or teaching friends and family, attending seminars or workshops, reading or watching information provided by experts in books, magazines or online, or interacting with other people.

The most common way fishers learn and share information about responsible fishing is by directly interacting with people close to them: 47.6% had taught fishing tips, techniques and skills to people close to them in the last year and 35.5% had taught responsible fishing skills (Figure 11.3). Reading, listening to or watching guidance on best practice fish handling was relatively common, with 28.9% having done this in the last 12 months, and 60.2% having done this at some point. It was much less common for fishers to speak to other fishers to encourage them to be responsible in their fishing activities (21.5% had done so in the last year, and 35.7% had ever done this), or to teach fishing skills in general or responsible fishing skills specifically to people they didn't know well (34.1% and 28.1% respectively had ever done these things). Very few (10.7%) had ever attended a seminar, workshop or training day on best practice fish handling.

These findings highlight that currently responsibility for transferring information about responsible fishing practices appears to rest largely on fishers teaching others close to them, and to a lesser extent on fishers accessing information via books, magazines, and online information. High reliance on close social networks to learn new skills may reduce how rapidly and effectively skills spread across the broader recreational fishing community, as people are less likely to share skills outside their immediate social circle.

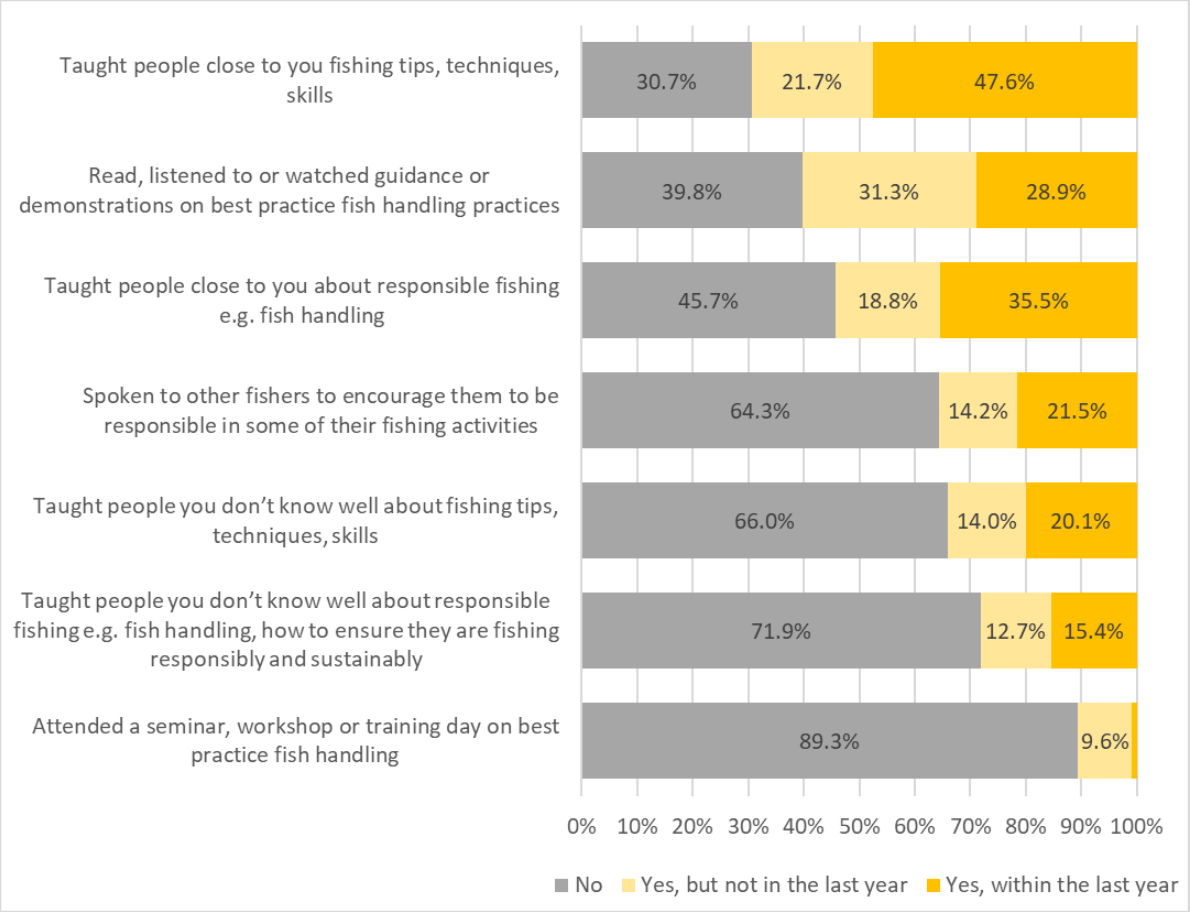
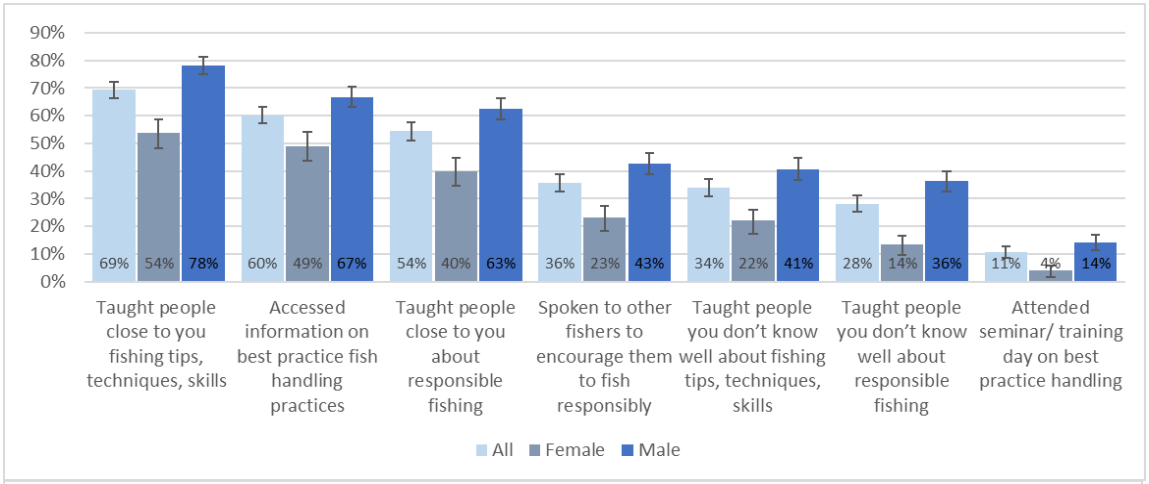
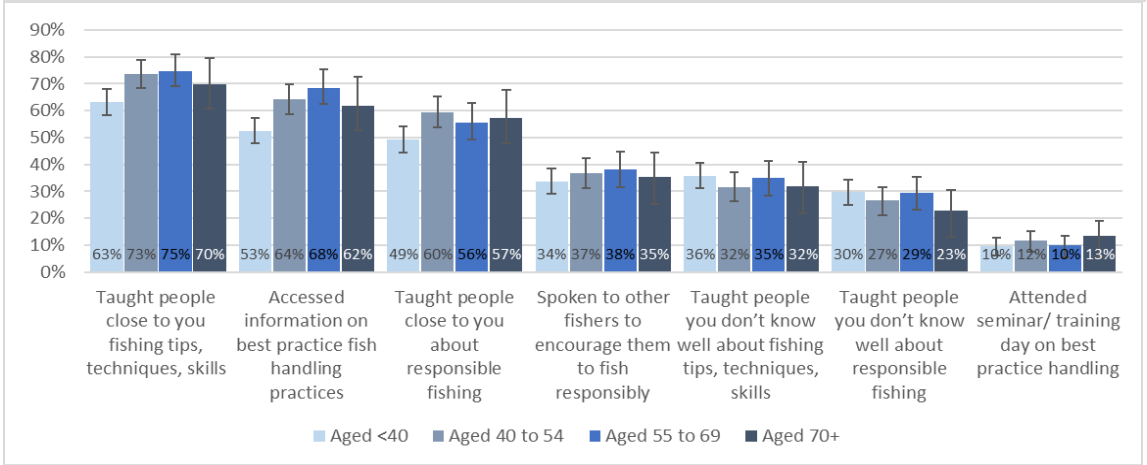
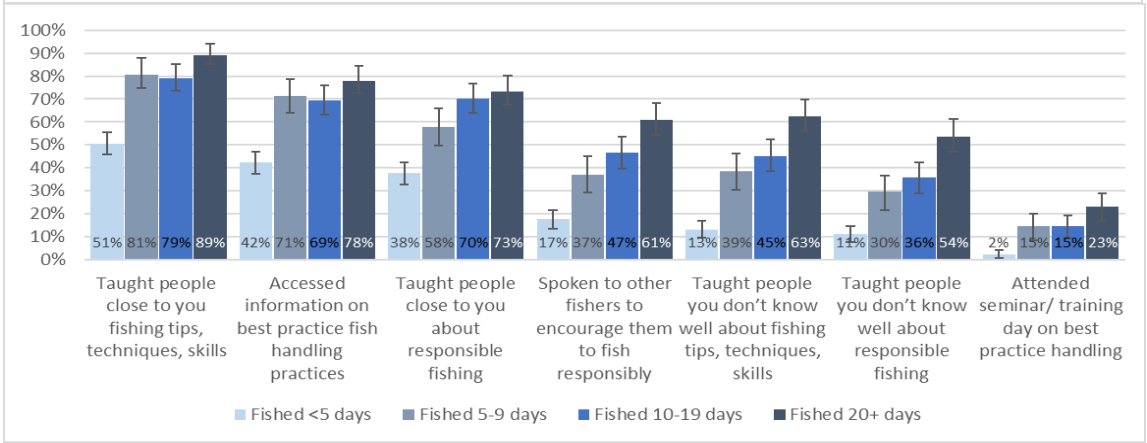


Figure 11.3 Participation in learning and teaching activities that support growth in responsible fishing practices, Stage 3 2021 RWS data

Male fishers were significantly more likely to (i) access information about fishing, and (ii) to teach fishing skills to both close family/friends and those they didn't know well (Figure 11.4). There were few differences by age, although fishers aged under 40 were slightly less likely to access information on best practice fish handling or teach people close to them. Those who fished five days or less in the last year were much less likely to either access information, or to teach others, compared to those who fished five or more days a week. Similarly, those who found fishing less important were significantly less likely to access information or to teach others about fishing compared to those for whom fishing was more important.







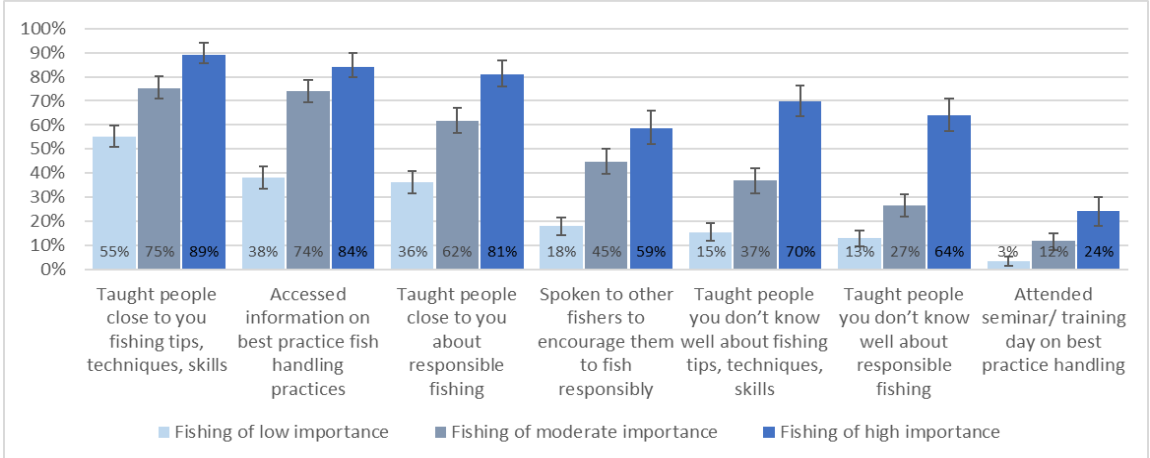


Figure 11.4 Participation in learning and teaching activities that support growth in responsible fishing practices, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

Recreational fishers were asked if in future they would be willing to get involved in different stewardship activities. When asked if they were willing to get involved in 'teaching people you don't know well to fish responsibly', 21.1% of fishers were willing, 26.2% potentially willing depending on circumstances, and 52.7% not willing to do this. Female fishers were much less likely to be willing to do this (34%) than male fishers (55%), as were those who fished few days a year (29%) or for whom fishing was of low importance (28%). Those who fished 10 or more days a year and those for whom fishing was highly important were much more likely to be willing to teach people they don't know about responsible fishing. This suggests that a majority of avid fishers are willing to become engaged in teaching others about responsible fishing, including many who have not done this in the past.

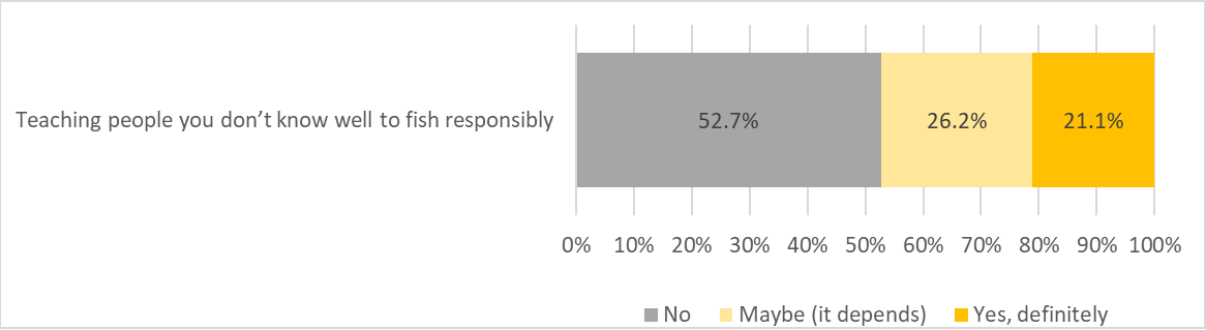


Figure 11.5 Willingness to get involved in future activities – teaching people you don't know to fish responsibly, Stage 3 2021 RWS data

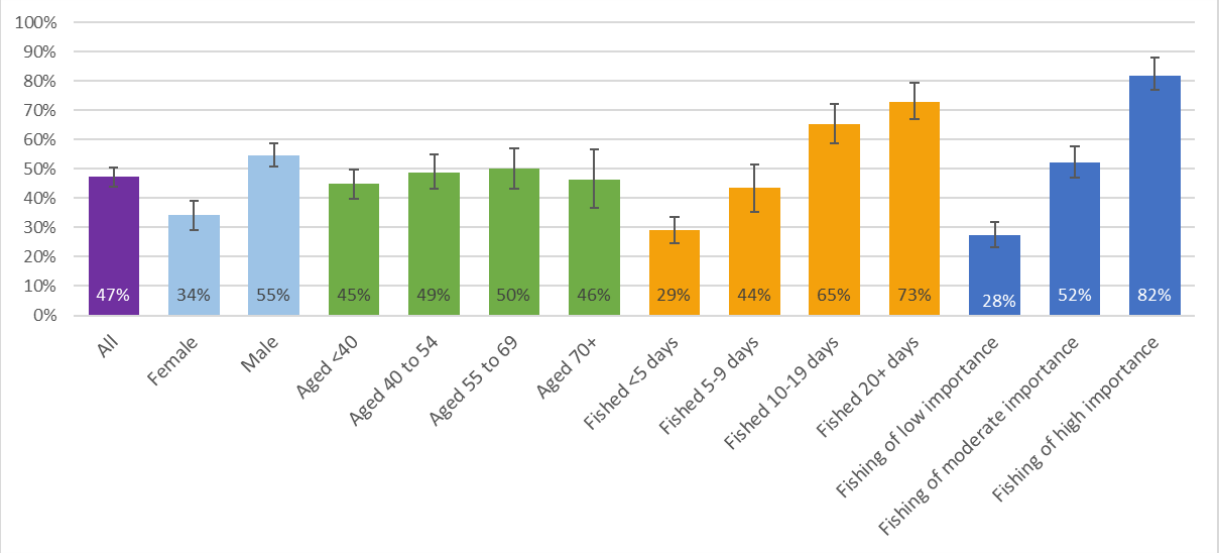


Figure 11.6 Willingness to teach people you don't know to fish responsibly, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

11.5 Results: Caring for health of the aquatic environment

Investing time in caring for the health of the aquatic environment is a way many fishers contribute to environmental stewardship, in addition to ensuring they fish responsibly (discussed in Section 11.4) and contributing to monitoring and data collection (discussed in Section 11.6).

To understand more about the ways recreational fishers contribute to caring for the aquatic environment, fishers were asked (i) whether they had spotted environmental problems or illegal activities when fishing, (ii) whether they had actively supported stewardship by reporting environmental problems/illegal activities, picking up rubbish/litter when fishing, taking part in clean-up days, or becoming involved in habitat protection or rehabilitation activities, and (iii) how willing they were to get involved in these types of activities in future.

First, fishers were asked if, in the past, they had ever:

- Spotted an environmental problem when out fishing they thought needed to be acted on e.g. a spill or debris, or invasive species, or
- Seen people engaged in potentially illegal activities in fishing areas.

No timeframe was given for this question, and hence answers reflect recall of doing these things at any point since a person started fishing. Most fishers had not seen environmental problems or illegal activities, while 39.7% had seen illegal activities, and 43.7% had seen environmental problems they felt needed to be acted on (Figure 11.7). Most of those who had seen either of these things had done so once or twice, and fewer had observed either of these issues 'a few times' or 'regularly'.

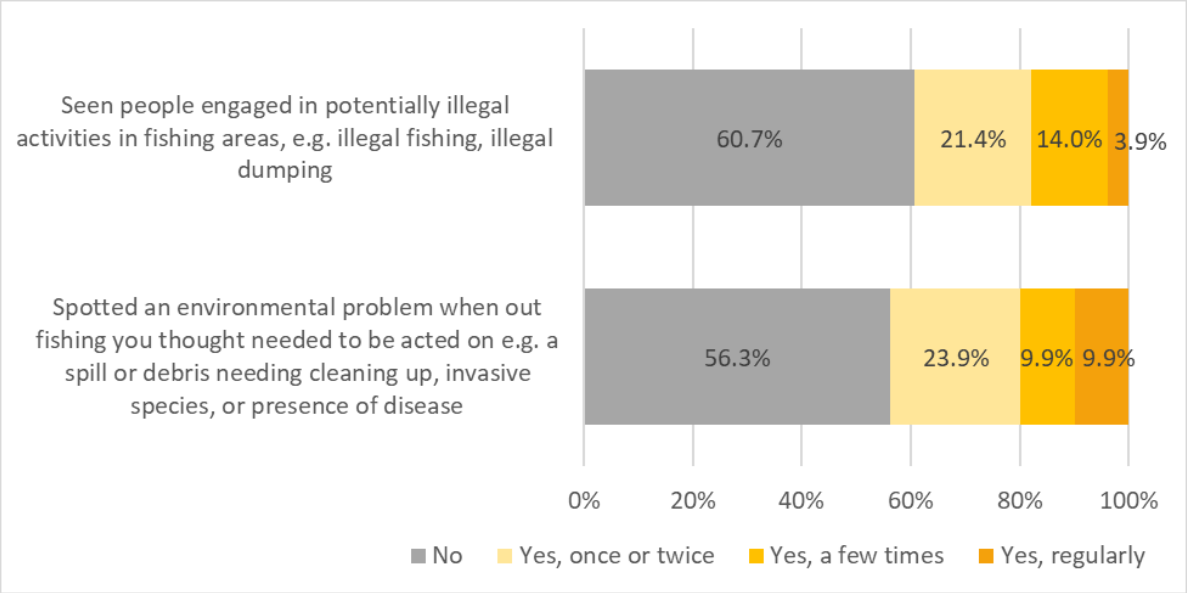


Figure 11.7 Past experience of seeing environmental problems or potentially illegal activities when fishing, Stage 3 2021 RWS data

Those who fished more often, and for whom fishing was more important, were around twice as likely to report spotting an environmental problem, and over three times more likely to report spotting potentially illegal activities, compared to those who fished less than five days a year or for whom fishing was not a highly important activity (Figure 11.8). This suggests that avid fishers are more likely than less avid fishers to be aware of and able to identify environmental problems and illegal activities when fishing. It also likely reflects that those who go fishing more often have more opportunities to spot these types of issues compared to those who fish less frequently.

There were fewer differences between male and female fishers, and fishers of different ages. However, female fishers were significantly less likely to spot potentially illegal activities compared to male fishers, and younger fishers slightly less likely to see illegal activities than older fishers (Figure 11.8).

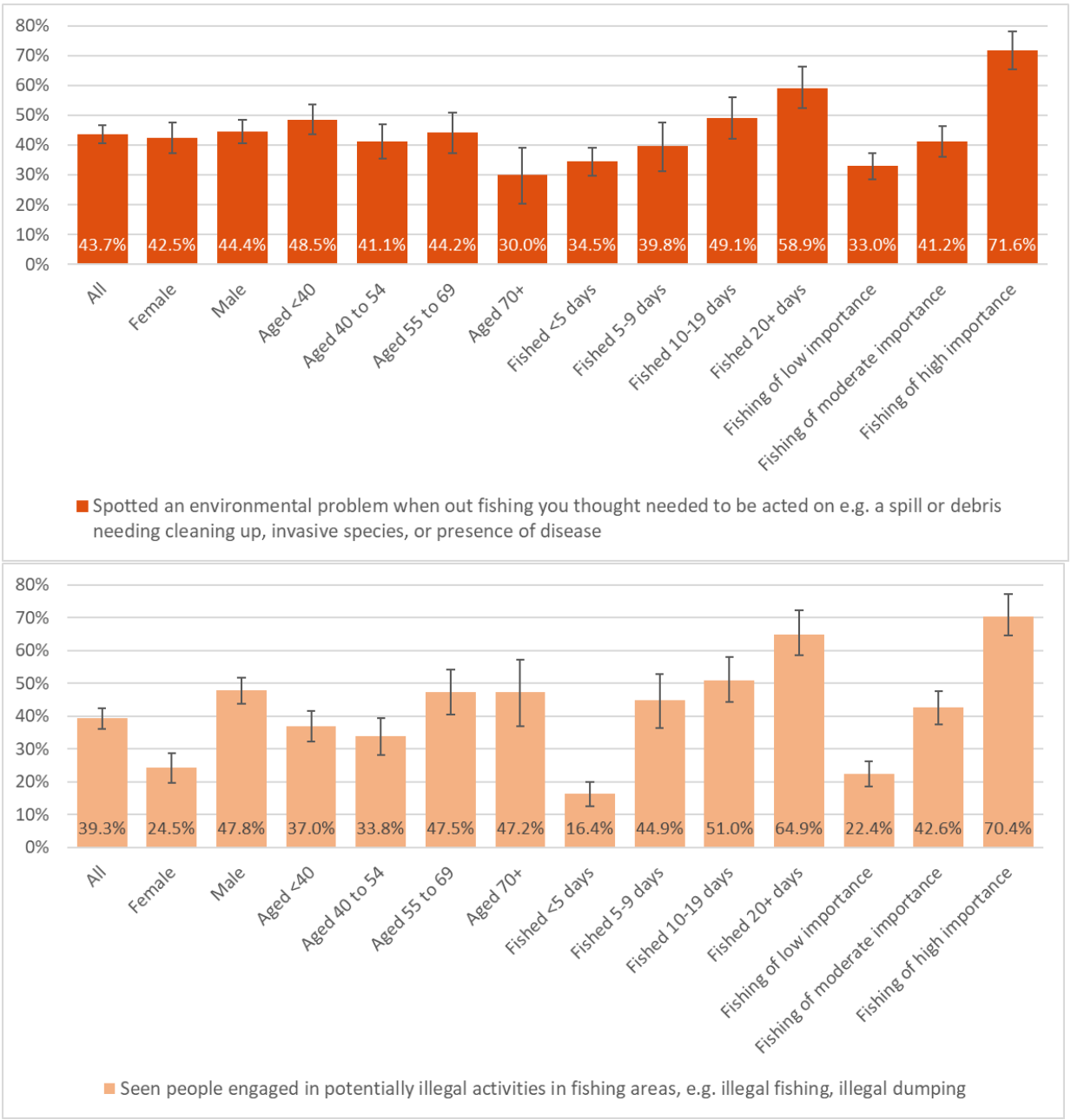


Figure 11.8 Past experience of seeing environmental problems or potentially illegal activities when fishing, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

Seeing a problem can be a trigger for taking action, whether that action is reporting the problem seen, or getting involved in actions such as clean-up days, or habitat rehabilitation and protection activities.

Recreational fishers were asked if they had ever:

- Picked up rubbish/litter when out fishing and taken it to an appropriate bin/disposal facility
- Undertaken habitat rehabilitation or protection activities as part of a group activity e.g. an organised day working to help support health of a particular fishing area or increase habitat
- Undertaken habitat rehabilitation or protection activities on my own

- Taken part in a ‘clean up’ day where you help clean up rubbish in or around river, lake, estuary or ocean areas
- Donated to an organisation that seeks to improve health of aquatic environments or otherwise to support aquatic habitats
- Reported an environmental problem such as rubbish, presence of an invasive species, or water quality issues, or
- Reported seeing potentially illegal activities.

Survey participants could report they had done the activity in the last year, had done it but not in the last year, or that they had never done it (Figure 11.9). The most common action reported was picking up rubbish or litter when out fishing and taking it to an appropriate bin or disposal facility, with 75.4% of fishers having done this within the last year, and 14.1% at some point before that. Only 10.5% had never done this. It was much less common for fishers to take part in other activities such as clean-up days (31.0%), donating to organisations that work to support aquatic environmental health (23.3%), undertaking habitat rehabilitation (18.6%), reporting environmental problems (17.1%), undertaking self-directed habitat rehabilitation activities (17.0%) or reporting potentially illegal activities (16.9%).

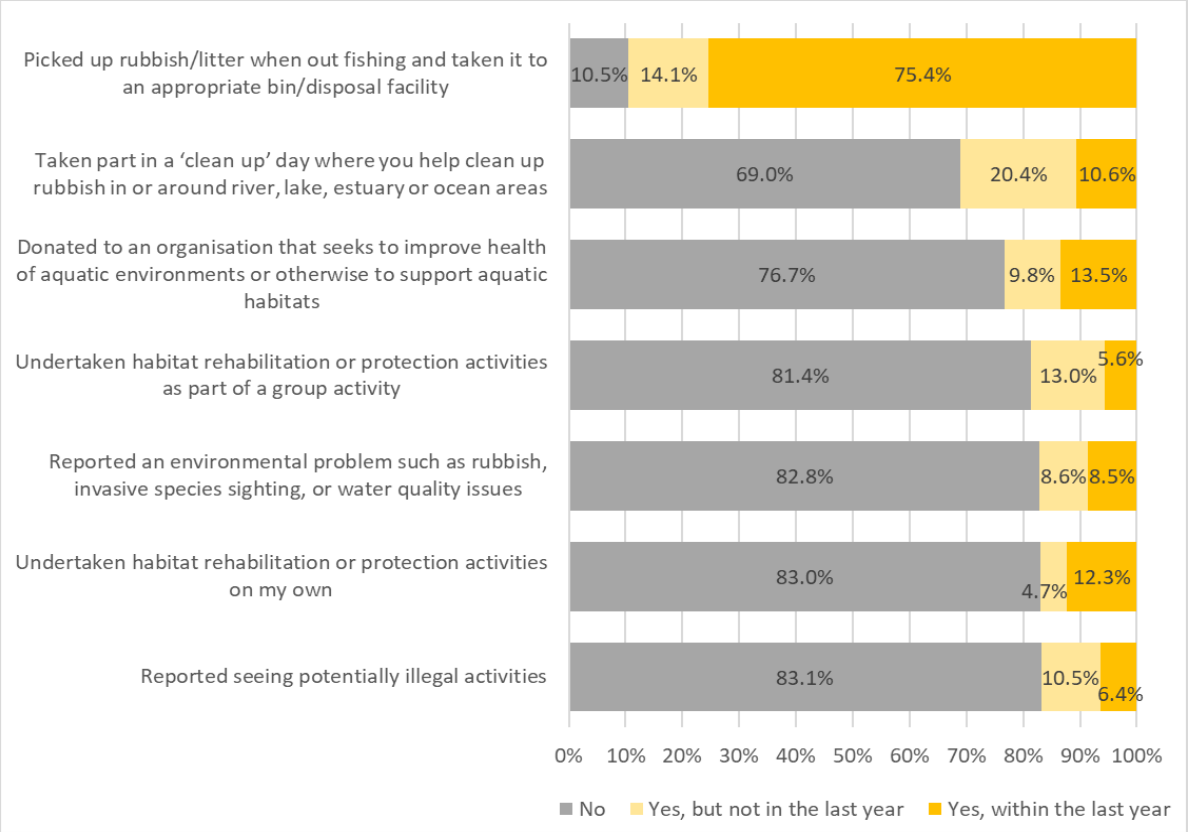


Figure 11.9 Involvement in activities that improve environmental and social health in aquatic areas, Stage 3 2021 RWS data

Those who fished more often and for whom fishing was highly important were significantly more likely to take part in all stewardship activities (Figure 11.10). Male and female fishers were similarly likely to engage in most of the stewardship activities asked about, including rubbish collection/clean up days, donation to environmental organisations, and undertaking habitat rehabilitation or protection on their own. However, women were less likely than men to get involved in groups undertaking habitat rehabilitation/protection, or to report environmental problems or illegal activities they observed. There were few differences by age, although those aged 40-69 were more likely to have taken part in clean-up days, donated to an organisation or been involved in habitat rehabilitation/protection groups compared to younger of older fishers.

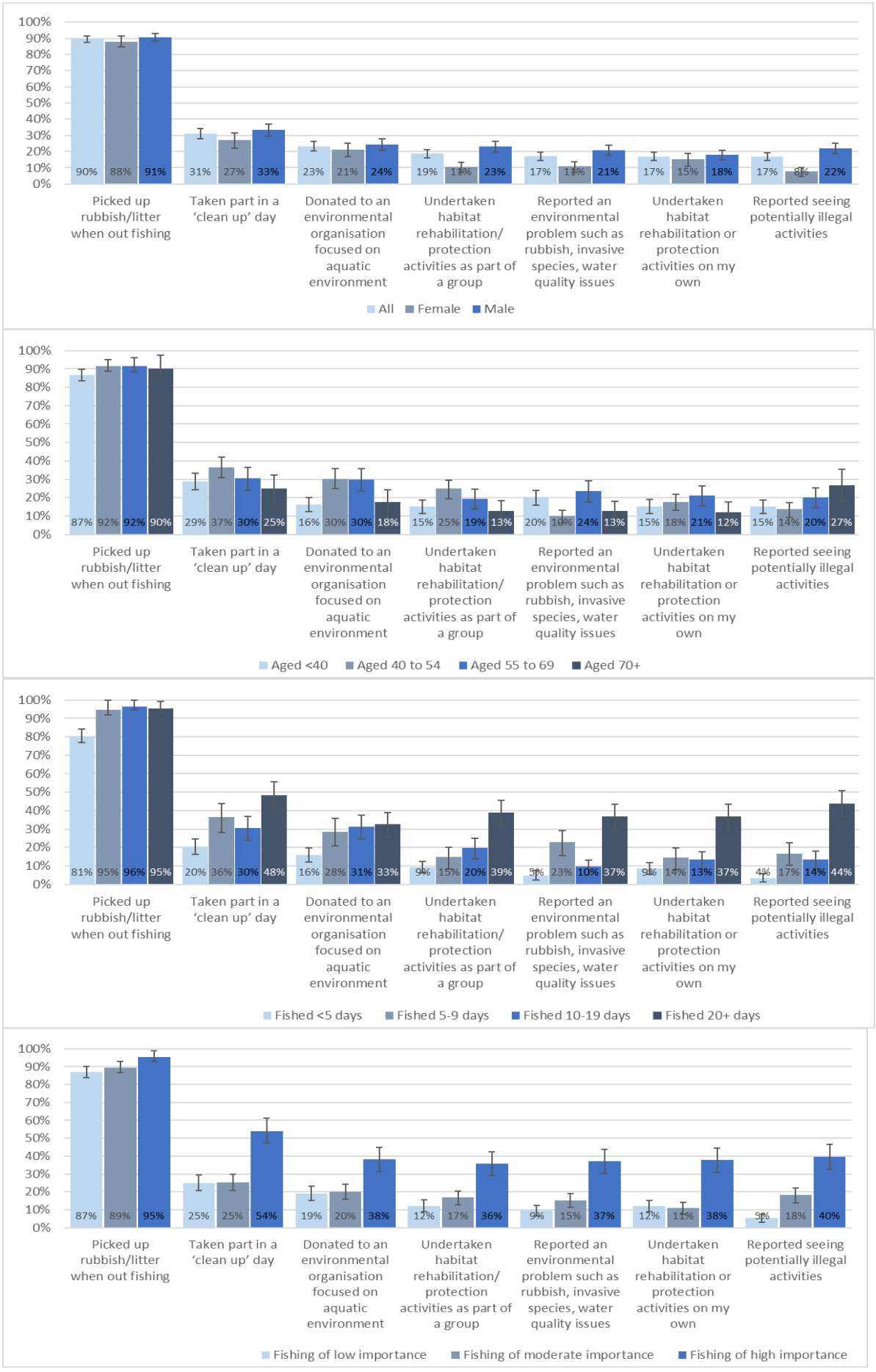


Figure 11.10 Involvement in activities that improve environmental and social health in aquatic areas, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

Most fishers were willing to get involved in three activities in future: picking up rubbish/litter when out fishing (66.3%), reporting potentially illegal activities (60.3%) and reporting observations of environmental problems (59.4%). Another one in four said they might be willing to do these things depending on circumstances, while very few were unwilling to do them (Figure 11.11). Fewer reported being willing to get involved in habitat protection and rehabilitation activities: 24.6% would not, 44.0% might depending on circumstances, and 31.5% definitely would.

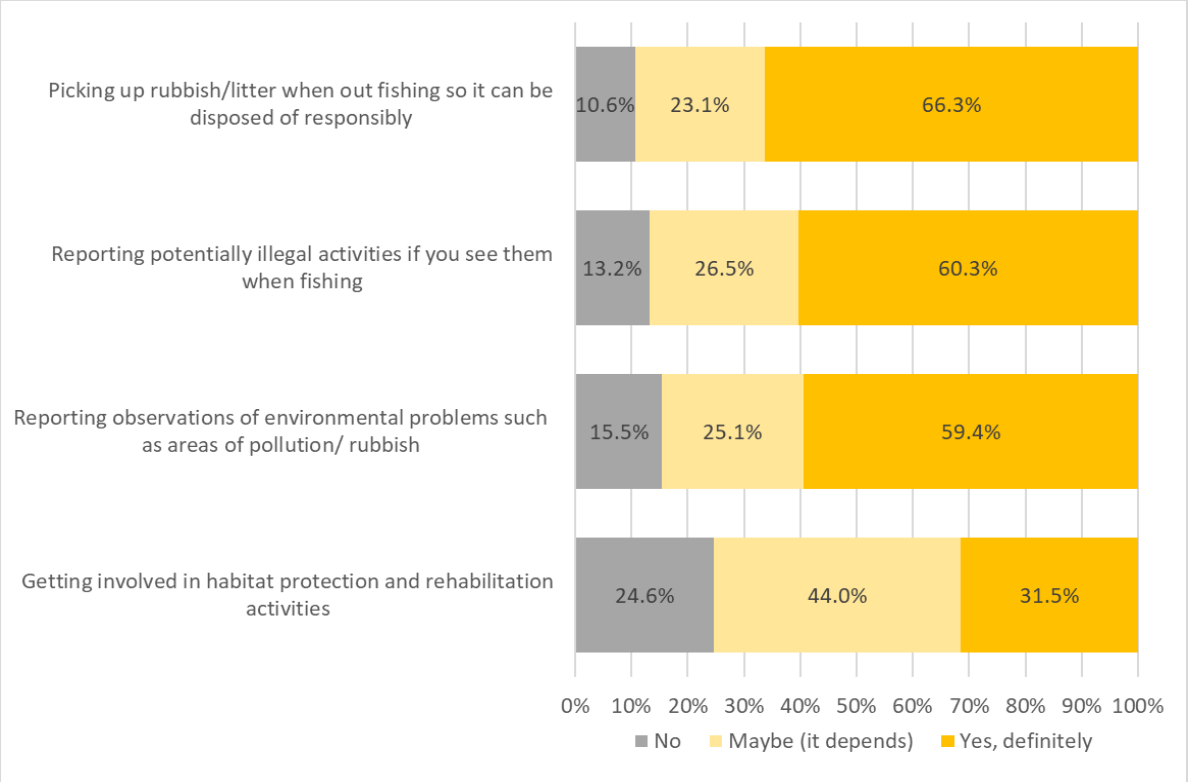
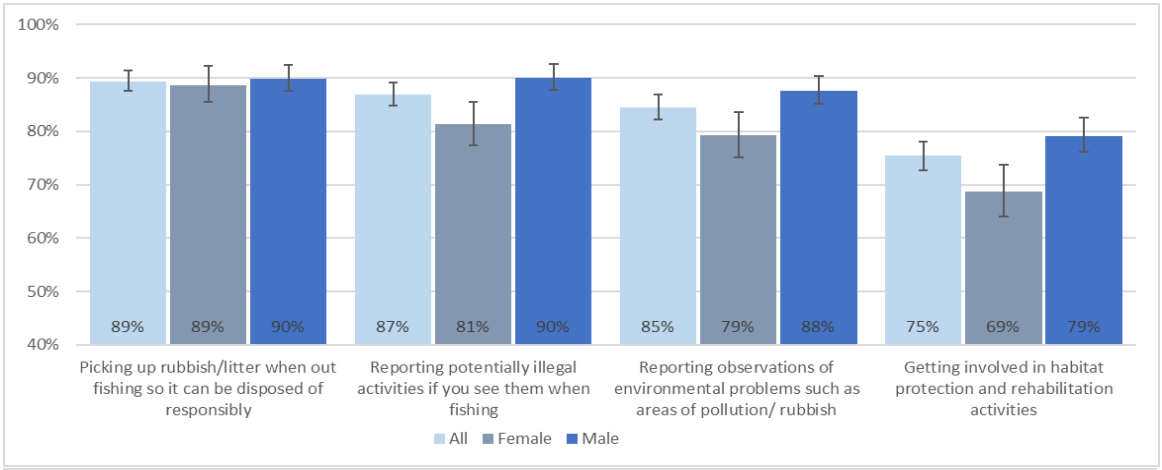
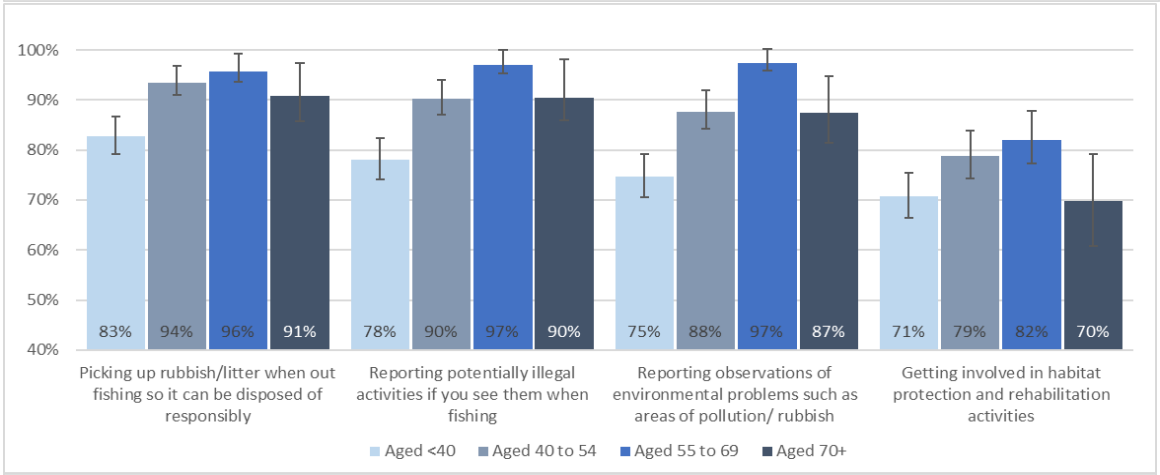


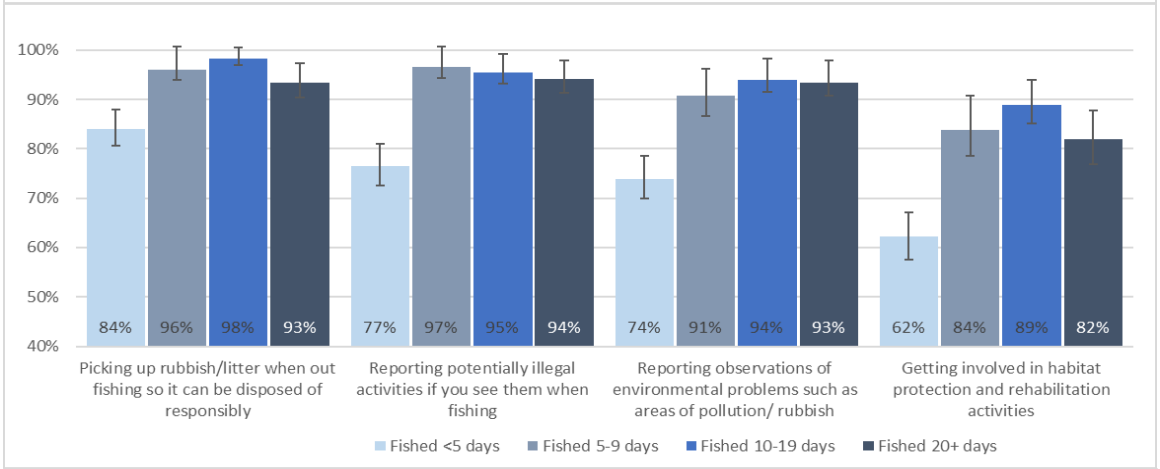
Figure 11.11 Willingness to get involved in future activities involving reporting or acting on environmental problems or potentially illegal activity, Stage 3 2021 RWS data

Female fishers were a little less likely than male fishers to be willing to be involved in reporting environmental problems, or potentially illegal activities; or to get involved in habitat protection and rehabilitation activities (Figure 11.12). Younger fishers were the least willing to get involved in any of the four stewardship actions asked about and were significantly less likely than those aged 40 and older to be willing to do all except habitat protection/rehabilitation activities. Those aged 70 and older were somewhat less likely to be willing to do all, although not significantly so, while those aged 55-69 were most likely to be willing to do all of the activities asked about.

Those who fished more often were significantly more likely to be willing to pick up rubbish/litter, report environmental problems or illegal activities, or get involved in habitat protection/rehabilitation, compared to those who fished fewer than five days a year. Similarly, those who found fishing very important were more likely to be willing to engage in stewardship activities in future compared to those for whom fishing had low importance. For example, 71% of those who fished less than five days a year were willing to get involved in habitat protection/rehabilitation activities, compared to 84% of those who fished 5-9 days a year, 89% of those who fished 10-19 days a year, and 82% of those who fished 20 or more days a year.







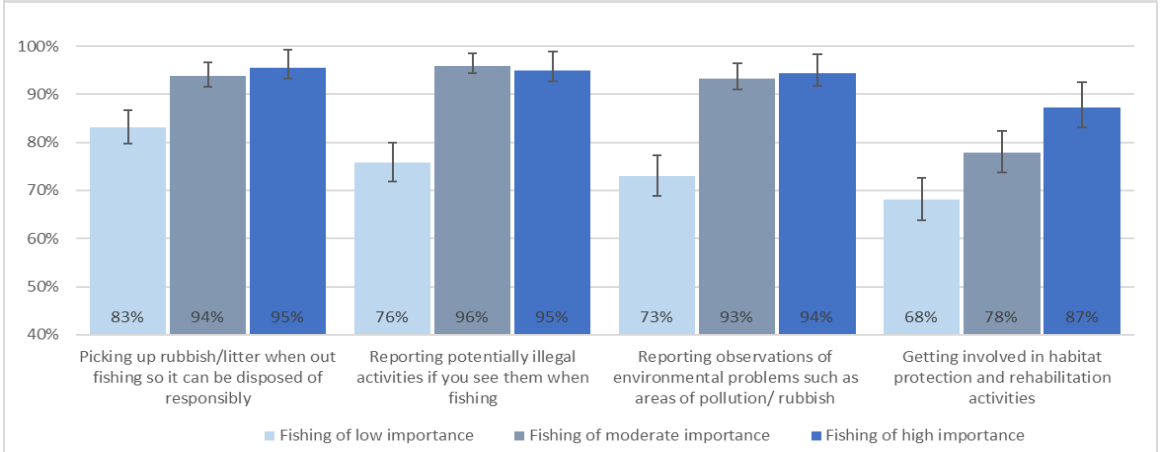


Figure 11.12 Willingness to get involved in future activities involving reporting or acting on environmental problems or potentially illegal activity, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

11.6 Results: Contributing to scientific understanding

This section examines the ways recreational fishers contribute to scientific understanding through voluntarily contributing their time and effort to help collect and/or process scientific data. This is often referred to as citizen science, although the many ways recreational fishers contribute to building scientific knowledge are not always labelled as citizen science.

Participating in scientific data collection – whether called citizen science or given other labels - is rapidly growing as a way people contribute to environmental stewardship. These types of initiatives aim to support environmental health through improving knowledge about current environmental health and ecosystem functioning or monitoring the effectiveness of interventions intended to support environmental health.

In recreational fishing, the boundary is not always clear cut between something that is 'citizen science' and more general involvement of recreational fishers in providing data that contributes to scientific knowledge, for example through participating in studies in which they report their catch and effort. Increasingly, citizen science style approaches are being used to enable recreational fishers to report catch and effort, such as the use of app-based data platforms (Gundelund et al. 2021), or specific efforts to engage avid fishers in regularly documenting and reporting their recreational catch to inform fisheries management decisions (Støttrup et al. 2018). The involvement of recreational fishers in scientific data collection also goes well beyond monitoring catch and effort, with examples of recreational fishers being engaged in studies that involved them taking tissue samples (Williams et al. 2015) and collecting water samples for eDNA analysis (Miya et al. 2022), amongst others.

Recreational fishers were asked whether they had ever:

- Contributed to assessment of fish stocks by providing information about fishing activities and catch (this might be completing a regular fishing diary, doing a phone interview, or completing a boat ramp or other survey)
- Tagged or caught fish as part of a scientific study
- Collected samples of water for a scientific study for analysis e.g. for water quality, species DNA or other purposes
- Recorded environmental or habitat conditions for a scientific study such as water temperature, environmental health, in fishing locations for later analysis, or
- Reported sightings of particular species that are rare, endangered, or of interest more generally.

All of these are ways recreational fishers are sometimes encouraged to become engaged in contributing data to scientific efforts, whether these efforts are specifically labelled as 'citizen science' or simply as scientific data collection efforts. As many of these types of contribution can be made by recreational fishers as part of either traditional scientific research or citizen science efforts, participants were not specifically asked to label whether they had done the activity as part of a citizen science effort.

Two in five fishers (20.6%) have contributed to assessment of fish stocks at some point by providing information about their fishing activities and catch, while around 10% reported having at some point collected other types of data, usually not in the last year (Figure 11.13).

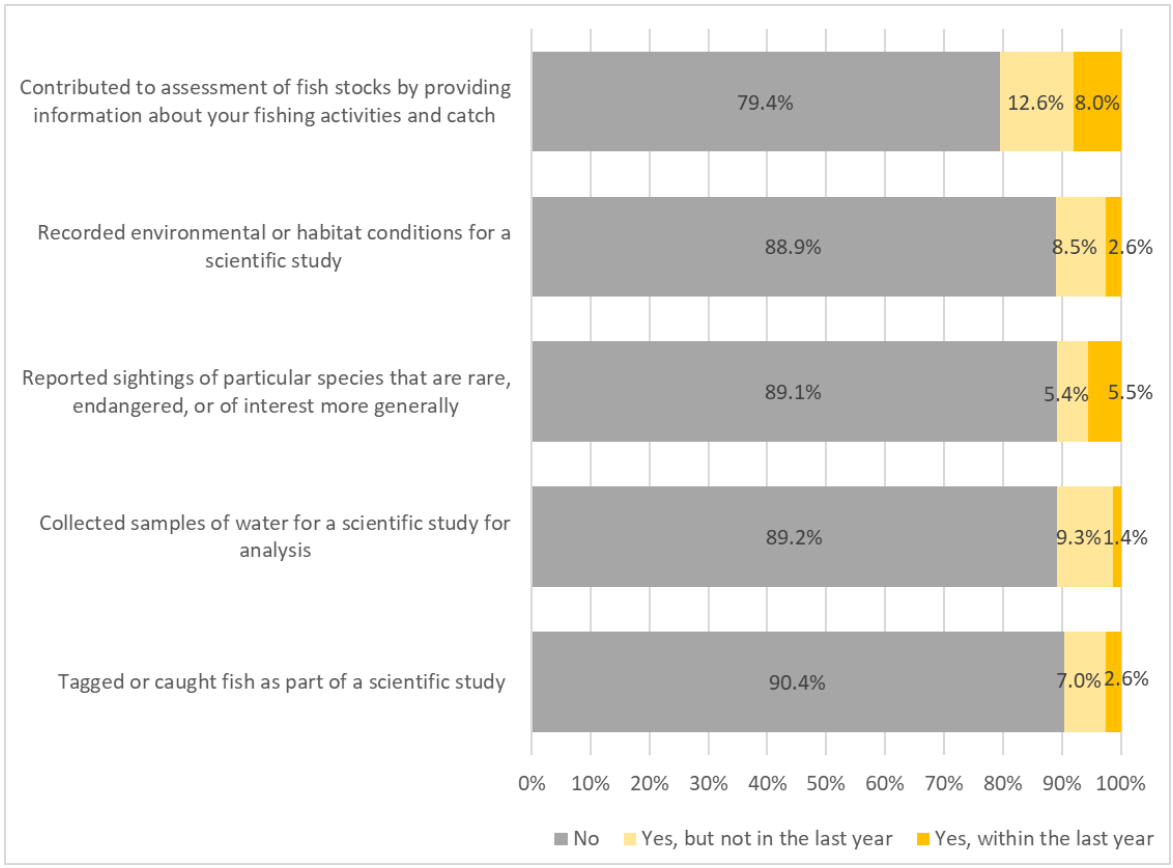


Figure 11.13 Involvement of recreational fishers in collecting data that increases knowledge of environmental health, Stage 3 2021 RWS data

Male fishers were much more likely than female fishers to have contributed to stock assessment by providing information about fishing activities and catch (28% compared to 8%, Figure 11.14). Male fishers were also more likely than female fishers to have tagged or caught fish as part of a scientific study, and to have reported species sightings. There were conflicting findings regarding age and participation in scientific data collection: younger fishers were more likely than older fishers to report having recorded environmental or habitat conditions or collected water samples, while those aged 40 to 69 were slightly (but not significantly) more likely to have contributed to stock assessments.

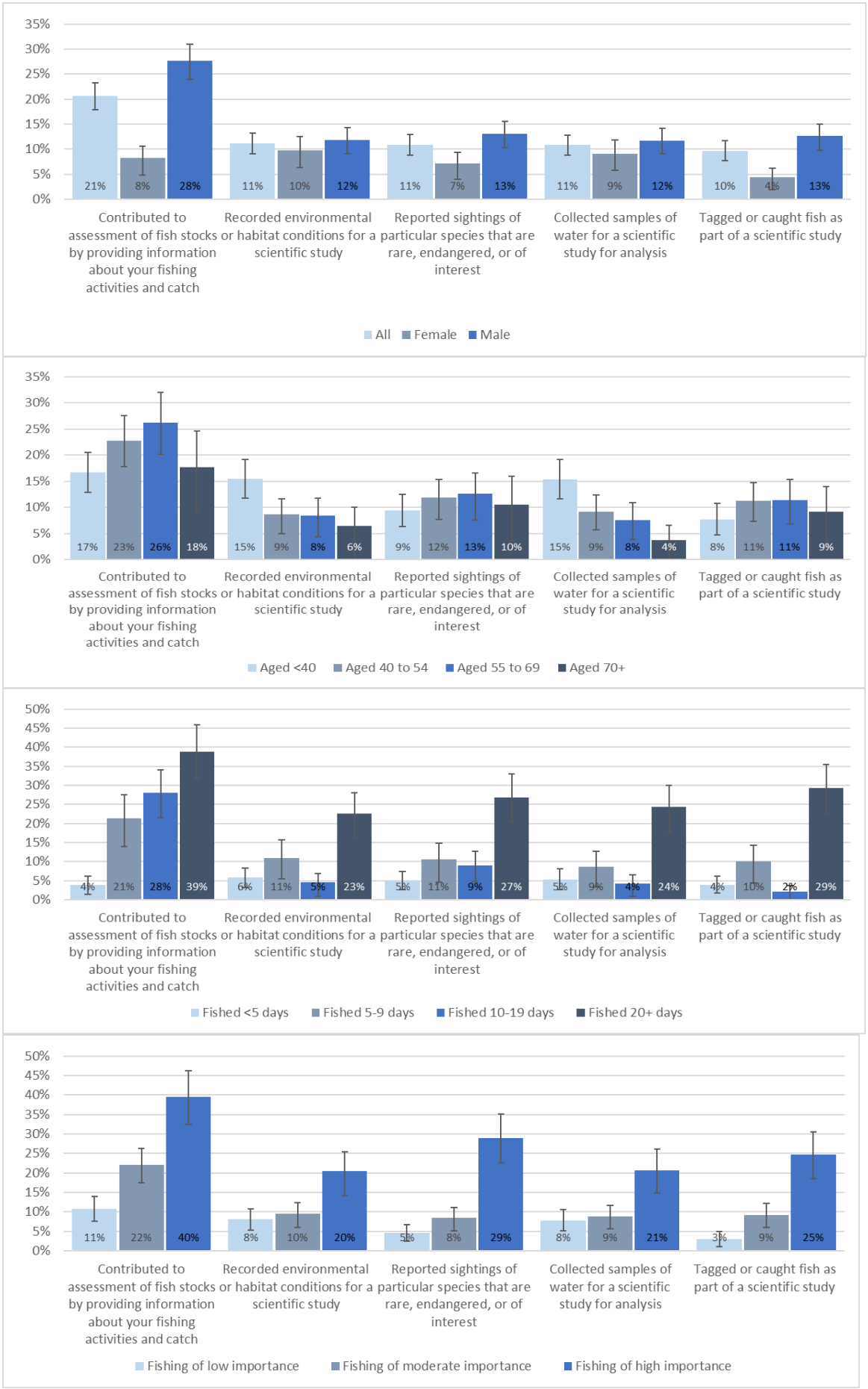


Figure 11.14 Involvement of recreational fishers in collecting data that increases knowledge of environmental health, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

Fishers were asked if they were willing to get involved in future in the following types of scientific data collection activities:

- Reporting catch (species and amount) and the specific location in which the catch occurred, if the information would not be published publicly, but would be used to inform things like stock assessments
- Reporting catch (species and amount) and the general area in which the catch occurred (e.g. reporting it occurred in a zone that covered a reasonable area so the specific spot was not identifiable), if this information would not be published publicly, but would be used to inform things like stock assessments
- Reporting sightings of specific fish or other aquatic species (irrespective of species being targeted/caught)
- Reporting sightings of bird species if seen while fishing
- Taking samples of water
- Uploading photos of fish caught to an app so they can be identified by others and used for stock assessment.

Most recreational fishers are willing to get involved in the collection of scientific data: 79.4% are willing to report catch, 78.6% to report aquatic species sightings, 73.2% to report bird species sightings, 72.5% to upload photos of their catch to an app, and 65.2% to take samples of water (Figure 11.15). However, of those who are willing to do these things, around half said that their willingness was conditional. In other words, their willingness to do these things depended on the specific circumstances, and they were not willing to do these activities under all circumstances.

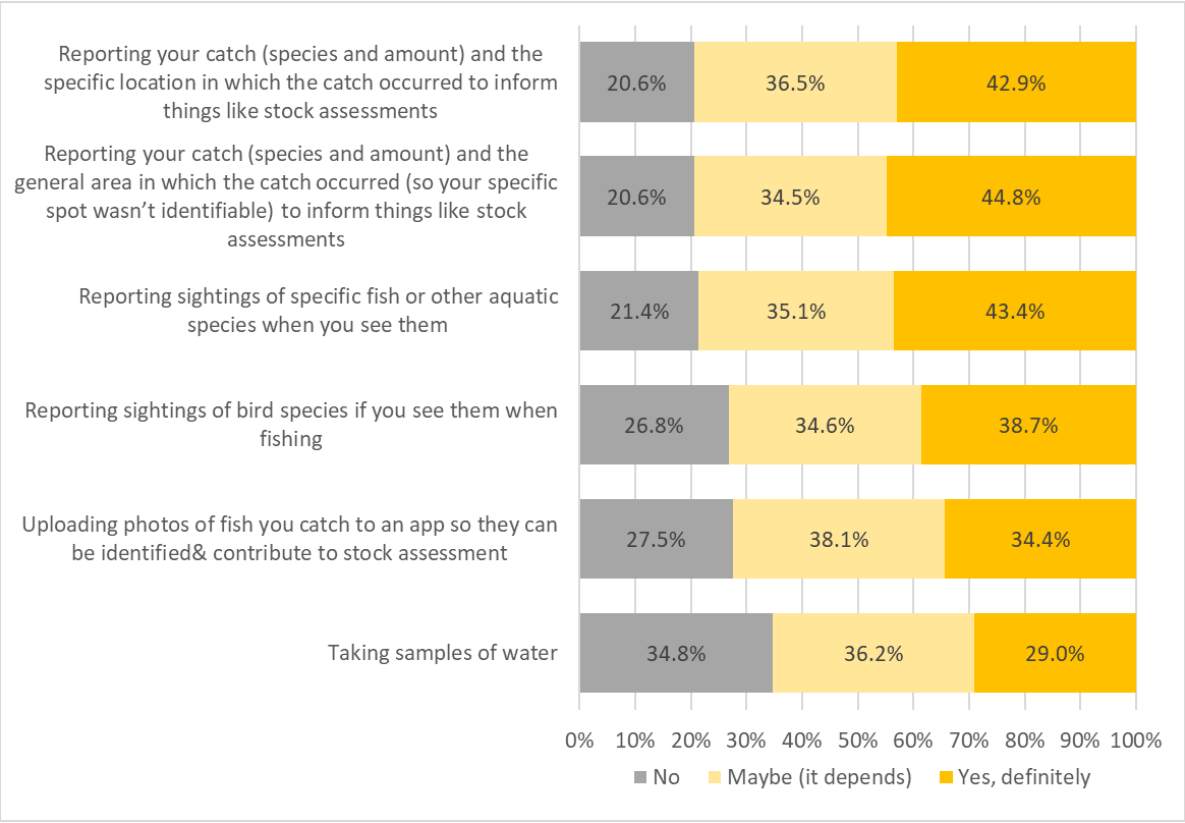


Figure 11.15 Willingness to get involved in collecting data that increases knowledge of environmental health, Stage 3 2021 RWS data

This highlights the importance of identifying the factors that may impact the willingness or ability of fishers to contribute to data collection. These may range from trust in those who will use the data, to practical constraints such as time and skills. For example, Martin et al. (2016) interviewed

recreational fishers, divers and other marine users to ask about their views on participating in citizen science initiatives. They found that while most felt positive about the potential to contribute to knowledge, barriers to participating included concerns about how the data they collected would be used, whether information would be accurate enough to be useful to science, and concerns about their own ability to provide accurate data.

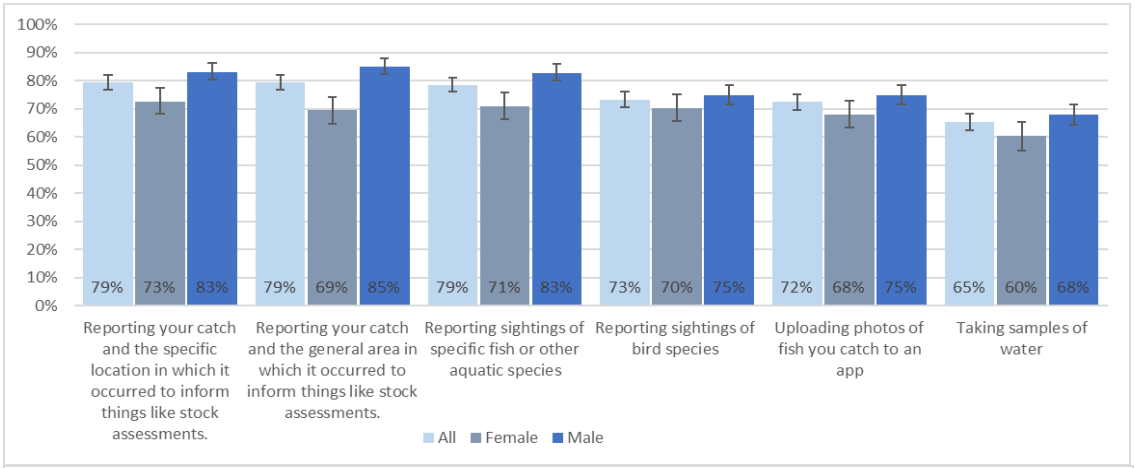
A majority of all types of fishers were potentially willing to contribute to scientific data collection (Figure 11.16). Fishers were somewhat, but usually not significantly, less likely to be willing to contribute if they were female, aged 70 and older, fished less than five days a year, or did not consider fishing an important part of their life.

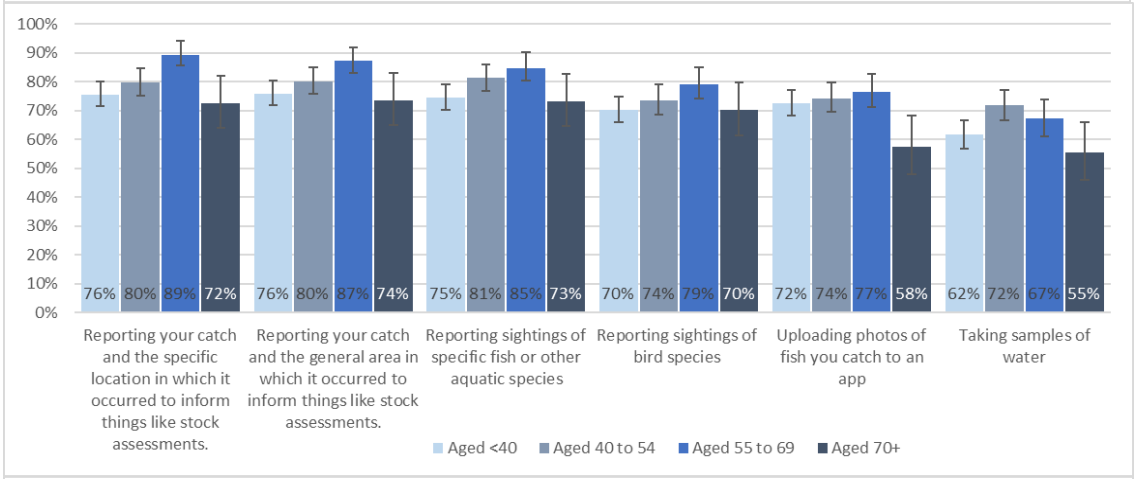
Multiple studies have found that some recreational fishers are unwilling to report information about their catch and effort due to concerns about how that information will be used (e.g. Dedual et al. 2013, McCluskey and Lewison 2008). Concerns raised by fishers include concern that their information may be used to justify implementing area closures or other restrictions on fishing, may result in public identification of good fishing spots that in turn leads to overfishing or overcrowding of those spots, lack of trust in the rigour and methods used by scientists who analyse catch data, and lack of understanding of the scientific process (Dedual et al. 2013). However, some studies have found that, despite a common perception that recreational fishers are unwilling to report catch due to a belief this may lead to fishing access restrictions, most fishers do not have this belief (Midway et al. 2020).

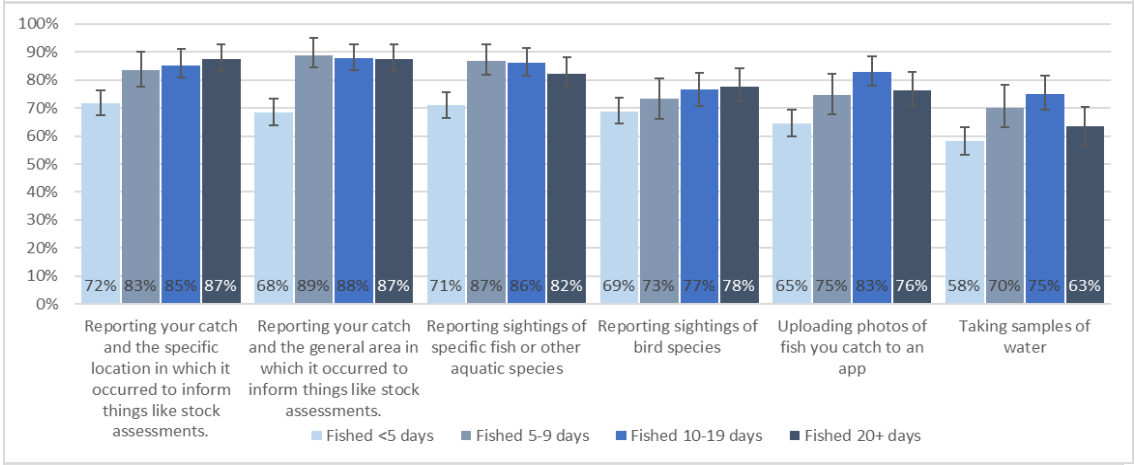
Given the importance of catch and effort reporting to the sustainable management of fisheries, fishers were asked the extent to which they agreed or disagreed that:

- Recreational fishers should contribute to building knowledge through reporting their catch data
- Guarantees are needed about how data provided will be used before recreational fishers report catch
- Anyone asking for data should provide an easy to read report of the results to the fishers providing data.

In total, 57.1% of fishers agreed that recreational fishers should contribute to building knowledge through reporting their catch data, while 14.9% disagreed and 28.0% were either unsure or neither agreed or disagreed (Figure 11.17). Just over half (51.3%) would need guarantees about how their data would be used before they would report catch data, while 23.7% would not need this, and 25.1% were unsure or neutral. Almost three-quarters (74.5%) agreed that anyone who asked for data should provide an easy-to-read report of results to the fishers providing data.







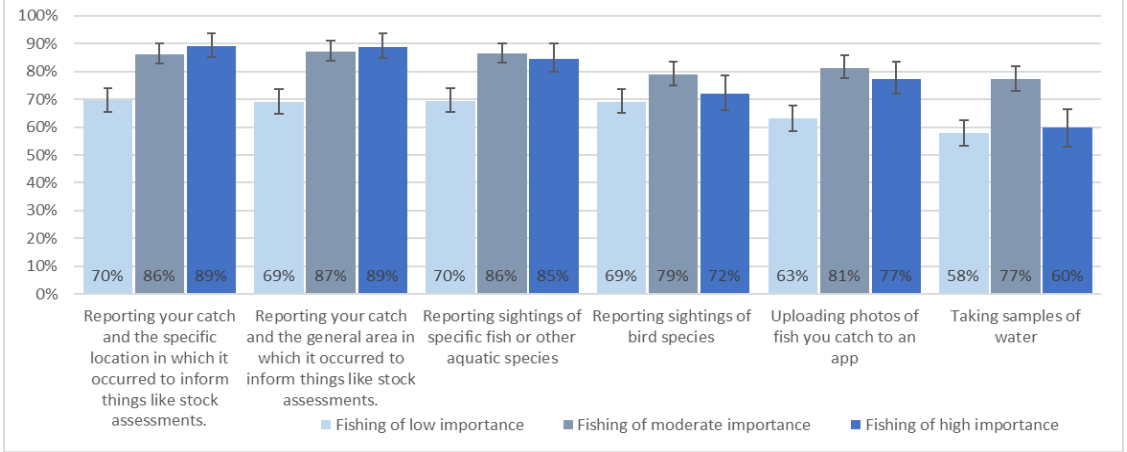


Figure 11.16 Willingness to get involved in collecting data that increases knowledge of environmental health, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

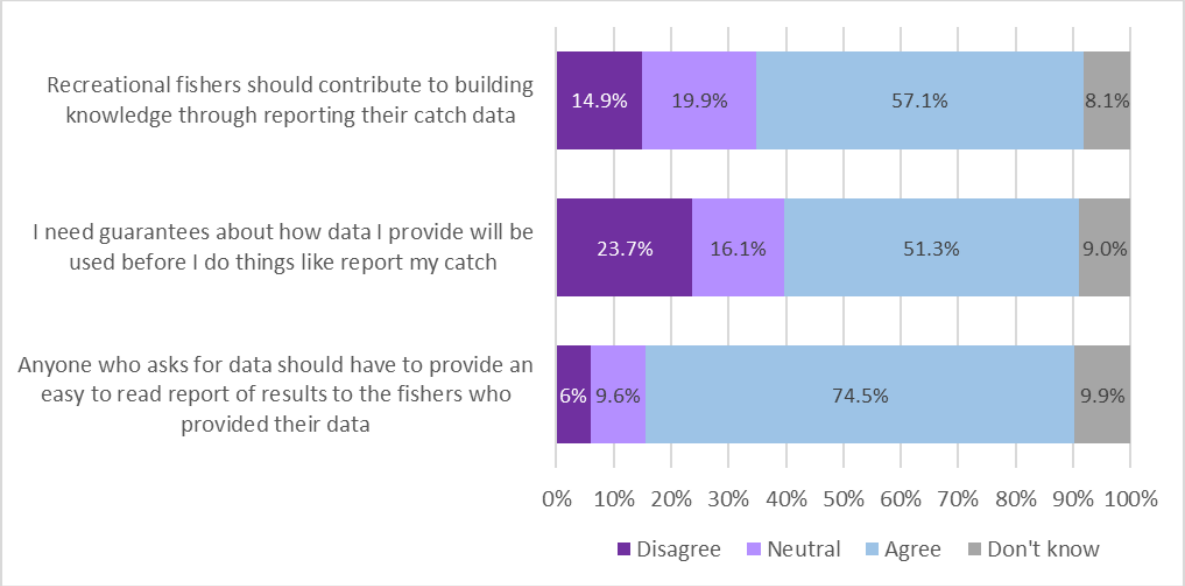
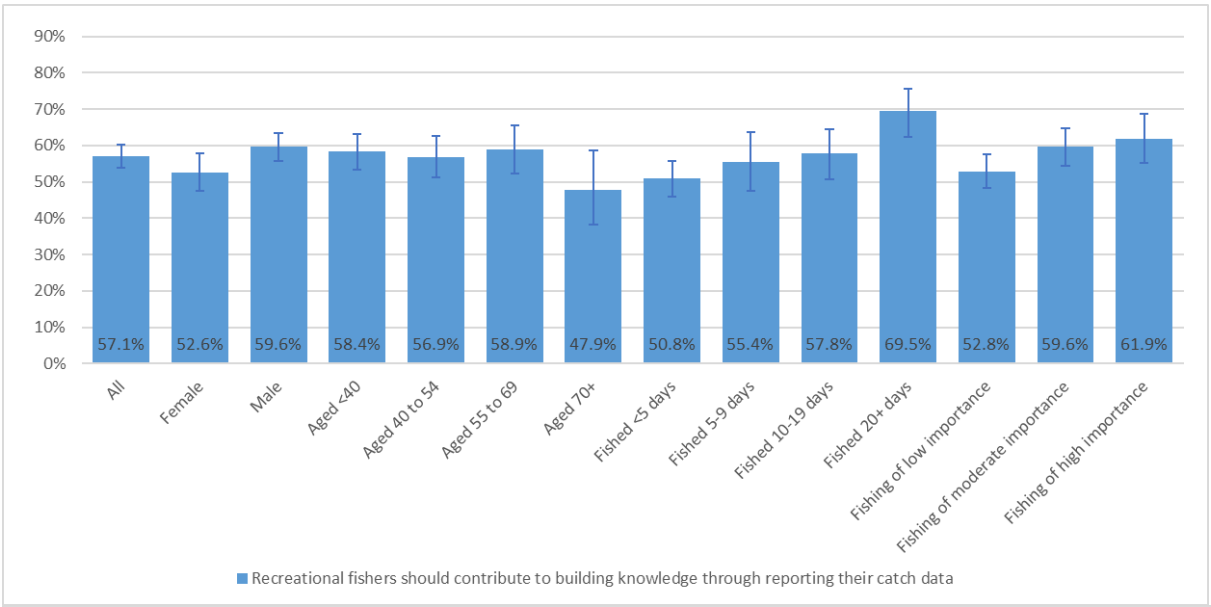
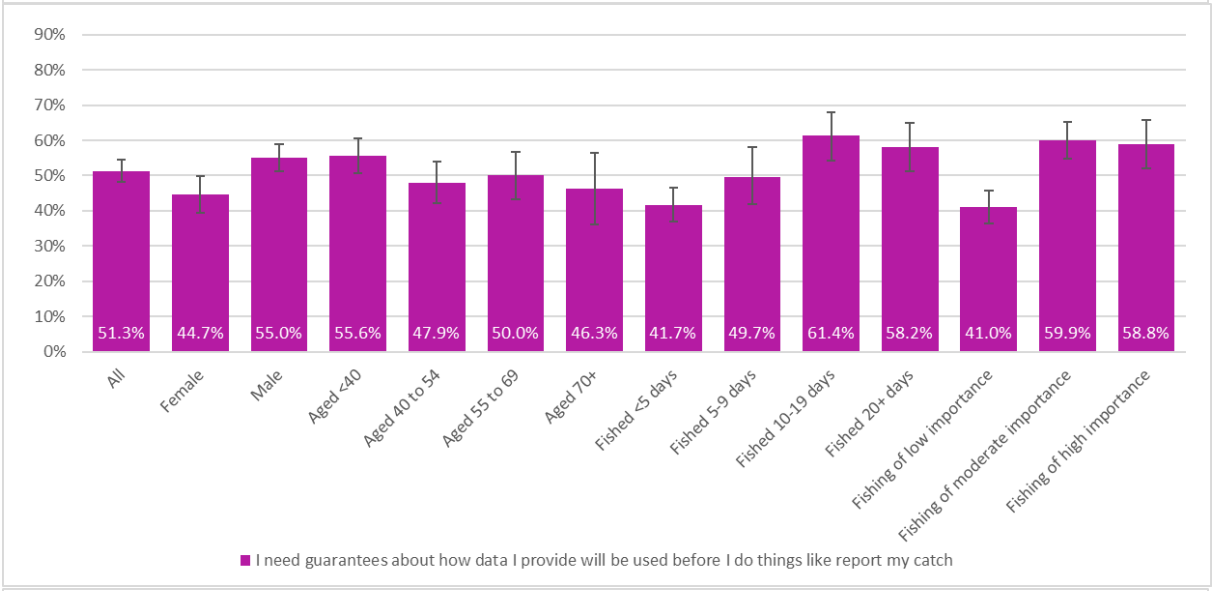


Figure 11.17 Recreational fisher views about reporting catch data, Stage 3 2021 RWS data

Those who fished 20 or more days a year were the most likely to agree that recreational fishers should contribute to building knowledge through reporting catch data, with 69.5% of this group agreeing. Meanwhile those least likely to were fishers aged 70 or older (47.9%), those who fished five or less days a year (50.8%), and those for whom fishing was of low importance (52.8%) (Figure 11.18).

Those most likely to want guarantees about how data would be used before providing information about their catch and effort were more avid fishers and those who considered fishing an important part of their life. Fifty-eight point two per cent of those who fished 20 or more days a year, and 58.8% of those for whom fishing was highly important, wanted these types of guarantees. Those who fished less often, or for whom fishing was less important, were less likely to feel they needed guarantees. This suggests that those who are most willing to report catch data are also most likely to want clear information on how the data they provide will be used before they report it. Similarly, those who fished more often and found fishing very important were most likely to want to be provided access to findings produced from catch data they provided.





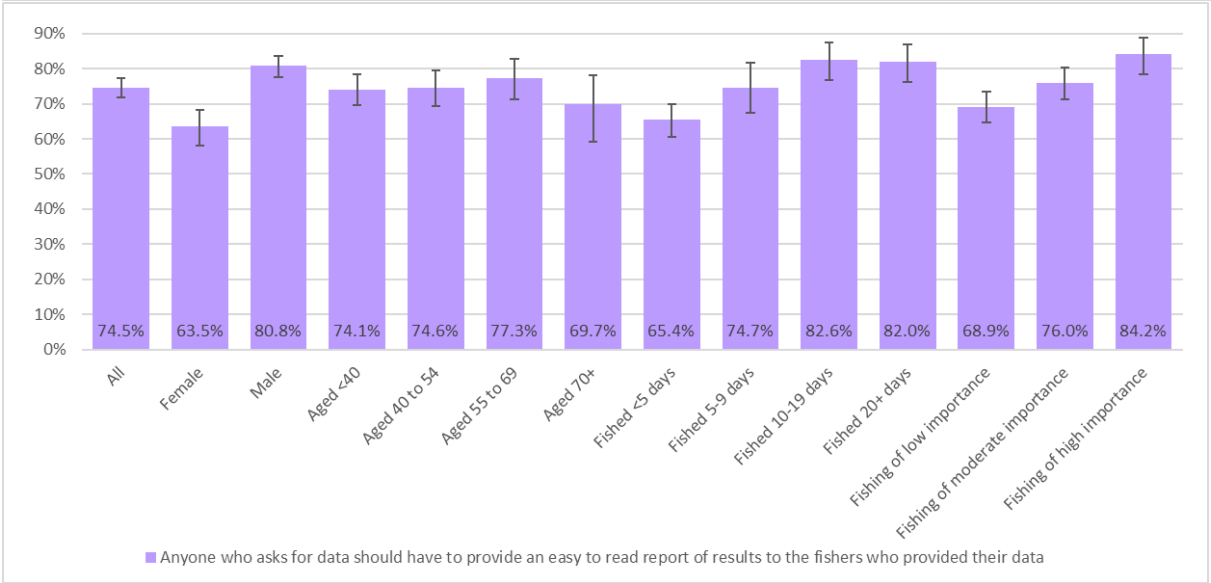


Figure 11.18 Recreational fisher views about reporting catch data, by gender, age, importance of fishing and fishing avidity, Stage 3 2021 RWS data

11.7 Conclusions

While most fishers feel confident in their ability to fish responsibly, not all do – in particular, younger fishers, female fishers and those who fish fewer days. These groups have significantly less confidence in their skills to do things like identify species and size limits accurately or identify boundaries of fishing zones. Non-avid and female fishers are also less likely to report problems they spot while fishing, and somewhat less likely to engage in a range of environmental stewardship activities, including reporting catch and effort and some habitat rehabilitation and protection activities. Avid fishers, in contrast, have more confidence in their skills and knowledge, are more likely to have engaged in environmental stewardship activities in the past, and are more likely to be willing to do so in future, compared to non-avid fishers.

The findings suggest there are significant opportunities to increase engagement of avid fishers in teaching others about responsible fishing, and in other environmental stewardship activities: this group is already more likely to be engaged in these things, and indicates a high level of interest in doing more. This provides a potential pathway to supporting those who fish less often, or have lower interest in fishing, to build their skills and ability to be good stewards. Supporting avid fishers to connect to less avid fishers, thus enabling them to pass on key skills and encourage participation in responsible practice, has potential to support increased environmental stewardship amongst less engaged fishers. This study did not ask participants to identify whether and what types of training courses, skills building or information sessions they wished to take part in, due to constraints in the number of questions that could be asked. The findings suggest this should be investigated in future studies, together with examining more about the types of actions fishers are willing to engage in to encourage positive stewardship behaviour in the fishing community.

When investing in encouraging engagement in environmental stewardship activities by fishers, there is a particular need to engage female and younger fishers. The findings suggest that female fishers are less likely to be involved in a range of activities, including catch and effort reporting. Greater investment may be needed in encouraging female participation in this reporting, to ensure the fishing patterns of this group of fishers are understood as part of understanding catch and effort dynamics.

The data collected did not examine the factors that acted as barriers to engaging in environmental stewardship activities. The findings do, however, suggest that for many fishers engagement in stewardship activities is conditional on a range of factors. Past studies suggest that these factors may include things such as their level of trust in those managing the fishery or stewardship activity, their level of confident that the information they provide will be used appropriately, and their confidence that they have the skills and capacity to contribute meaningfully.

12.0 Lessons learnt conducting the NRFS

Chapter authors: Jacki Schirmer and Andy Moore

Key points

- Online surveys are making data collection simpler, and in recent decades it has become possible to recruit survey participants using methods not previously available including online survey panels and social media advertising; at the same time, it is becoming harder to achieve a suitable sample using a single population database
- This study trialled the use of several methods to both take advantage of new opportunities and address emerging challenges, including a range of survey recruitment methods to form a blended sample, with model-based weighting used to generate findings representative of the population from the data collected.
- There is increasing use of non-probability based sampling to achieve samples, combined with model-based inference to address bias in samples; model-based inference methods are also commonly used to address bias in samples achieved using probability-based sampling
- Overall, the findings show that the blend of survey recruitment methods and model-based inference we used provides a method that can be used to undertake these sorts of surveys in the future and generate valid findings.
- These findings suggest that the approach we used can be added to the existing range of methods that are used to collect social and economic data on recreational fishing in Australia
- With rapid ongoing change in the 'survey landscape', including rapid evolution of online survey panels, available methods for surveys should continue to be reviewed and assessed in future
- Of the survey recruitment methods we tested, it is recommended that if used in future survey some survey recruitment methods – recruitment via fishing clubs and social media advertising – should only be used as part of a blended sample and not on their own, due to higher risk of bias.

12.1 Introduction

Worldwide, it is becoming both easier to conduct surveys – but harder to achieve a robust sample of survey respondents. The rapid growth of online surveys, and tools that can be used to rapidly design and implement them, means that almost anyone can rapidly design and put a survey into the field. However, rapidly declining survey participation rates, as well as declining availability of comprehensive 'sample frames' (lists of contact details for a particular group or population), are both enhancing the challenges to achieve a robust sample of survey respondents.

While the primary objective of the National Recreational Fishing Survey (NRFS) was the assessment of the social and economic contributions of recreational fishing, two secondary objectives were also included. These focused on assessing the suitability of different approaches to recruiting survey participants for conducting surveys examining social and economic dimensions of recreational fishing. The two objectives were to:

- Identify which approaches to recruiting survey participants and completing surveys can be used to produce representative and robust results
- Recommend most appropriate and cost-effective survey method that can be used to examine social and economic aspects of recreational fishing in Australia.

This chapter compares data collected using a number of different survey recruitment methods, to identify which of these methods are 'fit for purpose' for use in future social and economic surveys of recreational fishers, and under what circumstances. The methods trialled were predominantly lower cost survey methods. These were examined to determine if they could be implemented as cost effective methods to monitor social and economic dimensions of recreational fishing.

First, the rapidly changing global context for conducting surveys is reviewed, focusing on the challenges and opportunities that have emerged when seeking to achieve robust samples in social and economic surveys. The methods section then describes how the different survey recruitment methods used in the NRFS were analysed to evaluate their suitability for use. The findings sections examine data collected for the NRFS using differing survey recruitment methods, to identify whether different methods were 'fit for purpose' for use as part of a blended sample that was weighted based on a superpopulation model. First, the extent to which using different methods to recruit survey participants results in differing estimates of social and economic aspects of recreational fishing is examined (such as estimates of fishing participation, avidity, and social values related to fishing). This is followed by evaluating whether using model-based weighting sufficiently reduces these differences in estimates by correcting for the effect of survey recruitment method. This is examined using data from Stage 1 (which sampled from the adult population of Australia) and from Stage 2 (sample of current fishers). Stage 3 data are then examined to evaluate whether using low-cost online and email-based methods to conduct a longitudinal survey are fit for the purpose of regularly sampling recreational fishers in a diary-style survey or result in unacceptably high rates of survey drop out over time.

12.2 Challenges and changes affecting the use of surveys worldwide

Understanding the economic and social contributions of recreational fishing relies on being able to successfully survey recreational fishers. This section examines the methods previously used in recreational fishing surveys that have examined social and economic aspects of fishing. It then identifies the challenges facing those conducting these surveys, due to a range of factors including changing communication methods, technology, and willingness to participate in surveys. The rapid rise of non-probability sampling and online surveys (often used together) is then examined, focusing on both the challenges they present, and the methods used to try to address disadvantages of these approaches and produce robust data from them. The material presented in some sections is drawn from content developed by the University of Canberra's Regional Wellbeing Survey team to explain approaches to survey sampling, which is also available in user guides to surveys conducted by this team.

12.2.1 Methods previously used in Australian recreational fishing surveys

Historically, social and economic data on recreational fishing has been collected via surveys conducted by phone, face to face, or by mailing a paper survey questionnaire. Use of online surveys to collect data on some social and economic aspects of recreational fishing has been increasing, primarily since 2005.

Recreational fishing surveys seeking to understand social and economic aspects of fishing will typically need to sample either (i) the Australian population (studies seeking to compare fishers and non-fishers, for example those estimating participation rates in fishing), or (ii) the recreational fisher population (studies seeking to understand patterns of behaviour, values or actions undertaken by fishers). Sampling requires being able to contact a suitable sample of people from the population that can be analysed in ways that produce results representative of the population. Participants may be recruited from a sample frame, or by contacting people without having a formal sample frame. A sample frame is a database of contacts (phone numbers, postal addresses, and/or emails) from which a specific sample can be selected. For example, the first NRIFS used the White Pages as a sample frame to achieve a sample of Australian households (Henry and Lyle 2003) as, at the time, the White Pages

had very high coverage of Australian households. Selecting a sample from a recreational fishing licence data base is another example of using a sample frame. Surveys that do not use a sample frame typically invite participation directly from a population, for example by advertising (whether online, or using flyers/posters in a given neighbourhood), or sample at given locations where the target population are likely to be located (a shopping centre, a fishing ramp, or other areas). Some fishing surveys examining behaviour on fishing trips may use face to face interviews at fishing ramps, an example in which no sample frame is used.

In an ideal world, studies that use sample frames would have access to frames that are perfectly representative of the population being surveyed, while those that do not use sample frames would be able to sample in ways perfectly representative of the population being examined. In reality, neither of these things are likely. Sample frames are rarely perfect, and it is important to understand the ways any given sample frame is likely to differ to the population a survey is seeking to understand. For example, a recreational fishing survey may sample from a database of recreational fishing licence holders. This database will not include contact details for any groups who are not required to hold a licence to go fishing. This may mean that groups such as those over a certain age, or pension card holders, are not included in the sample frame. Those seeking to survey recreational fishers will need to decide whether to

(i) draw their entire sample from the licence database and ignore the groups who are not included in the database
(ii) sample from the licence database and add to this by also collecting additional samples that include the groups not covered by the licence database (using either an alternative sample frame or sampling not reliant on sampling frames), or
(iii) find an alternative way of achieving a sample that does not use the licence database.

The use of blended sampling is becoming increasingly common. In blended sample, either (i) more than one sampling frame is sampled from to ensure adequate coverage of a target population, or (ii) a combination of sampling methods is used that include both sampling frames and other approaches (e.g. Robbins et al. 2019).

In 1999-2000 when the NRIFS was undertaken, the sample frame used in many surveys, whether involving recreational fishers, health surveys or others, was the White Pages. At this point in time, the White Pages had very high coverage of the Australian residential population, with 80% to 90% of Australian households typically listing their address and landline phone number. However, the advent of mobile phones and changes in communication more generally resulted in rapid change in the coverage of the White Pages. By 2006, only 73.8% of households were listed in Australia's electronic white pages, and this declined to 49.6% by 2013 (Dal Grande et al. 2016). It is highly likely to have declined substantially more between 2013 and 2020 (data on coverage were not able to be sourced for a more recent period than 2013). The decline in White Pages coverage is not random across the population: those who are older, home owners and do not have mobile phones, are much more likely to be listed in the White Pages, while younger people and those who do not have a landline are much less likely to have a listing (Dal Grande et al. 2016).

Because the White Pages cannot be considered to provide a representative sample of the Australian population anymore, many recreational fishing surveys that rely on sample frames have shifted away from using this as a sample frame. They have typically shifted to using either (i) random sampling of landlines and mobile phones from a market research database such as SamplePages (www.samplepages.com.au), often combined with random digit dialling of landlines and/or mobile phones, (ii) surveying a sample of recreational fishing licence holders (possible only in states/territories where a licence is required), or (iii) using online surveys, sometimes recruiting via an online survey panel (online survey panels are discussed further subsequently in this chapter). For example, Tasmanian recreational fishing surveys conducted in 2007-08 and 2012-13 used the White Pages as a sampling frame, while the 2016-17 Tasmanian survey shifted to using the SamplePages database with a regionally stratified random sample (Lyle et al. 2009, 2014, 2019). Meanwhile,

Victorian recreational fishing surveys in recent years have relied on sampling from online survey panels (Ernst and Young 2009, 2015, 2020).

Given that the methods used to achieve samples in recreational fishing surveys are changing over time, it is important to review broader challenges and opportunities in survey research, and what these may mean for surveys seeking to examine social and economic dimensions of recreational fishing. Four key areas are important to consider: survey response rates, availability of sample frames, probability versus non-probability sampling, and the use of statistical weighting.

12.2.2 Declining survey response rates and concern about survey nonresponse bias

The first potential challenge to be considered when designing social and economic surveys of recreational fishing is that of declining survey response rates, and whether they present a likely threat to ability to produce robust social and economic estimates from surveys.

Willingness to participate in surveys has declined rapidly worldwide in recent decades, for all types of survey including phone and mail (Connelly et al. 2003, Keeter et al. 2017, Pickett et al. 2018). For example, Gallup – one of the most prominent polling firms worldwide – have reported rapidly declining response rates to key surveys such as the Gallup Poll Social Series: response rates to this phone survey fell from an average 28% response rate in 1997 to 7% in 2017 (Marken 2018). Keeter et al. (2017) identified that Pew Research Center phone survey response rates declined from 36% in 1997 to 9% in 2016. There are many reasons for this decline, including growing concerns about privacy and confidentiality, and survey fatigue associated with 'the growing number of unsolicited requests from the survey and the marketing industry' (Arcos et al. 2020).

Surveys examining participation in outdoor activities and natural resource management are no exception to the rule of declining survey participation, with Connelly et al. (2003) identifying rapid decline in response rates to mail surveys examining natural resource management topics even after controlling for factors known to influence willingness to respond, such as the relevance of the survey topic to the respondent and the complexity of the survey questions.

The decline in response rates appears to have been particularly marked for phone surveys, high for mail surveys, and less strong for face-to-face surveys, according to a review by Czajka and Beyler (2016). However, even though some survey modes may have experienced a less steep decline in survey response rates, declining response rates are a significant challenge for all types of surveys:

> Household sample surveys depend upon their ability to reach and engage the individuals they select as potential respondents. The viability of such surveys is being challenged by declining response rates and related developments that affect not only the quantity but the quality of the information collected. (Czajka and Beyler 2016, p. vii)

Does this decline in survey response rates present a threat to quality of survey data, and ability to rely on findings? Traditionally, advice on conducting best practice surveys has recommended that survey researchers should seek to achieve as high a response rate as possible, with many textbooks making claims about the levels of response needed to have a 'quality' survey and often setting benchmarks such as 60% or 70% that are rarely, if ever, achieved in surveys in the 2020s (Picket et al. 2018). This advice is based on the common assumption that higher response rates reduce overall bias in survey response. Based on this assumption, many have expressed concern that declining response rates may increase non-response bias in surveys (Hendra and Hill 2018, Picket et al. 2018), meaning bias that occurs 'when the kinds of people who are contacted and who agree to participate in a survey are systematically different from those who can't be contacted or who refuse to participate' (Keeter et al. 2017 p. 5).

However, despite high response rates commonly being recommended as a way of ensuring survey quality, multiple studies have found that in reality, there is often little to no association between

response rates and non-response bias (Czajka and Beyler 2016, Keeter et al. 2017, Hendra and Hill 2018, Marken 2018). In a review of multiple studies examining response bias, Czajka and Beyler (2016) concluded that the evidence suggested that large non-response bias can occur in almost any survey irrespective of response rate. The growing number of studies showing limited association between response rates and bias has led to:

> … a consensus that survey nonresponse rates do not immediately cause bias in the sample but that specific features of the population, the sample, or the survey design will lead to bias being more evident. (Nield and Nordstrom 2016)

In other words, low response rates on their own are not the cause of non-response bias, however they may exacerbate the many other factors that do cause non-response bias. If these factors are present, then lower response rates may increase total size of bias in response, while not being the ultimate 'cause' of this bias. If factors likely to cause bias are not present, then responses will be representative, even if the response rate is low. Connelly et al. (2003) noted that the risk of bias depends on factors such as the homogeneity of the target population being surveyed and their willingness to respond to the survey, and particularly whether these things vary together with the things a survey is measuring. More formally:

> …bias in a variable's mean comes from the probability that an individual will respond and how that probability is correlated with the variable of interest. … a higher response rate could actually lead to higher mean biases in cases where the variable is highly correlated with the individual's probability of responding to the survey.' (Nield and Norstom 2016 p. 3, citing Groves 2006)

Studies into response rates and quality of survey data have found that in some cases, high response rates are associated with *poorer* quality data rather than the higher quality some would expect (e.g. Hendra and Hill 2018):

> Efforts to add respondents in order to increase response rates may not reduce bias and could actually increase it, depending on whether the additional respondents are more representative or less representative of sample members who are underrepresented among the existing respondents. There is also evidence that reluctant respondents may provide data of lower quality than respondents who participated more willingly. (Czajka and Beyler 2016, p. ix)

The growing agreement that response rates are not in and of themselves a particularly useful indicator of survey quality or of non-response bias has led to discussion of what criteria should be used to indicate quality. Instead of relying on response rates as a measure of quality, the sources of bias that a low response rate may amplify should be examined. These may include things such as the likelihood of bias being introduced as a result of the sampling frames or survey recruitment methods used, and design features of the survey such as the types of incentives provided and survey design.

A key risk for non-response bias relates to survey 'salience'. Put simply, people are more likely to participate in a survey if they are interested in the topic of the survey. For example, the Pew Research Center found that telephone polls examining social engagement and political views are biased to those who are more socially involved and engaged in political activity, and can readily under-represent the views of those who are less engaged in community and political activities (Keeter et al. 2017). For recreational fishing surveys, it is likely that a survey that is principally about fishing will, unless designed carefully to reduce salience bias, achieve a response biased towards fishers, and possibly towards more avid or enthusiastic fishers. This is a problem for surveys seeking to understand the proportion of people who do and don't engage in fishing, which need to have an equal probability of response from fishers and non-fishers; as well as for surveys seeking to identify fishing effort. When seeking this type of information in a recreational fishing survey, it may be more important to ensure salience bias is reduced than to seek high response rates.

One way of reducing this type of salience bias is to include questions on specific interests as part of a broader 'omnibus' survey that asks about multiple topics, rather than being focused on a single topic. This approach has been found to be effective in reducing salience bias when asking questions about a

person's lifestyle and activities, even for surveys with low response rates (Keeter et al. 2017). This suggests that as long as the overall survey is not structured to be specific to one particular activity or interest, it is likely to be possible to get an unbiased picture of participation in outdoor activities such as fishing, even in surveys with low response rates.

Another method sometimes used to reduce salience bias and increase response rates is providing survey incentives such as a small payment to complete a survey or a prize draw (Schirmer 2009). Provision of incentives has been shown in some studies to improve sample quality, and in many to increase numbers of responses. While findings regarding effects on sample quality are mixed, most have found either no effect on response bias, or a positive effect, and there is little evidence that prize incentives reduce the quality of survey responses (see Singer and Ye 2013 for a review of studies). Other methods used to improve quality of survey samples include use of responsive survey design (in which participants are only asked questions relevant to them), providing multiple survey mode options (such as the option of completing by mail, online or by phone), and two-phase sampling (a short survey followed by another subsequent phase) (Czajka and Beyler 2016).

Overall, while declining response rates are a challenge, the 'crisis' sometimes claimed in relation to declining survey response rates is 'both real and imagined' (Pickett et al. 2018, p.7). Rather than assuming higher survey response rates will automatically increase quality of responses, it is more important to critically examine sources of non-response and sample bias *irrespective of response rate*. It is useful to increase response rates, particularly to ensure cost-effectiveness of efforts to conduct surveys – but when doing so, it is important to work to grow responses in ways that either (i) do not increase bias or (ii) that can track bias to enable this bias to be subsequently addressed using methods such as statistical weighting. Resources should only be directed to increasing response rates if this is the best way to achieve quality survey responses and minimise bias. In some cases, expanding the size of the sample sent an invitation to participate in a survey may be more appropriate than attempting to raise response rates amongst a smaller sample.

While declining response rates may not be as significant an issue for surveys as they initially appear to be, they do have two important implications beyond highlighting the importance of evaluating likely sources of response bias in surveys. First, lower response rates often result in significantly increased cost of data collection. Second, the finding that response rate is not a highly effective indicator of representativeness of a sample highlights the need to identify appropriate indicators – and the opportunity to develop indicators that are as applicable to non-probability as probability-based surveys (discussed further subsequently in this chapter).

While low survey response rates will not necessarily increase bias or have implications for quality, they do have the significant disadvantage that they result in higher costs per survey response. The cost of achieving a given sample size has increased substantially for many surveys due to declining response rates, as it requires contacting many more people than used to be required to achieve a given number of responses. The resulting increase in cost is often significant (Jager et al. 2017, Buelens et al. 2018, Andridge et al. 2019, Arcos et al. 2020). This increased cost can reduce ability to conduct regular surveys, or to achieve large samples in any given survey, and suggests a need to examine alternative, cost effective approaches to recruiting survey participants.

Many of the most cost-effective methods of achieving a survey sample use non-probability sampling approaches. Non-probability sampling is often dismissed based on the assumption that samples achieved using non-probabilistic approaches will achieve more biased samples than probability-based sampling. However, as discussed subsequently in this chapter, the finding that declining response rates can exacerbate sources of non-response bias in probability surveys has led some to call for reconsideration of non-probabilistic survey methods as potentially important ways of achieving robust survey samples. For example, Czajka and Beyler (2016) argued that declining response rates effectively reduce the likelihood of a difference in inherent quality of samples achieved using probability versus non-probability sampling:

> Declining response rates encourage consideration of alternatives to reliance on probability surveys … Strategies that have been suggested include making greater use of administrative records, learning how to extract useful information from "big data," and developing better ways to use the data obtained from nonprobability samples. (p. x).

The growing focus on understanding bias in survey responses irrespective of response rates has led to a shift in how response bias is examined for both probability and non-probability based samples – increasing opportunity to better use both types of sampling to achieve a robust survey sample. Whereas probability-based surveys traditionally assessed quality of responses by examining survey response rate (the proportion of people from a sample frame who responded to an invitation to complete a survey), as noted earlier this is a poor indicator of response quality. Better insight can be achieved by comparing responses to known benchmark characteristics of the target population to identify the nature and extent of biases in a given survey sample. This type of benchmark analysis is now routinely done as part of many surveys, both probability and non-probability based (Keeter et al. 2017). This type of benchmark analysis is commonly used in recreational fishing surveys (e.g. Henry and Lyle 2003, Misson et al. 2020). It is particularly useful as, by acknowledging and identifying bias, it is possible to use statistical weighting (discussed subsequently in this chapter) to correct for identified response biases. While statistical weighting is not a 'cure-all' for survey response bias, in many circumstances it can be used to significantly reduce the effect of known biases in survey samples.

Overall, the implications of research into declining survey response rates for those seeking to conduct recreational fishing surveys include:

- Survey sample bias should not be assessed based on survey response rates
- Bias in survey samples should be assessed based on comparison of response to benchmark information on the population being surveyed – something that can be done with any sample, whether recruited using a sample frame or not, or a sample achieved through probabilistic or non-probabilistic sampling
- Rising costs of surveys associated with declining response rates suggest a need to explore more cost effective options for conducting surveys – and many of the lower cost approaches available are non-probabilistic.

12.2.3 Changing availability of sampling frames

As noted earlier in this chapter, when designing a survey methodology, the first steps are often identifying the target population being studied, and then identifying how best to sample from this population – whether via a sample frame, or another method. For example, for the screening survey conducted at the start of the first NRIFS, the target population was all households in Australia, as the goal was to understand fishing participation by all people aged five and over and the White Pages was at the time a sample frame with good coverage of that population (Henry and Lyle 2003).

The use of sample frames is most commonly associated with probability-based sampling approaches. Probability-based surveys involve sampling from a frame in such a way that it is possible to identify the probability that a person was selected to participate in the survey. Usually, this involves randomised sampling. Probability based sampling relies on having access to a sample frame that has good coverage of a survey's target population. It is therefore important to consider how the coverage and availability of sampling frames is changing. A sample frame is a set of information containing contact information about a particular target population – for example, the postal addresses of households, or phone numbers, or emails. By identifying the number of people to be surveyed from that sample frame, and randomly selecting those who will be surveyed from the sample frame (with or without stratification into specific groups),), it is possible to identify the probability that any individual person (or household or business, etc) had of being selected to participate in the survey (hence the term 'probability-based' sampling).

Sample frames are typically an imperfect representation of the 'target population'. The White Pages – once a reasonably comprehensive compilation of Australian private household addresses – by 2013 included under half of Australian households. Even databases such as the Australian Electoral Roll are in reality an imperfect sample frame, as the electoral roll excludes those who are ineligible to vote (including the many adults living in Australia who are not Australian citizens), as well as those who have not enrolled to vote despite being eligible to, or who have changed address without updating their details on the electoral roll[22].

When a sample frame can be an imperfect representation of the target population, there is potential for bias when selecting a random sample from the sample frame. However, it is important to note that the presence of bias does not mean a frame cannot be used if a sample frame has overall good coverage of the target population then, even if not perfect, it is likely to be suitable for use.

In recent decades, the coverage of many sample frames has declined, meaning that they typically include a smaller proportion of the target population than used to be the case. For example, two decades ago, sampling frames such as the White Pages included phone numbers and postal addresses for 80% to 90% of Australia's households, and commercial survey sampling frames could achieve good coverage of the population using databases of landline phone numbers. In the past two decades, the emergence of mobile phones means that phones are now typically linked to individuals rather than households, while use of landlines has declined substantially: as of 2019, while 95.9% of Australians used a mobile phone, and 83.5% had access to internet at home, only 48.6% lived in households that had a landline – down from over 96% having a landline as recently as 2001 (Roy Morgan 2019). This means that traditional phone survey databases, focused on landlines, have reasonably limited coverage of households, and quite biased coverage of households, as households with older residents are more likely to have landlines, while younger people are very unlikely to have a landline (Keeter et al. 2017). At the same time, listings in the White Pages have declined to a small percentage of households. This has been identified as a concern for achieving suitable samples of recreational fishers (Taylor and Ryan 2019).

Commercial databases of phone numbers (mobile and/or landline) and postal addresses can be purchased, and as of 2019 had largely replaced use of the White Pages as sampling frames in Australia. However, these often do not have very high coverage of Australian households and, as households can opt out of these databases, there will typically be bias in their coverage. In many (but not all) cases, sampling from listed phone numbers (mobile plus landline) cannot achieve suitable coverage of the population. To address this, many surveys recruit participants using random-digit dialling (RDD) – meaning dialling randomly generated mobile phone numbers that fall with the range of known issued phone numbers across Australia.

While the use of RDD means it is theoretically possible to reach all phone users (landline and mobile), and data collected for research purposes is typically exempt from 'do not call' registers, there is growing use of apps that block unwanted phone calls (Marken 2018). This means that, similar to other modes of research, RDD does not provide an unbiased sample frame from which to select a sample, as the use of blocking apps takes some users out of the sample frame.

Sample frames remain key to recruiting participants in many surveys, despite the arguably growing potential for any given sample frame to be systematically different to the target population as its coverage of the population declines (Mercer et al. 2017). It is important to note that a decline in coverage does not automatically result in growing bias – instead, it results in increased *risk* of bias. For example, Texeira et al. (2016) found that fishers of similar age and gender who were listed in a public telephone directory had a similar distribution of fishing avidity to those who were not listed.

[22] The Electoral Roll is also only made available to survey researchers conducting medical research and is not accessible for the purpose of recreational fishing surveys.

This suggests that even with reduced coverage of the population, using a public telephone directory to sample recreational fishers can produce robust findings in some circumstances.

The risk of bias in sampling frames does not mean they should not be used. Instead, it means that researchers need to identify how to address that bias – either at the sampling stage, and/or through use of statistical weighting after obtaining a sample. Additionally, it suggests a need to investigate the use of alternative frames not always considered for use. For example, in Australia it is possible to access current data on all geographic addresses using the Global National Address File (G-NAF). The G-NAF is regularly updated, and includes postal addresses, but no information on the residents or businesses using that address (Geoscape 2023). Despite having no names of residents, and containing both residential and non-residential addresses, it is possible to use the G-NAF to select a survey sample, by analysing the database to identify residential addresses, and selecting a sample of addresses. When specifically sampling recreational fishing, recreational fishing licence databases provide a sample frame that can be and is used in some states and territories as a sample frame for surveying recreational fishers. Currently, not all Australian states and territories require a recreational fishing licence; those that do require a licence do not require all groups of people to have a licence under all circumstances, with many having some exempt groups. A national registry of recreational fishers, in which fishers were required to register, has potential to provide a sample frame for future surveys of recreational fishers (see for example Tate et al. 2020, Taylor and Ryan 2020). However, currently this is not available.

Perhaps the most common method used to reduce risk of bias in a sample obtained using a biased sample frame is stratified random sampling – specifying the size of sample to be invited from a number of groups which have differing representation in a sample frame. For example, a researcher may identify that a population is made up of equal proportions of people aged under 40 and aged 40 and older, but that the people included in a given sample frame are biased such that 30% of the sample frame is aged under 40, and 70% are aged 40 and older. The potential for bias when sampling from this frame can be addressed through stratifying the sample by age. The survey sampling may specify that 50% of a sample of 2,000 people to be invited to complete the survey will be randomly selected from those aged under 40, and the other 50% from those aged 40 and over, in the sample frame. This stratification results in a final sample that properly represents the different ages in the actual population. While stratification is perhaps most commonly used to ensure sufficient representation of different groups, this use of stratification is another application in which stratified sampling from a frame can improve sampling outcomes.

However, in many cases stratified random sampling is unlikely to fully address bias in responses. In reality, most surveys will have some bias in responses, even if the group of people invited to participate in the survey was perfectly representative of the population being studied. This is because some of those invited to participate will be more likely to participate than others. Given this, it is common to use statistical weighting to correct for biases in samples achieved from any survey. When sampling has been undertaken using stratified probability sampling, this can be done by using weights to adjust for the different probabilities of sampling relative to distribution of sampling characteristics in the population being sampled. In addition, however, it is common to find that additional post-hoc weighting is needed, which corrects for biases identified in the resulting sample that have resulted from non-response bias. These differences are often identified by comparing the characteristics of the sample to the known characteristics of the population using available data sources. The known characteristics of the population are used to construct a ‘superpopulation’ model that specifies what characteristics an ideal sample would have; the characteristics of the actual sample can then be compared to this. As noted in Chapter 3, a superpopulation is a benchmark model that specifies, as far as possible, the relevant characteristics of the population the survey is studying. This model-based approach does not rely on the use of probability sampling, and can be used with samples achieved using non-probabilistic sampling methods (Little 2004).

12.2.4 Non-probability sampling – can it produce robust findings?

Increasingly, many surveys recruit participants using non-probabilistic methods. 'Non-probability' surveys recruit survey participants in ways that do not enable calculation of the probability that a member of a given population or sample frame was selected to participate in the survey.

Many assume that use of non-probability sampling equates to 'convenience sampling' – recruiting survey participants using any convenient method with little structure or design involved in the sampling methodology. In reality non-probability sampling can use many different recruitment methods, and some are much more likely to result in a robust survey sample than others. For example, sampling from a database of contacts until different quotas are met is an example of non-probability sampling which can, if designed well, achieve a robust sample.

Examples of non-probability sampling approaches include 'river sampling' in which an ad is placed on a website that 'hooks' some people who see the ad as they are travelling through the 'river' of the internet, purposive sampling (researchers specify type of sample required based on specific criteria), expert selection (experts picked who should be sampled based on their knowledge), case studies (many or all people in a given part of the target population are sampled as a case study), location sampling (recruiting at locations where the target population is likely to be present e.g. in a shopping centre, via ads on a website this population frequents, at a fishing ramp), and volunteer sampling (general invitations to participate are provided in non-individualised form e.g. flyers, posters, media), amongst others (Tyrer and Heyman 2016, Vehovar et al. 2016). These will result in samples of varying quality depending on the population being sampled, their interest in the topic of the survey, and how the sampling methods (particularly the approach to recruiting survey participants) are designed.

The view that probability-based surveys are the only meaningful way of sampling robustly became widespread from the 1930s, as part of a long history of debate about how best to build knowledge about a population using sampling. Until the 1800s, collecting data from an entire population was widely viewed as the only way to understand a population. The development of sampling theory, arguably building from Anders Kiaer's 1880s proposal of a representative method for sampling from a population using purposive sampling, represented what Bethlehem (2009) describes as one of Kuhn's 'intellectually violent revolutions', in that it reshaped ideas about how it was possible to understand a population. The idea of sampling is that it is possible to make inferences about a population using data drawn only from a part of that population, if the sample is appropriately designed.

Early approaches to using 'designed based inference' (meaning the use of specifically designed sampling) rather than census approaches to understanding a population used non-probabilistic approaches, most alike to purposive and quota sampling. The idea of probabilistic selection as a way of achieving a representative sample developed in the early 1900s and until the 1930s existed alongside non-probabilistic methods (Bethlehem 2009; Brewer 2013). In 1947, the United Nations Statistical Commission issued guidelines for statistical sampling that advocated for the use of probability sampling and highlighted that purposive and quota sampling were not equivalent to random selection. By 1950 what is now considered the classical theory of random sampling was 'more or less completed' (Bethlehem 2009, p. 16). However, while probability sampling was dominant in statistical sampling through the 1950s to 1980s in social and economic research as the 'gold standard', in market research there was continued development of use of non-probabilistic methods, particularly the use of quota sampling and model-based weighting (Bethlehem 2009).

As early as the 1950s, concerns were raised that relying solely on probability-based sampling using randomised selection – or on design-based inference more generally, in which the design of sampling was considered the main or in some cases only step to achieving a representative sample of the population - was not the panacea some were promoting it to be. Godambe challenged this 'model free' orthodoxy, publishing a proof he argued showed that a uniformly best randomization-based estimator

of a population mean did not exist. He argued that design-based inference methods were not sufficient to create bias-free inference to a given population, and that it was necessary to minimize sampling variance from the population by using a superpopulation model (Godambe 1955, cited in Brewer 2013). Model-based inference is based on the idea that inference about a population can be made through adjusting a survey sample so that its characteristics match a model that specifies the distribution of important characteristics of the population.

From the 1980s onwards, three broad approaches to inferring from a survey to a population have been used in survey research, with ongoing debate about which is most appropriate and when. First, many continue to argue for reliance on design-based inference using probability sampling alone. In this approach, statistical inference to the population is based entirely on the sampling design, and the probability of selection into the sample determines the weighting given to make population inference. However, it is widely recognised that this approach has problems when non-sampling error occurs such as response bias (Chambers 2011). Given this, many use a second approach: model-assisted inference, in which inference to a population is made by combining both design-based inference and subsequent model-based adjustment that seeks to address issues such as non-response bias. Finally, there is growing use of model-based inference using superpopulations. In this approach, model-based inference is used without examining the probability of selection into a survey sample. This third approach still enables use of probabilistic sampling, but can also be used to make inference from blended sampled collected using multiple sampling techniques, including probability and non-probabilistic approaches (Chambers 2011).

Model-based inference can be used both to select a sample - by designing sampling to match a pre-determined hypothetical population that has the desired characteristics - and to guide subsequent correction of bias in achieved samples using statistical weighting. Model-based inference focuses on identifying how the sample relates to the 'superpopulation' – simply put, the hypothetical target population (Smith and Dawber 2019). This can be as simple as sample matching, where data from a benchmark population – such as data from a national Census – are compared to data from the sample, with respondents sampled until they match the composition of the target population identified using Census data.

The use of model-based weighting enables design of specific methods to address known risks of bias in recruitment of survey samples. For example, propensity score matching is used in treatment/control studies and increasingly applied to weighting nonprobability samples, and involves identifying the conditional probability of a person being selected based on a set of benchmark data and known rates of incidence of key confounding characteristics or behaviours (for example, a person with a particular health condition may be known to visit the supermarket only 1/3 as often as a person who is healthy, and the sampling can be corrected to address this known difference in behaviour). Quota sampling can be used to achieve a representative sample in sample matching or propensity matching, or more broadly to set quotas for sampling until the sample reaches benchmarks for participation based on the superpopulation, or the modelled characteristics of the target population to be surveyed (Smith and Dawber 2019).

Those who use model-based inference often face criticism of their approach from others. Some of these criticisms result from the application of standards developed to assess design-based inference, particularly probability based statistical inference theory, to model-based inference approaches (Baker et al. 2013, Buelens et al. 2018). By definition, model-based weighting does not meet the criteria set by theories focused on design-based inference, which are based on the idea of achieving quality of survey data through design of sampling. Model-based inference can, of course, be done well and poorly – when done poorly, it may involve collecting data from an extreme sample that is biased in ways that cannot be addressed using the population characteristics incorporated in the model that is used to produce statistical weights. When done well – with a sample that is of suitable quality to support model-based weighting – it can produce relevant and robust data (Chambers 2011).

This again returns to the central importance of assessing the quality of data collected using any sampling method. However, quality needs to be assessed in ways appropriate to the type of sampling and inference approach being used. Those using probability-based statistical inference need to ensure the data were collected in ways enabling estimation of probability of selection. Those who use broader designed based inference need to assess the quality of the sample, likely biases, and whether there is sufficient sample of all groups to support model-based inference.

Both probability- and non-probability surveys face the challenge that there is no perfect way to sample randomly from most large populations. Both also vary dramatically in quality depending on either the quality of the sample frame used (probability surveys) or the quality of the sampling method used to achieve sufficient sample of the target population (non-probability surveys). This means that rather than ask 'can non-probability surveys achieve robust findings', a better question is 'what design considerations need to be implemented for any survey (whether using probability or non-probability sampling) to collect data that is suitably robust to enable use of model-based inference'. This question should be asked of surveys using any type of sampling method, including online, face to face, mail and phone surveys, and those selecting a sample from a sample frame versus recruiting the sample in other ways. In other words, those conducting any recreational fishing survey need to carefully consider how to reach their target population, and identify the likely biases resulting from the use of different approaches to recruiting survey participants, whether they are probability or non-probability based.

In reality, many probability surveys are subject to similar types of selection bias that are the basis for concerns about quality of non-probability survey methods. Because of this, some argue that many surveys claiming to be probability based are in fact best treated as non-probability sampling - particularly if some parts of the target population are omitted or are sampled at levels too small to enable robust weighting of responses, or if there are overall very low response rates from some parts of the population (Vehovar et al. 2016). Conversely, some argue that non-probability sampling methods that achieve good coverage of all parts of the target population 'can turn to probability samples, particularly in case of volunteer samples (e.g. mail-in, web self-selection)' (Vehovar et al. 2016 p. 328). Both probability and non-probability based survey recruitment need to identify methods to address the risk of poor survey quality due to selection bias (those who are invited to participate not being representative of the target population) and response bias (those who opt to respond being systematically different to those who do not respond).

In recent years, a number of studies have examined how best to reduce risk of selection and response bias, as well as how to assess the quality of a study without relying solely on statistical inference theory that assumes sampling randomly with a known probability of selection into the sample will automatically eliminate most bias. Most studies evaluating non-probability surveys have used methods developed specifically to measure the quality of probability-based surveys. Mercer et al. (2017) argue that this leads to inappropriate conclusions. They developed a different approach to examining the quality of surveys that, rather than focusing on how the sample is recruited or response rates – both issues shown to have limited validity in many circumstances – uses principles developed in fields that seek to make causal inferences but often have to deal with observational, non-randomised data when doing so, such as epidemiology, political science and economics. They argue for use of a general framework 'that emphasizes the characteristics of the realized sample, regardless of how it was generated' (p. 251). This means that rather than evaluate a survey based on the methods by which participants were recruited into the survey and the success of that recruitment, survey quality should be assessed based on the characteristics of the resulting sample and whether it has the basic characteristics needed to address any identified biases in the sample when compared to the target population. Specifically, they propose that three aspects be assessed when determining whether the survey sample could 'lead to biased results:

- Exchangeability – Are all confounding variables known and measured for all sampling units?
- Positivity – does the sample include all of the necessary kinds of units in the target population, or are certain groups with distinct characteristics missing?

- Composition – does the sample distribution match the target population with respect to the confounding variables, or can it be adjusted to match?' (Mercer et al. 2017 p. 252)

Baker et al. (2013) also emphasised the importance of being able to adjust samples to match the target population, which in turn means it is critical to have clear theory driving how and why participants in a survey are selected, and that multiple theories can inform design of non-probability sampling, whereas probability sampling relies on a single theory (probability based sampling). They recommend the use of pseudo-designed-based inference (applying design-based methods in the absence of a probability based sample design), based on recognition that design based inference (ensuring survey recruitment methods are designed to maximise likelihood of a representative response) can still form part of non-probability approaches to survey samples (Buelens et al. 2018).

Vehovar et al. (2016) suggest that improving quality of any sample can be achieved through ensuring non-probability samples are 'spread as broadly as possible' – in other words, using methods that ensure all parts of the target population are reached and a sufficient sample achieved from each key part of the population; incorporating some probability sampling design principles where possible, such as clearly incorporating elements of randomization where possible in selection; and ensuring as equal a probability of being invited to participate in the study as possible.

In the NRFS, sample quality was addressed using both design-based inference and model-based inference. Design-based inference involved probabilistic sampling where feasible and using pseudo-design-based inference approaches where non-probability sampling needed to be used.

As described in Chapter 3, sampling design for the NRFS involved identifying a number of different sampling methods that, when used together, would theoretically ensure all parts of the target population were reached. This meant a blended sample was used. Each of these sampling methods was then designed using the principle of pseudo-design-based inference, with selection being as random as possible within the constraints of the sampling method (or probability based where a sample frame was available).

The NRFS then used model-based inference, with a superpopulation model developed and used to generate statistical weights that enabled inference to the population. However, a critical first step before doing this was to assess whether the data collected were 'fit for purpose' – were they suitable for analysis, in terms of exchangeability, positivity, and composition. There are a range of standard methods for assessing bias in the sample achieved, involving reporting on the characteristics of the sample achieved compared to the target population using benchmark data, which is done in this report. In addition, emerging methodologies are beginning to identify approaches to estimating non-ignorable selection bias in non-probability surveys (Andridge et al. 2019). The purpose of this chapter is assessing the extent to which the different sample recruitment methods described in Chapter 3 were 'fit for purpose' for making inference to the broader population using model-based inference.

12.2.5 Challenges and opportunities of online surveys and online survey panels

The NRFS collected data via both online and paper-based surveys, with participants able to choose to either complete surveys online or using a paper form. The large majority of survey participants completed the survey online. Given this, and that the Qualtrics blended online panel sample was used as one of the sample recruitment methods, it is useful to briefly review the challenges and opportunities involved in collecting data online, and recruiting participants via online survey panels.

Over the past few decades, the growth of the internet and associated ability to conduct online surveys has provided a way of conducting surveys at lower cost than phone, mail or face to face surveys. Online surveys have been used since the late 1990s as a survey method, and their use has grown rapidly, due in large part to their lower costs and ability to rapidly collect data compared to other methods (Callegaro et al. 2014, Blom et al. 2016). The growing use of online surveys has also been a response to the 'increasing difficulties that traditional modes, such as face to face or telephone interviews, are facing to obtain samples that achieve the highest quality standards' (Arcos et al. 2020).

This rapid growth and the growing cost and reducing efficacy of other survey methods mean that 'there are compelling reasons to expect that internet interviewing will become the dominant survey mode in the social sciences over the next few decades, largely replacing written, face-to-face, and telephone interviewing' (Blom et al. 2016 p. 9). While initially online surveys were inherently biased due to only a small proportion of the population having internet access of suitable capacity and speed to successfully complete a survey, the rapid adoption of high speed broadband and devices that can readily be used to participate in online surveys – including smart phones, tablets and computers – has changed this. As noted earlier, a much larger proportion of Australians now have access to internet at home than have a landline in their home.

While the risk of bias resulting from inability to access an online survey is reducing, it does remain. Not all households have access to the internet, and not all people have the ability to access and complete a survey online; in particular, internet speed and reliability remains poor in some communities in Australia. The simplest way to address technology-related bias is to ensure the survey can be completed on paper as well as online, and that not all survey recruitment methods rely on a person being online. Given this, all NRFS surveys were available both online and in paper form, and survey recruitment methods included both methods that relied on a person having good internet access (online survey panel and social media recruitment) and others that reached people who did not spend significant time online (such as mailing flyers inviting participation to letterboxes, as described in Chapter 3).

Only some of those who completed the NRFS surveys online were recruited via an online survey panel, enabling comparison of the responses achieved via the panel to responses achieved using other survey recruitment methods.

Worldwide, multiple large online survey panels have been established since the 1990s. An online survey panel is simply a group of people – often numbering in the thousands – who have volunteered to complete surveys online, usually in return for earning points that can be redeemed for rewards such as gift cards. These panels are not necessarily representative of the broader population, as the types of people who volunteer to be part of online panels will vary depending on how the panel recruited its participants. Online survey panels are not in and of themselves a sampling method: instead, they are large groups of people who can be sampled using a range of methods, such as quota sampling. For example, a researcher may use data from a population census to identify the proportion of men, women and people of different ages in their target population, and require that the sample targeted from the online survey panel be representative of the population by those groups. This type of approach to sampling from an online survey panel is intended to address the likely bias in coverage of the target population by the online survey panel. These online panels are widely used to recruit participants for online surveys due to their low cost and rapid availability – survey participants can be recruited with low cost emails that take little time to send and do not incur phone or mailing costs (Blom et al. 2016). A key debate has been whether the large numbers of 'online survey panels' (online panels) developed by a range of research companies can produce robust data if sampled from appropriately.

A key issue with online panels is that they have recruited their participants in a wide range of ways. Many have simply advertised online, inviting people to become members of their panel through methods such as banner ads on websites, with all or almost all of those who sign up for the panel being accepted; many also use methods such as snowball sampling (providing incentives for existing members to recruit additional members) (Callegaro et al. 2014, Blom et al. 2016). Online panels are by nature 'opt in', meaning people volunteer to join them, and hence will be biased towards those who have more interest in completing surveys (Walter et al. 2019).

While methods of recruiting online panel members vary, in almost all cases members have been recruited using non-probability methods, and thus the panel (sample frame) will not be representative of the general population. For example, studies in the United States have identified that members of online panels are 'more diverse, younger, more educated, but more poorly paid than the general US

population' (Walter et al. 2019 p. 426). However, in recent years, some panels have begun to use probability-based methods to recruit their members, such as sending invitations to a randomly selected set of households to become panel members: these still represent a minority of online panels (Callegaro et al. 2014, Blom et al. 2016).

While the members of most online panels will not be an exact representation of the general population, in many cases panels have a large number of members – thousands or, in some cases, tens of thousands of panel members. When this is the case, they may be able to provide a relatively large sample of desired characteristics, although this will depend on the specific demographic and geographic characteristics required in the sample and whether they are represented in even a large online panel's membership. In most cases, researchers seeking to survey a target population using an online panel use quota sampling to try to achieve a sample representative of their target population. This involves specifying the number of people they wish to survey in different demographic groups, such as the number of people of different ages, gender, and cultural backgrounds. By using quota sampling, it is possible to achieve a sample that has similar demographic characteristics to the target population despite the online panel itself not having the same characteristics as the target population.

This approach relies on having benchmark data for the variables by which the sample is selected – which ideally should be those where responses have greatest risk of being biased. In reality, there are limits to the availability of benchmark data – in particular, there are often forms of likely response bias for which there are not benchmark data. For example, in the 2015 UK election, incorrect polling predictions were argued to result from bias in pre-election samples towards more engaged voters. Broadly, those polled were biased towards those who both did vote and towards those who stated they intended to vote but did not then do so (Mortimore et al. 2017). This highlights that risk of bias is variable depending on the type of questions being asked. Issues such as social desirability bias (e.g. a voter stating they intend to vote in a poll because they feel they should be seen as active politically, when in reality they do not actually vote) are greater when people are asked about likely future behaviour, and somewhat less problematic when asking about past behaviour and actions, within limits. It is important to carefully consider what types of response bias may be present, to identify which can and cannot be addressed using quota sampling, and to evaluate whether model-based inference can reduce the effect of this bias.

A key question asked in many studies has been whether using quota sampling of online panels can achieve results that converge with data produced using conventional probability based phone or mail survey methods. Multiple studies have examined this question, and have produced divergent results. In general, however, more recent studies are identifying greater convergence of results, whereas earlier studies tended to find online panels did not produce data of as high quality as traditional survey methods. Callegaro et al. (2014), reviewing studies mostly conducted in the 2000s as online panels were first emerging, found that online panels could be used but in many cases had significant quality issues and produced results that did not converge with probability-based surveys. However, they also found that non-probability online panels did produce results that converged with probability based conventional surveys for one topic – pre-election polling. This likely reflected that this area of survey research had the best developed methods and online panels, and had this achieved better quality more rapidly compared to other areas of survey research. More recently, Walter et al. (2019) found that with suitable care in designing quota sampling used, online panel data 'has similar psychometric properties and produces criterion validities that generally fall within the credibility intervals of existing meta-analytic results from conventionally sourced data … with appropriate caution, OPD [online panel data] are suitable for many exploratory research questions' (p. 425). Their study examined the overall psychometric properties of responses, rather than whether responses estimating population-level properties were similar, but support the concept of well-designed online panel surveys having high validity when used appropriately.

Some have raised concerns that online panel surveys may be at higher risk of 'insufficient effort responding' – poor quality responses resulting from people 'ticking and flicking' instead of taking time to carefully consider their survey answers. Most online panel respondents have low stakes in the

survey topics and complete surveys for monetary incentives; the concern has been that this will lead to low effort to complete survey questions accurately. However, when reviewing studies that have examined this issue, Walter et al. (2019) found that no evidence of higher rates of insufficient effort in online panels compared to other surveys, and instead found evidence that, in those online panels that have instituted quality checking, there is likely to be *less* incidence of insufficient effort than is found in other surveys.

The findings of studies examining the quality of online panels highlights that the appropriate question is not whether online panels as a whole can produce quality data, but under what circumstances online panels produce quality data. Answering this question enables researchers to select the best quality online panel, and to avoid using online panels that have poor management or particularly problematic membership. Baker et al. (2013, p. 102) point out that:

> There is a tendency to lump all online samples from opt-in panels into the single bucket of online, as if opt-in panels were a sampling method. They are not. Users of opt-in panels may employ different sampling, data collection, and adjustment techniques. Research evaluations of older methods of non-probability sampling from panels may have little relevance to the current methods being used.

Callegaro et al. (2014) found that key factors influencing quality of online survey panels included how the company managing the panel invited members and managed panel member deletions – for example, does the company check the quality of survey completions and remove people from the panel if there is evidence they are not providing meaningful answers to surveys? Some online panels do this, while others do not. A key challenge in assessing the quality of online survey panels is a lack of data on their processes and quality, with little transparency regarding their membership and internal processes of quality control for many panels (Callegaro et al. 2014). The quality of an online panel will depend in part on factors such as how well they retain participants after initially recruiting them, which in turn relies on how well the survey company interacts with their members and implements strategies such as use of incentives to retain them in the survey panel (Blom et al. 2016). This emphasises that rather than assume all online panels use particular recruitment methods or have similar quality, the focus should be on (i) selecting high quality online panels that can provide a robust sample that meets the needs of a given survey and its target population requirements, and (ii) carefully designing how the sample will be selected from the online panel and how responses will be adjusted post-sampling.

Overall, the growing literature examining online surveys suggests that well-designed samples recruited from online panel can under the right circumstances be as effective as well designed surveys using phone, mail or face to face methods. The right circumstances include the online panel having reasonable coverage of target populations and sufficient processes of quality control in both recruitment and management of their panel. This suggests that online panels can form part of sampling strategies. However, as online panels will not include people who have difficulty accessing online surveys or who do not prefer to join a panel, some recommend the use of mixed-mode surveys, which use a combination of survey panels and other methods of recruiting respondents to ensure all parts of their target population are reached (Blom et al. 2016). When using an online panel to recruit survey participants, care should be taken to use panels that demonstrate evidence of quality control, and of having clear methods for maintaining participation and where appropriate ‘refreshing’ the panel with new participants (Blom et al. 2016).

12.3 Methods

Model-based inference relies on collecting data that is suitable for statistical weighting against a superpopulation model. The concept of statistical weighting is described in more detail in Appendix 2.5: broadly, it refers to a statistical process in which known biases in the responses received are corrected for, by either addressing differential probabilities of selection into a survey (design-based weighting) or correcting differences between a sample and a superpopulation model that describes key characteristics of the overall population (model-based weighting). In the NRFS, model-based

weighting was used, after first assessing suitability of the samples achieved using different survey recruitment methods for this type of weighting.

This chapter presents the findings of analysis used to assess the suitability of samples achieved using different survey recruitment methods. Overall, the survey sample was considered fit for purpose if it met the three criteria proposed by Mercer et al. (2017): (i) exchangeability - measurement of key confounding variables, (ii) positivity - a sample of all necessary units in the target population, and (iii) composition - being suited for applying model-based inference via generation of statistical weights that enable adjustment of the sample distribution to match the target population.

By examining the suitability of the sample achieved for weighting using model-based inference, this chapter also examines the broader effectiveness of different survey recruitment methods for use in future surveys.

The methods used to collect data were described in Chapter 3. The composition of the sample achieved in different stages is described in Chapter 3 and in Appendices 2.5 and 2.8. These sections should be referred to for evidence of the criteria of exchangeability - they show how potential confounding variables were identified and measured in the NRFS, to ensure they could be included in model-based weighting, and used as appropriate to examine specific groups known to be important for understanding social and economic dimensions of recreational fishing. For example, some survey recruitment methods deliberately sought to recruit more avid fishers, and were expected to result in (deliberate) oversampling of avid fishers. Given this, it was critical to ensure fishing avidity was measured in the survey, thus enabling its inclusion as a potential confounder in some analyses, and its used in statistical weight generation as part of the Stage 2 model-based weighting process.

Chapter 3, and associated appendices, also describe how different survey recruitment methods were designed to reach different parts of the population, including some methods specifically targeted to achieve a sample of younger respondents known to be less likely to respond to other methods. These should be referred to for demonstration of the criteria of positivity: a sample was achieved of all necessary units in the target population.

This chapter analyses for the third criterion, positivity: whether the samples generated were suitable for generating inference to the population as part of a blended sample that used model-based inference. The key issue here was to assess whether some survey recruitment methods had a significant effect on the key outcome variables being measured after the application of model-based statistical weights. In other words, after weighting the sample, did data collected using different survey recruitment methods generate different answers about the social and economic contributions of recreational fishing?

As noted earlier, methods for assessing the suitability of a sample for model-based inference are still emerging (Andridge et al. 2019). They should be designed to identify whether model-based weighting can sufficiently address dependent-variable bias (Andridge et al. 2019). If it does, then correcting for known characteristics of a population, such as the distribution of people of different age, gender, residential location, occupation, or fishing avidity, will result in a sample where the survey recruitment method does not cause a meaningful amount of variation in the dependent variables being examined.

In the case of the NRFS, the dependent variables are social and economic characteristics and contributions of recreational fishing, including participation in fishing, importance of different aspects of fishing, substitutability of fishing, and expenditure on fishing. Known characteristics of the population that could be used in the superpopulation model were, for the general population, data available in the 2016 Australian Census of Population and Housing, such as age, gender, whether a person was a farmer, and what state or territory they lived in. For the current fisher population, benchmark data were more limited, as was discussed in Chapter 3 and Appendix 2.8, and included age, gender, household income, residential location, and fishing avidity; benchmark data were drawn from (i) previous surveys of recreational fishing and (ii) characteristics of recreational fishers

identified using data from the 2018 Regional Wellbeing Survey. In an ideal world, developing weights that adjust the distribution of the blended sample to match the characteristics of the superpopulation (age, gender etc) would result in a situation where the type of survey recruitment method used is responsible for very little of the observed variation in estimates of dependent variables such as fishing expenditure, or participation in fishing.

This is examined in this chapter for Stage 1 and Stage 2 data by (i) comparing the findings each survey recruitment method would produce if used to generate findings about fishing participation, fishing avidity etc. without the use of weighting and (ii) identifying whether controlling for the factors included in superpopulation models reduces the size of effect of survey recruitment method. This was done for each survey recruitment method and used to determine whether data collected using different methods could be included in the blended sample that was ultimately weighted using superpopulation models. First, some descriptive analysis with confidence intervals was undertaken. This was followed by regression modelling with a range of dependent variables representing the different outcomes being examined as part of the NRFS. The methods are described in further detail as findings are presented. Findings for Stage 1 data are reported in Section 12.4, and for Stage 2 data in Section 12.5.

Section 12.6 then examines drop-out bias in the Stage 3 sample: the Stage 3 sample was derived from the Stage 2 sample, and continued over time, and the most important assessment of fitness for purpose was to examine the characteristics of those who opted into the Stage 3 sample, and of those who opted to continue completing regular surveys during Stage 3.

12.4 Comparing survey methods – Stage 1 data collection, adult population (fishers and non-fishers)

12.4.1 Overview

Data collection in Stage 1 of the NRFS aimed to estimate participation in recreational fishing amongst adult Australians, and to understand differences in a range of social and demographic characteristics of fishers compared to non-fishers. Doing this required being able to conduct analyses that produced findings representative of the Australian adult population. This in turn required either achieving a perfectly representative sample of Australian adults, or recruiting a sample that was biased to some groups but for which statistical weights could be produced that enabled production of data representative of Australian adults. The latter approach was used for this study.

While data for Stage 1 were all collected as part of a single survey – the Regional Wellbeing Survey RWS) – a number of different methods were used to recruit the people who participated in the RWS, described in detail in Chapter 3 and Appendix 2.4. A total of five recruitment methods were used, some of which used probability-based random sampling, and some quota and opportunistic sampling:

- Flyers delivered to randomly selected sample of households (stratified random sampling, this is a form of probability sampling)
- Online survey panel using quota sampling using an online panel provider (the Qualtrics blended panel) which has strict criteria in place for managing quality of survey participants and screening quality of survey responses (non-probabilistic quota sampling, with random sampling from the panel participants until quota reached)
- Social media advertising: displaying advertisements inviting participation in the survey in social media feeds. These advertisements are targeted to specific groups and regions and displayed to users of the social media platform (in this case, Facebook and Instagram) who meet those demographic and geographic criteria. This type of recruitment is opportunistic sampling; however it was possible to specify criteria for the display of advertisements that ensured this method achieve some properties of quota sampling, with randomness of display within quotas.

- ‘Word of mouth’: People encouraging their networks to participate in the survey, whether by email, online sharing of posts, or including an item about the survey in a newsletter (opportunistic sampling, non-probabilistic).
- Existing participants in the long-term online omnibus Regional Wellbeing Survey. These existing participants were originally recruited using a range of methods, which included both probabilistic (direct invitation to randomly selected households) and non-probabilistic (word of mouth, social media advertising) methods. The majority were originally recruited using probabilistic selection methods.

These five methods sought to achieve samples that complemented each other, and which when blended would provide sufficient sample of different parts of the Australian adult population. In particular, flyers were targeted to achieving a sample of middle aged and older adults, social media advertising to achieving samples of younger and middle-aged adults, and the online panel a sample that, due to the use of quotas, was representative of the Australian adult population by age, and which had a large urban sample. Existing participants were known to be biased to older Australians, with older people more likely to continue participating in the survey, while word of mouth was a form of convenient, opportunistic sampling which was expected to have significant, albeit not predictable, bias.

Before being analysed, the sample achieved was assessed, to identify whether data collected using each of the five recruitment methods (as well as a sixth group – people who completed the survey online but did not identify how they were recruited to participate in it) was suitable for inclusion in a blended sample that was then weighted using a superpopulation model of the Australian adult population.

The goal of assessment was to identify whether applying statistical weights developed based on a superpopulation model resulted in consistent findings in relation to the key outcomes being assessed in the NRFS – in Stage 1, these were participation in fishing, fishing avidity, and social values related to recreational fishing. The superpopulation specified the characteristics of the adult population using data from the 2016 Australian Bureau of Statistics *Census of Population and Housing*, using the criteria of location (urban/rural and state/territory), age, gender, and whether a person was a farmer (described in Appendices 2.4 and 2.5).

To assess suitability, the following steps were used:

1. Comparison of unweighted findings by recruitment method, to identify whether there were significant differences between recruitment methods in estimation of recreational fishing characteristics prior to application of statistical weighting
2. Regression modelling to identify whether correcting for population benchmarks included in the superpopulation model removed effect of recruitment methods

Based on the outcomes, the data that could be weighted as part of the blended sample was identified, and then weighted using the superpopulation model (as described in Appendix 2.5).

12.4.2 Comparison of unweighted findings

Step 1 involved comparing unweighted data by recruitment method, to identify how different estimates of key recreational fishing attributes would be if unweighted data from each recruitment method were used. Given that different recruitment methods sought to recruit people of different ages, who were expected to have differing likelihood of participating in fishing, it was expected some significant differences would be found. This was the case: as shown in Figure 12.1, online panel participants were less likely to have gone fishing in the last 12 months (21.7%, biased towards urban residents) compared to those recruited via social media (29.6%, deliberately biased towards younger adults). However, mean fishing avidity did not vary significantly based on recruitment method.

Figure 12.1 Comparison of fishing participation and fishing avidity estimates by survey recruitment method, Stage 1 2018 RWS data

Fishing preferences and beliefs sometimes varied significantly between the samples recruited by different methods, although not often (Figure 12.2): there was only 3% variation in the proportion of fishers who agreed that 'a fishing trip can still be successful, even if no fish/crabs/lobster are caught' across all recruitment methods except the online panel, amongst whose respondents fewer agreed with the statement. The proportion agreeing they would rather catch one or two bigger fish than ten smaller fish varied from 34.7% to 41.9% between different samples, although differences were not statistically significant except between those recruited using a flyer/letter and those for whom the recruitment method was not known.

Those recruited via the online panel were significantly more likely to say they liked to fish where there were several kinds of fish to catch, compared to all other recruitment methods. Across these three measures, the differences were only sometimes significant, and relatively small in magnitude, suggesting a high likelihood that they could be addressed using statistical weighting – as long as the differences were associated with differences in factors such as age, gender or location of respondents (information for which benchmark data could be sourced for the superpopulation).

Similarly, the online panel survey participants sometimes differed to others in terms of the things they found important about recreational fishing (Figure 12.3), but differences were in most cases relatively small in magnitude. A second stage of analysis compared findings by gender and age group, to test whether it was likely that some of the differences identified between recruitment methods were associated with the differing gender and age composition of each sample. This data, provided in Appendix 9.1, showed that when broken down and compared by gender and age group there was greater similarity in the estimates compared to that shown in Figures 12.1 to 12.3.

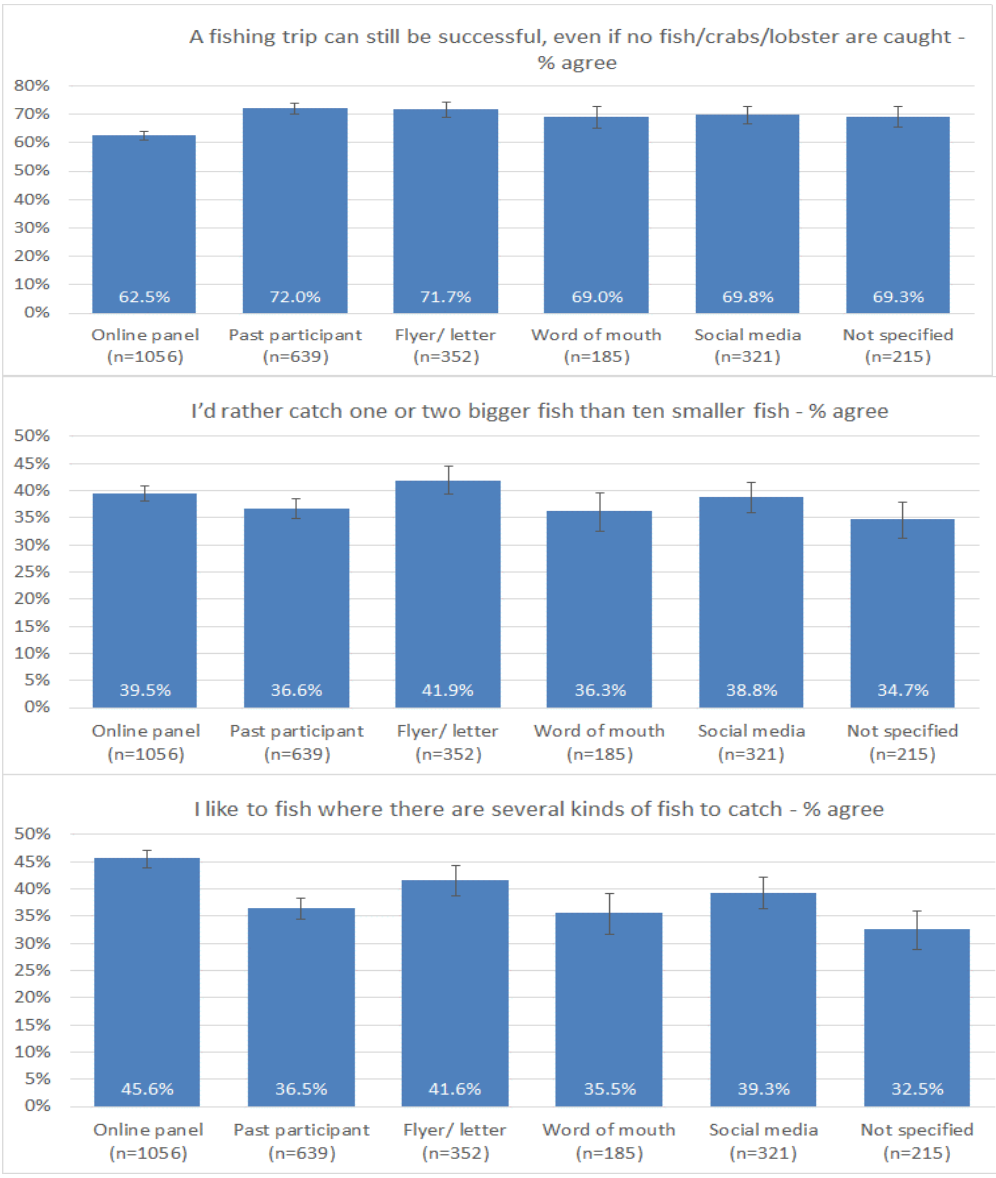


Figure 12.2 Comparison of estimates of recreational fishing, beliefs, values and preferences by recruitment method, Stage 1 2018 RWS data

Figure 12.3 Comparison of estimates of fishing satisfaction and importance of different social outcomes by survey recruitment method, Stage 1 2018 RWS data

12.4.3 Regression analysis

A series of regression models were used to test whether the type of recruitment method used was a predictor of each of the outcomes examined in Figures 12.1 to 12.3 (fishing participation, fishing avidity, fishing preferences, fishing satisfaction and fishing importance). Each regression model was conducted using two steps: in the first step, only the different recruitment methods were included. This enabled identification of the extent to which recruitment method was a predictor of variation in estimates of fishing participation/avidity/preferences/satisfaction/importance. The second step then added the variables included in the superpopulation – age, gender, urban/rural location, farmer status, and state/territory of residence. The findings from the second step enabled identification of whether recruitment method remained a large predictor after inclusion of these factors in the modelling, or if the effect of recruitment method reduced after controlling for factors included in the superpopulation model.

The overall objective was to test whether weighting data would substantially reduce the effect of recruitment method on findings. This was done by examining effect sizes, with statistical significance values also identified. Effect size was focused on as sample sizes achieved using some methods were large, meaning that even very small effects were likely to be statistically significant, despite involving very small differences in findings. This can be seen in Figures 12.1 to 12.3: in most cases, even where differences were statistically significant, the actual difference in the finding was usually less than 10%, and this was prior to any control for factors such as differences in age, gender etc that were examined in regression modelling. This is expected as when there is 'a sufficiently large sample, a statistical test will almost always demonstrate a significant difference … yet very small differences, even if significant, are often meaningless' (Sullivan and Feinn 2012, p. 279-280).

The variables examined in regression modelling focused on those that had the highest variation between recruitment methods (as shown in Figures 12.1 to 12.3), as well as ensuring the models covered the different types of social attributes that would be examined using Stage 1 data (fishing participation, avidity, preferences, and importance).

Table 12.1 summarises findings of the regression modelling. Full details of the regression models conducted using the Stage 1 data are provided in Appendices 9.2 to 9.5.

The first step of all six regression models examined whether survey recruitment method was a significant predictor of difference in estimates of the social aspects of recreational fishing that were dependent variables (fishing participation, avidity, preferences, and importance of nature connection/relaxing/spending time with friends as a part of fishing). In the first step, no recruitment method was a consistent significant predictor across all six social dimensions examined. Only one was a significant predictor at the p=0.01 level, with recruiting participants via the online panel a significant predictor of whether fishing was considered an important way of spending time with friends. At the p=0.05 level of significance, only three findings were significant in the first step of the model – those recruited through being past participants in the RWS were somewhat more likely to be avid fishers, while those recruited via social media were somewhat more likely to find fishing important for nature connection and for spending time with friends.

When only survey recruitment methods were included in the modelling, the model explained less than 4% of variance in any of the fishing-related variables examined – recruitment methods explained 0.6% of variation in fishing participation, 0.3% of variation in fishing avidity, 3.8% of variation in views about whether a person liked to fish where there were several types of fish, 0.8% of variation in how important current fishers found fishing for nature connection, 1.1% of variation in importance of fishing for relaxing/unwinding, and 2.6% of variation in importance of fishing for spending time with friends. This means that even without weighting of data, the overall effect of survey recruitment method on fishing characteristics was small.

Table 12.1 Effect of survey recruitment method on recreational fishing social attributes, – with and without controlling for age, gender, farmer status and location, Stage 1 2018 RWS data

	Dependent variable	Fishing participation		Fishing avidity		Like to fish where there are several types of fish		Fishing importance – nature connection		Fishing importance – relaxing/ unwinding		Fishing importance – spending time with friends	
		Logistic regression		Linear regression		Linear regression		Logistic regression		Logistic regression		Logistic regression	
	Model step	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Overall model fit	R2[a]	.006	.089	.003	.037	.038	.120	.008	.021	.011	.019	.026	.043
	p-value	<.000	<.000	.246	<.000	.062	<.001	<.000	<.000	<.000	<.000	<.000	<.000
Independent variables – survey recruitment methods Exp(B)/ ß[b]	Online panel (n=4867, 1056[c])	.817	.760	-.097	-.041	.062	.055	1.223	1.281	1.351	**1.465***	**1.942****	**1.776****
	Past participant (n=2750,639)	.898	.888	**-.095*[d]**	**-.110***	.026	.018	.861	.917	.848	.829	.956	1.020
	Flyer/letter (n=1467,352)	.944	1.006	-.064	-.070	.041	.037	1.089	1.203	.967	1.045	1.164	1.235
	Word of mouth (630, 185)	1.219	1.209	-.054	-.042	.002	.003	1.087	1.051	1.069	1.030	1.168	1.172
	Social media (1084, 321)	1.254	1.307	-.040	-.007	.028	.038	**1.540***	1.371	1.295	1.272	1.448	1.393
Independent variables – socio-demographic variables in super-population model (added in Step 2 only) Exp(B)/ ß[b]	Gender		**2.215****		**.127****		**.109****		**.754****		1.077		1.069
	Urban/rural		**1.925****		**.110****		**.030****		**1.242***		**1.312****		1.045
	Farmer		**1.321****		**-.045***		-.004		1.016		**1.369****		**1.263***
	Age		**.977****		**.052***		-.012		**.990****		**.993****		**.986****
	NSW/ACT		**.713***		-.116		-.049		1.239		1.307		.846
	Vic		**.672***		**-.117***		**-.070***		1.166		1.232		.979
	Qld		1.030		**-.114***		-.028		1.260		**1.542***		.984
	SA		1.177		**-.125***		-.051		1.429		1.477		1.107
	WA		1.155		-.062		-.034		1.383		1.344		1.141
	Tas		**.684***		-.082		**-.055***		1.101		1.198		.813

[a] For logistic regression models, the Nagelkerke R square is reported

[b] For logistic regression models, the Exp(B) (odds ratio) is reported as it is comparable across predictor variables; for linear regression models, the ß (standardized coefficient) is reported to enable comparison of effect size both across Model Step 1 and 2, and between predictor variables.

[c] Numbers in brackets indicate sample sizes for (i) all asked questions about whether they had gone fishing (including those who were not current fishers) and (ii) current fishers (questions about aspects of fishing such as fishing values were asked of current fishers).

[d] Bold indicates significant predictor at 0.05 level or less; * indicates significant at p=0.05 level; ** indicates significant at p=0.01 level.

After including superpopulation model characteristics in the second step of the regression modelling, only two of these remained significant predictors – online panel participants were still more likely to report fishing was an important way of spending time with friends (significant at p=0.01 level), and past participants were still somewhat more avid fishers (significant at p=0.05 level). In one case, the significance of the recruitment method as a predictor increased in the second step of the model – after controlling for age, gender etc, online panel participants were somewhat more likely to find fishing important as a way of relaxing/unwinding. In all models, at least one (and usually more than one) of the superpopulation characteristics were highly significant predictors of the social outcome. In particular, gender and age were strong predictors of almost all social aspects of fishing.

As noted earlier, effect sizes are often more important to examine than p values, particularly where sample sizes are large. In Stage 1, sample sizes for each method varied depending on the question. Questions about fishing participation were asked of a larger sample, while those asked only of current fishers involved a much smaller sample. Table 12.1 shows odds ratios (Exp(B)) for logistic regressions, and the standardized coefficient (ß) for linear regression. This allows comparison of change not only between Step 1 and Step 2 of each model, but between the predictor variables included in the model.

Ideally, the effect that the survey recruitment method has on any given dependent variable should be small. In most cases, the effect was small and insignificant both with and without controlling for the variables included in the superpopulation model: for example, recruitment method was not a statistically significant predictor of participation in fishing before controlling for these variables, even for those recruitment methods with large sample sizes (Table 12.1). Where a recruitment method had a large effect on the dependent variable, ideally that effect would reduce once superpopulation characteristics were controlled for. In Stage 1 data, controlling for superpopulation variables had the following effects in the five models examined:

- Dependent variable 'Fishing participation': Reduced already small and insignificant effect of three survey recruitment methods; slightly increased small effect for two methods
- Dependent variable 'Fishing avidity': Reduced already small and insignificant effect of three survey recruitment methods; slightly increased one insignificant effect; slightly increased one significant effect
- Dependent variable 'Like to fish where there are several types of fish': Reduced already small effect of three survey recruitment methods; slightly increased small effect for two methods
- Dependent variable 'Fishing importance – relaxing/unwinding': Reduced already small and insignificant effect of three survey recruitment methods; slightly increased one insignificant effect; increased one effect to point where it was statistically significant at p=0.05 level
- Dependent variable 'Fishing importance – spending time with friends': Reduced size of effect for one survey recruitment method that was a significant predictor, and another that had a small effect; increased size for another insignificant predictor.

Overall, the findings suggested that there was no *consistent* bias introduced into the findings by the use of any specific recruitment method and controlling for the factors included in the superpopulation model in most cases – although not all - reduced the usually already insignificant effect of survey recruitment method. Given this, all recruitment methods were identified as suitable for inclusion in the blended sample, and analysis with use of statistical weighting.

However, while survey recruitment methods were rarely significant predictors of any of the social dimensions of fishing examined, they sometimes were, albeit inconsistently. In particular, online panel participants had significantly different values regarding the importance of fishing for maintaining social connection. This points to a need for further study of the differences between those recruited via online panels and others, and why these values may be different. The first step in this type of exploration would be to repeat data collection and identify if online panel participants are consistently different across repeated surveys.

12.4.4 Conclusions

The analysis of Stage 1 data suggested that (i) survey recruitment method was rarely a significant predictor of variation in the social attributes of recreational fishing for which data were to be analysed, and (ii) that controlling for factors included in the superpopulation model overall reduced the effect of recruitment method on findings. Given this, data from participants recruited using all five survey recruitment methods were analysed as a blended sample, after developing statistical weights using the superpopulation model.

12.5 Comparing survey methods – Stage 2 data collection (current and recent fishers)

A similar analysis was undertaken using Stage 2 data. The Stage 2 sample – and hence the types of variables included in the superpopulation model – were different to the Stage 1 sample. For Stage 2 data, the primary goal was to be able to analyse data to identify information about current fishers in Australia and produce estimates of expenditure on fishing, as well as of the social contributions of fishing. This meant that it was important to examine fishing values, the importance of different aspects of fishing, and fishing expenditure, when evaluating the extent to which different survey recruitment methods were fit for purpose.

In Stage 2 data, controlling for superpopulation variables had the following effects in the seven models examined (Table 12.2 and Appendix 9.6):

- Dependent variable 'Like to fish where there are several types of fish: All survey recruitment methods had small and insignificant effects, and controlling for superpopulation variables did not change this
- Dependent variable 'Fishing importance – spending time outdoors: Controlling for superpopulation variables reduced the effect of all three recruitment methods that had larger effect sizes in the Step 1 model, by a significant proportion; and did not significantly increase effect size amongst those that had a small effect on the dependent variable in Step 1
- Dependent variable 'Fishing importance – relaxing/unwinding': Controlling for superpopulation variables reduced the effect of all three recruitment methods that had larger effect sizes in the Step 1 model, by a significant proportion; and did not significantly increase effect size amongst those that had a small effect on the dependent variable in Step 1
- Dependent variable 'Fishing importance – spending time with friends': Controlling for superpopulation variables reduced the effect of all four recruitment methods that had larger effect sizes in the Step 1 model, by a significant proportion; and did not significantly increase effect size amongst those that had a small effect on the dependent variable in Step 1
- Dependent variable 'Self-estimated total expenditure on fishing': Six of the seven recruitment methods had a large effect on this variable in Step 1; the effect of all reduced significantly when controlling for superpopulation variables, although the effect of the seventh increased slightly.
- Dependent variable 'Calculated total expenditure on fishing': Four survey recruitment methods had a large effect on this variable in Step 1; this reduced to two after controlling for superpopulation variables
- Dependent variable 'Fished (i) less or (ii) same/more in past 12 months compared to previous year: Four survey recruitment methods had a large effect on this variable in Step 1; this reduced to two after controlling for superpopulation variables. However, the effect of another recruitment method increased significantly in Step 2.

Table 12.2 Effect of survey recruitment method on recreational fishing social attributes, with and without controlling for age, gender, First Nations status, born overseas, household income, location and fishing avidity, Stage 2 NRFS data

	Dependent variable	Like to fish where there are several types of fish		Fishing importance – spending time outdoors		Fishing importance – relaxing/ unwinding		Fishing importance – spending time with friends		Self-estimated total expenditure on fishing		Calculated total expenditure on fishing		Fished (i) less or (ii) same/more in last 12 months compared to previous year	
		Linear regression		Linear regression		Linear regression		Linear regression		Linear regression		Linear regression		Logistic regression	
	Model step	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Overall model fit	R2[a]	.000	.002	.075	.103	.046	.069	.009	.031	.099	.278	.014	.045	.010	.106
	p-value	.645	.381	<.000	<.000	<.000	<.000	<.000	<.000	<.000	<.000	<.000	<.000	<.000	<.000
Independent variables – survey recruitment methods (n= current fishers only) Exp(B)/ ß [b]	Online panel (n=1882[c])	-.007	.005	**-.257**** [d]	**-.190****	**-.169****	**-.092****	.015	.025	**-.173****	-.027	**-.087****	-.017	.938	**1.505****
	Stage 1 (n=1696)	.039	.038	.028	.030	.023	.024	.009	.025	.023	**.042***	.022	.026	1.072	1.228
	Social media (n=4188)	.018	.024	**.060****	**.046***	**.088****	**.079****	**.099****	**.062****	**.184****	**.119****	**.056***	.033	**1.453****	1.166
	News media (n=381)	.007	.008	**.036****	.025	**.037****	**.027***	.027	.008	**.110****	**.068****	.025	.010	**2.421****	**1.787****
	Fishing club (n=919)	.004	.007	.027	.009	**.037***	.020	**.075****	**.059****	**.217****	**.166****	**.089****	**.066****	**1.379***	1.111
	Friends/ family (n=590)	.006	.010	-.003	-.004	-.021	-.017	**.056****	**.045****	**.067****	**.049****	.027	.022	1.352	1.285
	Flyer in mail (n=179)	.012	.014	.002	.003	-.007	-.004	**.038****	**.033***	**.075****	**.080****	**.031***	**.033***	1.248	1.321
Independent variables – socio-demographic variables in super-population model (Step 2 only) Exp(B)/ ß [b]	Gender		.018		-.019		.017		**.088****		**.051****		.013		**1.384****
	Age		.014		**.034***		**.049****		**-.081****		**-.036****		.011		**.990****
	First Nations		.015		**-.035****		**-.027***		**-.028***		**-.033****		-.022		1.013
	Born overseas		.008		-.010		-.012		-.022		**-.030****		-.002		.851
	Household income		-.020		**.026***		.009		**.041****		**.278****		**.120****		**1.084****
	Urban/rural		.020		-.018		-.004		**-.027***		.014		.010		.897
	Fishing avidity		-.003		**.177****		**.155****		**.066****		**.319****		**.138****		**1.327****

[a] For logistic regression models, the Nagelkerke R square is reported

[b] For logistic regression models, the Exp(B) (odds ratio) is reported as it is comparable across predictor variables; for linear regression models, the ß (standardized coefficient) is reported to enable comparison of effect size both across Model Step 1 and 2, and between predictor variables.

[c] Numbers in brackets indicate sample size of current fishers only.

[d] Bold indicates significant predictor at 0.05 level or less; * indicates significant at p=0.05 level; ** indicates significant at p=0.01 level.

Recruitment methods on their own explained less than 2% of the variance in four of the seven dependent variables: calculated total expenditure (in which reported expenditure on multiple aspects of fishing was summed to produce a total expenditure figure), whether a person fished less or more in the past 12 months than in the previous year, the importance of spending time with friends, and whether a person liked to fish where there were several types of fish. For these variables, even without controlling for variables in the superpopulation, and even though some recruitment methods were significant predictors, it is unlikely that differences in recruitment method would result in a difference in findings of greater than 2%, and most likely that they would contribute less than 1% variance – particularly after weighting the sample, given that including superpopulation variables reduced the effect of recruitment methods on the dependent variable in almost all cases. For these four variables, adding superpopulation variables into the model in Step 2 increased explanatory power of the model considerably (between two to ten times higher than Step 1), suggesting that the factors controlled for in the statistical weighting process had a larger effect than survey recruitment method on the dependent variables examined.

While recruitment methods explained around 4.6% of variation in the importance of relaxing/unwinding as a part of fishing and 7.5% of variation in the importance of spending time outdoors, their effect reduced considerably after controlling for superpopulation variables, again suggesting very little of the variation in findings for this variable would be contributed by biases in recruitment methods.

However, for one of the seven dependent variables examined, recruitment methods explained a relatively large proportion of variance, and this did not decrease substantially after controlling for superpopulation variables: self-estimated total expenditure on fishing. This survey item asked respondents to estimate their *total* household expenditure on fishing. It was not used to calculate expenditure estimates presented in Chapter 7 (survey respondent's answers to detailed questions about expenditure on different items were used to estimate expenditure). This item was included in the survey for two reasons – to test how similar estimates of expenditure using a single survey item were to estimates calculated from more detailed questions about expenditure on different aspects of fishing, and to test for presence of strategic bias. Survey recruitment methods explained 9.9% of variance in this variable in Step 1 of the model, particularly participation in fishing clubs (much higher self-reported expenditure), social media (higher self-reported expenditure), and the online panel (lower expenditure). This in itself would not be highly problematic if controlling for superpopulation variables removed a large amount of the effect of survey recruitment methods. However, while the second step of the model saw the effect of online panel recruitment effectively reduced to an insignificant level, the same did not occur for other survey recruitment methods. The effect was greatest for those recruited by social media, and through promotion by fishing clubs, with respondents recruited by these two methods reporting higher expenditure on fishing, even after controlling for the superpopulation variables. This suggested that for this survey item, it was possible that there was some strategic bias in responses to the question (conscious or unconscious), with some fishers reporting higher estimates of expenditure than were realistic, and/or that the superpopulation variables did not include important variables that could control for the bias introduced by survey recruitment method.

Importantly, expenditure estimates calculated based on answers to the more detailed questions asked in Stage 2 regarding expenditure on different aspects of fishing did not show the same bias. Whereas survey recruitment method explained almost 10% of the variation in self-estimated total expenditure on fishing, recruitment method explained only 1.4% of variance in expenditure when expenditure was calculated based on responses to individual items asking about expenditure on different aspects of fishing ('calculated total expenditure on fishing'). Controlling for superpopulation variables removed much of this relatively small effect of survey recruitment method for calculated total expenditure, and the effect remaining was sufficiently small to contribute very little variation to the findings.

The findings suggested that for all but one of the seven variables, survey recruitment method either had little effect on variation in the dependent variable, or had a limited effect that was sufficiently

reduced by statistical weighting to enable use of survey data from all recruitment methods. The exception was self-estimated total expenditure on fishing, which showed significant bias related to survey recruitment method that remained present even after controlling for variables included in statistical weighting. This variable was never intended for use in producing estimates of economic contribution: it was included in the Stage 2 survey to test the effect of survey recruitment methods and effect of different approaches to measuring expenditure. The bias found was expected, and confirmed that a single item measure of self-reported total expenditure is not fit for purpose to use in place of the more detailed questions about expenditure that were used to identify economic contribution of fishing in Chapter 7.

These findings highlight the complexity of attempting to correct bias in sample recruitment using available benchmark data. The limited benchmark data available for recreational fishers does, when used to create statistical weights, significantly reduce the effect of different survey recruitment methods on findings. For most variables, use of statistical weighting reduced the effect of survey recruitment method such that recruitment methods explained 1% or less in variation in social and economic dimensions of fishing. However, this was not the case when asking a question that was considered highly likely to be subject to strategic bias (self-estimated total expenditure on fishing), highlighting that the effect of survey recruitment method can only be reduced sufficiently if survey questions are designed to reduce risk of key types of bias.

The analysis confirmed that data from all survey recruitment methods could be used as part of a blended sample that was weighted using model-based weighting, with the variables included in the superpopulation successfully reducing effect of survey recruitment methods to a small level of effect that would contribute very little variation in findings. This was possible for all variables intended to be used to produce findings from the Stage 2 data set – but not for a test variable included to test bias, which as expected, varied significantly by survey recruitment method.

12.5 Comparing survey methods – Stage 3 participation drop-out

All people who participated in the Stage 2 survey and indicated they had either fished in the previous 12 months, and/or intended to fish in the next 12 months, were asked if they were willing to participate in regular surveys conducted in Stage 3. Those who agreed to this were then invited to take part in Stage 3. Of the 11,849 Stage 2 participants who had eligibility to participate in Stage 3, a total of 6,315 gave permission to be contacted and invited to take part in Stage 3. When these participants were subsequently contacted and asked to participate in Stage 3 surveys, a total of 1,491 took part in the third Stage 3 survey, conducted in July 2020 (the first and second Stage 3 surveys were conducted while Stage 2 data collection was ongoing, and included only Stage 2 participants who had participated to date; the third survey represents the highest Stage 3 sample). By the final regular Stage 3 survey, conducted in July 2021, the total respondents declined to 517, despite two to three reminders being sent to participants about the survey by email. Table 3.8 in Chapter 3 provides sample size for each of the Stage 3 surveys conducted.

Given that the Stage 3 sample at its largest included 12.6% of those who participated in Stage 2, and that this declined to 4.4% of the Stage 2 sample by the time the final Stage 3 regular survey was conducted, it was considered likely some bias had been introduced into the sample. No attempt was made to systematically sample from the Stage 2 subset, as one of the objectives of data collection in Stage 3 was to examine what types of bias occurred in the sample when design-based inference was not used to attempt to shape the sample.

Stage 2 data were compared to identify differences between three groups of fishers:

- Current fishers who participated in Stage 2
- Fishers who participated in the third Stage 3 survey, which asked about the period of May-June 2020

- Fishers who participated in the final regular Stage 3 survey.

This comparison enables identification of the types of fishers more likely to agree to participate in ongoing surveys, and those most likely to continue participating in regular surveys over an extended period of time.

As shown in Figure 12.4, fishers of different ages had very different likelihood of both choosing to take part in the Stage 3 surveys and continuing to take part in them until they were complete. While 13.1% of Stage 2 survey participants eligible to take part in Stage 3 were aged under 30 (already an underrepresentation of young people which was subsequently addressed through use of weighting), this dropped to 6.2% of those who opted to take part in Stage 3 and had dropped to 2.6% by the last of the regular Stage 3 surveys. Amongst those aged 30-44, there was also a decline, although not as steep as that seen amongst those younger than 30. Those aged 45-59 were similarly likely to take part in Stage 2 and Stage 3, while those aged 60 and older were much more likely to opt to take part in Stage 3 and to continue participating in it.

Overall, while there was dropout from all age groups through Stage 3, the drop out was much more common amongst those aged 45 and older, and much less common amongst those aged 60 and older. This suggests a need to identify more specific methods for maintaining participation of younger people in long-term surveys. Women were also less likely to take part in Stage 3 (Figure 12.5), while there was no significant change in the proportion of those born in Australia versus overseas who chose to take part in Stage 3 and to continue taking part. Participation of those identifying as Aboriginal and/or Torres Strait Islander was 4.5% in the Stage 2 survey, but declined to 2.4% amongst those who chose to participate in Stage 3, suggesting a need to identify more effective methods of encouraging ongoing participation of this group in long term surveys.

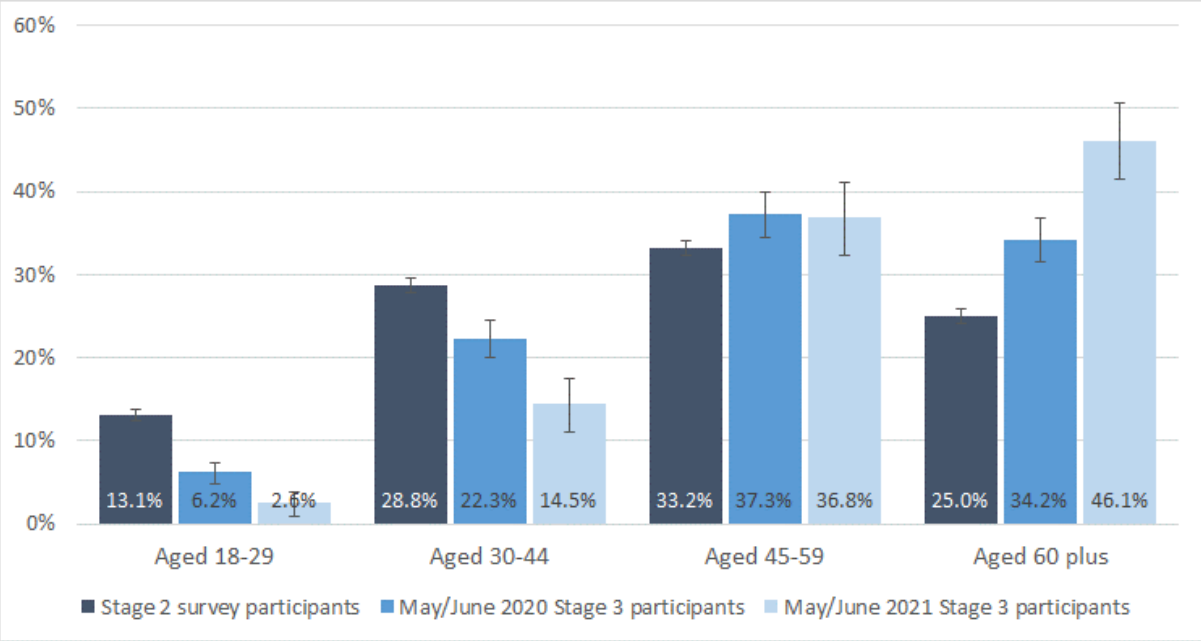


Figure 12.4 Comparison of Stage 2 and Stage 3 survey sample composition - age

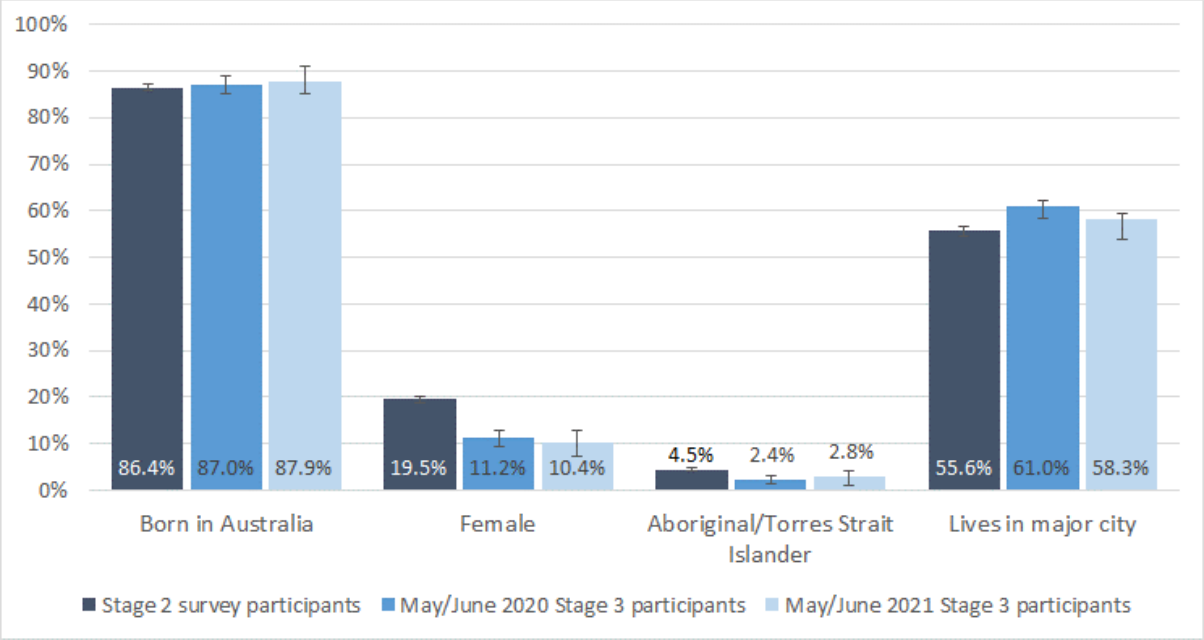


Figure 12.5 Comparison of Stage 2 and Stage 3 survey sample composition – gender, country of birth, First Nations and urban/rural residential location

Those who found fishing important as a way of spending time with friends, or for getting physical exercise, were no more or less likely to opt to take part in Stage 3 or continue to participate in it compared to those who found these things less important (Figure 12.6). Those who found fishing important for relaxing/unwinding were slightly more likely to take part in Stage 3, and those who found fishing important as a way of spending time outdoors more likely to.

More avid fishers were more likely than less avid fishers to choose to take part in Stage 3 and continue participating in it (Figure 12.7), as were those who found fishing more important to their life. Those who self-reported spending more on fishing were slightly more likely to take part in Stage 3, but the difference was not statistically significant.

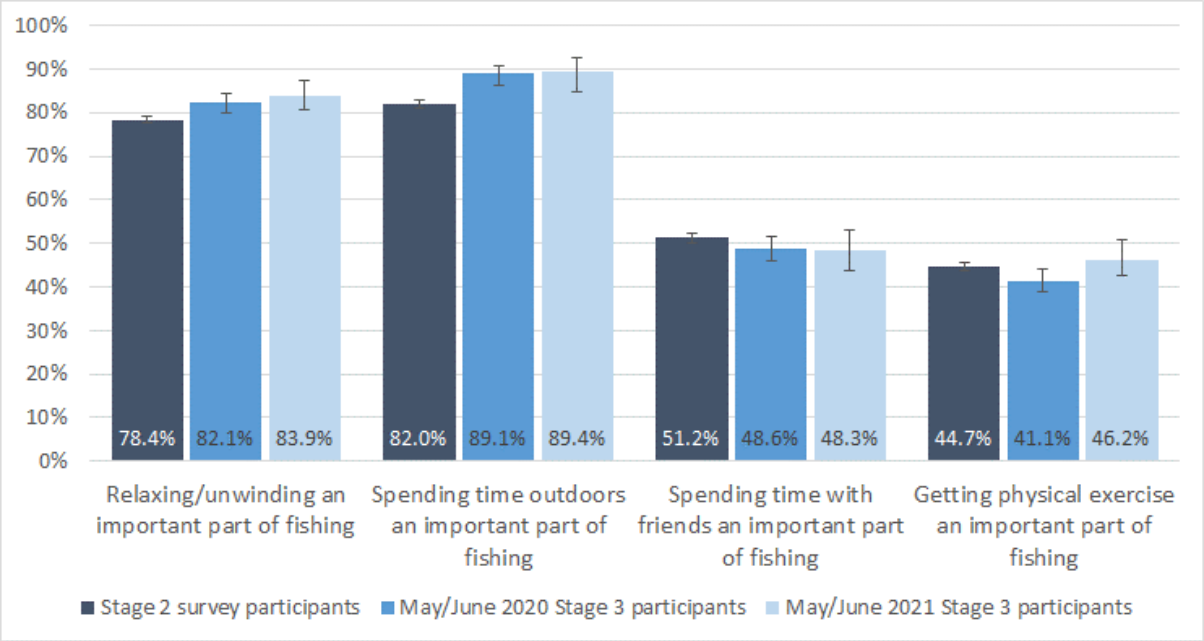


Figure 12.6 Comparison of Stage 2 and Stage 3 survey sample composition – importance of different aspects of fishing

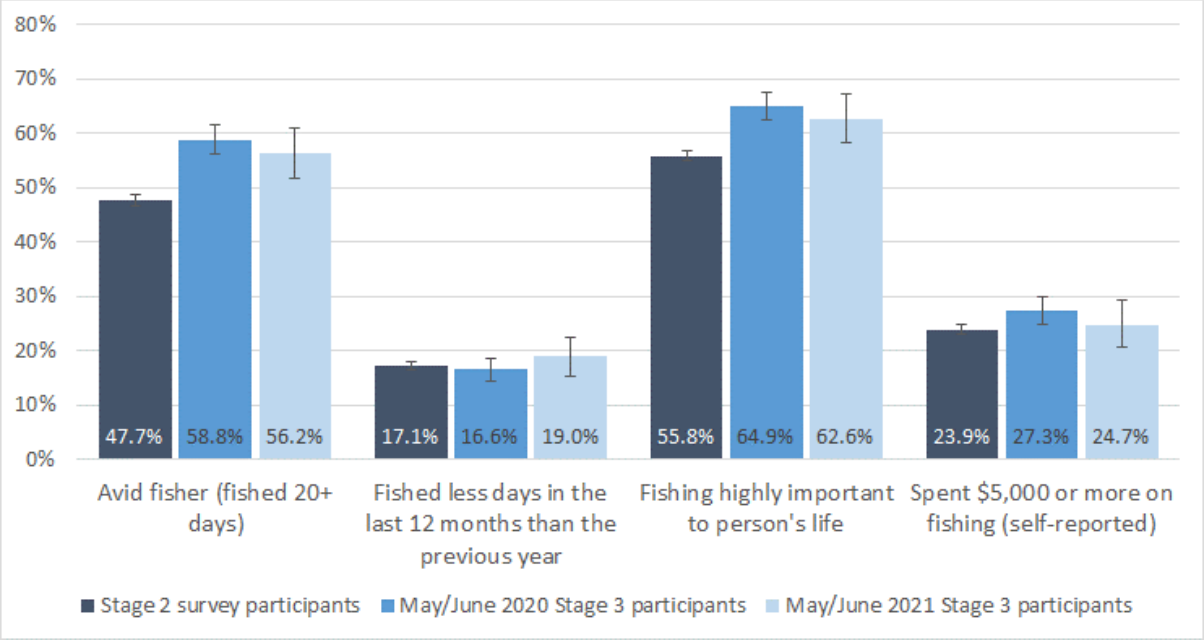


Figure 12.7 Comparison of Stage 2 and Stage 3 survey sample composition – fishing avidity, importance, and self-reported expenditure

The comparison of samples suggests that despite the low proportion of fishers who opted to continue taking part in all regular Stage 3 surveys, this drop in responses introduced mostly readily correctable bias into the sample – the two largest differences in the same were age and gender, variables for which benchmark data are readily available. This was tested by conducting regression in which it was identified whether controlling for age and gender removed the differences identified in fishing related variables – fishing avidity, and fishing importance. The full regression models are provided in Appendix 9.7. The regression modelling showed that even after controlling for known benchmark variables (age, gender), those who were more avid fishers and found fishing more important were more likely to opt to participate in Stage 3.

The findings highlight that effectively weighting the Stage 3 sample required using the Stage 2 survey as well as the overall current fisher superpopulation model used to weight Stage 2, and would require including some modelling of variation in outcome variables being examined as part of the project (e.g., importance of fishing) as well as of independent benchmark variables. While this is possible, it increases risk of introducing bias in findings related to social and economic outcomes.

Given this, rather than weight the Stage 3 sample, the Stage 3 sample was not analysed to produce inference about the broader population, with insights from Stage 3 restricted to identifying comparisons between different groups of fishers – a type of analysis able to be validly undertaken as it does not involve making inference about characteristics of the entire recreational fishing population.

13.0 Recommendations

This section identifies overall recommendations for those seeking to collect social and economic data on recreational fishing. It is important to note that these recommendations do *not* apply to surveys collecting data on recreational fishing catch, which has different sampling requirements to social and economic data. It is also important to note that no single approach to conducting survey research is recommended. This is because the most suitable methods will depend on the goals of the survey, the population/populations being studied, the ability to use different survey recruitment methods to successfully reach these populations, and the cost of recruiting survey participants using different methods. We do however make recommendations regarding when and how the types of methods examined in this study can be applied. The criteria used in making recommendations are to enable use of sampling methods that are both:

- Able to produce findings in which survey recruitment methods do not have a meaningful effect on the findings produced
- Cost-effective, defined as having a low enough cost to support collection of data on a regular basis to track change.

The first key recommendation relates to estimating overall participation in recreational fishing, and key characteristics of recreational fishers needed to produce reliable and valid data characterising recreational fishers in Australia. This is needed to populate superpopulation (benchmark) models that can then be used to weight findings of stand-alone surveys of recreational fishers so that findings can be produced that are representative of the recreational fisher population in Australia.

The only national survey currently producing regular estimates of participation in recreational fishing in Australia is the AusPlay survey (see Appendix 3). However, as is detailed in Appendix 3, the AusPlay survey relies on a very restrictive definition of participation in sports and recreational activities that results in significant under-estimation of participation in recreational fishing.

Our findings suggest that it is possible to include questions about recreational fishing participation in larger surveys examining a range of topics. The AusPlay survey is not well suited for this in its current form, due to the specific focus on sporting and physically active pursuits, which leads to many people not reporting recreational fishing activities. We recommend that future studies seeking to generate data on recreational fishing participation and the characteristics of fishers (e.g., distribution of age, gender, location, cultural groups) should:

- Include questions about recreational fishing as part of larger omnibus surveys of the general population that ask about a range of topics. This can reduce cost of collecting data, reduce risk of salience bias, and (subject to the omnibus survey using appropriate methods) the data collected can be benchmarked against data from the Census of Population and Housing to produce findings representative of the population.
- Carefully assess the recruitment methods used in any omnibus survey, to evaluate their suitability for producing estimates representative of the population, whether through achieving a sample that is representative without the need for weighting, or through achieving a sample to which statistical weights can be applied to produce results representative of the population. We do not specifically recommend one recruitment method as being more viable than others, given our finding that multiple survey recruitment methods can be suitable if designed well.
- Ensure questions about participation in recreational fishing included in the survey are designed to include all recreational fishers. We recommend that the definitions of recreational fishing applied in this study, which were designed based on that used in a large number of previous recreational fishing studies, be applied. This means that participation should identify

who has gone fishing in the previous 12 months as the definition of 'current fishers'. Surveys may also collect data about historical participation in fishing. Importantly, as identified in Appendix 3 and Chapter 4, surveys should not frame recreational fishing as an activity undertaken primarily for sport or physical exercise, as many recreational fishers do not view recreational fishing as being for these purposes.

Collecting data on recreational fishing participation, and key characteristics of fishers, via omnibus surveys can enable estimation of the nationwide (or, in regional studies, region-wide) characteristics of fishers. This can then enable the development of benchmark models used to weight findings of surveys conducted specifically amongst recreational fishers.

With regard to surveys of current fishers that seek to examine social and economic aspects of fishing in more depth, it is recommended that:

- Standalone surveys of fishers be used, as these can ask the detailed questions required to provide insight into social and economic contributions of recreational fishing
- Stratified sampling be used in which avid fishers are deliberately oversampled in order to ensure sufficiently robust data from this group, who make up a small proportion of the recreational fishing population but contribute a large share of expenditure and fishing activity. If probability-based sampling is used to recruit fishers, design-based weights can be applied to calibrate the resulting stratified sample. If non-probabilistic methods are used to recruit part or all of the sample, then our findings suggest using model-based weighting is a viable method to weight the sample.
- Survey sampling strategies should be designed to ensure collection of sufficient sample of each 'cell' used when weighting samples of fishers. At a minimum, we recommend ensuring an absolute minimum sample size of 100 in each category to be weighted, which should include fishers of different gender, age groups, residential location, cultural background and either household income or level of formal educational attainment.
- If seeking to model economic contribution, surveys should not rely solely on recruiting fishers via social media and fishing clubs, as this has higher potential to result in a biased sample, and ensure questions are included that can be used to assess strategic bias likelihood (such as the total expenditure question included in the Stage 2 survey).

Finally, with regard to regular diary surveys conducted on a monthly to quarterly basis, it is recommended that:

- If online surveys are used to collect data, investment is made in also making personal contact with those participating in the diary survey, to encourage continued participation. Our use of regular non-personalised emails was not effective in retaining participants, and suggests a need to use either direct phone contact, or personalised email contact, both of which involve significant cost. This cost is justified to address the bias otherwise resulting from high rates of drop out.
- Specific approaches be designed to achieve both initial and continued participation in these surveys by groups who are at higher risk of dropping out, including younger people and those identifying as Aboriginal or Torres Strait Islander.

Of the different survey recruitment methods trialled, all were able to be used, albeit some with more caution than others. Our findings demonstrate that a range of recruitment methods can generate similar results if designed appropriately, and if sufficient sample size is collected. However, it is important to note that while we identified that key findings of this study were similar to other data collections – in particular, our estimates of recreational fishing participation were similar to most (but not all) key state-based surveys conducted at a similar time to this study – there remains a lack of a comparison set of data that can be said to provide the benchmark for recreational fishing. There is no

census of recreational fishing that can provide nationwide estimates. This is a common issue for estimates generated using surveys: recent reports have recommended the use of comparison between estimates achieved using different methods as a way of assessing reliability of findings (see for example Hartill and Thompson 2016), which was the approach used in this study.

This comparative assessment did highlight potential for bias when using some recruitment methods. In particular, there is higher risk of bias in estimates of economic contribution if fishers are recruited using social media advertisements, or by promoting a survey via fishing clubs. It is recommended these two methods only be used as part of a blended sample in which their effects can be identified through comparing distribution of responses to that from other survey recruitment methods. The use of quota sampling also has potential to reduce bias in survey responses achieved using these methods.

Using a high-quality online survey panel has good potential to produce robust data (meaning data that are reliable and valid based on comparison to known benchmark data, and when compared to data generated using other recruitment methods), however it is important to ensure the panel provider has procedures for excluding non-valid participants, for example those seeking to take part in a survey multiple times for rewards.

Overall, the various survey options trialled as part of the NRFS all resulted in data that was able to be used in the study. The survey recruitment methods used were all selected as relatively low cost options, although cost of implementing each varied. The cost per survey response achieved was lowest in this study for recruiting participants via fishing clubs and direct email, followed by social media advertising However, the lowest cost options – recruiting participants via fishing clubs or social media advertising – had a higher likelihood of bias in responses which, while its effect was reduced to a very small amount using statistical weighting, would have been problematic if the survey relied solely on these recruitment methods.

The rapidly evolving nature of survey data collection methods means that there is likely to be ongoing rapid change in ability to use methods such as social media advertising (the popularity of different social media platforms, algorithms used to determine display of ads, and likelihood of people responding to ads in their feeds are all likely to change), and online survey panels (availability and quality of panels is likely to continue changing substantially over time). This would on the surface appear to suggest that it is best to continue using more traditional survey methods such as recruiting participants through random selection of phone numbers or addresses, which requires then incurring costs of phone calls or printing and sending posted mail items. However, likelihood of achieving a suitable sample using these methods alone is also changing over time, and they also often involve significantly higher cost compared to recruiting via online survey panels and social media, where participants can be directed to an online survey with less cost involved in initial recruitment contact compared to phone and mail surveys. For example, in this study, the average cost incurred to achieve a valid survey response (including costs of postage, advertising, staff time etc) was as follows (rounded to the nearest $1):

- $2 per response for those recruited via emails and promotion to fishing organisations
- $3 per response for social media advertisement
- $10 per response achieved via mailed flyers.

These costs are indicative only, likely to change over time and depending on the specific sample being sought, and do not reflect change in costs per survey response as data collection continues. For example, the number of social media advertisement displays required to achieve a survey response may initially be low, but may change after the first 2,000 or 3,000 responses, when the supply of those who can be easily recruited into the survey has been exhausted. After this point, it may take much higher numbers of advertisements (and hence cost) to achieve each additional survey response.

It is recommended that blended samples are used that use a range of recruitment methods to achieve a sufficient sample size from each group that forms part of any superpopulation used to generate model-

based weights. The ability to use model-based inference effectively in the NRFS was due to having a large sample size, which included sufficient sample by age, gender, and location to support this type of model-based inference. In this study, the location targeting focused on achieving sufficient sample from (i) major cities versus (ii) rest of state population, by individual state and territory. This was achieved. More specific sampling by region is possible using the methods that were tested, with postal methods, social media advertising, and online panels all able to be targeted to sample from other specific geographic regions, such as ABS Statistical Areas. However, for some regions, some recruitment methods cannot achieve a sufficient sample if used on their own. For example, many online survey panels would not have sufficient panel members living in some rural regions to be able to achieve desired sample sizes of recreational fishers for that region. This may change in future, given the rapid growth of a wide range of online survey panels, including some focusing on improving ability to survey in areas outside major cities. In this study, we were able to address limitations of any single recruitment method through the use of blended sampling: for example, younger participants were much more likely to be recruited via online panel or social media than by any other method; had the NRFS relied solely on other methods, insufficient numbers of young participants would likely have resulted. This is why we recommend that future studies carefully assess the likely coverage different survey recruitment methods can achieve, and design a recruitment strategy that where necessary includes more than one method of recruiting survey participants. This type of blended sample can be specifically designed to achieve the desired sample, with the limitations of each recruitment method being addressed through inclusion of other recruitment methods that do not have that limitation.

Appendices

Appendix 1: References

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Appendices 2 to 7

Appendices 2 to 7 are provided as a separate file.