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REVIEW

Evolution and objectives of diverse Australian recreational fisheries monitoring programs

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Abstract Approximately half a billion people engage in recreational fishing, and are estimated to capture at least 10 million tons of fish annually, equivalent to 12% of the global fish catch. However, the recreational fishing sector can be difficult to monitor due to the lack of mandatory reporting of catch and participation. Australia, where one in five adults, or 4.2 million people, participate in recreational fishing annually, highlighted the need to collect information and monitor recreational fishing activity, catch, fish biology, and economic and social values in its 1994 'National Policy for Recreational Fishing.' Here, we identify past and present Australian recreational fisheries monitoring programs (RFMPs) and provide a comprehensive overview of their objectives and methodologies, specifically considering their alignment with the four key research foci identified in the 'National Policy for Recreational Fishing in Australia.' We identified 40 unique marine state-wide multi-species RFMPs across all Australian states and territories. Most RFMPs focus on collecting catch, fishing activity and social and economic values information, and rarely contribute information on fish biology. However, there has been ongoing expansions in the number and scope of RFMPs, and an increasing proportion of offsite (i.e., information collected outside the fishing location) programs. While offsite monitoring programs are often cost-effective, we emphasize the crucial role played by onsite monitoring surveys. Results from this review can be used in plans for further expanding recreational monitoring programs towards a more comprehensive and in depth understanding of the recreational fisheries sector in Australia.

Keywords Recreational fisheries · Fisheries monitoring · National Policy for Recreational Fishing in Australia · Fisheries biology · Australia

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Introduction

Recreational fishing is defined as fishing for aquatic animals that do not constitute the individual's primary source of nutrition and are not sold or traded on any market (FAO 2012). Approximately 220 million

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people participate in recreational fishing across the globe (Brownscombe et al. 2019). Using Canadian fisheries data for extrapolation, it was estimated that recreational fisheries account for 12% of global harvest or roughly 10.86 billion tons (Cooke and Cowx 2004; Greiner and Gregg 2010). However, there is considerable uncertainty regarding these estimates, due to the difficulty associated with estimating the catch and effort of recreational fisheries. In many locations there is a lack of compulsory reporting of recreational fishing activity, potentially impacting the accuracy of fisheries stock assessments and fisheries sustainability (Telfer 2010; Brownscombe et al. 2019; Ryan and Conron 2019). Most countries, particularly Australia, are moving towards rectifying this gap as recreational fishing represents a significant component of fisheries and must be considered to effectively assess total fisheries harvest and sustainability. In Australia, 4.2 million people participate in recreational fisheries annually. Western Australia has 750,000 recreational fishers, and their contribution has been valued to be worth $AUD 1.1 billion to the state's economy (Department of Primary Industries and Regional Development 2024). Similarly, approximately one million people in Queensland participate in recreational fisheries annually, directly and indirectly contributing $AUD 333.7 million to Queensland's economy (State of Queensland (Department of Agriculture and Fisheries) 2024). This level of participation highlights the importance of monitoring and managing recreational fisheries in Australia (Telfer 2010).

Despite the increasing importance of recreational fisheries, monitoring this sector is very challenging owing to the highly diverse and disparate nature of recreational fishing activities and participants (Moore et al. 2023; Pawson et al. 2008). Historically, statewide recreational fisheries monitoring within Australia was limited and sporadic, with little to no information available. In 1994, Australia produced the 'National Policy for Recreational Fishing in Australia,' which identified four key research foci for states and territories to consider when designing and implementing their recreational fisheries monitoring programs (RFMPs) (Henry and Lyle 2003). The four foci highlight important information to be collected in RFMPs and to be used to support sound fisheries management decisions (Henry and Lyle 2003). Additionally, they could be used to structure RFMPs, ensuring appropriate alignment of the monitoring objectives and methods. The research foci identified are; recreational fishing activity, catch monitoring, fish biology of harvested species, and economic and social values of recreational fishers (Henry and Lyle 2003). Catch and activity data allows the overall level of exploitation within the recreational sector to be understood and managed (Taylor et al. 2012; Wise et al. 2012). The study of harvested species biology allows for fish population structures to be understood and can be used beyond recreational fisheries monitoring, including fisheries stock assessments (Fairclough et al. 2014). Social and economic values are important components of recreational fisheries due to the unique nature of the fisheries and can be used when implementing new management strategies so that they are better designed and perceived (Coleman 1998; Henry and Lyle 2003). By identifying these focus areas, Australian recreational fisheries monitoring is able to structure programs to collect accurate, comparable, and applicable data to be able to manage fisheries effectively.

Henry and Lyle (2003) then developed the 'National Recreational and Indigenous Fishing Survey' (NRIFS) to collect nationally consistent and comparable data across Australian states and territories fulfilling most of these research foci identified in the 'National Policy for Recreational Fishing in Australia.' The NRIFS conducted surveys in the form of onsite and offsite surveys. Onsite surveys are defined as data collected at or near the fishing location through interviews (Pollock et al. 1994; Henry and Lyle 2003; Ryan et al. 2009). Offsite surveys differ as information is instead collected externally from the fishing location and after the fishing activity has taken place, where sampling occurs based on a sample list of anglers (Pollock et al. 1994; Henry and Lyle 2003). Telephone-diary surveys were used as the offsite survey program in NRIFS, and the onsite survey used was called 'Onsite Surveys' and was used to sample both land- and boat-based fishers. These foundational NRIFS survey structures and the research foci of the 'National Policy for Recreational Fishing in Australia' have been integral in Australia's recreational fisheries monitoring, highlighting the benefit of the extent rather than the number of programs. As the nationwide NRIFS was only conducted in 2000–2001 and no nationwide surveys followed,

states and territories continue to collect local recreational data, following the original structure of the NRIFS or have adapted some of the methods to meet their individual data needs and requirements (Lyle et al. 2009; Lawson 2015; West et al. 2024).

Variations that have occurred for onsite surveys include the use of 'Boat Ramp Surveys' by states and territories to collect information and data on boat-based fishers exclusively. Instead of using the 'Telstra White-pages' to determine participants for the 'Telephone-diary Survey,' specific databases of residents (e.g., SamplePages) are now used (Henry and Lyle 2003; Lyle et al. 2019; West et al. 2022). Additionally, new offsite and onsite programs of similar structures have been implemented since the initial NRIFS to collect specific, state-wide data, expanding on the initial information of recreational fisheries (e.g., Offshore and Gamefishing Telephone-diary Survey and Remote Camera Surveys) (Lai et al. 2021; Tracey et al. 2020). The objectives and methods of RFMPs have also evolved with a shift from nationally administered programs, to an increasing number and diversity of RFMPs within each different jurisdiction. Having variations between programs, regardless of following the original structure, means that states and territories are able to fill the local data needs and better represent the local recreational fishery (Ryan et al. 2013; Lyle et al. 2019; Murphy et al. 2020; West et al. 2022). While the NRIFS has provided a foundational structure, no single national survey would be able to comprehensively and effectively address the diverse nature of recreational fisheries to the same capacity of locally administered programs such as that now used.

Australian RFMPs are numerous and varied, but there is yet to be a comprehensive synthesis of the specific objectives, data priorities, and sampling methodologies across the range of different monitoring programs. Importantly, RFMPs are conducted independently across different Australian states and territories resulting in significant diversification in approaches and methods. Previous reviews of Australian RFMPs have tended to focus on specific locations, or programs (Griffiths et al. 2010; Tate et al. 2020; Fowler et al. 2022). Here, we review Australian marine RFMPs, including both past and present to:

1. Identify recreational fisheries monitoring programs (RFMPs) that have been implemented in Australia and their evolution over time.
2. Determine the variation of objectives and methods within the current Australian RFMPs.
3. Identify gaps in the current RFMPs objectives and methods in reference to the key research foci identified in the 'National Policy for Recreational Fishing in Australia.'
4. Suggest ways to address the identified gaps within Australian RFMPs.

This synthesis will help evaluate the current recreational fisheries monitoring programs implemented by states and territories, identify gaps, and inform future expansions or modifications to these programs in Australia.

Methods

We conducted a narrative literature review, collating information on all past and present Australian marine recreational fisheries monitoring programs (RFMPs). We included both peer-reviewed papers and grey literature. Because little literature exists on the topic, we employed an exhaustive search method for retrieving relevant literature. We first used Scopus, Web of Science, and Google Scholar to search for literature. We used key search terms such as "Australia," "Recreational Fisheries Monitoring," and the name of each Australian coastal state and territory (e.g., New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria, and Western Australia). Additionally, we visited each state and territory fisheries monitoring web pages to collate additional reports (e.g., monitoring reports) and information that were not available on any of the three search databases. We also searched the references of the literature identified using the process above, as well as peer-reviewed papers that were not usable, for additional relevant references. We contacted relevant fisheries personnel to request access to case reports that were necessary to the research but were inaccessible. The full list of papers used is listed in *Appendix Table 5* and *Appendix References.*

We considered RFMPs that were marine and multi-species and were implemented across distinct states or territories. Additionally, we included Charter Fishery Programs, as most states and territories categorise them as a form of recreational fisheries due to the participants being recreational fishers and

generally subject to rules and regulations of the recreational fishery. We excluded RFMPs that had location- or species-specific (< 3 species) sampling due to wanting to provide a broad overview of Australia's RFMPs and maintain uniformity in our synthesis. For example, South Australia 2013–2014 'Onsite surveys' specifically assessed recreational take of Blue Swimmer Crabs and Pipi's in select locations. While this survey is potentially representative of the South Australian recreational fishery, we did not include this survey due to being location and species-specific. We acknowledge that while some surveys that are either location- and/or species-specific could provide foundational information, they are not often considered by states and territories as main programs to monitor RFMPs due to the infrequency of their implementation in most cases. Additionally, we excluded literature that discusses programs monitored by the Australian Government's Department of Agriculture and Fisheries or by multiple states (i.e., Southern Bluefin Tuna Fishery). Excluding larger multi-jurisdiction programs provided consistency in the scale of programs being compared.

We grouped each state and territory's RFMPs into the following identified programs based on similarities in survey time periods, methods, objectives, and survey demographics to reduce confusion when referencing within this work (Table 1). Distinctions between offsite and onsite surveys have also been made; Onsite surveys differ from offsite surveys due to the data being collected at or near the fishing location during or immediately after the relevant fishing activity. In contrast, offsite surveys are conducted independently of the relevant fishing activity, asking recreational fishers to provide an account of fishing activity in previous weeks, months, or the year. Many donor programs, whereby fishers provide fish skeletons (frames), are also considered as offsite surveys because trained fisheries staff do not donate the fish frames nor do they collect the frames immediately after fishing has ceased.

Full details of the categorisation and methods of each of the investigated RFMPs can be found in *Supplementary Information Table 6*.

Additionally, we have grouped and summarised the objectives of different RFMPs (Table 2). Some of the objectives names identified in states and territories RFMPs are not synonymous, thus grouping the objectives into a single name allowed for comparability between RFMPs and states and territories. The RFMPs objectives have been grouped and named based on the similarities in the context of what is investigated. The lack of other literature of a similar nature to ours resulted in groupings being based on our best judgement. Table 2 summarises RFMPs objectives used in our review and how they relate to the research foci of 'The National Policy of Recreational Fishing in Australia'.

We have aimed to summarise all the objectives outlined in the literature of RFMPs within the 20 objectives listed in Table 2. Our summary is based solely on the information from the literature and thus additional objectives implemented by states and territories could have been missed due to not being explicitly outlined in the summarised information from peer-reviewed literature, grey literature, technical reports, internal documents, and government websites. All specific objectives implemented by states and territories in their RFMPs and their corresponding grouped objectives are presented in *Supplementary Information Table 7*. We note that we did not summarise any numeric data within the present review, only descriptive information such as that outlined above to summarise Australia's recreational fishery.

Results

We compiled information from a total of 67 different sources representing 39 unique recreational fisheries monitoring programs (RFMPs). Notable differences between the timeline, objectives, and methods of RFMPs have occurred between both program and state and/or territory levels and are discussed below.

The evolution of recreational fisheries monitoring programs

The number of offsite and onsite surveys implemented to monitor recreational fisheries in various Australian states and territories has fluctuated from year to year since 2001 (Fig. 1). Offsite surveys have displayed an overall steady increase in the number of programs implemented across all Australian states and territories, to an overall peak of ~ 18 offsite programs in 2018. Comparatively, onsite surveys have had a steady number of programs implemented,

Table 1 Summary of Recreational Fisheries Monitory Programs (RFMPs) and their onsite or offsite categorisation, original name, and the definition for grouping

RFMPs category	Onsite or offsite	Original RFMPs Names and Reasons for Groupings
Aerial Survey	Onsite	Both access point and roving surveys that use an aircraft to conduct the stratified random sampling
Angler Diary Survey	Offsite	Includes Mail-back Surveys and Angler Diary Surveys, where diaries/logbooks are used to collect data but are mailed back to fisheries departments for data collation
Boat Ramp Surveys	Onsite	Both Boat Ramp Surveys and Bus-route/Creel Surveys where only returning boat-based fishers are sampled
Charter Fishery[a] Logbooks	Offsite	Logbooks that are used as a mandatory (in most states) form of reporting completed by Charter Operators
Charter Fishery Observer Program	Onsite	Exclusive to New South Wales, where trained fisheries personnel collect data on board a charter fishery vessel
Donation Program	Offsite	The collation of programs where fish skeletons/frames are donated to collect biological data, which are; 'Framed, Tagged, and More,' 'Keen Angler Program,' 'Research Angler Program', and 'Send Us Your Skeletons.'
Gamefish[b] Angler Diary	Offsite	Exclusive to Tasmania where exclusively Game fishermen fill out Angler Diaries/Mail-back Surveys to provide data to fisheries
Gamefishing Monitoring Programs	Onsite	Includes New South Wales Gamefish Tournament Monitoring Program where information is collected through variable forms including 'Sched Updates' (radio communication of fish caught during tournaments) and Onsite Surveys
Gamefishing Tagging Program	Onsite	Within the Gamefishing Monitoring Program select participants will tag gamefish species to provide valuable biological data
Offshore[c] and Gamefishing Onsite Survey	Onsite	Differs to Gamefishing Monitoring Program due to data exclusively being collected from boat ramps. Also differs from Boat Ramp Surveys due to the information being exclusively collected from Tasmanian (and sometimes Victorian) offshore and game fishermen
Offshore and Gamefishing Telephone-diary Survey	Offsite	Similar to the broader Telephone-diary Survey, however only offshore and game fishers are sampled. Is exclusively run in Tasmania and due to their jurisdictional rules and regulations (no mandatory reporting) also includes charter fishery logbooks
Onsite Surveys	Onsite	Where both shore- and boat-based fishers are sampled at fishing locations around the state through Access-point, Roving, and Creel surveys
Remote Camera Survey	Onsite	Exclusively run in Western Australia where cameras are set up at fishing locations (e.g., boat ramps) to collect fishing data
Satisfaction and Expectation Survey	Offsite	Includes Community Satisfaction surveys, and Satisfaction and Expectation Surveys from both Queensland and Western Australia. Collects information on the fishers expectation when fishing and their satisfaction with fishing
Telephone-diary Surveys	Offsite	Encompasses three different phases of the survey('Screening Survey,' 'Diary Survey,' and 'Satisfaction and Expectation Survey'). Diaries/logbooks are also used in this survey but differ to Angler Diary Surveys due to trained staff collecting the information recorded in the 'diaries' from the fishers over the phone.

[a] **Charter Fishing** represents fishing activities by non-professionals (amateur fishers) that pay a 'Charter operator' take fishing, providing logistic support and advice (Telfer 2010)

[b] **Gamefishing** target types of gamefish and sportfish (e.g., Billfish, Tuna, Sharks & Rays, and Sportfish- Trevally, Wahoo, Mackerel) within a competition setting the continental shelf towards the shelf break and in waters outside the continental shelf (Lowry and Murphy 2003)

[c] **Offshore fishing** reflects the specific type and locality of fishing activities which overlaps with Gamefishing but is distinguished here because there is no competition, and the target species are mostly demersal living caught in deeper waters (Tracey et al. 2020)

with a slight increase. In 2019 and 2020 there was a decline to only five onsite surveys.

The 'Telephone-diary Survey' has been the most common recreational fisheries monitoring program implemented by Australian states and territories since 2000/2001, collecting data via phone interview surveys (Fig. 2). Each state and territory has implemented the 'Telephone-diary Survey' intermittently, being implemented at least twice to date by all states and territories. However, there has been an overall reduction in the number of states and territories currently using this program (Fig. 2). Similarly, the 'Charter Fishery Logbook' program is run by several states and territories but more consistently compared to the 'Telephone-diary Survey' as part of requirements for charter fishers to access the fishery. A small number of programs reflect the intermittent implementation nature of the 'Telephone-diary Survey.' Notable programs include 'Offshore and Gamefishing Telephone-diary Survey' and 'Remote Camera Surveys' (Fig. 2). Programs that are run over long time periods similar to the 'Charter Fishery Logbooks' include the 'Boat Ramp Surveys,' 'Charter Fishery Observer Program,' 'Donation Programs,' 'Gamefishing Monitoring Program,' and ' Gamefishing Tagging Program' (Fig. 2). Some programs do not have consistent sampling, which particularly varies between states and territories. Programs like this include 'Angler Diary Surveys' and 'Onsite Surveys' (Fig. 2). Additionally, some programs are only run in one or two states and territories (e.g., the 'Charter Fishery Observer Program' in New South Wales and the 'Offshore and Gamefishing Telephone-diary Survey' in Tasmania) (Fig. 2). Programs that are not currently used by states and territories reflect an infrequency in the number of times they have been implemented. Such programs include 'Aerial Surveys,' 'Gamefish Angler Diaries,' and 'Satisfaction and Expectation surveys' (Fig. 2).

While only RFMPs that have been implemented in the past and present were included in Fig. 2 based on available information indicating precise years of implementation, we note that each state and territories website indicate the programs that they are still using and the relevant RFMPs to monitor recreational fisheries. For example, while South Australia and the Northern Territory conducted their last 'Telephone-dairy Survey' in 2021–2022 and 2019–2019, respectively (based on relevant reports and information), their official website indicates the continued implementation of the programs. For the circumstance where states and territories have indicated the continued implementation of relevant RFMPs, despite not having a 2024 report, it has still been regarded as a 'current' RFMPs (Figs. 3 and 4; Table 3). Additionally, we have been able to make inferences about the objectives and methods implemented from historic and recent literature (e.g., peer-reviewed literature, grey literature, reports, and websites) for those determined as current RFMPs.

Both the 'Telephone-diary Survey' and the 'Charter Fishery Logbook' are the two most used programs by Australian states and territories as of 2024 (Fig. 3). Based on current RFMPs, offsite surveys are being used by more states and territories, but there is a consistent reliance on onsite surveys, where in 2024 there were more onsite surveys (six) than offsite surveys (five) in use in Australia (Fig. 3). For example, there are five states and territories currently using the 'Telephone-diary Survey' but only three using the 'Boat Ramp Surveys' (Fig. 3).

Objectives and methods of current (2024) recreational fisheries monitoring programs (RFMPs) in Australia

The three most prominent objectives implemented in RFMPs by states and territories are fishing effort, fish catch, and fish length data (Fig. 4). All programs to date address one out of these three objectives (Fig. 3, Table 1). Catch and effort objectives are part of all programs except for three programs in 2024 (Fig. 4). However, seven programs have implemented length data as a key objective despite it being the third most implemented objective (Fig. 4).

Catch and activity of recreational fishers have been investigated through several other RFMPs objectives outside of catch and effort representation including; Client Participation, Complementation to other Programs, Fish Condition, Fishing Activity, Impact Assessments, Increase in Data and Sector Representation, Maintaining Sustainability, Management Strategies, Spatial Representation and Temporal Representation (Fig. 4, Table 2). The two other research foci, economic and social representation and fish biology monitoring/data collection, are minimally represented within Australian RFMPs with only four and

Table 2 Grouped objective names used within our review, the context behind the grouping, and which research focus is addressed from the 'National Policy for Recreational Fishing in Australia.'

Grouped Objective Name	Context for Grouping	Research foci of 'National Policy for Recreational Fishing in Australia'			
		Catch	Activity	Fish Biology	Economic and social values of recreational fishers
Age Data	Objectives implemented by states and territories that determine fish age through data collection			✓	
Catch Representation	Programs with the objective to determine catch metrics such as retained and released fish	✓			
Client Participation	Objectives that outlined the level of participation of recreational fishers and their ability to correctly identify fish species within programs	✓	✓		✓
Complementation to other Programs	Objectives outlining the collection of data to complement other RFMPs data	✓	✓	✓	
Demographic and Profiling Information	Grouped objectives investigating the profiles of participants in some RFMPs based on their demographics				✓
Effort Representation	Objectives investigating the amount of effort invested in recreational fishing		✓		
Fish Condition	Objectives to highlight the health of fish post-capture, in catch and release scenarios	✓	✓	✓	
Fish Growth	Objectives to determine fish growth of select species			✓	
Fisher Attitudes and Opinions	RFMPs with the objectives looking at attitudes and opinions of recreational fishers				✓
Fishing Activity	Objectives investigating fisher activity specifically not in the same capacity of effort		✓		
Impact Assessments	Objectives that investigated damaging aspects of the fishery influenced by the activity of recreational fishing	✓	✓	✓	
Increase in Data and Sector Representation	RFMPs that have an objective to collect more data or provide some greater level of representation for the recreational fishery	✓	✓	✓	✓
Length Data	Objectives implemented to determine fish length			✓	
Maintaining Sustainability	Objectives in RFMPs that look at maintaining sustainability in the recreational fishery	✓	✓	✓	
Management Strategies	Objectives that look at management strategies involved in recreational fisheries	✓	✓	✓	✓

Table 2 (continued)

Grouped Objective Name	Context for Grouping	Research foci of 'National Policy for Recreational Fishing in Australia'			
		Catch	Activity	Fish Biology	Economic and social values of recreational fishers
Sex Data	Objective to determine thesex of fish for biological data			✓	
Socio-economic Information	Objectives investigating either the socio-economic or just economics of the recreational fishery				✓
Spatial Representation	Objectives outlined that specify a large amount of space and area to be sampled	✓	✓		
Temporal Range	Objectives outline to collect temporal data and build upon current temporal data	✓	✓		
Weight Data	An objective implemented in RFMPs to determine data of fish weight to monitor harvest fish populations			✓	

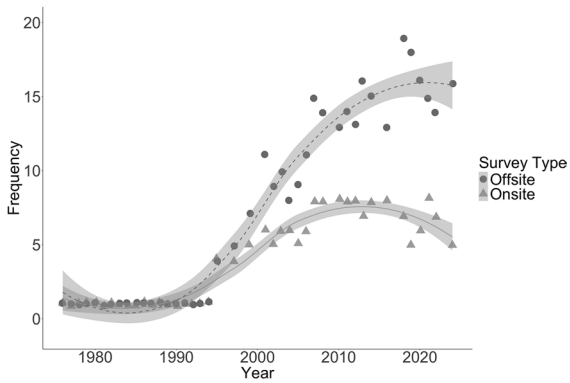

Fig. 1 The frequency (y-axis) of offsite (circle) and onsite (triangle) surveys implemented in all Australian states and territories over time (x-axis). Fitted curves (local polynomial regression fitting) and corresponding 95% confidence intervals are added

six objectives, respectively, outlined for each (Fig. 4, Table 2). Specifically, fish biology, while technically having more objectives correlated with RFMPs in 2024, the segment of each objective is minuscule compared to the proportion of other objectives relating to the other three research foci (Fig. 4).

New South Wales and Western Australia have the highest number of programs implemented, which may be correlated to a higher number of objectives considered by RFMPs in these states in 2024 (Fig. 4; Supplementary Table 7). However, this is not always the case. For example, Queensland has more programs implemented (three) in 2024 but has a similar number of objectives to Victoria which has only two programs implemented (Figs. 3 and 4; Supplementary Table 7). Additionally, offsite surveys generally have a higher number of distinct objectives, compared to onsite surveys. An example is Tasmania's offsite 'Offshore and Game fishing Telephone-diary Survey,' which has six objectives identified (e.g., catch representation, effort representation, spatial representation, demographic and profiling information, temporal range, and socio-economic information) whereas Queensland's onsite 'Boat Ramp Survey' has only four objectives (e.g., effort representation, catch representation, length data, temporal range) (Fig. 4; Supplementary Table 7). While biological data (length data) is collected in the onsite 'Boat Ramp Surveys,' the offsite 'Telephone-diary Survey' instead collects demographic and profiling information, socio-economic information and spatial representation (Fig. 4). It should be noted that some objectives (e.g., Growth Representation) are associated with an individual program that is unique to a state or territory (e.g.,

Fig. 2 Timeline of past and present Recreational Fisheries Monitoring Programs implemented by state and territory. The x-axis is the years that programs have run for each Australian state and territory (y-axis); WA- Western Australia, VIC- Victoria, TAS- Tasmania, SA- South Australia, QLD- Queensland, NT- Northern Territory, and NSW- New South Wales. The individual colours are respective to each individual state and territory. Each point is respective to either the start or end of the program per survey period. The lines indicate the survey/program duration by joining the start and end points. The light-grey highlighted programs indicate onsite surveys, and the dark grey highlight indicates offsite surveys

'Gamefishing Tagging Program') (Figs. 3 and 4). The methods and the type of data collected in onsite surveys could contribute to the lower number of objectives implemented in onsite surveys versus offsite surveys.

The data collection methods used in any given RFMPs will reflect the number and type of objectives implemented in the corresponding RFMPs. An example of this complementation is the implementation of both diaries and trained staff members within the 'Telephone-diary Survey.' Based on the three-step process of the 'Telephone-diary Surveys' (i.e., Screening Survey, Diary Survey, and Attitudinal/Wash-up Survey) and the use of both diaries and trained staff, there is a larger capacity to collect more data. Trained staff will collect and enter the data from the recreational fishers based on the information they recorded in the diaries after recreational fishers have finished fishing. Similar methods are used in 'Telephone-diary Surveys' among all states and territories, which often means that the objectives implemented are also similar with slight variations for some states or territories (e.g., Northern Territory-Socio-economic Information) (Fig. 4, Table 3).

Many of the programs have had their objectives and methods implemented for more than a decade (Figs. 1 and 4; Table 3). However, 'Donation Programs' for most states and territories have only been implemented in the last decade. Additionally, the 'Donation Programs,' while classed as an offsite survey, only uses trained staff members. Unique objectives and data are also noted in the 'Donation Programs' compared to other RFMPs (Fig. 4).

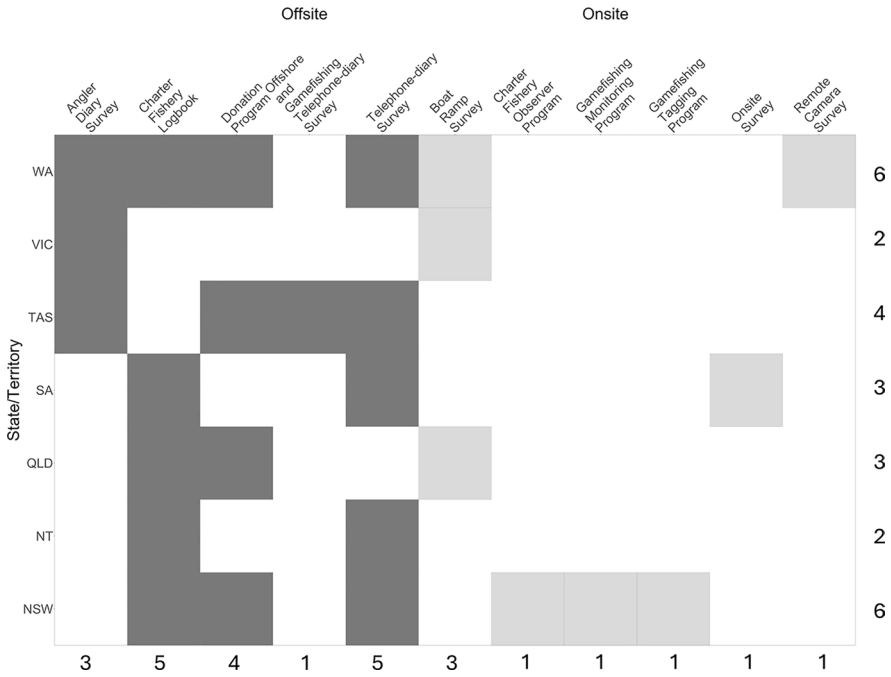

Fig. 3 The Recreational Fisheries Monitoring Programs (RFMPs) used by each state in 2024 (WA- Western Australia, VIC- Victoria, TAS- Tasmania, SA- South Australia, QLD- Queensland, NT- Northern Territory, and NSW- New South Wales), with numbers indicating the total number of programs used in each state or territory (right corner) and the total number of states or territories using each program (bottom). Areas with coloured squares (dark grey indicates Offsite Surveys, and light grey indicates Onsite surveys) are programs that run in the respective state or territory

Key methods of data collection remain similar within each offsite or onsite survey due to the initial groupings established in the NRIFS. Offsite surveys can be run without trained staff by using either diaries or logbooks filled out by individual fishers (Table 1). However, offsite surveys will also utilise trained staff members to collect data through interviews over the phone with fishers (Table 3). The use of trained staff is the most prominent form of data collection within onsite surveys, where there is the exception of using cameras in 'Remote Camera Surveys.' However, trained staff do analyse the images taken from the cameras. Similar information is collected by trained staff members in onsite surveys as the logbooks/diaries used in offsite surveys, but fish length data can also be collected in some programs (i.e., 'Boat Ramp Surveys' and 'Onsite Surveys') (Fig. 4, Table 3).

Biological monitoring programs within Australian recreational fisheries

All four key research foci of the "National Policy for Recreational Fishing in Australia" (catch, activity, social and economic representation, and fish biology), have been addressed in some capacity within Australian RFMPs, but at different scales. While some 'fish biology' is investigated in specific programs such as the 'Boat Ramp Surveys' and 'Donation Programs,' the focus is much less compared to the other objectives. Social and economic representation currently has a smaller proportion of objectives in RFMPs compared to catch and activity objectives, but the data collected to meet this research focus has been addressed for over two decades, in multiple states and territories. Fish biology has only been thoroughly applied and addressed across multiple states in the last decade (Figs. 2 and 4).

The implementation of 'Donation Programs' within Australia was initiated in Queensland. The methods were first used in Queensland in 2001 and expanded in 2006 to become the 'Keen Angler Program' (Figs. 1 and 5). The 'Keen Angler Program' was the only program to exclusively collect biological data (Length, Sex, and Age) compared to programs such as 'Boat Ramp Surveys' where only 'Length data' is collected in addition to other catch and activity data (Fig. 4).

Within our study objectives associated with 'Donation Programs' are proportionally less than all other RFMPs objectives (Figs. 4 and 5). Fish Length is universally recognised as a key outcome of 'Donation Programs,' but 'Donation Programs' can also provide other important information such as 'Age Data.' The 'Charter Fishery Observer

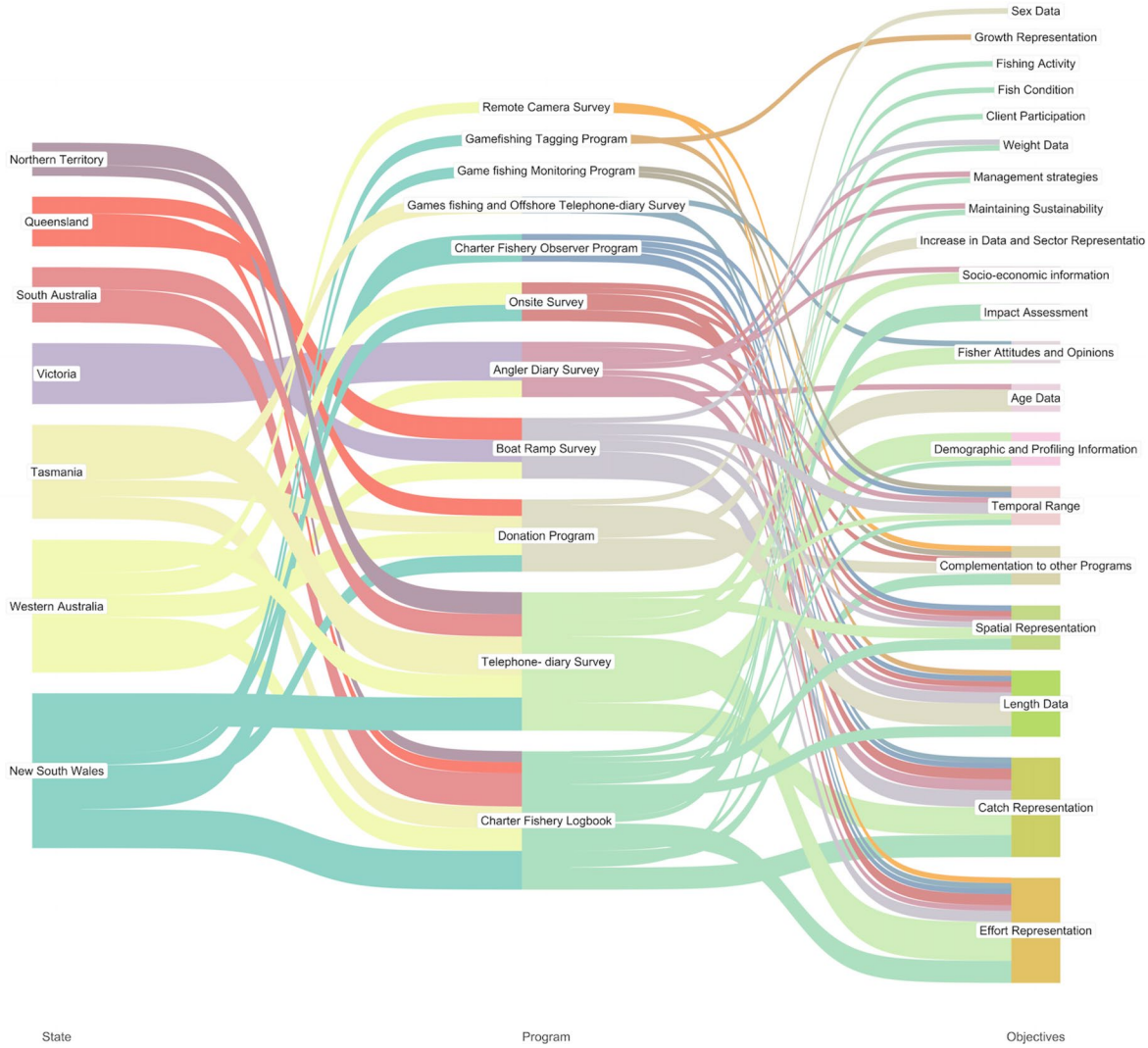

Fig. 4 Sankey diagram representing the programs (middle) used in each state and territory (left) in 2024, and the corresponding documented program objectives (right). The 'node' thickness corresponds to the number of entries into each node and has been arranged in ascending order

Program' also collects biological samples (collecting otoliths for fish age determination) as an objective but has disclosed in the methods that sampling otoliths is only undertaken if time permits during data collection unlike 'Donation Programs' (Fig. 4). Collecting 'Sex Data' is an additional piece of biological data collected in 'Donation Programs,' but is only specifically outlined as an objective for New South Wales 'Research Angler Program' (Fig. 5). However, the methods implemented for the other 'Donation Programs' specifically determines the sex of samples without noting it as a key research objective within the literature.

The method of acquiring fish sample donations is the main difference between each of the 'Donation Programs.' In New South Wales, Tasmania, and Western Australia, fishers are required to drop their fish skeletons (i.e., frames) at selected drop-off points, where pick-ups or postage is determined between the location and fisheries. In Queensland, fishers either contact fisheries staff of the Queensland Department of Primary Industries or can also 'drop off' frames at select locations. Each state requires anglers to

Table 3 Summary of Recreational Fisheries Monitoring Programs (RFMPs) for each corresponding state and territory, and the methods used to sample respective personnel in 2024. Onsite and offsite survey classification for each RFMPs has been represented

Program Name	State	Initial commencement	Onsite or Offsite Survey	Have there been Changes to the Methods?	Current Data Collection Method	Personnel Surveyed
Charter Fishery Logbook	New South Wales	2000	Offsite	No	Logbooks	Charter Operators
Charter Fishery Observer Program	New South Wales	2014	Onsite	Yes	Trained Staff	Participating personnel on a Charter Operator
Donation Program	New South Wales	2013	Offsite	No	Trained Staff	Recreational Fishers
Game fishing Monitoring Program	New South Wales	1993	Onsite	Yes	Trained Staff	Recreational Game fishers
Game fishing Tagging Program	New South Wales	1973	Onsite	No	Trained Staff/ Recreational Game fisherman	Recreational Game fishers
Telephone-diary Survey	New South Wales	2000	Offsite	Yes	Diaries/ Trained Staff	Recreational Fishers
Charter Fishery Logbook	Northern Territory	1993	Offsite	No	Logbook	Charter Operators
Telephone-diary Survey	Northern Territory	1994	Offsite	Yes	Diaries/ Trained Staff Members	Recreational Fishers
Boat Ramp Survey	Queensland	2006	Onsite	Yes	Trained Staff Surveys	Boat-based Recreational Fishers
Charter Fishery Logbook	Queensland	1993	Offsite	No	Logbook	Charter Operators
Donation Program	Queensland	2001	Offsite	Yes	Trained Staff	Recreational Fishers
Charter Fishery Logbook	South Australia	2005	Offsite	No	Logbooks	Charter Operators
Onsite Survey	South Australia	2000	Onsite	Yes	Trained Staff	Shore- and Boat-based Recreational Fishers
Telephone-diary Survey	South Australia	2000	Offsite	Yes	Diaries/ Trained Staff	Recreational Fishers
Angler Diary Survey	Tasmania	2009	Offsite	Yes	Diary	Recreational Fishers
Donation Program	Tasmania	2019	Offsite	No	Trained Staff	Recreational Fishers
Offshore and Game fishing Telephone-diary Survey	Tasmania	2011	Offsite	No	Diaries/ Trained Staff	Offshore and Game fishing Recreational Fishers
Telephone-diary Survey	Tasmania	2000	Offsite	Yes	Diaries/ Trained Staff	Offshore and Game fishing Recreational Fishers
Angler Diary Survey	Victoria	1997	Offsite	Yes	Diaries	Recreational Fishers
Boat Ramp Survey	Victoria	1977	Onsite	Yes	Trained Staff	Boat-based Recreational Fishers
Angler Diary Survey	Western Australia	2007	Offsite	No	Diaries	Recreational Fishers
Boat Ramp Survey	Western Australia	2011	Onsite	Yes	Trained Staff	Boat-based Recreational Fishers

Table 3 (continued)

Program Name	State	Initial commencement	Onsite or Offsite Survey	Have there been Changes to the Methods?	Current Data Collection Method	Personnel Surveyed
Charter Fishery Logbook	Western Australia	2001	Offsite	No	Logbooks	Charter Operators
Donation Program	Western Australia	2014	Offsite	No	Trained Staff	Recreational Fishers
Remote Camera Survey	Western Australia	2005	Onsite	Yes	Camera's	Shore- and Boat-based Recreational Fishers
Telephone-diary Survey	Western Australia	1999	Offsite	Yes	Diaries/ Trained Staff	Recreational Fishers

complete labels with basic catch information including the catch location and date of capture. Information collected beyond this varies between states. The processing of samples and collection of biological data including length, age, and sex can also vary between states. Using the donated fish frame, all programs will extract sagittal otoliths for age determination, sex will be macroscopically determined by investigating the gonads, and length will be measured.

Discussion

Evolution and key parameters of Australian recreational fisheries monitoring programs

Understanding the objectives and methods of recreational fisheries monitoring programs (RFMPs) are important for several reasons. Objectives are critical in being able to categorise programs (e.g., onsite and offsite) and determine what data is collected (Conron et al. 2014). By identifying the objectives of all RFMPs in Australia, we were able to determine the benefits and limitations of differing survey formats and their applications in present and future monitoring. Similarly, by identifying the variations between the survey formats throughout time, the limitations, advantages, and potential costs of differing monitoring programs can be considered (Tate et al. 2020).

Each RFMPs reviewed is centred around addressing one or more of the research foci identified in the 'National Policy for Recreational Fishing in Australia;' catch, activity, fish biology, and economic and social values of recreational fishers, though much of the data and information provided by RFMPs have relevance beyond recreational fisheries, such as understanding the structure and status of fisheries stocks (Henry and Lyle 2003). All states and territories have implemented monitoring programs aimed at quantifying the level of fish catch and fishing effort occurring within relevant recreational sectors. This information is critical for understanding the overall recreational fisheries harvest, and its comparative ecological footprint relative to commercial fisheries, but there are often constraints to collecting effective catch and effort data (Taylor et al. 2012; Smallwood et al. 2017; Murphy et al. 2020; Ryan et al. 2022). The diverse and dispersed nature of recreational fisheries means that there is variability in participants which can influence the ability to extrapolate information to the broader recreational fishing sector. The methods of some RFMPs will ultimately influence the collection and representation of the data collected, and thus without appropriate methods, effective representation of overall fishing activity would not be achieved (West et al. 2015). However, there is a high proportion of Australian RFMPs addressing both catch and effort as an objective in 2024, and it can be assumed that catch and activity as a research focus from the 'National Policy for Recreational Fishing in Australia' have been adequately met in Australian recreational fisheries (Fig. 4).

Anthropogenic impacts, beyond the impact of retaining fish, that occur as a result of recreational fishing can additionally be investigated as a result of the various methods and select objectives implemented. In select 'Boat Ramp Surveys,' 'Onsite Surveys,' and 'Charter Fishery Logbooks' the number of non-retained (released) fish are recorded. As a result, the catch rates of the recreational fishery can consider

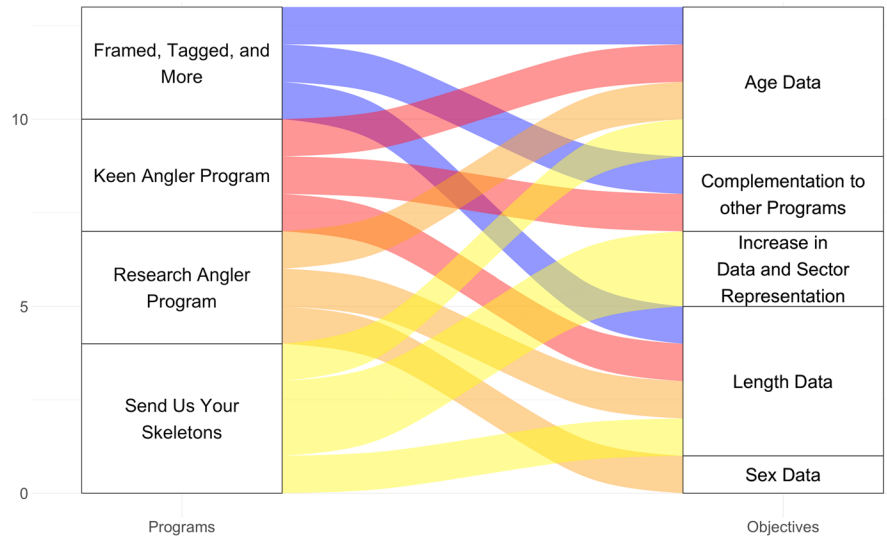

Fig. 5 'Donation Programs' used by varying states (left: 'Framed, Tagged, and More'- Tasmania, 'Keen Angler Program'- Queensland, 'Research Angler Program'- New South Wales, and 'Send Us Your Skeletons- Western Australia) linked to their corresponding objectives (right). The height of the "Programs" box represents the number of distinct objectives, and the height of the "Objectives" box represents the number of programs with the same objective. Each distinct colour represents a distinct program.

both the number of retained and released fish. Additionally, the amount of by-catch can be determined. 'Post-capture survival' is also estimated in the 'Charter Fishery Observer Program' giving it a numeric value from one to four based on the physical damage of fish prior to release after capture. Some states also record interactions with wildlife during Charter fishing operations (e.g., South Australia and Tasmania) (Fig. 4; Supplementary Table 7). By disclosing information on non-retained fish and interactions with wildlife (non-target organisms), the effects of recreational fishing beyond harvest levels can be investigated and monitored appropriately (Tracey et al. 2020; Hughes et al. 2021; Durante et al. 2022). Not doing so could contribute to the mismanagement of marine environment use that could influence the ability to recreationally fish. Future advancement to RFMPs could include the implementation of objectives and methods to collect data that consider recreational fisheries interactions with non-target species and their impacts in states and territories that do not investigate similar parameters.

There has been a consistent implementation of RFMPs that address the research focus of 'economic and social values' from the 'National Policy for Recreational Fishing in Australia' (Tables 2 and 4). In doing so, the ability to determine reasons why people fish, awareness of current issues, and opinions on management, can be considered during the implementation of management policies (Coleman 1998; Henry and Lyle 2003; Tracey et al. 2013). However, not all states and territories in 2024 have programs in place to address the economic and social values of recreational fisheries (Fig. 4). Much like biological characteristics, if not addressed in future RFMPs, this lack of information could be detrimental to the fishery.

Many of the methods implemented in various RFMPs are intended to collect data that can determine and represent the status of fisheries and targeted stocks, especially when used in conjunction with commercial fishery data. Our review has identified that the categorisation of either onsite or offsite surveys changes what objectives are implemented in individual RFMPs and data outputs of the corresponding programs (Fig. 4). We have identified that typically more and diverse objectives are implemented in offsite programs. Mainly, onsite surveys will have fewer objectives but have the ability to collect data not often collected in offsite surveys (e.g., biological data). 'Donation Programs' are the exception where they are the only offsite surveys to collect

biological data. However, 'Donation Programs' are some of the newest programs to be implemented by states, and thus could be forging a new form of data collection. We have observed an increasing trend in the quantity of biological information available which has become important as part of monitoring in the last decade (Figs. 2 and 5). Most of the methods used in the monitoring programs include using trained staff members, regardless of categorisation, which increases the quality of the results and reduces the level of non-response (Henry and Lyle 2003; West et al. 2015). Additionally, the implementation of trained staff is pivotal in representing the recreational fishery at a better resolution and ensures data quality control. Onsite surveys tend to have higher level of data quality control compared to offsite surveys due to its exclusive use of trained staff to collect data, although some offsite surveys utilize trained staff as well.

While location and species-specific RFMPs are unable to sample the recreational fishery to the same capacity as statewide and multi-species RFMPs, there are still benefits to them by providing foundations to some RFMPs and investigating specific but pivotal parts of the recreational fishery. There is often a trade-off in monitoring between the scale and the representation of the data produced from RFMPs. While some programs may be smaller in scale by sampling specific locations and/or species (e.g., South Australia's 2013–2014 'Onsite Survey') they may still be representative of the fishery and contribute to the ability to monitor and manage the fishery (Giri and Hall 2015). By conducting this review there have potentially been programs excluded that do play a significant role in understanding the recreational fishery. Additionally, location and species-specific research and RFMPs have potentially been formative in the implementation of statewide monitoring programs, and the understanding of the recreational fishery which may not have been appropriately credited within the literature (Beckmann et al. 2024; Giri and Hall 2015; Schilling et al. 2023; Steffe and Murphy 2011). It is also acknowledged that information of RFMPs is often difficult to publish, which may have influenced the information available and therefore the representation within our review.

Recreational fisheries is an ever-evolving landscape, where mapping the structures of RFMPs applied through time, such as done here, is beneficial in future program expansions, adaptations, and implementation. To date, there have been few summaries of RFMPs in Australia. Fowler et al. (2022) identified that visualizing trends of objectives implemented in New South Wales RFMPs allows for the identification of data gaps and monitors harvest strategies within the recreational fishery, enabling the determination of benefits and limitations of differing survey formats to be applied in future monitoring. The present review has built upon this information, by identifying the gaps on a national scale. Similarly, Tate et al. (2020) identified changes in the methodologies employed to monitor Western Australia's recreational fishery throughout time. Their research supports our findings and also determined that adapting methodologies throughout time has increased and improved the understanding of recreational fisheries. Building upon Tate et al. (2020)'s findings, our review has highlighted the overall need to implement additional methodologies and programs to ensure that all states and territories are able to fulfill the research foci of the 'National Policy for Recreational Fishing in Australia.' Additionally, Commonwealth-managed species have additional complexities associated within Australian recreational fisheries monitoring and research. Griffiths et al. (2010) identified the need and the potential to use innovative, cost-effective, and statistically robust model-based survey techniques, due to the increase in diverse categories of recreational fishers. However, the challenge of diversification is not exclusive to Commonwealth/Australian-managed fish populations. Increases and advances in technologies have also meant novice fishers are able to increase participation and harvest rates within the recreational fishing sector (Taylor et al. 2012). Without our review identifying marine RFMPs nationally, we would not be able to identify if catch, effort, fish biology, and socio-economic characteristics of recreational fisheries are being appropriately monitored. Georgeson et al. (2015) have also provided insight into the objectives and approaches necessary to conduct cross-jurisdictional and national surveys of the recreational fishery. To do so they also used the "National Policy for Recreational Fishing in Australia" research foci as a basis, but did not investigate the ability of current RFMPs to meet these foci on a state or territory level. The reviews above provided much-needed insights into Australian recreational fisheries, but without identifying changes on a

national and jurisdictional scale, important information including shifts in program structures would not be determined and could hinder our ability to monitor recreational fisheries in the future.

The main changes to programs on a national scale that have not been previously identified is the shift to a higher frequency of offsite surveys compared to onsite surveys (Fig. 1). Offsite surveys are relatively cost-effective, facilitating large spatial scale and broader assessments of the recreational fishery activity (Ryan et al. 2009; Lyle et al. 2014). We have identified a continued implementation of onsite surveys by all states, particularly in the form of 'Boat Ramp Surveys,' and it is evident that there is still a relevant need for them. While offsite surveys (e.g., 'Telephone-diary Survey') allow for many RFMPs objectives and policy research foci to be met, without onsite surveys, there are some objectives and foci that would be collected at a smaller capacity. Onsite surveys also limit the level of bias that is associated with the methods of offsite surveys (e.g., potential misinformation provided by fishers) (Ryan et al. 2009). While several states are embracing the increase to more offsite surveys, it is important to note the consistent use of both onsite and offsite surveys to complement the other RFMPs to ensure different but valuable data is collected (Figs. 2 and 4).

Our review of Australian RFMPs shows that a large diversity of past and present monitoring programs effectively address each of the distinct research foci outlined in the "National Policy for Recreational Fishing in Australia," namely recreational fishing activity, catch monitoring, fish biology of harvested species, and economic and social values of recreational fishers. However, the range of RFMPs in individual states and territories does not comprehensively address all foci. Catch and fishing activity research foci have been addressed by all states and territories, and at a higher proportion than the other two research foci (economic and social values of recreational fishers and fish biology) (Fig. 4). The extent to which catch and activity has been addressed does vary between states and territories. Some RFMPs have been implemented for less time comparatively to others. The research focus of economic and social values of recreational fisheries reflects a similar pattern but with fewer programs. Some states and territories still investigate economic and social values consistently, but there were more programs previously that investigated this research focus. Fish biology has had the inverse trend, with a higher implementation of biological monitoring programs in recent years. Comparatively to the other monitoring programs, the number of RFMPs with fish biology objectives such as the 'Donation Programs' is much smaller but increasing in number. There is a need to understand the contribution of these programs in terms of the representation of the recreational fishery and fish populations being monitored (Table 4).

Importance of donation programs to collect biological data

Biological data collected by RFMPs is sparse despite its significance for fisheries and stock monitoring. 'Age Data' collected within fisheries monitoring is critical in understanding the age structures of key target species (Fig. 5) (Fairclough et al. 2014). Other biological parameters such as 'Length and Sex Data' are critical in understanding growth parameters within species, when used in conjunction with age data. The collection of biological data is not only useful for understanding the recreational fishery but can also be used for stock assessments (Fairclough et al. 2014). Catch and effort can be used to determine the amount of harvestable biomass remaining, but without fish age to determine growth rate and mortality, productivity and therefore biomass estimates can be highly uncertain (Campana and Thorrold 2001). The length of sampled fish can be used to determine both the length frequency and growth parameters when used in conjunction with age data (Schilling et al. 2023). Furthermore, by additionally determining sex, the differences in growth rates of males and females within fish populations can be determined, assisting in the ability to implement management strategies including sex-specific regulations and size limits.

Despite the ability of 'Donation Programs' to collect critical biological data, they are often classed as smaller programs comparatively to the others (Fig. 1). There is a large potential for 'Donation Programs' to grow but there is a need to understand how representative the data is of the broader recreational harvest (Table 4). The collection of biological data within the recreational fishing sector specifically can assist in detecting changes in fish populations, particularly when management has changed (e.g., removal of

commercial fisheries in select locations), and provide additional data by complementing larger, more established programs (Figs. 4 and 5) (Fairclough et al. 2014). We have identified that many of the larger programs implemented collect similar, if not the same data, within and between states and territories. On the other hand, we have presented that 'Donation Programs' have been established to cater to the individual needs of fisheries agencies, fisheries, and monitored species (Figs. 4 and 5).

To date, most states and territories depend in part or solely on the commercial fishing sector for catch and effort data and also biological data. With changes in fisheries regulations and management not only in Australia but elsewhere, there is potential for greater allocation of the catch share to the recreational fishery. Decisions about allocation of resources between sectors are not simple with few guidelines outlining optimum results (Mazur et al. 2020). Adding to the complexity of monitoring fisheries could lead to potential reductions in the voluntary donation of biological samples from a sector of the fishery. If biological data is not provided by the commercial sector, 'Donation Programs' can fill this need. 'Donation Programs' provide relevant information about the fished population but do vary based on the overlap of the recreational and commercial fisheries. In this instance some investigation of the differences between data from each sector and associated monitoring programs is necessary (Table 4).

Current applications of 'Donation Programs' are either species-specific research or to monitor select biological characteristics on smaller scales (Schilling et al. 2023). Minimal research has been conducted on the foundations of these programs, and the data potential beyond what is currently used. Fairclough et al. (2014) determined that the 'Send Us Your Skeleton Program' ('Donation Program') has long-term viability within Western Australia's fisheries stock assessments (Fig. 5). Fairclough et al. (2014) also determined that 'Donation Program' data provided better representations of key biological characteristics (e.g., age, mortality, and size range) and there was an overall reduction in the annual cost per skeleton when a greater number was sampled. 'Donation Program' data also has the potential to better represent species distribution (Graba-Landry et al. 2022). The data collected within Graba-Landry et al. (2022) study expanded the distribution of the researched species in Tasmania. Additionally, with increasing anthropogenic changes, the opportunity to use biological and 'Donation Program' data can improve and build upon current understandings of key recreational fish species (Graba-Landry et al. 2022). While these programs are state-wide, the current applicability is notably for research such as that mentioned previously (Fairclough et al. 2014; Graba-Landry et al. 2022). However, without research into the comparisons between other fisheries sectors (e.g., commercial) and programs (e.g., 'Boat Ramp Surveys), where similar data is collected, the true potential of 'Donation Programs' will not be understood (Table 4).

The future of recreational fisheries monitoring

This overview of past and present Australian RFMPs reveals the extensive utility and diversity of data that can be provided by such programs. Beyond Australia's recreational fishery, there is a common criticism around the world that recreational fisheries do not have compulsory reporting like the commercial sector and many charter fishing sectors (Telfer 2010; Ryan and Conron 2019). Compulsory reporting within the recreational sector would be difficult, making it necessary to implement alternative RFMPs. We summarised our suggestions for future research and implementations of Australian RFMPs (see Table 4). We suggest that RFMPs shift towards implementing methods that ease the ability to collect scientifically accurate and reliable data. For example, the use of recreational fishing licenses, such as in New South Wales, can ease the ability to determine sample populations of recreational fishers. However, the synthesis of monitoring programs for recreational fisheries is still imperative, and should be done more frequently than what has been observed in literature. Beyond Australia's coast, limited large-scale synthesis of RFMPs has occurred, where only one review of a similar capacity has been recorded investigating the recreational fisheries of Italy. Tarantino et al. (2025) conducted a review of peer-reviewed papers investigating the marine recreational fisheries of Italy. They, similar to our review, identified the need to adopt and adapt methodologies in order to acquire substantial data (Tarantino et al. 2025). Investigation of RFMPs in association with research foci of policies however has never been conducted, reducing the ability to determine the effects and appropriately monitor

Table 4 Key recommendations and justifications for future research and implementations of Australian Recreational Fisheries Monitoring Programs (RFMPs)

Recommendation	Justification
Ensure that all Australian states and territories have RFMPs to address all four research foci of the 'National Policy for Recreational Fishing in Australia.'	While we know that there is a high number of RFMPs addressing the research foci of fish catch and fishing effort, there are a limited number of RFMPs investigating economic and social values. We have also highlighted that there is an increasing number of RFMP focussing on fish biology. However, there is a need to continue expanding research of fish biology to all states and territories due to the inherent value of biological data in monitoring fish populations, especially given likely limited fishery independent monitoring of stocks targeted by both recreational and commercial fishing sectors
Compare and contrast biological data obtained from RFMPs to that of other fishery sectors and information sources	As identified in our review there is an expansion of RFMPs that focus on obtaining biological information, such as the 'Donation Programs.' However, the ability of these programs to provide comprehensive and unbiased representation of target stocks is not fully understood. Fishery biological data sources should therefore be investigated and compared to information from other fisheries sectors and sources to explore specific differences in the selectivity of recreational fisheries relative to other sectors (e.g., commercial) and maximise representation of target populations. Additionally, with the potential shift in catch share from the commercial to recreational sector, there is a further need to explore the comparability of sectors through biological monitoring programs to fill potential data gaps
Encourage greater levels of voluntary participation and data reporting from recreational fishers in RFMPs to better represent and understand recreational fisheries	A common criticism and difficulty associated with statewide and multi-species RFMPs is that there is no compulsory reporting (excluding the Charter Fishery) like other sectors (e.g., commercial). An approach that has been implemented by some states, i.e., South Australia, Tasmania, and Victoria, are mandatory phone application-based monitoring programs that are species-specific that could be beneficial as a framework to future multi-species and statewide RFMPs. However, there could be many difficulties associated with implementing mandatory reporting in RFMPs, though there are alternative strategies to maximise participation and levels of data reporting (e.g., New South Wales recreational licence database). There have been implementations of some voluntary phone applications (e.g., New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia) that has the potential to be used to broaden the data availability for the recreational fishery sector. However, by expanding and developing programs to be able to gather data more readily and cost-efficiently, there would be a need for further summaries and synthesis of RFMPs similar to our review

recreational fishing activity. Furthermore, there is a need to push for more marine recreational fishing statistics to not only monitor the status of fisheries but also the management of fisheries (National Research Council of the National Academies 2006). By conducting our review, we highlight the need to invest in research on the topic of recreational fisheries in Australia and elsewhere.

Conclusion

The abundance and diversity of Recreational Fisheries Monitoring Programs (RFMPs) throughout Australia largely address the four distinct research foci identified in the "National Policy for Recreational Fishing in Australia," though there is notable interannual variation in the operation of programs, reflecting

limited sustained and ongoing programs. Moreover, there are inconsistent applications of different RFMPs, and corresponding objectives and methods, across different states and territories. Some RFMPs implemented by states and territories are more effective at representing these research foci, based on the objectives and methods implemented. While there has been a focus on a small number of objectives, this study highlights shifts in focus and methodologies through time, correlating to the apparent increase in offsite surveys, and a steady implementation of onsite surveys. These shifts reflect an evolution in the way that RFMPs are undertaken and data needs from the sector. Shifts in objectives implemented in RFMPs have meant information such as non-retained fish numbers and wildlife interactions are recorded in addition to basic fisheries data (e.g., number of retained fish). Additionally, these shifts reflect changing social values of fisheries and management needs. Similarly, we have seen a greater focus on collecting biological data. However, there is a need to balance programs investigating the research foci of the "National Policy for Recreational Fishing in Australia" to ensure that all aspects of the fishery are appropriately represented and there are no gaps in data like what we have previously seen in recreational fisheries monitoring. The decline in programs investigating social and economic values could potentially pose negative effects as issues of catch sharing and the use and non-use values of fisheries are explored. Additionally, continuing the expansion of programs investigating fish biology means there is a need to investigate the utility of data collected in these programs. Beyond the "National Policy for Recreational Fishing in Australia" , there is an increasing importance in investigating recreational fisheries globally. There are also substantial opportunities and benefits in being able to expand and capitalise on recreational fisheries monitoring where recreational fisheries have a larger catch share than associated commercial fisheries. Expansions in sampling programs will continue to occur throughout time adapting to data needs and requirements for state and territory recreational fisheries monitoring. Australian fisheries agencies will potentially be able to take this information and adapt their monitoring programs to ensure that program objectives and methodologies meet data needs. The 26 programs run across all Australian coastal states and territories in 2024 reflect the importance fisheries agencies put on collecting recreational fisheries data. It has been noted that recreational fisheries account for significant amounts of harvest in countries beyond Australia. This significance amplifies the need to understand monitoring and data collection in the recreational fisheries sector, which can be applied to future research and management to achieve sustainability for fisheries.

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Author contributions S.W. conceptualisation of the study, conducted the investigation, performed the formal analysis, performed visualization, and contributed to the writing of the manuscript (original draft, review & editing). M.S.P. conceptualisation of the study, contributed to the writing of the manuscript (original draft, review & editing), and supervision. A.M. conceptualisation of the study, contributed to the writing of the manuscript (original draft, review & editing), and supervision. R.B.C. conceptualisation of the study, contributed to the writing of the manuscript (original draft, review & editing), and supervision.

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Appendix

See Table 5.

Table 5 Each state and territories grouped programs and the references used to collect information to be able to create Figs. 1 - 5

State and Territory	Grouped Program	Used	Reference
New South Wales	Charter Fishery	Timeframe, Objectives, Methods	Gray and Kennelly (2016) Gray and Kennelly (2017) Hughes et al. (2021)
New South Wales	Charter Fishery Observer Program	Timeframe, Objectives, Methods	Gray and Kennelly (2016) Hughes et al. (2021)
New South Wales	Donations Programs	Timeframe, Objectives, Methods	NSW Research Angler Program. https://www.dpi.nsw.gov.au/fishing/recreational/resources/fish-tagging/researchangler Stewart et al. (2020) Schilling et al. (2023)
New South Wales	Gamefishing Monitoring Programs	Timeframe, Objectives, Methods	Murphy et al. (2002) Lowry and Murphy (2003) New South Wales Department of Primary Industries and Regional Development (2023)
New South Wales	Gamefishing Tagging Program	Timeframe, Objectives, Methods	Murphy et al. (2002) New South Wales Department of Primary Industries and Regional Development (2023)
New South Wales	Telephone-diary Survey	Timeframe, Objectives, Methods	Murphy et al. (2020) West et al. (2015) Lyle et al. (2002)
Northern Territory	Charter Fishery	Timeframe, Objectives, Methods	Northern Territory Government (2020) Handley (2009) Northern Territory Government (2014) Northern Territory Government (2011)
Northern Territory	Onsite Survey	Timeframe	Coleman (2004) West et al. (2012)
Northern Territory	Telephone-diary Survey	Timeframe, Objectives, Methods	West et al. (2022) West et al. (2012) Coleman (1998) Coleman (2004)
Queensland	Angler Diary Survey	Timeframe	Stenekes and Sahlqvist (2011)
Queensland	Boat Ramp Survey	Timeframe, Objectives, Methods	Fishery Monitoring of Fisheries Queensland, Department of Agriculture and Fisheries (2017) Department of Primary Industries and Fisheries (2008) Martin et al. (2019)
Queensland	Charter Fishery Logbooks	Timeframe, Objectives, Methods	Greiner and Gregg (2010) Tobin et al. (2017)
Queensland	Donation Program	Timeframe, Objectives, Methods	Department of Primary Industries and Fisheries (2008) Schilling et al. (2023) Stenekes and Sahlqvist (2011)
Queensland	Satisfaction and Expectation Survey	Timeframe	Martin et al. (2019)
Queensland	Telephone-diary Survey	Timeframe	Webley et al. (2015) Taylor et al. (2010) Teixeira et al. (2020) McInnes (2008) Lawson (2015) Webley et al. (2020)

Table 5 (continued)

State and Territory	Grouped Program	Used	Reference
South Australia	Angler Diary Survey	Timeframe	Jones (2009)
South Australia	Charter Fishery Logbook	Timeframe, Objectives, Methods	Knight et al. (2007) Durante et al. (2022) Jones (2009)
South Australia	Onsite Surveys	Timeframe, Objectives, Methods	Jones (2009) Beckmann et al. (2023) Giri and Hall (2015) Government of South Australia, Primary Industries and Regions South Australia (2020)
South Australia	Telephone-diary Survey	Timeframe, Objectives, Methods	Jones (2009) Beckmann et al. (2023) Giri and Hall (2015) Government of South Australia, Primary Industries and Regions South Australia (2020)
Tasmania	Angler Diary Survey	Timeframe, Objectives, Methods	Tracey et al. (2011)
Tasmania	Charter Fishery Logbook	Timeframe	Tracey et al. (2013) Tracey et al. (2020) Forbes et al. (2009) Morton and Lyle (2003)
Tasmania	Donation Program	Timeframe, Objectives, Methods	Graba-Landry et al. (2023) Graba- Landry et al. (2022) Champion et al. (2018)
Tasmania	Gamefishing Angler Diary	Timeframe	Morton and Lyle (2003)
Tasmania	Offshore and Gamefishing Onsite	Timeframe	Forbes et al. (2009) Tracey et al. (2013) Morton and Lyle (2003)
Tasmania	Offshore and Gamefishing Telephone-diary Survey	Timeframe, Objectives, Methods	Tracey et al. (2013) Tracey et al. (2020) Tracey et al. (2020)
Tasmania	Onsite Survey	Timeframe	Lyle et al. (2009)
Tasmania	Telephone-diary Survey	Timeframe, Objectives, Methods	Lyle et al. (2009) Lyle et al. (2014) Lyle et al. (2019)
Victoria	Angler Diary Survey	Timeframe, Objectives, Methods	Bridge and Conron (2010) Conron et al. (2014) Conron and Oliveiro (2016) Conron et al. (2018) Ford and Gilmour (2013) Ryan et al. (2009)
Victoria	Boat Ramp Surveys	Timeframe, Objectives, Methods	Ford and Gilmour (2013) Ryan and Conron (2019) Ryan et al. (2009)
Victoria	Telephone-diary Survey	Timeframe	Ryan et al. (2009)
Western Australia	Aerial Survey	Timeframe	Tate et al. (2020)
Western Australia	Angler Diary Survey	Timeframe, Objectives, Methods	Tate et al. (2020)
Western Australia	Boat Ramp Survey	Timeframe, Objectives, Methods	Smallwood et al. (2017) Tate et al. (2020) Ryan et al. (2013) Ryan et al. (2022) Wise et al. (2012)

Table 5 (continued)

State and Territory	Grouped Program	Used	Reference
Western Australia	Charter Fishery Logbook	Timeframe, Objectives, Methods	Telfer (2010) Wise et al. (2012)
Western Australia	Donation Program	Timeframe, Objectives, Methods	Fairclough et al. (2014) Send us your skeletons. https://www.fish.wa.gov.au/Fishing-and-Aquaculture/Recreational-Fishing/Send-Us-Your-Skeletons/Pages/default.aspx
Western Australia	Onsite Survey	Timeframe	Lai et al. (2019) Lai et al. (2021) Tate et al. (2020)
Western Australia	Remote Camera Survey	Timeframe, Objectives, Methods	Lai et al. (2021) Tate et al. (2020) Ryan et al. (2013)
Western Australia	Satisfaction and Expectation Survey	Timeframe	Tate et al. (2020)
Western Australia	Telephone-diarySurvey	Timeframe, Objectives, Methods	Lai et al. (2021) Ryan et al. (2013) Tate et al. (2020)

Appendix: References

1. Beckmann CL, Durante LM, Graba-Landry A, et al (2023) Survey of Recreational Fishing in South Australia 2021-22. South Australian Research and Development Institute (Aquatic and Livestock Sciences)
2. Bridge N, Conron S (2010) State-wide Angler Diary Program 1997-2006. Department of Primary Industries, Victoria
3. Champion C, Hobday A, Tracey S, Pecl G (2018) Rapid shifts in distribution and high-latitude persistence of oceanographic habitat revealed using citizen science data from a climate change hotspot. Glob Change Biol 24:5440–5453. https://doi.org/10.1111/gcb.14398
4. Coleman APM (1998) Fishcount: a survey of recreational fishing in the Northern Territory. Northern Territory
5. Coleman APM (2004) The National Recreational Fishing Survey: The Northern Territory. Northern Territory Department of Business, Industry and Resource Development
6. Conron S, Oliveiro P (2016) State-wide Angler Fishing Diary Program 2011–14. Victorian Government, Department of Economic Development, Jobs, Transport and Resources
7. Conron SD, Giri K, Hindell JS, et al. (2018) Comparison of catch rates and catch composition among 'research-angler' diary and fishery-independent survey methods in Victoria, Australia. Zool and Ecol 28:265–279. https://doi.org/https://doi.org/10.1080/21658005.2018.1518125
8. Conron SD, Grixti D, Bruce TK, et al. (2014) New and innovative approaches to monitoring small-scale recreational fisheries. Fisheries Research and Development Corporation (FRDC), Fisheries Victoria, Department of Environment and Primary Industries
9. Department of Primary Industries and Fisheries (2008) Fisheries Long Term Monitoring Program Sampling Protocol- Bream, Whiting and Flathead (2007 onwards). Department of Primary Industries and Fisheries
10. Department of Primary Industries and Regional Development, Western Australia (2024) Send us your skeletons. https://www.fish.wa.gov.au/Fishing-and-Aquaculture/Recreational-Fishing/Send-Us-Your-Skeletons/Pages/default.aspx. Accessed 25 Jun 2024
11. Durante LM, Smart JJ, Tsolos A (2022) South Australian Charter Boat Fishery 2020/21. Final Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences)

12. Fairclough DV, Brown JI, Carlish BJ, et al (2014) Breathing life into fisheries stock assessments with citizen science. Sci Rep 4:7249. https://doi.org/10.1038/srep07249
13. Fishery Monitoring of Fisheries Queensland, Department of Agriculture and Fisheries (2017) Monitoring Queensland's boat-based recreational fishing. Fishery Monitoring of Fisheries Queensland, Department of Agriculture and Fisheries
14. Forbes E, Tracey S, Lyle J (2009) Assessment of the 2008 Recreational Gamefish Fishery of South East Tasmania, with Particular Reference to Southern Bluefin Tuna. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania
15. Ford J, Gilmour P (2013) The State of Recreational Fishing in Victoria, a review of ecological sustainability and management options. Victorian National Parks Association, Melbourne
16. Giri K, Hall K (2015) South Australian Recreational Fishing Survey 2013/14.Victorian Government, Department of Economic Development, Jobs, Transport and Resources
17. Government of South Australia, Primary Industries and Regions SA (2020) Management Plan for Recreational Fishing in South Australia. Government of South Australia, Primary Industries and Regions SA
18. Graba- Landry A, Champion C, Haddy J, et al (2022) Opportunities and impacts of range extending scalefish species: Understanding population dynamics, ecosystem impacts and management needs. Institute for Marine and Antarctic Studies, Hobart
19. Graba-Landry A, Champion C, Twiname S, et al (2023) Citizen science aids the quantification of the distribution and prediction of present and future temporal variation in habitat suitability at species' range edges. FoB 15:e58207. https://doi.org/10.21425/F5FBG58207
20. Gray CA, Kennelly SJ (2016) First implementation of an independent observer program for the charter boat industry of NSW: data for industry-driven resource sustainability. WildFish Research, Sydney, Australia
21. Gray CA, Kennelly SJ (2017) Evaluation of observer- and industry-based catch data in a recreational charter fishery. FME 24:126–138. https://doi.org/10.1111/fme.12210
22. Greiner R, Gregg D (2010) Considering recreational catch and harvest in fisheries management at the bio-regional scale. Fish Manag Ecol 17:336–345. https://doi.org/10.1111/j.1365-2400.2009.00727.x
23. Handley AJ (2009) Fishery Status Reports 2009. Northern Territory Government Department of Resources
24. Hughes J, Johnson D, Ochwada-Doyle F, Murphy J (2021) The NSW Recreational Fisheries Monitoring Program - Charter Fishery Monitoring 2017/18. NSW Department of Primary Industries
25. Jones K (2009) South Australian Recreational Fishing Survey 2007/08. PIRSA Fisheries
26. Knight M, Doonan A, Tsolos A (2007) The South Australian Recreational Charter Boat Fishery. South Australian Research and Development Institute (SARDI) Aquatic Sciences
27. Lai EKM, Mueller U, Hyndes GA, Ryan KL (2019) Comparing estimates of catch and effort for boat-based recreational fishing from aperiodic access-point surveys. Fish Res 219:105305. https://doi.org/10.1016/j.fishres.2019.06.003
28. Lai EKM, Ryan KL, Mueller U, Hyndes GA (2021) Corroborating effort and catch from an integrated survey design for a boat-based recreational fishery in Western Australia. Fish Res 236:105865. https://doi.org/10.1016/j.fishres.2020.105865
29. Lawson A (2015) An investigative analysis of Queensland's statewide recreational fishing surveys. Fisheries Queensland, Department of Agriculture and Fisheries
30. Lowry M, Murphy J (2003) Monitoring the recreational gamefish fishery off southeastern Australia. Mar Freshw Res 54:425. https://doi.org/10.1071/MF01269
31. Lyle J, Coleman APM, West L, et al (2002) New Large-Scale Survey Methods for Evaluating Sport Fisheries. University of Tasmania. https://www.tourismnt.com.au/system/files/uploads/files/2020/fishing-segment-profile.pdf
32. Lyle J, Stark K, Tracey S (2014) 2012-13 Survey of Recreational Fishing in Tasmania. The Institute for Marine and Antarctic Studies, University of Tasmania

33. Lyle J, Tracey S, Stark K, Wotherspoon S (2009) 2007-08 Survey of Recreational Fishing in Tasmania. University of Tasmania
34. Lyle JM, Stark KE, Ewing GP, Tracey SR (2019) 2017-18 Survey of Recreational Fishing in Tasmania. The Institute for Marine and Antarctic Studies, University of Tasmania
35. Martin T, Wild S, Webley J, Staunton-Smith J (2019) Performance of Queensland's net-free zones. Fisheries Queensland, Department of Agriculture and Fisheries, State of Queensland
36. McInnes K (2008) Experimental results from the fourth Queensland recreational fishing diary program (2005). The State of Queensland, The Department of Primary Industries and Fisheries
37. Morton A, Lyle J (2003) Preliminary Assessment of the Recreational Gamefish Fishery in Tasmania, with particular reference to Southern Bluefin Tuna. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania
38. Murphy J, Ochwada-Doyle F, West L, et al (2020) Survey of recreational fishing in NSW 2017/18. NSW Department of Primary Industries
39. Murphy JJ, Lowry MB, Henry GW, Chapman D (2002) The Gamefish Tournament Monitoring Program – 1993 to 2000. NSW Fisheries
40. New South Wales Department of Primary Industries and Regional Development (2023) DPIRD Game Fish Tagging Program Report 2022–2023. New South Wales Department of Primary Industries and Regional Development
41. Northern Territory Government (2011) Fishery Status Reports 2010. Northern Territory Government Department of Resources
42. Northern Territory Government (2014) Fishery Status Reports 2012. Northern Territory Government Department of Primary Industry and Fisheries
43. Northern Territory Government (2020) Fishing Tourism. Tourism Northern Territory https://www.tourismnt.com.au/system/files/uploads/files/2020/fishing-segmentprofile.pdf
44. NSW Department of Primary Industries and Regional Development (2024) NSW Research Angler Program. https://www.dpi.nsw.gov.au/fishing/recreational/resources/fish-tagging/researchangler Accessed Jul 2024
45. Ryan K, Morison A, Conron S (2009) Evaluating methods of obtaining total catch estimates for individual Victorian bay and inlet recreational fisheries. Department of Primary Industries, Queenscliff
46. Ryan KL, Conron SC (2019) Comparing indicators of recreational fishing in Port Phillip Bay, Australia, from 2008 to 2011 with variability from a background period (2003–07). Mar Freshw Res 70:1345–1357. https://doi.org/10.1071/MF18346
47. Ryan KL, Lai EKM, Smallwood CB (2022) Boat-based recreational fishing in Western Australia 2020/21. Department of Primary Industries and Regional Development, Western Australia
48. Ryan KL, Wise BS, Hall NG, et al (2013) An integrated system to survey boat-based recreational fishing in Western Australia 2011/12. Department of Fisheries, Western Australia
49. Schilling HT, Stewart J, Litherland L, et al (2023) Age and growth of Pomatomus saltatrix in the south-western Pacific Ocean (eastern Australia), with a global comparison. Mar Freshw Res 74:463–478. https://doi.org/10.1071/MF22216
50. Smallwood C, Ryan K, Tate A (2017) Weight-length summaries for Western Australian fish species derived from surveys of recreational fishers at boat ramps.Department of Primary Industries and Regional Development, Western Australia
51. Stewart J, Hughes JM, Stanley C, Fowler AM (2020) The influence of rainfall on recruitment success and commercial catch for the large sciaenid, Argyrosomus japonicus, in eastern Australia. Mar Environ Res 157:104924. https://doi.org/10.1016/j.marenvres.2020.104924
52. Tobin A, Sumpton W, Saunders R, et al. (2017) What data how? Empowering and engaging industry to ensure the needs of contemporary fisheries data are achieved. James Cook University, Townsville, Australia.
53. Tate A, Ryan K, Smallwood C, et al (2020) Review of recreational fishing surveys in Western Australia. Department of Primary Industries and Regional Development,Western Australia
54. Taylor S, Webley J, McInnes K (2012) 2010 Statewide Recreational Fishing Survey.Depart-

ment of Agriculture, Fisheries, and Forestry, Fisheries Queensland
55. Teixeira D, Janes R, Webley J (2020) 2019–20 statewide recreational fishing survey Key results. Fisheries Queensland, Department of Agriculture and Fisheries
56. Telfer C (2010) The Western Australian charter boat industry: Working towards longterm sustainability. Edith Cowan University
57. Tobin A, Sumpton W, Saunders R, et al (2017) What data how? Empowering and engaging industry to ensure the needs of contemporary fisheries data are achieved.James Cook University, Townsville, Australia
58. Tracey S, Lyle J, Ewing G, et al (2013) Offshore recreational fishing in Tasmania 2011/12. Institute for Marine and Antarctic Studies, University of Tasmania
59. Tracey SR, Lyle JM, Stark K, et al (2020) Recreational Fishing For Southern Bluefin Tuna In Australia 2018/19. Institute for Marine and Antarctic Studies University of Tasmania
60. Tracey SR, Lyle JM, Stark K, Twiname S (2020) Offshore Recreational Fishing in Tasmania 2018/19. Institute for Marine and Antarctic Studies, University of Tasmania
61. Tracey S, Reinfrank R, Lyle J (2011) Evaluation of a recreational angler logbook program for Tasmania. Institute for Marine and Antarctic Studies University of Tasmania
62. Webley J, McInnes K, Teixeira D, et al (2015) Statewide Recreational Fishing Survey 2013-14. Department of Agriculture and Fisheries, State of Queensland
63. Webley J, Mission S, Phillips B, et al (2020) Statewide recreational fishing survey 2019-20: Methodological Report (July 2020). Social Research Centre
64. West LD, Lyle JM, Matthews SR, et al (2012) Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Government, Australia
65. West LD, Stark KE, Dysart K, Lyle JM (2022) Survey of recreational fishing in the Northern Territory: 2018 to 2019. Department of Industry, Tourism and Trade,Northern Territory
66. West LD, Stark KE, Murphy JJ, et al (2015) Survey of Recreational Fishing in New South Wales and the ACT, 2013/14. NSW Department of Primary Industries
67. Wise BS, Telfer CF, Lai EKM, et al (2012) Long-term monitoring of boat-based recreational fishing in Shark Bay, Western Australia: providing scientific advice for sustainable management in a World Heritage Area. Mar Freshwater Res 63:1129–1141. https://doi.org/10.1071/MF12054

References

Beckmann CL, Durante LM, Stark K, Tracey S (2024) Evaluation of an app-based recreational fishing survey against population benchmarks from a traditional probability-based survey. The South Australian Research and Development Institute (Aquatic and Livestock Sciences), Adelaide

Brownscombe JW, Hyder K, Potts W et al (2019) The future of recreational fisheries: advances in science, monitoring, management, and practice. Fish Res 211:247–255. https://doi.org/10.1016/j.fishres.2018.10.019

Campana SE, Thorrold SR (2001) Otoliths, increments, and elements: keys to a comprehensive understanding of fish populations? Can J Fish Aquat Sci 58:30–38. https://doi.org/10.1139/f00-177

Coleman APM (1998) Fishcount: a survey of recreational fishing in the Northern Territory. Northern Territory

Conron SD, Grixti D, Bruce TK, et al (2014) New and innovative approaches to monitoring small-scale recreational fisheries. Fisheries Research and Development Corporation, Fisheries Victoria, Department of Environment and Primary Industries

Cooke SJ, Cowx IG (2004) The role of recreational fishing in global fish crises. BioScience 54:857–859. https://doi.org/10.1641/0006-3568(2004)054[0857:TRORFI]2.0.CO;2

Department of Primary Industries and Regional Development (2024) Annual Report 2023–2024. Western Australia Department of Primary Industries and Regional Development, Western Australia

Durante LM, Smart JJ, Tsolos A (2022) South Australian Charter Boat Fishery 2020/21. South Australian Research and Development Institute (Aquatic Sciences)

Fairclough DV, Brown JI, Carlish BJ et al (2014) Breathing life into fisheries stock assessments with citizen science. Sci Rep 4:7249. https://doi.org/10.1038/srep07249

FAO (2012) Recreational fisheries. FAO, Rome

Fowler AM, Ochwada-Doyle FA, Dowling NA et al (2022) Integrating recreational fishing into harvest strategies: linking data with objectives. ICES J Mar Sci 79:285–307. https://doi.org/10.1093/icesjms/fsab270

Georgeson L, Moore A, Ward P, et al (2015) A framework for regular national recreational fishing surveys. Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)

Giri K, Hall K (2015) South Australian Recreational Fishing Survey 2013/14. Victorian Fisheries.

Graba- Landry A, Champion C, Haddy J, et al (2022) Opportunities and impacts of range extending scalefish species: Understanding population dynamics, ecosystem impacts and management needs. Institute for Marine and Antarctic Studies, Hobart

Greiner R, Gregg D (2010) Considering recreational catch and harvest in fisheries management at the bio-regional scale. Fish Manag Ecol 17:336–345. https://doi.org/10.1111/j.1365-2400.2009.00727.x

Griffiths S, Pepperell J, Tonks M, et al (2010) Developing innovative and cost-effective tools for monitoring recreational fishing in Commonwealth fisheries. Fisheries Research and Development Corporation

Henry G, Lyle J (2003) The National Recreational and Indigenous Fishing survey. Fisheries Research and Development Corporation (FRDC)

Hughes J, Johnson D, Ochwada-Doyle F, Murphy J (2021) The NSW Recreational Fisheries Monitoring Program - Charter Fishery Monitoring 2017/18. NSW Department of Primary Industries

Lai EKM, Ryan KL, Mueller U, Hyndes GA (2021) Corroborating effort and catch from an integrated survey design for a boat-based recreational fishery in Western Australia. Fish Res 236:105865 https://doi.org/10.1016/j.fishres.2020.105865

Lawson A (2015) An investigative analysis of Queensland's statewide recreational fishing surveys. Fisheries Queensland, Department of Agriculture and Fisheries

Lowry M, Murphy J (2003) Monitoring the recreational gamefish fishery off south-eastern Australia. Mar Freshw Res 54:425. https://doi.org/10.1071/MF01269

Lyle J, Tracey S, Stark K, Wotherspoon S (2009) 2007-08 Survey of Recreational Fishing in Tasmania. University of Tasmania

Lyle J, Stark K, Tracey S (2014) 2012-13 Survey of Recreational Fishing in Tasmania. The Institute for Marine and Antarctic Studies, University of Tasmania

Lyle JM, Stark KE, Ewing GP, Tracey SR (2019) 2017-18 Survey of Recreational Fishing in Tasmania. The Institute for Marine and Antarctic Studies, University of Tasmania

Mazur K, Bath A, Savage J, Curtotti R R (2020) Allocating fish stocks between commercial and recreational fishers - examples from Australia and overseas. Australian Bureau of Agricultural and Resource Economics and Sciences

Moore A, Schirmer J, Magnusson A et al (2023) National Social and economic survey of recreational fishers 2018–2021. FRDC, ABARES, UC

Murphy J, Ochwada-Doyle F, West L, et al (2020) Survey of recreational fishing in NSW 2017/18. NSW Department of Primary Industries

National Research Council of the National Academies (2006) Review of Recreational Fisheries Survey Methods

Pawson MG, Glenn H, Padda G (2008) The definition of marine recreational fishing in Europe. Mar Policy 32:339–350. https://doi.org/10.1016/j.marpol.2007.07.001

Pollock KH, Jones CM, Brown TL (1994) Angler survey methods and their applications in fisheries management. American Fisheries Society, Bethesda

Ryan KL, Conron SC (2019) Comparing indicators of recreational fishing in Port Phillip Bay, Australia, from 2008 to 2011 with variability from a background period (2003–07). Mar Freshw Res 70:1345–1357. https://doi.org/10.1071/MF18346

Ryan K, Morison A, Conron S (2009) Evaluating methods of obtaining total catch estimates for individual Victorian bay and inlet recreational fisheries. Department of Primary Industries, Queenscliff

Ryan KL, Wise BS, Hall NG, et al (2013) An integrated system to survey boatbased recreational fishing in Western Australia 2011/12. Department of Fisheries, Western Australia

Ryan KL, Lai EKM, Smallwood CB (2022) Boat-based recreational fishing in Western Australia 2020/21. Department of Primary Industries and Regional Development, Western Australia

Schilling HT, Stewart J, Litherland L et al (2023) Age and growth of *Pomatomus saltatrix* in the south-western Pacific Ocean (eastern Australia), with a global comparison. Mar Freshw Res 74:463–478. https://doi.org/10.1071/MF22216

Smallwood C, Ryan K, Tate A (2017) Weight-length summaries for Western Australian fish species derived from surveys of recreational fishers at boat ramps. Department of Primary Industries and Regional Development, Western Australia

State of Queensland (Department of Agriculture and Fisheries) (2024) Annual Report 2023–2024 Department of Agriculture and Fisheries. Department of Agriculture and Fisheries, Queensland

Steffe A, Murphy J (2011) Recreational Fishing Surveys in the Greater Sydney Region. NSW Department of Primary Industries

Tarantino G, Curreli F, Bolognini L et al (2025) A review of marine recreational fisheries research in Italy. Reg Stud Mar Sci 81:103996. https://doi.org/10.1016/j.rsma.2024.103996

Tate A, Ryan K, Smallwood C, et al (2020) Review of recreational fishing surveys in Western Australia. Department of Primary Industries and Regional Development, Western Australia

Taylor S, Webley J, McInnes K (2012) 2010 Statewide Recreational Fishing Survey. Department of Agriculture, Fisheries, and Forestry, Fisheries Queensland

Telfer C (2010) The Western Australian charter boat industry: Working towards long-term sustainability. Edith Cowan University

Tracey S, Lyle J, Ewing G, et al (2013) Offshore recreational fishing in Tasmania 2011/12. Institute for Marine and Antarctic Studies, University of Tasmania

Tracey SR, Lyle JM, Stark K, Twiname S (2020) Offshore Recreational Fishing in Tasmania 2018/19. Institute for Marine and Antarctic Studies, University of Tasmania

West LD, Stark KE, Murphy JJ, et al (2015) Survey of Recreational Fishing in New South Wales and the ACT, 2013/14. NSW Department of Primary Industries

West LD, Stark KE, Dysart K, Lyle JM (2022) Survey of recreational fishing in the Northern Territory: 2018 to 2019. Department of Industry, Tourism and Trade, Northern Territory

West LD, Lyle JM, Matthews SR, et al (2012) Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Government, Australia

Wise BS, Telfer CF, Lai EKM et al (2012) Long-term monitoring of boat-based recreational fishing in Shark Bay, Western Australia: providing scientific advice for sustainable management in a world heritage area. Mar Freshw Res 63:1129–1141. https://doi.org/10.1071/MF12054