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Survey of recreational fishing in NSW, 2019/20 – Key Results

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**Department of
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Survey of recreational fishing in NSW, 2019/20 - Key Results

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Objectives

To provide detailed information on recreational fishing in NSW waters. Data elements included:

Annual catch and effort information for long-term (1 or 3-year duration) NSW recreational fishing licence holders (RFL holders) and other members of their households (RFL household fishers) – by fishing method, platform (boat or shore), waterbody type (e.g. ocean waters, estuaries, rivers and lakes/dams) and for six defined fishing zones during 2019/20.

Key words

Recreational fishing, telephone-diary survey

Non-Technical Summary

This report provides a summary of recreational fishing participation, fishing effort and catch in NSW waters for the 2019/20 survey year and builds on two previous surveys completed in 2013/14 and 2017/18. These surveys were conducted as part of the NSW-DPI Fisheries' Recreational Fisheries Monitoring Program (RFMP). The data captured by the RFMP allows for an examination of long-term trends in the NSW recreational fishery, and provides robust state-wide estimates for the more common fishing activities and species caught.

Participation, fishing effort and catch information was derived from a telephone-diary survey that collects data from households that include at least one resident with a long-term (1 or 3 years) NSW recreational fishing licence (RFL households). This survey provides the only source of quantitative data on the activities of recreational fishers across NSW, which is used in the assessment and management of the resources that recreational fishers exploit.

Survey statistics

The 2019/20 screening survey engaged with 1,990 RFL households from New South Wales, the Australian Capital Territory, Victoria, and Queensland comprising around 4,300 persons aged 5 years and older who resided within RFL households. The following diary survey involved 1,319 households (3,385 persons) in which fishing activity was monitored over a 12-month period. Around 7,400 person-based fishing events were reported by RFL householders who fished during the survey.

Fishing participation and effort

The survey estimated that 321,115 residents of RFL households aged five years and older fished at least once in NSW waters during the twelve months from November 2019 to October 2020 across a variety of freshwater and saltwater environments. This equated to a total estimated fishing effort of 1,653,531 fisher-days.

Overall, saltwater fishing represented 75% of the total fishing effort while fishing in freshwater accounted for the remaining 25%. The majority of saltwater fishing (66% of saltwater effort) occurred within estuaries with the remainder (34%) in ocean waters. For freshwater fishing, the majority of effort (66%) occurred in rivers, with the remainder occurring in lakes and dams (34%).

Shore-based fishing accounted for 51% of all effort and line fishing (with bait or lures) was the dominant fishing method at 88% of the total effort.

Regionally, three coastal saltwater fishing zones accounted for the vast majority (75%) of all state-wide effort, and the Central and North coastal regions (30% and 29% respectively) had the highest activity levels among the regions. Within the three freshwater inland zones the majority of freshwater effort (20%) occurred within the Murray-Darling region.

Catch

Survey participants recorded the capture of a diverse range of finfish, elasmobranchs (sharks and rays), crustaceans, molluscs, and other taxa, with 128 species and species groupings caught during 2019/20.

Overall, the total state-wide recreational catch of RFL households was estimated to be 7,849,661 individual organisms, with 4,121,144 being kept (53% of total catch) and the remaining 3,728,518 released (47% of total catch).

In terms of saltwater fish, Bream was the most common species/group caught (an estimated 1,098,534 individuals), followed by Dusky Flathead (572,822), Snapper (475,753), Sand Whiting (391,146) and Sand Flathead (370,182). Among freshwater fish, Murray Cod (198,045) was the most common species caught, followed by Golden Perch (97,543), European Carp (87,126), Australian Bass (84,273) and trout (Brown and Rainbow – a total of 64,102).

The smaller crustacean species dominated the remainder of the total catch, including saltwater nippers (823,391), followed by saltwater prawns (398,068) and freshwater shrimp (383,268). Freshwater yabbies (75,501) accounted for the majority of the larger crustaceans, followed by Blue Swimmer Crab (69,116), Mud Crab (38,620) and Rock Lobster (9,390).

Overall, 47% of all species/groups caught were released (or discarded), with the highest rate of release (>75%) observed for saltwater species/groups such as Bream, Red Rock Cod, Sergeant Baker, sharks and rays, and wrasse/groper. For freshwater species/groups the highest rates of release (>75%) were for Trout Cod, Silver Perch, Murray Cod and Freshwater Catfish.

By contrast, the lowest release rates (<25%) occurred for saltwater species/groups such as Blue Mackerel, Yellowtail Scad and Grey Morwong. Various crustaceans and molluscs also displayed low release rates e.g. Squid and Pipis. For freshwater species/groups, European Carp and Redfin Perch had the lowest finfish release rates along with Freshwater Yabbies and Shrimps for crustacean species/groups.

In terms of reasons for release, 'small size' was the primary release reason for over two-thirds of all species groups and especially for sought after edible species, such as Bream, Dusky and Sand Flathead, Sand Whiting, key freshwater finfish, the various crustaceans and squid. Large catches ('too many' or 'over bag limit') were the primary release reasons for Freshwater Yabbies and various small bait species. 'Catch and release' was the primary release reason for Murray Cod and Australian Bass, with 'un-wanted' the main reason for species/groups such as Red Rock Cod, and sharks and rays.

Total recreational harvest weights (tonnes) were estimated for 13 key species and compared with commercial fisheries data. A majority of the total (recreational plus commercial) harvest weight in 2019/20 was attributable to RFL households for two of the 13 species – 53% and 57% of the total harvest for Dusky Flathead and, Yellowtail Kingfish (respectively) were harvested by fishers within RFL households. Sand Flathead and Mulloway caught by RFL households accounted for almost half the total catch (48% and 44% of harvest, respectively). Catches (by RFL households) of Australian Salmon and Luderick were substantially smaller than the commercial harvest (7% and 8%, respectively, of the overall total).

Comparison with previous surveys

Sample size for the current survey (1,990 RFL households) was similar to previous surveys, with 1,882 and 1,960 RFL households engaged in the 2013/14 and 2017/18 surveys, respectively. Response rates remained high (89.6% in 2013/14, 82.6% in 2017/18 and 80.8% for 2019/20) as did the proportions of eligible RFL households that completed the survey (92.0% in 2013/14, 95.8% in 2017/18 and 92.9% in 2019/20). This consistency in response and completion rates allows for robust comparisons to be made between surveys.

The 2019/20 survey showed lower recreational fishing participation compared with previous survey years across both freshwater and saltwater fishing. Participation in 2019/20 was ~18% lower than in 2017/18, and ~27% lower than 2013/14. The 2019/20 survey also showed lower fishing effort and catch compared to 2017/18 (by ~23%) and 2013/14 (by ~31%).

Some species showed higher catches in 2019/20 compared to 2017/18, such as Bream (14% higher), Snapper (5%), Sand Whiting (13%), and Silver Trevally (27%), whereas the catches of others were lower, including Dusky Flathead (35% lower), Sand Flathead (43%), Grey Morwong (54%) and Mulloway (43%). Declines in catch estimates between 2017/18 and 2019/20 were greatest for freshwater species, including Murray Cod (52%), Golden Perch (50%), Australian Bass (66%) and Rainbow Trout (68%).

When interpreting any differences in the NSW recreational fishery through time it is critical to consider causes of inter-annual variability. These include environmental influences, natural changes in abundance, and socio-economic factors among survey years, as well as changes to fishing practices, targeting preferences, technology, and regulations.

The 2019/20 survey period encompassed a combination of extreme environmental and social factors that likely impacted on recreational fishing activity. During the early stages of the 2019/20 survey period, NSW experienced some of the worst drought conditions on record, as well as an extreme fire season that affected much of the state. This was followed by extensive flooding, followed by the COVID-19 pandemic, creating a perfect storm of challenges for both fishers and the natural environment during 2019/20. These major environmental and social impacts highlights the importance of the consistent, on-going time-series of recreational fishing surveys, undertaken within the RFMP.

Introduction

This study represents the third comprehensive assessment of recreational fishing in New South Wales (NSW) undertaken as part of the NSW-DPI Fisheries' Recreational Fisheries Monitoring Program (RFMP).

This report provides a snapshot of participation, fishing effort and catch, for the 2019/20 survey year and builds on two previous surveys completed in 2013/14 (West et al., 2015) and 2017/18 (Murphy et al., 2020). The developing time-series of data captured by the RFMP allows for an examination of long-term trends that will assist in the management of fisheries in NSW. These surveys give a 'big-picture' perspective of recreational catch and effort throughout NSW and provide robust state-wide estimates for the more common fishing activities and species caught.

Structure of this report

The first section of the report provides the background and need for the research, as well as detail of the survey design, methodology and the analysis approach. The results presented include survey statistics, estimates of participation, fishing effort (fisher-days) and catch (numbers kept, released and estimated harvest weight). Results are presented for the whole fishery, as well as within sub-groups including by waterbody, platform, method and region. Catch results are also examined in detail for 20 key species of interest. Commentary on the findings is intentionally brief, being primarily a data report. Appendices provide tabulations of key results presented graphically in the report body. These data are available in spreadsheet form by clicking the links in the Appendix section of the report. In addition to this report, a substantial database has been established in anticipation of requests for further detailed data summaries and analyses.

Background/Methods

Why do we monitor recreational fishing within NSW?

The fisheries resources of NSW are shared among recreational fishers, commercial fishers, charter operators, and people practising traditional Aboriginal fishing. Fisheries management seeks to ensure that use and exploitation of resources among sectors and stakeholders are both ecologically sustainable, and achieves socio-economic outcomes (Crowe et al., 2013; Fenichel et al., 2013; Ryan et al., 2016; Sutinen & Johnston, 2003). The non-fishing public also value a well-managed resource, and healthy aquatic ecosystems more broadly.

Recreational fishing is an important pastime for ~1 in 8 NSW residents, and represents the 3rd highest annual participation rate of all physical/recreational activities – behind only ‘walking/jogging for exercise’ and ‘fitness/gymnasium activities’ (West et al., 2015). With such a broad and diverse participation base, the recreational sector is estimated to contribute about \$3.4 billion into the NSW economy each year and creates the equivalent of about 14,000 full-time jobs (McIlgorm & Pepperell, 2013). In addition to harvest of fish for consumption, recreational fishing also supports substantial social outcomes for the community (Hyder et al., 2018), with primary motivations to go fishing including ‘to relax and unwind’, ‘to spend time with family’, ‘to fish for sport’ and ‘to be outdoors’ (Georgeson et al., 2015). The interaction with the natural environment that comes with recreational fishing not only provides demonstrated health benefits, but also fosters environmental stewardship among resource users and encourages the public to take an active interest in the health of our environmental assets (McPhee, 2017).

Effective fisheries management requires robust indices of effort and catch across space and time, for all sectors. Data collection in fisheries has historically focussed on the commercial sector, but contemporary fisheries are usually characterised by strong participation by recreational fishers, to the point where harvest for certain species by the recreational sector may exceed harvest by commercial fishers (Cooke & Cowx, 2006; Ihde et al., 2011; Lloret & Font, 2013; Ryan et al., 2016). Thus, data series that capture trends in recreational fishing through time are essential for characterising exploitation levels for many species. Furthermore, with diverse social outcomes, the collection of data on fishing quality and fisher experience in the context of motivational characteristics and objectives is important for tracking satisfaction through time, particularly where fisheries are managed within a harvest strategy framework.

NSW DPI-Fisheries and the NSW Recreational Fishing Trust have committed to ongoing collection of information on recreational fishing within NSW through off-site fisher surveys. These surveys provide data that is essential for meeting management and reporting requirements for several State and Federal agencies. In addition, ongoing catch, effort, and social data are particularly important for NSW as the fisheries management framework is shifting toward cross-sectoral harvest strategies, supported by biennial assessment and classification of key species under the national Status of Australian Fish Stocks (SAFS) reporting framework (see [SAFS](#)). The RFMP is responsible for delivering this monitoring data for recreational fishing within NSW.

The Recreational Fisheries Monitoring Program

The **RFMP** encompasses two components: 1) off-site fisher telephone-diary (TD) surveys; and 2) monitoring of the NSW 'for hire' charter fishery. Both components run on a biennial basis and, during each year, engage with thousands of recreational fishers who voluntarily provide information on their fishing activities within a well-designed scientific framework. The primary objective of the RFMP off-site fisher TD surveys is to collect data from which indices of catch, effort, participation, and satisfaction with recreational fishing can be derived.

The RFMP provides the only source of quantitative data on the activities of recreational fishers in NSW. This information is used in a number of different ways to assess the status of the resources that recreational fishers exploit. For example, data from the RFMP are used to ensure sustainable exploitation and management of these stocks and provide indicators of performance for this important industry. The information generated through the RFMP is the primary means by which the recreational sector can demonstrate its role as a significant user and custodian of wild fisheries resources. This in turn ensures that the interests of recreational fishers remain central in broader dialogue regarding resource management and that the needs of the recreational sector are therefore formally recognised and reflected in management arrangements and harvest strategies.

Benefits to recreational fishing are realised through a range of activities undertaken by the RFMP; some examples of these from recent years include:

- Incorporation of robust estimates of recreational catch, effort and size structures into resource assessments, status determination (e.g. SAFS), and quota setting, for species that are commonly exploited by recreational fishers. This is especially important for species for which recreational fishing comprises the majority of the harvest, such as Dusky and Sand Flathead, Mulloway, Tailor and Yellowtail Kingfish, and most freshwater species;
- Providing sources of evidence for threat and risk assessment under the Recreational Fishing Environmental Impact Assessment (EIA) process;
- Testing and evaluating the impact of proposed changes in management regulations, such as bag and size limits, which are increasingly being driven by recreational resource users;
- Providing data and analysis to support the deliberations and recommendations of Recreational Fishing NSW Advisory Council (RFNSW);
- Providing data required to support mandated reporting requirements for recreational industries, such as the National Plan of Action for Minimising Incidental Catch of Seabirds in Australian Capture Fisheries (Department of Agriculture and Water Resources, 2018);
- Assessing the potential exposure risk associated with contamination for recreational fishers (e.g. impact of exposure to Per and Poly Fluoroalkyl Substances (PFAS));
- Supporting the development of other fisheries management initiatives (e.g. stocking, artificial reefs);
- Providing supporting data and analysis to ensure continued access to Southern Bluefin Tuna by anglers;
- Consideration of potential impacts of droughts, bushfires and global pandemics on recreational anglers.

This report encompasses results from the off-site fisher TD survey component of the RFMP, with a focus on data collected during the 2019/20 TD survey (but also includes comparison with the results of previous surveys). A full background to recreational fishing surveys, fisher TD surveys, sampling frames, and a full description of the RFMP fisher TD survey methodology are provided in Murphy et al. (2020). However, important details are summarised below, so that readers of this report can interpret the results that are presented.

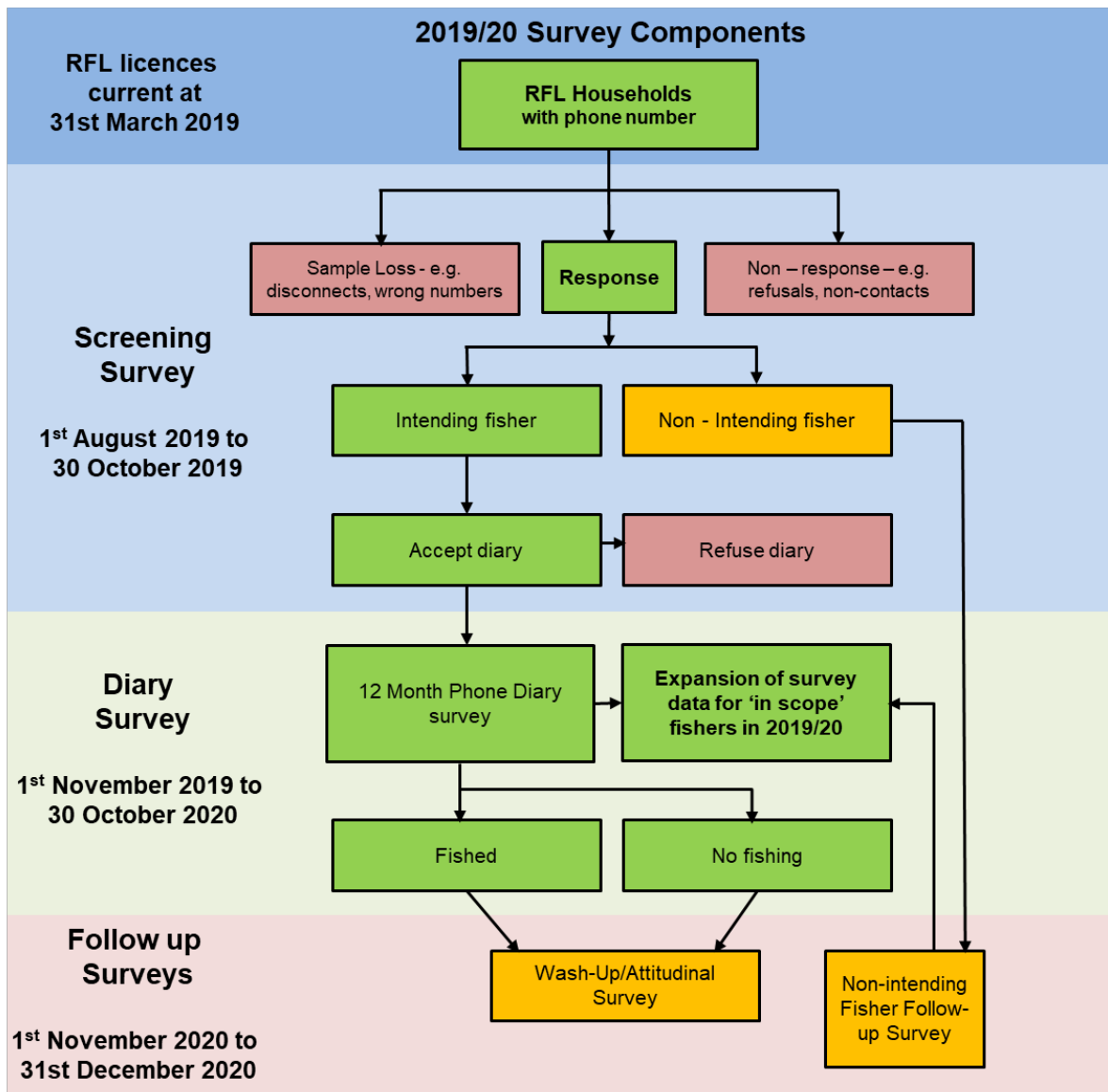
Who is included in the survey?

The biennial RFMP fisher TD survey targets *Recreational Fishing Licence (RFL) households*, which are defined as households that include at least one resident who possesses a long-term (i.e., of 1 or 3 years duration) NSW recreational fishing licence (otherwise known as a NSW Recreational Fishing Fee Receipt [RFFR] – (see [NSW Recreational Fishing Fee](#)). As the survey engages with the entire 'household', this includes other household members (aged 5 years and older) who may be exempt from holding an RFFR as well as any other long-term and short-term licence holders and non-fishers that reside within the household. The majority of fishing effort within NSW is attributable to RFL households resident within NSW and the ACT, Victoria and Queensland (Henry & Lyle, 2003; Murphy et al., 2020; West et al., 2015). Thus, RFL households across these jurisdictions are included in the survey. Small numbers of RFL households from other states (e.g., Tasmania) and international RFL holders are excluded from the survey frame.

Overview of survey approach

The TD survey methodology involves a multi-phase design, the principal components being an initial screening phase (referred to as the *Screening Survey*) to gather profiling information from a sample of RFL households (as at 31st March 2019) and a subsequent, intensive phase (referred to as the *Diary Survey*), in which respondents provide detailed catch and effort information over a 12-month period (for the 2019/20 survey, this ran from 1st November 2019 to 30th October 2020). Two additional phases follow on from the Diary Survey. Firstly, a sample of fishers from the Screening Survey who indicated that they did not intend to fish during the Diary Survey period, are contacted to verify whether they did actually fish during that period. This is called the *Non-intending Fisher Follow-up Survey* and identifies 'unexpected fishing' that may have occurred during the 12-month diary period, allowing for expanded estimates to be adjusted accordingly. Secondly, a *Wash-up/Attitudinal Survey* is conducted, which is used to assess a range of information such as opinions on the satisfaction of fishing and issues of importance to recreational fishers. The Wash-up/Attitudinal survey is subject to separate analysis and reporting and is not captured within this report.

Further details on the Screening Survey, Diary Survey, and Non-intending Fisher Follow-up Survey, are summarised in the figure below.



RFMP Telephone Diary Survey structure

Screening Survey

The Screening Survey is administered as a structured telephone interview on a stratified random sample of individual long-term RFL holders. Recreational Fishing Fee Receipts are assigned to an individual, which meant that the initial sampling frame was person-based. However, as noted above, the survey collects information for all household members (aged 5 years and older).

Survey respondents are asked for information on past fishing activity, any intention to fish in the coming 12 months, among other general profiling information (such as age and sex), for both themselves, and as well as for other members of the household. All eligible households (i.e. those intending to fish sometime over the next 12 months) are subsequently invited to participate in the Diary Survey.

The Screening Survey is stratified across 12 geographic areas defined by ABS Statistical Area classification, Level 4 (SA4) (see Murphy et al., 2020 for further details), and at least 15 calls are made to each active telephone number to maximise the proportion of the sample that is contacted. Disconnected numbers, wrong numbers etc. are treated as sample loss and not replaced. For the 2019/20 TD Survey, the Screening Survey occurred between 1st August and 30th October 2019.

Diary Survey

RFL households from the Screening Survey that accept the invitation to participate in the Diary Survey are issued with a diary kit (containing a diary card, a colour fish identification booklet and a covering letter providing further details about the survey), and fishing activity of all household members aged 5 years and older is monitored over 12 months. The approach taken in this survey differs to conventional fisher TD surveys in that the diary card is employed more as a 'memory jogger' than a logbook, and responsibility for data collection rests with the survey interviewers and not the diarists. Data collection is undertaken by several brief telephone interviews, in which trained interviewers record details of any fishing that had occurred since the last contact. The level of fishing activity determines the frequency of contact, but respondents are called at least once a month as a minimum, even if no fishing was planned. All fishing activity is recorded by the interviewer, including fishing event duration, location, method, gear quantities, as well as any kept or released catch (by species), and reasons for release.

Non-intending Fisher Follow-up Survey

A random sample is drawn from all RFL households (identified during the Screening Survey) that indicated no intention to go fishing during the diary period (and hence not eligible for the Diary Survey) and these households are re-contacted shortly after the conclusion of the Diary Survey. Respondents are asked during a brief telephone interview whether any fishing had occurred during the diary period, and any changes in household members during that period are assessed. Further details are collected from any households in which (unexpected) fishing was reported, including which individual household members had fished and the number of days fished during the 12 months of the diary period.

What data are reported during the Diary Survey?

Fishing participation and effort

The number of fishers, fishing events, and hours fished per event are recorded by diarists and reported to interviewers. Fishing information is collected on an 'event' basis, where an event is defined as a discrete fishing episode and the actual household member(s) involved in the event are recorded, along with the number of other (non-household member) fishers that may have participated in the event. Separate fishing events within a day are defined by a change in fishing region or waterbody type, a change in target species and/or fishing method. As a result, a day's fishing trip could comprise more than one event, which are reported separately, such as gathering nippers for bait, and then using them for fishing later in the day; or deploying crab traps and leaving them set while line fishing. In this report, fishing effort is presented in terms of the estimated number of fishers who fished during the survey (or *participation* in fishing) and also is expressed as fisher-days (i.e., separate days on which some form of fishing was undertaken by each fisher).

Catch

The diary kit includes a coloured species identification guide to support accurate species identification. While best efforts are made by diarists to accurately identify species, species-based catch reporting is subject to some limitations, particularly for different species which are morphologically similar. In these cases, species complexes are used for reporting (e.g., 'Bream' and 'Leatherjackets'). Where diarists could not identify a species with any confidence, or for obscure or rare species for which there were few records, these were pooled into broader taxonomic categories for analysis (e.g., 'scalefish, other/unidentified', and 'sharks and rays').

Catches are reported as numbers of individuals kept or harvested, and numbers released or discarded, by species, for each fishing event.

The harvested (or kept) portion of a catch may be used for a variety of purposes including consumption or bait, whereas fish may be released because of regulation (e.g. size and/or bag limits), ethical reasons and undesirability of the species (among other reasons). To better understand fisher motivations in relation to releasing or discarding species, respondents identify their reason(s) for release. The following release categories were identified and reported by diarists: 'too small' – implying that the fish was too small to be retained (not necessarily due to size limits regulations); 'undersized' – implying some knowledge and adherence to size limit regulations; 'catch and release' – implying a voluntary release ethic associated with either sport fishing or conservation (no inference about fish size); and 'too many' – implying a catch number in excess of personal needs, as opposed to legal bag limits. Other reasons for release included 'poor eating qualities', 'did not want', 'damaged or poor quality', and 'prohibited species'.

The weight (tonnage) of the recreational harvest is of interest to resource managers, scientists and the various stakeholder groups, particularly for species which are shared among multiple harvesting sectors. From a stock assessment perspective, estimates of recreational harvest weights enable comparison with other sectors (e.g. the commercial fishery), for which harvest is routinely reported by weight. Weight comparisons between the

recreational and commercial fishery sectors is presented in this report for 13 species of key interest to commercial and recreational fisheries management. Further details about the weight estimation process used to convert estimates of numbers to tonnages for this report are briefly discussed below in the 'catch – harvest weights' section; but also see Murphy et al. (2020) for further details.

How are the survey data analysed?

Analysis and expansion of survey data

Detailed descriptions of the TD design philosophy and methodology employed by the RFMP and expansion approaches employed with this type of survey data are provided in Lyle et al. (2002); Henry and Lyle (2003); Lyle et al. (2010). All analysis and expansion of survey data are undertaken using the statistical computing package R (R Core Team, 2017) principally through functions contained within the 'survey' package (Lumley, 2004; Lumley, 2010) which follows the algorithms outlined in Lyle et al. (2010). The analytical approach employed emulates that applied to other state-wide recreational fishing surveys within Australia (Lyle et al., 2002; Lyle et al., 2019; Lyle et al., 2014; Ryan et al., 2019; Ryan et al., 2015, 2017; West et al., 2015).

Measures of precision and accuracy

Measures of precision and accuracy are important to consider alongside the estimates of effort (numbers of days fished) or catch (numbers of fish) themselves. Standard error (SE) is provided for all estimates derived from RFMP fisher TD surveys, which provides a measure of statistical precision (the smaller the SE, the more accurate the estimate). When the SE is large, it becomes less likely that a given estimate may be an accurate representation of the true value. The size of the SE depends on factors such as the size of the sample, the design of the survey, and variability within the population being sampled. Increasing the size of the sample generally decreases the sampling error (NOAA, 2020) such that catch estimates for commonly caught species often have a smaller SE than catch estimates for rarely caught species. SE is displayed on charts in this report as bars above and below the estimated value (with each bar representing 1 SE).

Relative standard error (RSE) is also presented for some survey estimates. The RSE is simply the SE for an estimate expressed as a percentage of the estimate. As for SE's, large RSE's indicate low accuracy, while small RSE's indicate more accurate estimates. RSE allows for the comparison of the relative precision and accuracy between different estimates. As a general rule, estimates with RSE's of 30% or greater may be regarded as less robust (in all tables within this report these estimates are presented in bold face). In addition, estimates derived from records with a sample size of fewer than 20 RFL households should be considered with caution, since they may be particularly influenced by the activities of very few fishers (these estimates are presented in italics). These characteristics of estimate quality follow similar conventions used for recreational fishing surveys in other jurisdictions (e.g., Lyle et al., 2019; NOAA, 2020; Ryan et al., 2019).

When comparing results from the three RFL household TD surveys undertaken to date (2013/14, 2017/18 and 2019/20) in order to identify any changes or developments that

occurred in the recreational fishery over the intervening periods, the SE's provided with the point estimates must be taken into consideration. The degree of overlap between error bars on the survey point estimates provides an indication of statistical significance. Overlapping error bars suggest that the differences between the point estimates for the surveys are unlikely to be significantly different. Where there is no overlap of error bars between groups, the difference may be significant (and statistical testing should be applied to obtain a valid conclusion). It is important to note, however, that despite the robust nature and fundamental comparability of the studies, the comparison of just three points in time and the issue of inter-annual variability is a critical factor here – especially in terms of variation in the natural availability of certain species and therefore the catch levels in a given year, as well as other chance events that may impact fishing among years (i.e., flood, bushfire, pandemic etc.) – the potential impacts of events that occurred during the 2019/20 TD Survey are briefly discussed at the end of this report.

Reporting categories and definitions

Data from previous surveys

Some catch, effort and participation data within this report are presented alongside survey statistics from the two previous TD Surveys of RFL households conducted in 2013/14 and 2017/18. These include aggregated estimates (i.e., aggregated on a state-wide basis) for survey statistics (sample sizes, response rates), fishing effort (participation and fisher-days), catch estimates (by number - for all species combined), as well as taxa-specific data for 20 key species/groups of interest. When considering these data, it is important to note that Queensland (QLD) residents were not included in the 2013/14 RFL household survey (mainly due to sampling and cost constraints at the time), but the subsequent surveys included QLD resident fishers. Therefore, results presented in this report for 2013/14 may be an underestimate of RFL household fishing effort and catch for that year. Whenever results data for the 2013/14 year are presented in this report they are noted by an asterisk (*) highlighting the absence of QLD fisher data.

Sales of new RFFRs and renewals of existing ones for the 12 year period 2009/10 to 2020/21 are also presented as a supplementary indicator of trends in the NSW recreational fishery through time. Sales and renewal data may provide a measure of the eligible licenced population who intend to go fishing during a particular year. Sales of both short-term (three days and 1 month) and long-term (1 year and 3 years) licence categories are summarised.

More granular reporting categories are used (see below) to summarise estimates of effort and catch for the 2019/20 TD Survey. For information on results at these levels of reporting for the preceding surveys, see West et al. (2015) and Murphy et al. (2020).

Waterbody

The TD Survey is confined to fishing within NSW waters, which are defined as all waters within the borders of NSW and the Australian Capital Territory (ACT) and includes both State marine waters (out to 3 nm from the coast) and water further offshore to the 200 nm Exclusive Economic Zone (EEZ). Diarists report spatial information for fishing events, which

includes both specific details on the location, and also whether fishing occurred within the waterbody categories:

1) Ocean waters (from the coastline to the edge of the EEZ); 2) Estuarine waters (including bays and inlets); 3) Freshwater rivers; and, 4) Freshwater lakes/dams (public or private).

Platform

Effort and catch details by fishing platform (Boat or Shore) are presented on a state-wide basis and are also displayed by the waterbody reporting category for this report (e.g., Boat or Shore fishing within estuaries).

Method

A variety of fishing/harvesting methods were identified by diarists but for the purposes of analysis the following reporting categories have been defined: line fishing using bait; line fishing using lures (and/or jig/fly); pot/trap (baited, passive use); net (including scoop and drag/seine nets); dive collection (underwater spearfishing and hand collection by snorkel, scuba or hookah); and other methods (e.g., other hand collection and the use of pumps and spades).

Region

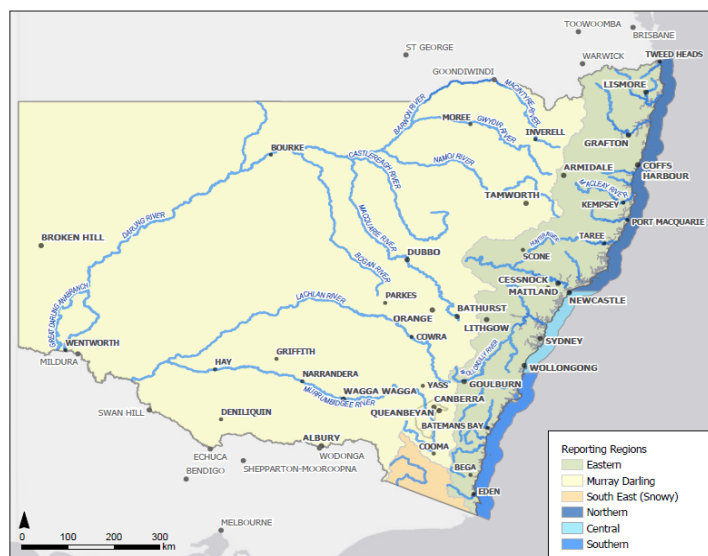
For reporting of data collected by the TD Survey, specific location details recorded by diarists were categorised into six fishing regions, reflecting the three major drainage basins of NSW for freshwater systems (Argent, 2016), and the three major coastal regions defined for the Marine Estate of NSW (NSW Marine Estate Management Authority, 2018).

Freshwater drainage basins include:

- 1) *Eastern* – East of the Great Dividing Range;
- 2) *Murray-Darling* – West of the Great Dividing Range and includes the waters of the Murray-Darling Basin and waterbodies within the ACT;
- 3) *South East* – includes the majority of the Snowy Mountains region.

Saltwater coastal regions include all estuarine, coastal (e.g. headlands and beaches) and marine habitats in:

- 4) *Northern* – Queensland border to Stockton Beach (just north of Newcastle);
- 5) *Central* – Stockton to Shellharbour (just south of Wollongong);
- 6) *Southern* – Shellharbour to the Victorian Border



Fishing regions used for reporting RFMP TD survey

Catch – numbers of fish and invertebrates

Estimates of catch recorded during 2019/20 are aggregated on a state-wide basis and displayed for all species combined, and by major finfish and invertebrate categories. Also, 20 species/groups have been separately assessed in the chapter *Report cards for key species*. These report cards present graphical summaries of the numbers kept and released for the 3 surveys on a state-wide basis; and for the 2019/20 survey by waterbody, platform, method and region. These 'report card' results are presented on a single page for the convenience of the reader.

Catch – harvest weights

Recreational harvest weight estimates can be obtained for a given species by multiplying the number of individual fish harvested (kept) by the average weight of an individual of that species, which, in turn, may be estimated from length data using established length-weight relationships.

The 2019/20 TD Survey was complemented by a simultaneous 12-month on-site Charter Fishery Monitoring Program (as part of the overall RFMP), which included a state-wide on-board observer component. This component provided size data that was used to calculate recreational harvest weights for the more common species captured in marine waters. For species not adequately represented in the on-board observer component of the Charter Fishery Monitoring Program, either due to a species' habitation of non-marine waters or relatively low sample sizes, a range of alternative existing data sources were used to estimate the average size.

These alternate data sources included the most recent on-site recreational fishing surveys within NSW for both estuarine and marine waters (see Murray-Jones & Steffe, 2000; Ochwada-Doyle et al., 2014a, 2014b; Reid & Montgomery, 2005; Steffe & Murphy, 2011). In cases where inadequate recreational length data were available from either the on-board observer component of the Charter Fishery Monitoring Program or recent on-site recreational surveys, mean weights were obtained from data collected for the commercial fishery sector.

Separate mean weight calculations were applied to species caught within estuaries and oceanic waters, due to the different size structures that can occur in each case. For each species considered in this section, weight estimates for the commercial sector were obtained from reported landings by NSW commercial fisheries for the same time period as the TD Survey (1st November 2019 to 30th October 2020).

Weight comparisons between the recreational and commercial fishery sectors are presented for 13 species of key interest to commercial and recreational fisheries management, and also where harvest estimates from the survey were considered sufficiently robust—i.e., the state-wide estimate for the kept component of the catch had an RSE <30% and a minimum of 20 households reported the catch.

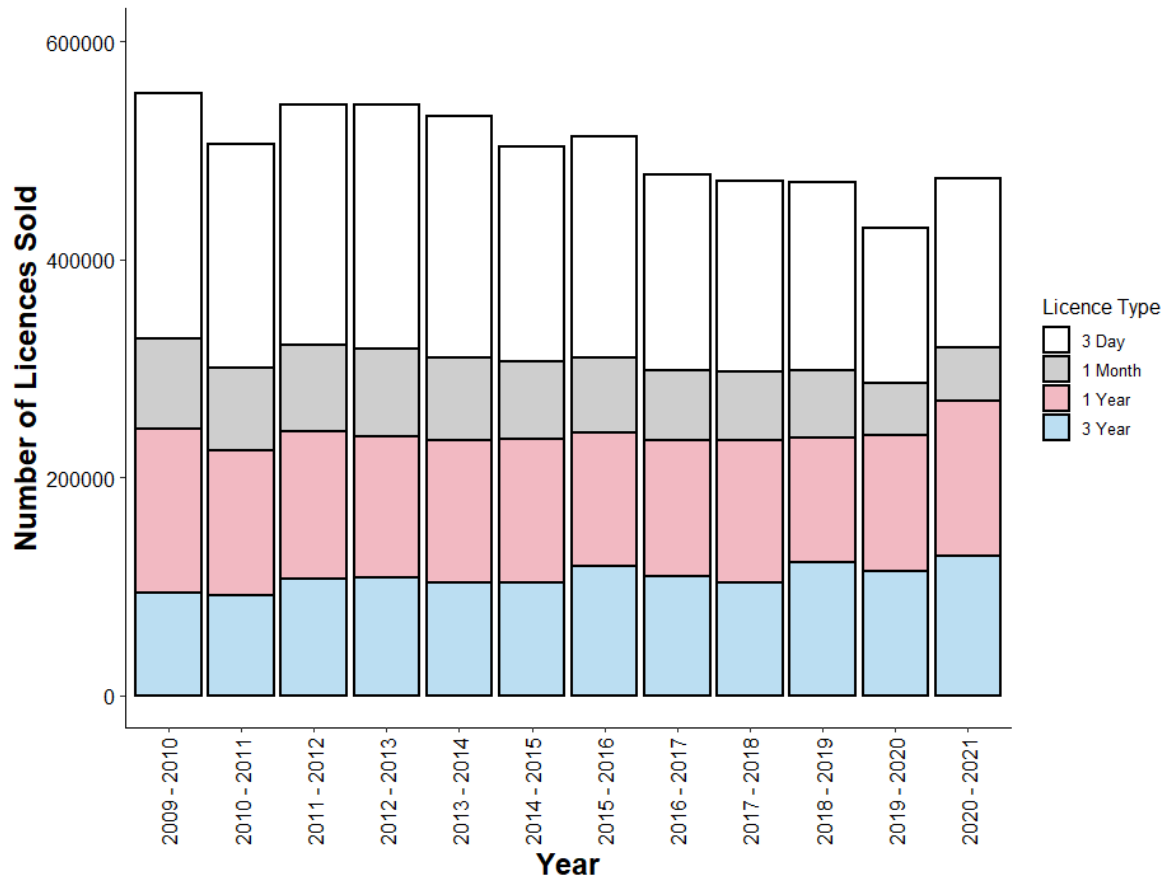
It should be noted that harvest estimates for the recreational sector presented in this report are confined to the harvest from RFL households *only* and do not include estimates from fisher households comprised exclusively of short-term and/or exempt fishers, nor households which may have taken up a long-term licence after 31st March 2019 (just prior to and during the diary period).

Therefore, harvest number and weight estimates from RFL households are considered to be underestimates of the total recreational harvest within NSW waters.

Results

NSW Recreational Fishing Fee Receipt sales

Summary of NSW Recreational Fishing Fee Receipt sales 2010-2021



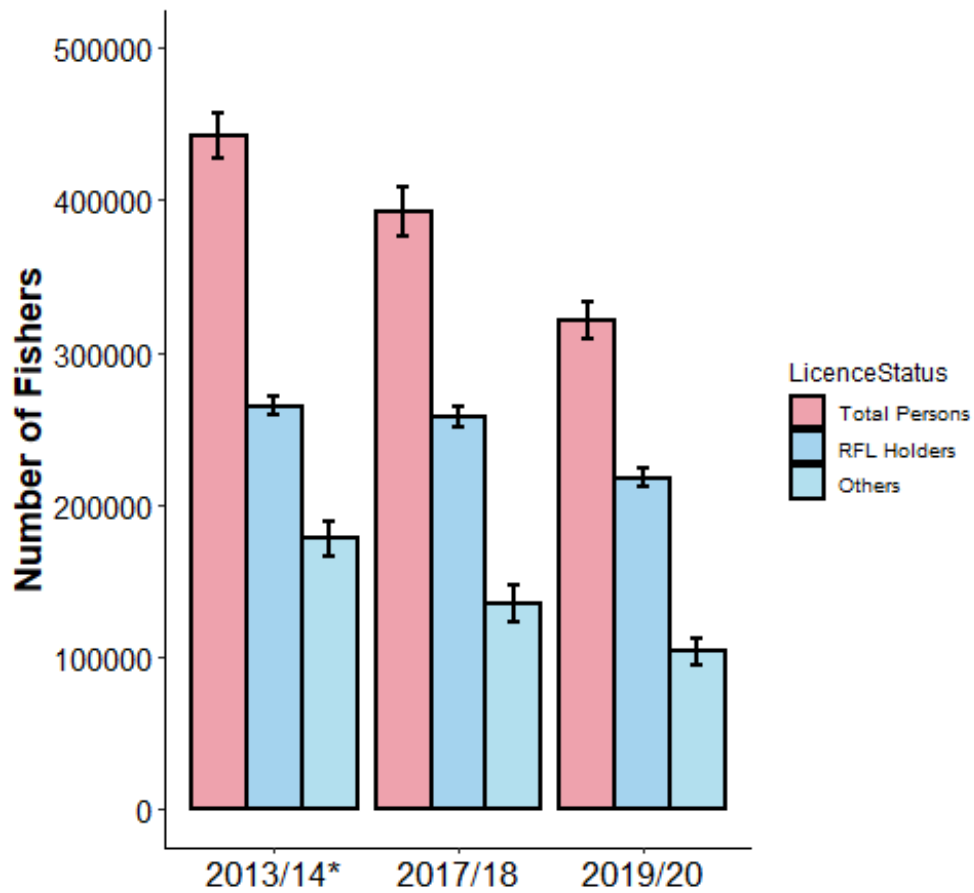
Broad RFMP Telephone-Diary Survey statistics

Summary of RFMP Telephone-Diary Survey statistics through time

	2013/14*	2017/18	2019/20
No. active long-term licence holders in NSW	392,194 (as at 1/11/2012)	432,218 (as at 31/03/2017)	430,223 (as at 31/03/2019)
Screening Survey			
No. of RFL households contacted (net sample)	1,882	1,960	1,990
No. of responses (rate in brackets)	1,686 (89.6%)	1,618 (82.6%)	1,608 (80.8%)
No. RFL household residents (≥ 5 yrs old) profiled	4,656	4,335	4,291
No. of RFL households eligible for Diary Survey	1,521	1,413	1,451
Diary Survey			
No. RFL households that commenced survey	1,445	1,312	1,319
No. of RFL households that completed survey	1,329	1,257	1,226
Total no. of residents (≥ 5 yrs old) surveyed	3,727	3,442	3,385
Total no. of person-based fishing events reported	14,458	10,951	7,396

Participation – number of fishers

Participation by RFL household residents who fished within NSW through time

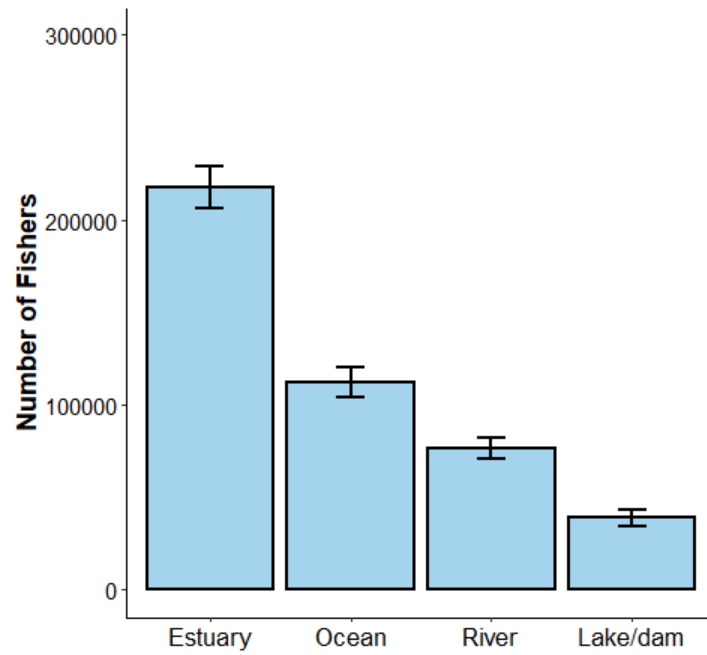


Participation by RFL household residents who fished within NSW through time in freshwater and saltwater

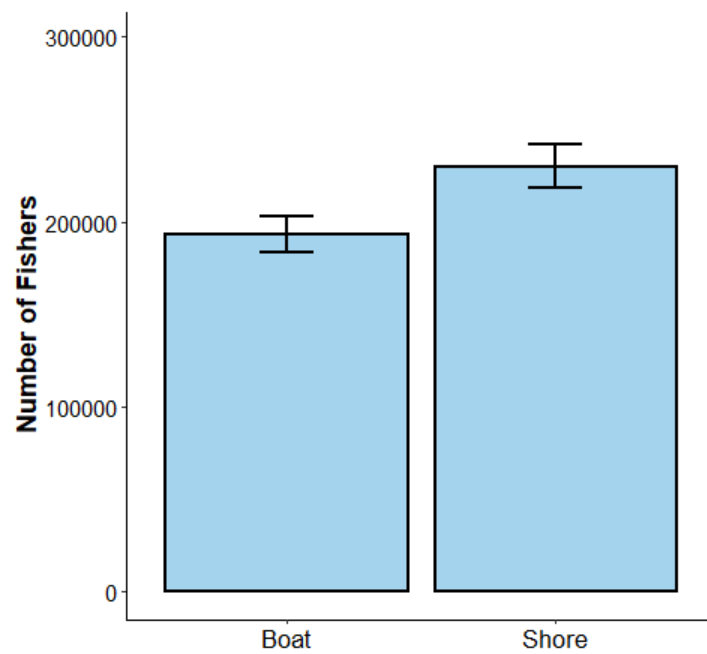
	2013/14*		2017/18		2019/20	
FRESHWATER	Number	RSE (%)	Number	RSE (%)	Number	RSE (%)
Total Persons	193,215	6	145,373	6	98,481	7
RFL holders	114,659	5	101,698	5	68,024	6
Others	78,556	10	43,675	12	30,457	12
Total Households	117,088	5	90,331	5	63,090	6
SALTWATER						
Total Persons	334,372	4	304,434	5	255,674	4
RFL holders	210,056	3	200,785	4	176,317	4
Others	124,316	8	103,649	11	79,357	10
Total Households	207,699	3	183,030	4	155,518	4
TOTAL FISHED**						
Total Persons	442,797	3	392,484	4	321,115	4
RFL holders	265,036	2	257,722	3	217,831	3
Others	177,761	7	134,762	9	103,284	8
Total Households	262,485	2	231,985	3	193,916	3

**Note: The numbers of fishers/households who fished in freshwater and saltwater are not directly additive, as some fished both.

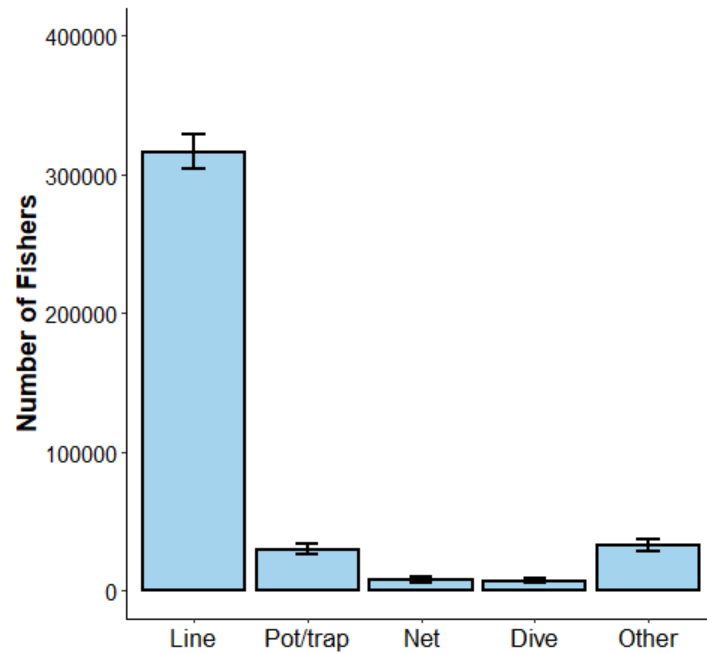
Participation by Waterbody for RFL households during 2019/20



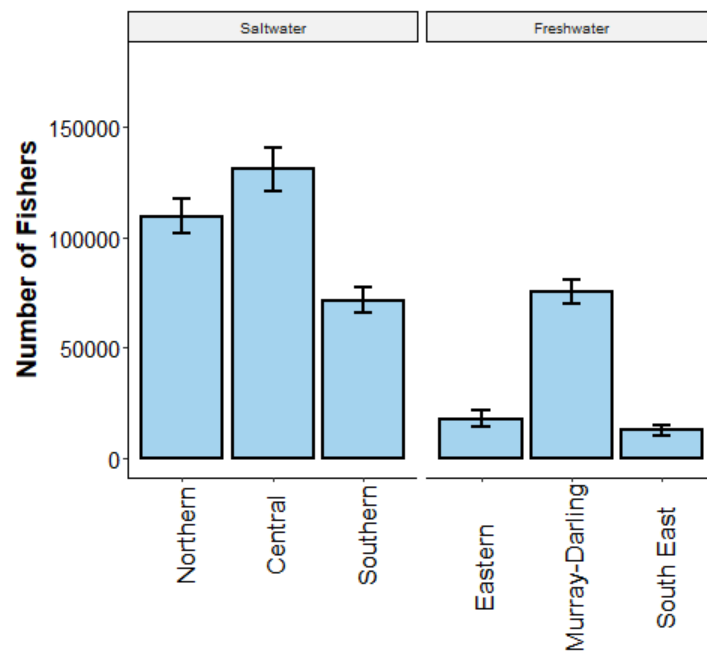
Participation by Platform for RFL households during 2019/20



Participation by Method for RFL households during 2019/20

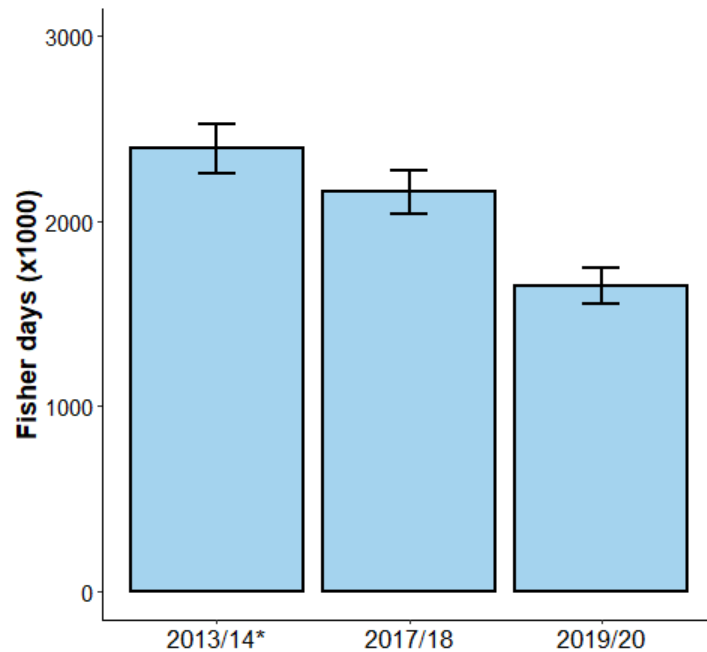


Participation by Region for RFL households during 2019/20



Fishing effort – number of fisher-days

Total state-wide fishing effort through time

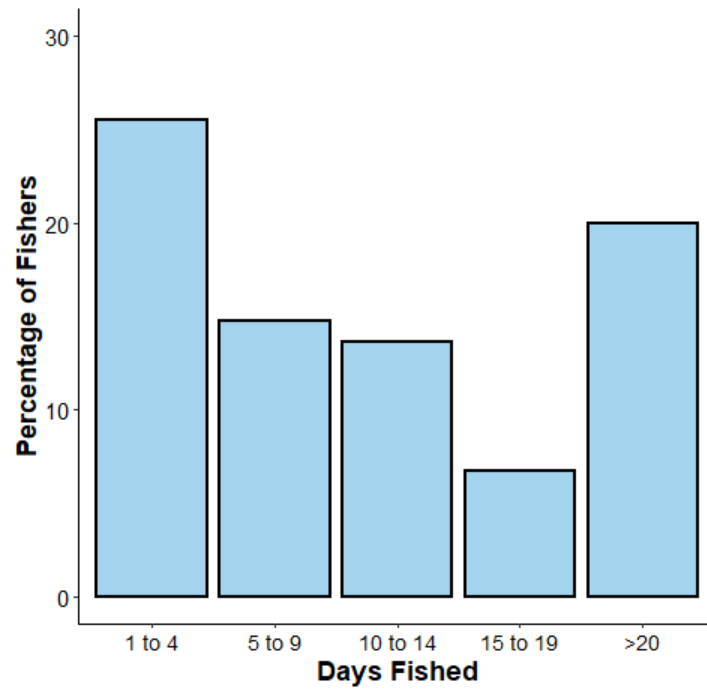


Fishing effort by RFL household residents who fished in NSW within freshwater and saltwater during 2019/20

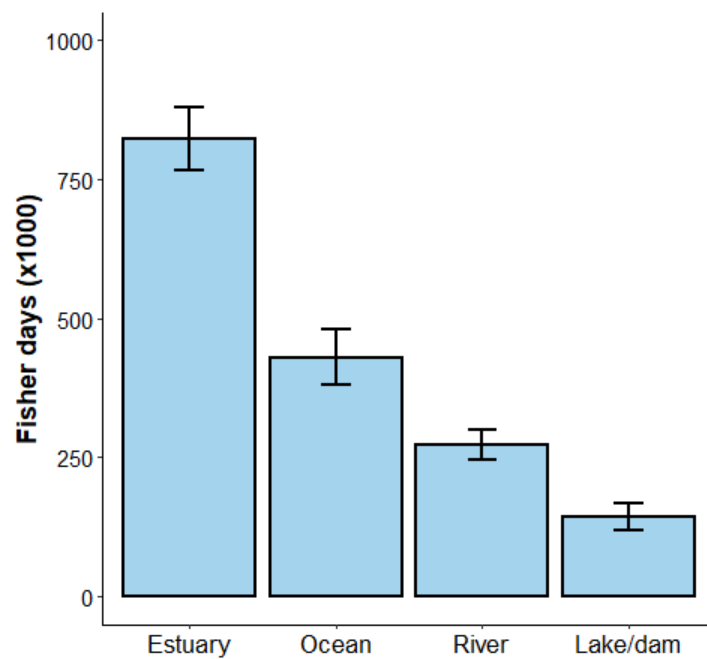
	Freshwater		Saltwater		Total*	
	Number	RSE (%)	Number	RSE (%)	Number	RSE (%)
Effort (Fisher-days)	416,659	9.38	1,237,696	6.77	1,653,531	5.81

*Note: The numbers of fisher days expended in freshwater and saltwater are not directly additive as some fishers fished both.

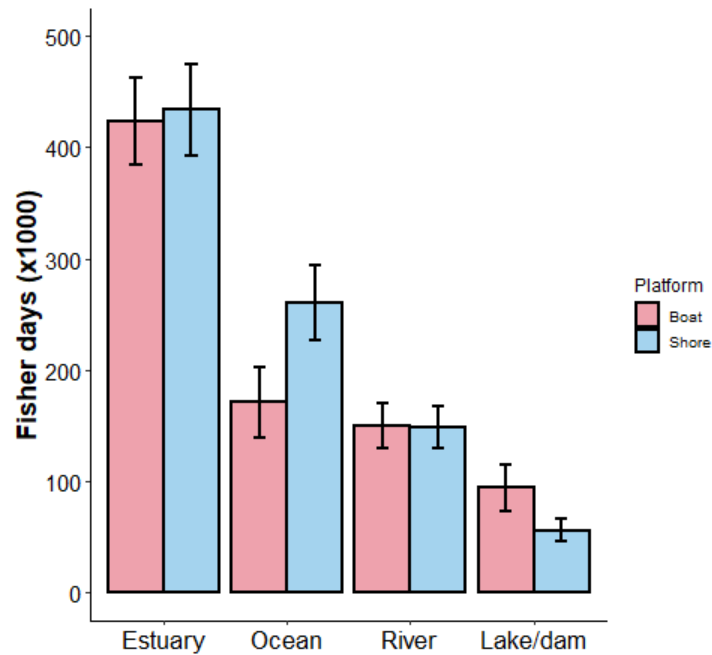
Days fished by avidity group for RFL households during 2019/20



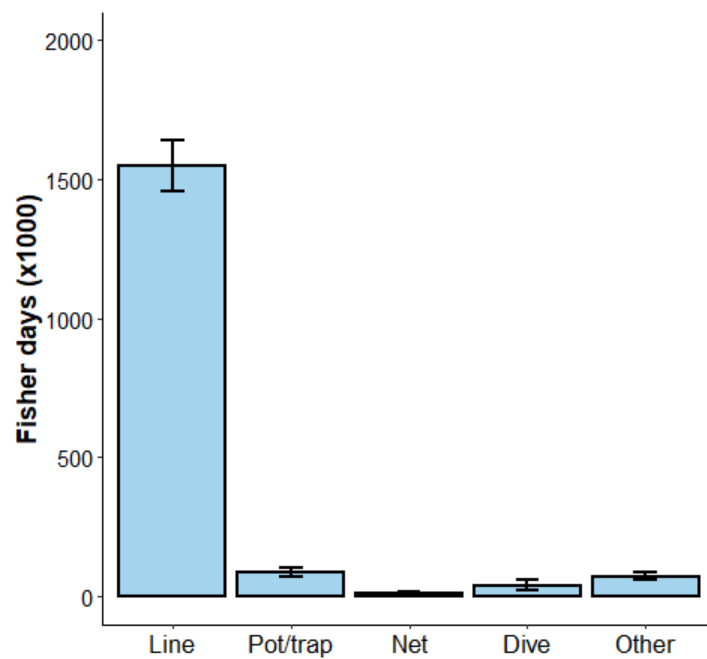
Fishing Effort by Waterbody for RFL households during 2019/20



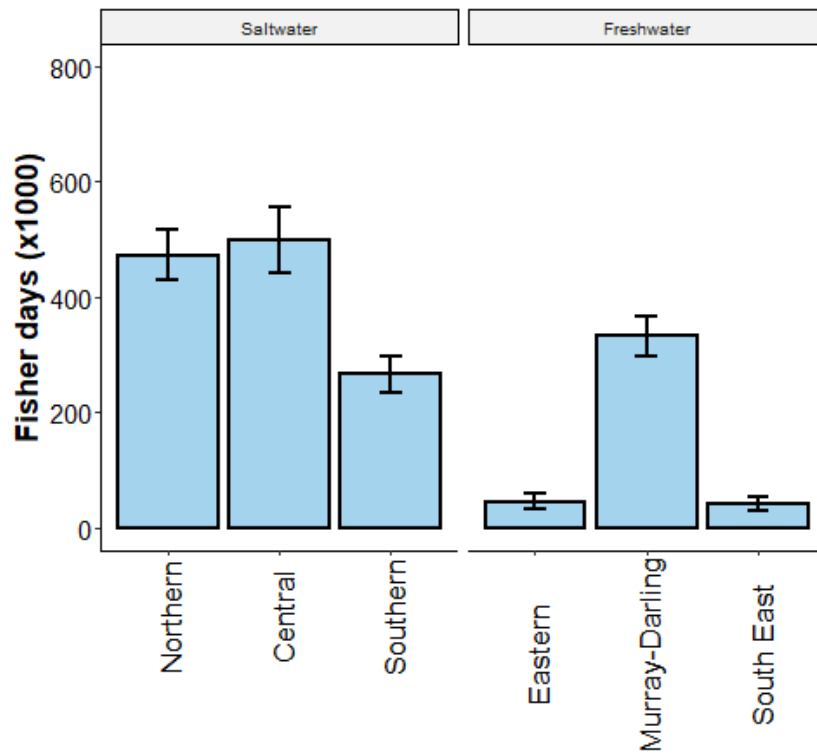
Fishing Effort by Platform and Waterbody for RFL households during 2019/20



Fishing Effort by Method for RFL households during 2019/20



Fishing Effort by Region for RFL households during 2019/20

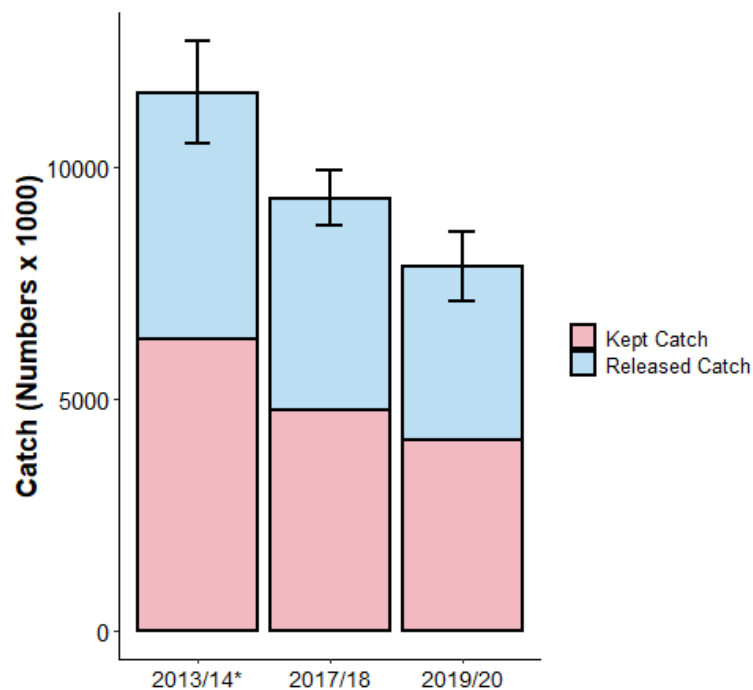


Catch – numbers of finfish and invertebrates

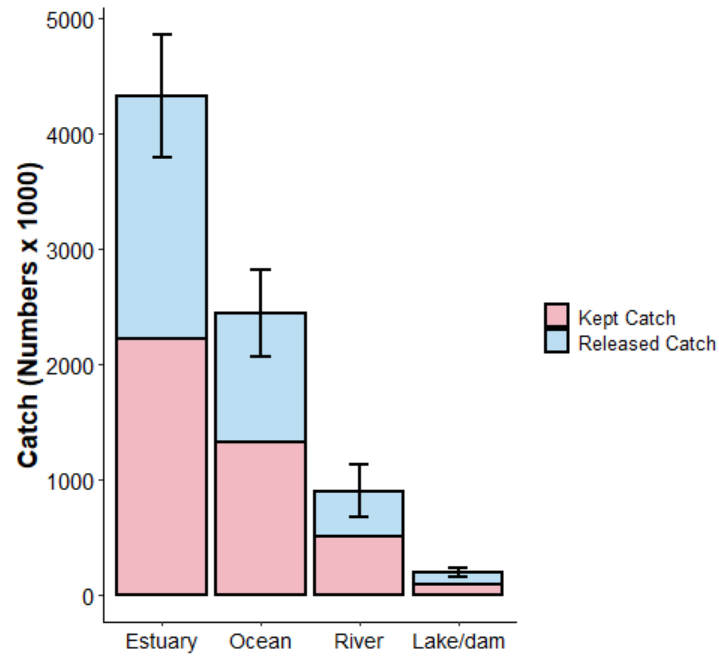
Recreational fishers in NSW caught a diverse range of finfish, elasmobranchs (sharks and rays), crustaceans, molluscs, and other taxa, with 128 species and species groupings caught during the 2019/20 TD Survey.

Overall, the total state-wide recreational catch of RFL households was estimated to be 7,849,661 (RSE 9.40%) individual organisms, with 4,121,144 being kept (52.5% of total catch) and the remaining 3,728,518 released (47.5% of total catch).

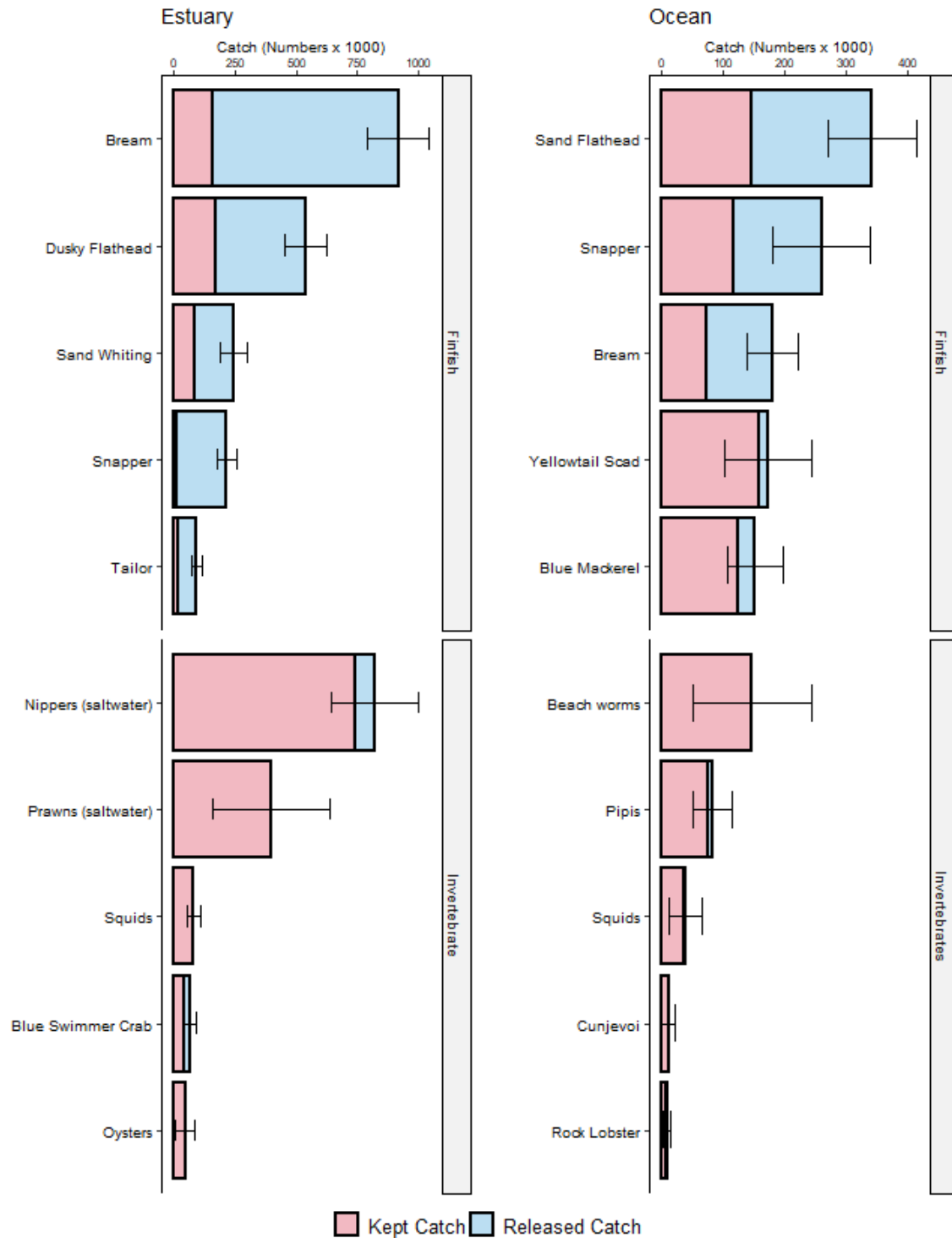
Total state-wide catch for RFL households through time (all species combined)



Total state-wide catch by Waterbody for RFL households during 2019/20 (all species combined)



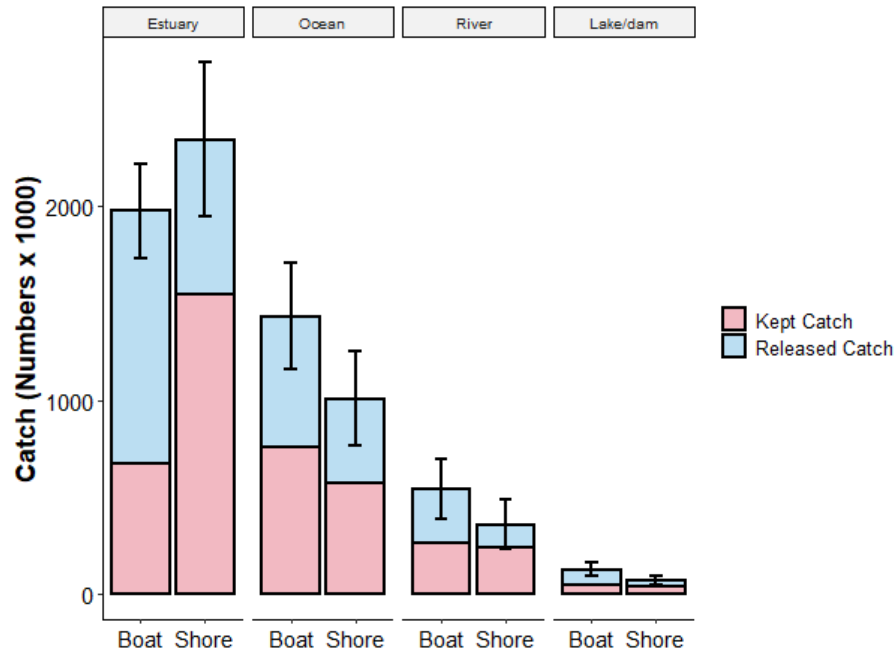
Total state-wide catch of top finfish and invertebrate species/groups by Waterbody (saltwater) for RFL households during 2019/20



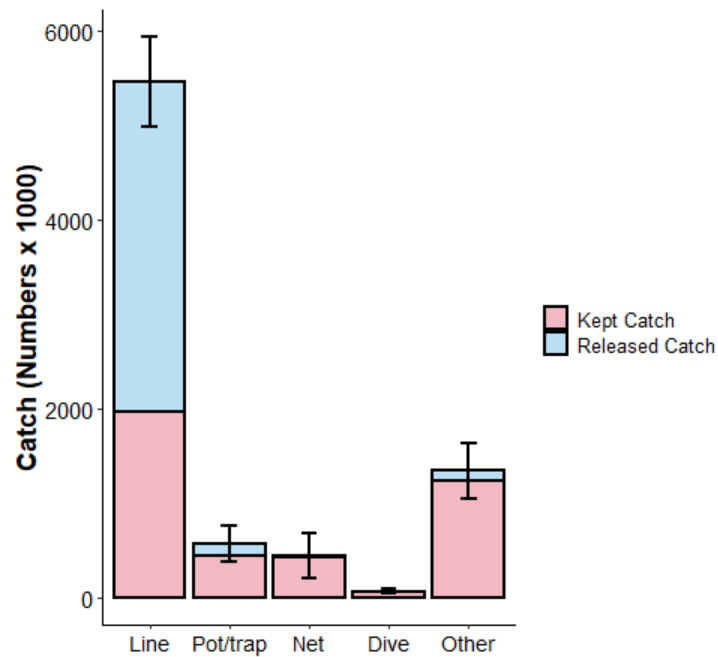
Total state-wide catch of top finfish and invertebrate species/groups by Waterbody (freshwater) for RFL households during 2019/20



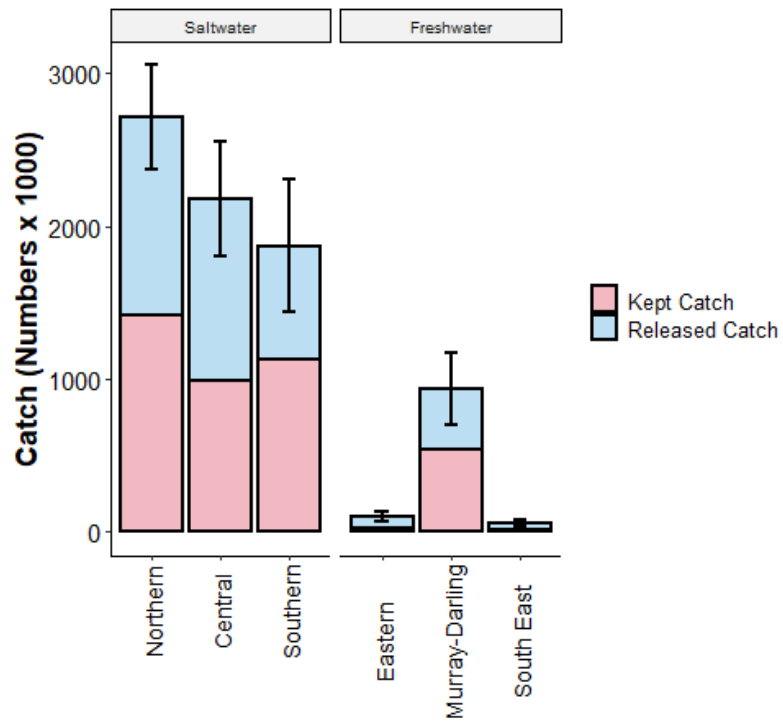
Total state-wide catch by Platform and Waterbody for RFL households during 2019/20 (all species combined)



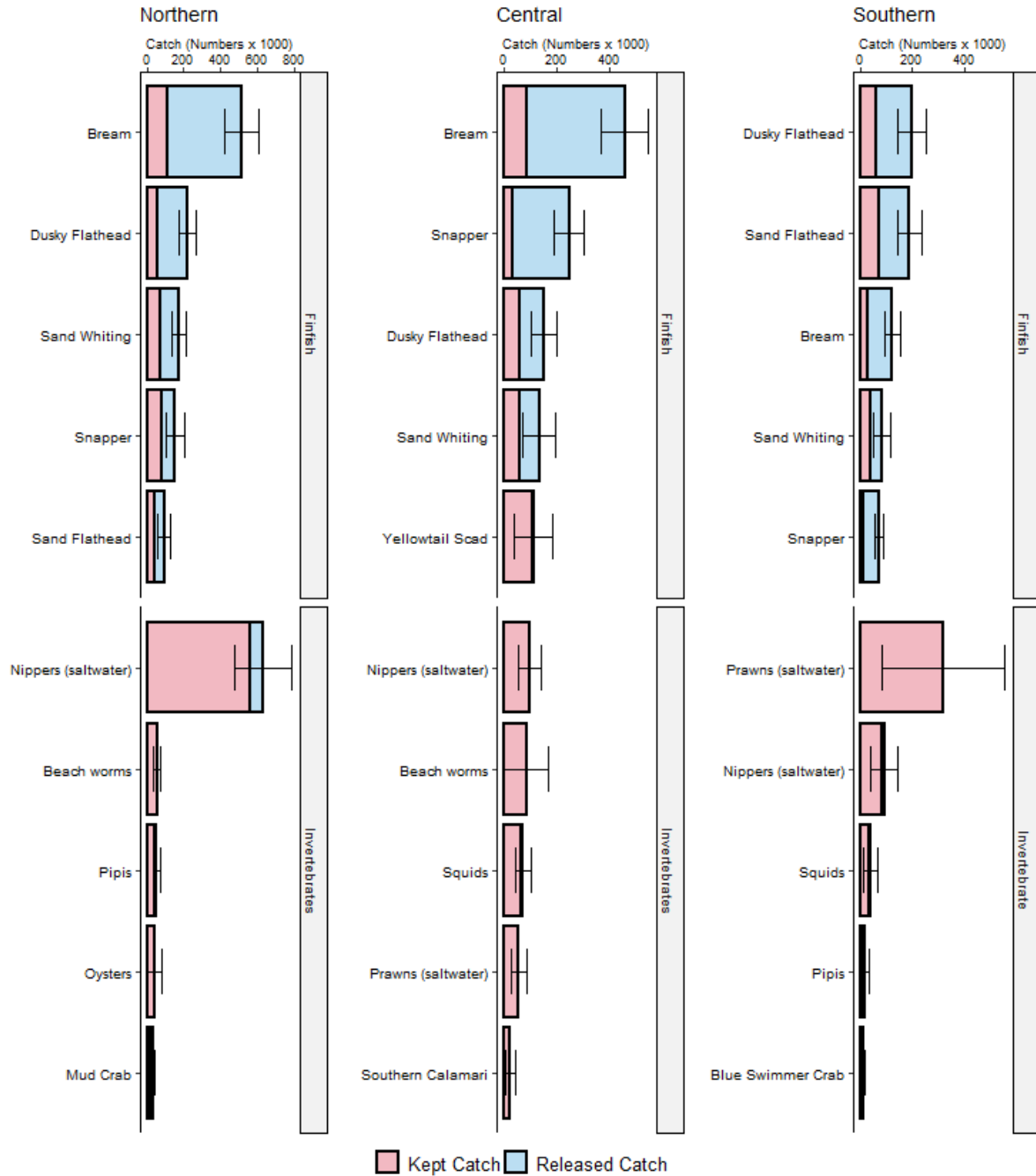
Total state-wide catch by Method for RFL households during 2019/2020 (all species combined)



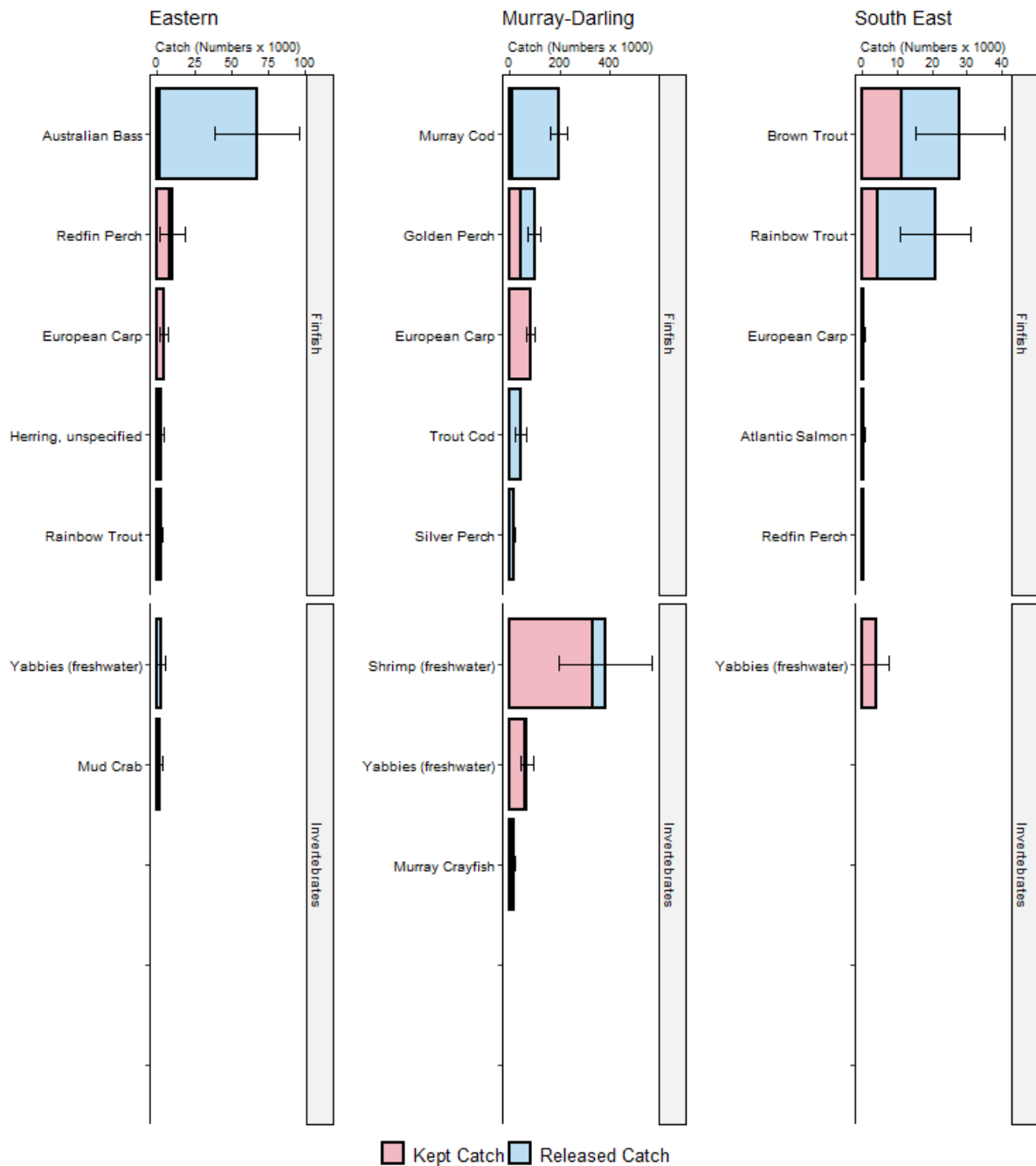
Total catch by Region for RFL households during 2019/20 (all species combined)



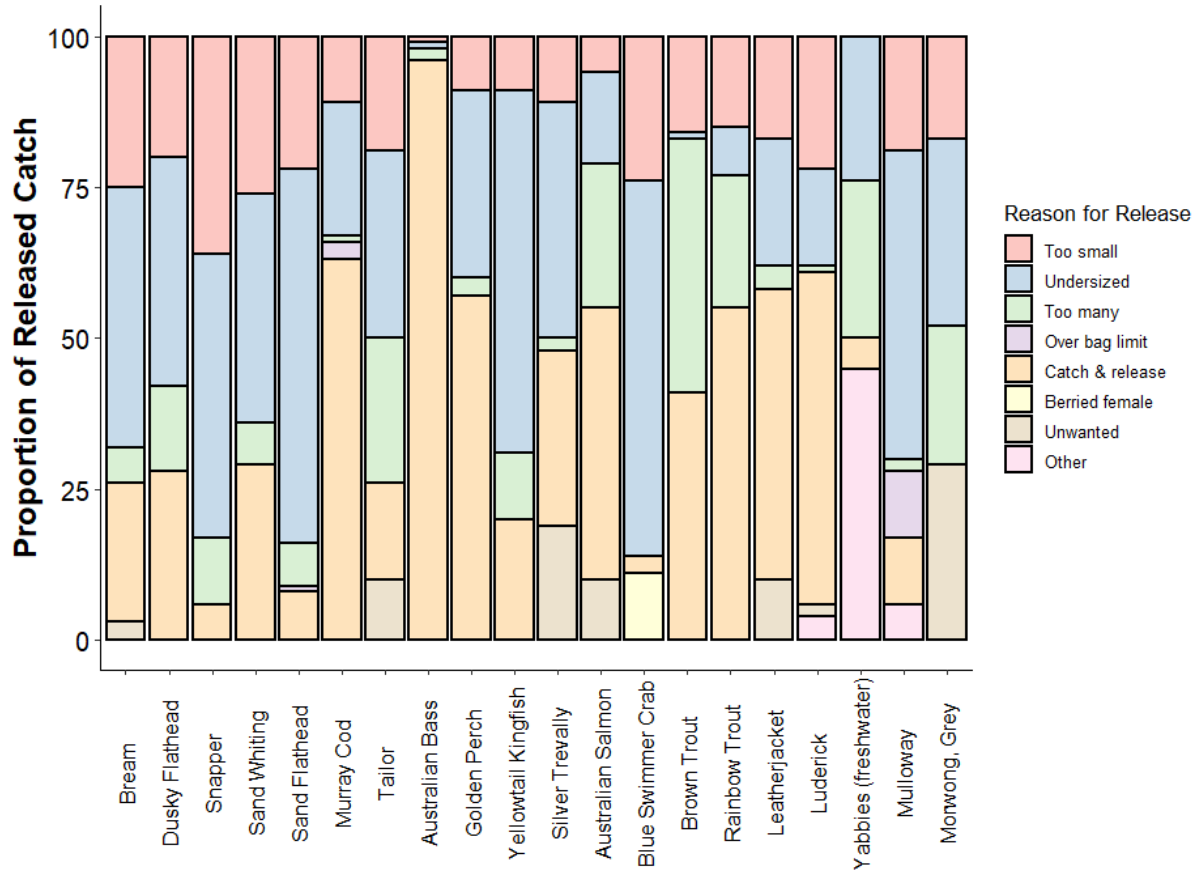
Total catch of top finfish and invertebrate species/groups by Region (saltwater) for RFL households during 2019/20



Total catch of top finfish and invertebrate species/groups by Region (freshwater) for RFL households during 2019/20

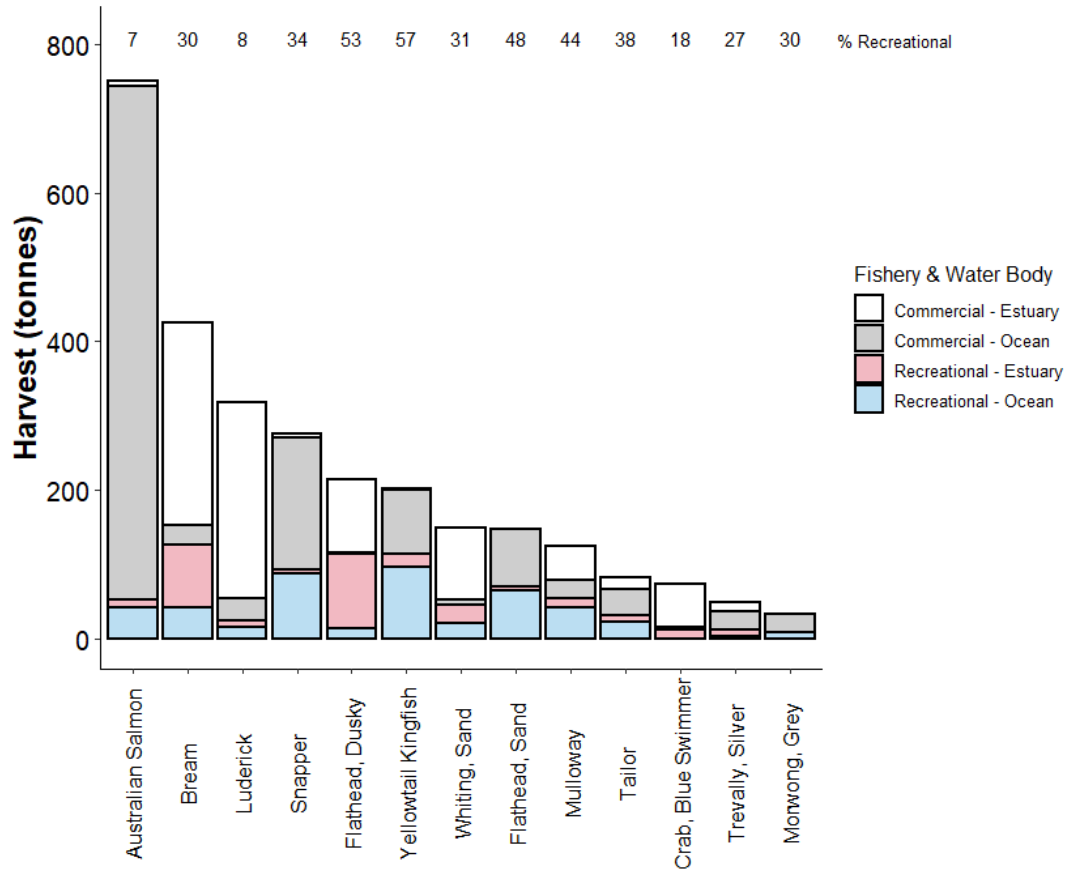


Reasons for release for key species released by RFL households during 2019/20



Catch – harvest weight

Estimates of harvest weights (tonnes) retained (kept) by RFL households alongside reported landings for the commercial fisheries sector during 2019/20

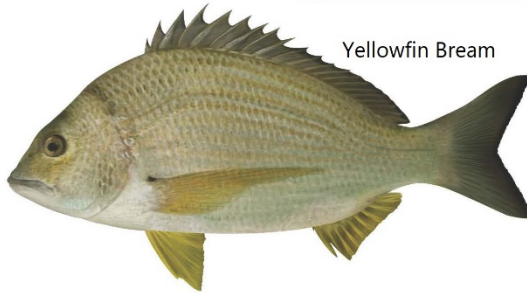


Report cards for key species

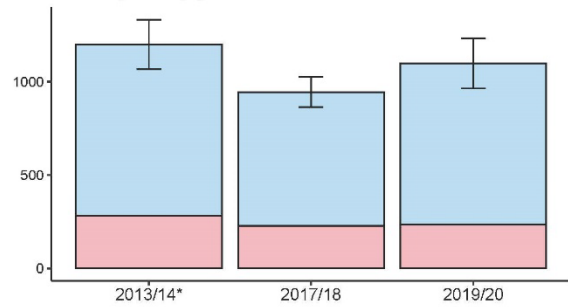
Bream - species complex

Bream

- 'Bream' is a species complex of Yellowfin Bream, Black Bream and their hybrids, with Yellowfin Bream dominating the state-wide catch for this group.
- Total state-wide catch was 1,098,534 (RSE = 12 %), with 21 % being kept and 79 % released during 2019/20.

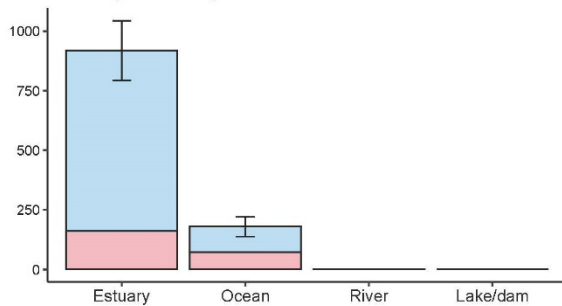


Catch by survey year

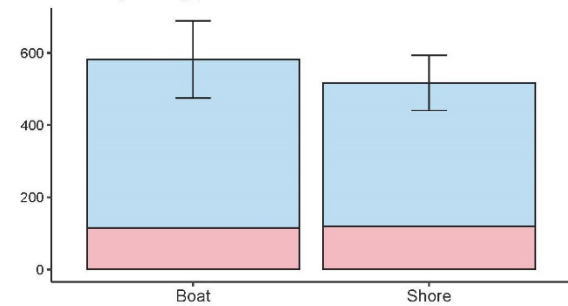


Catch (Numbers x 1000)

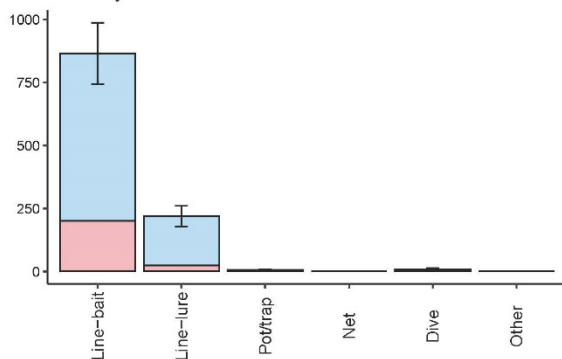
Catch by waterbody



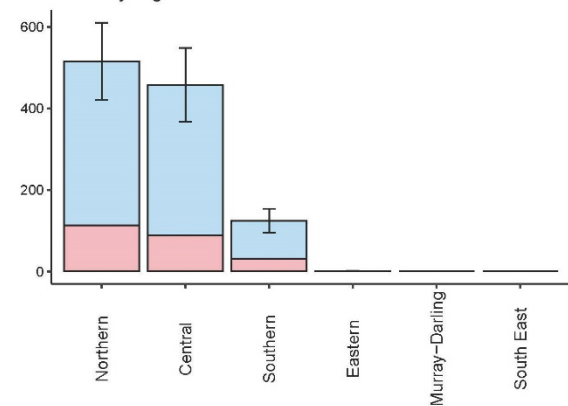
Catch by fishing platform



Catch by method



Catch by region

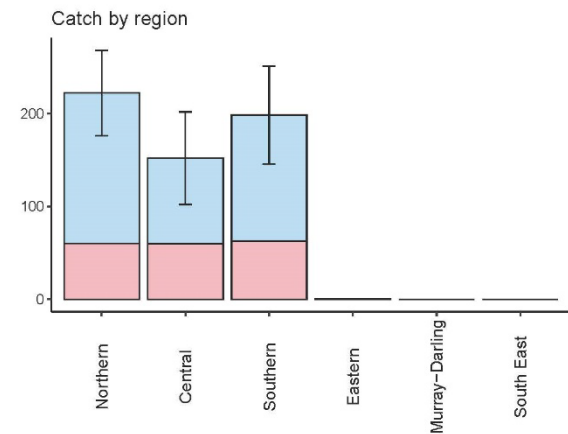
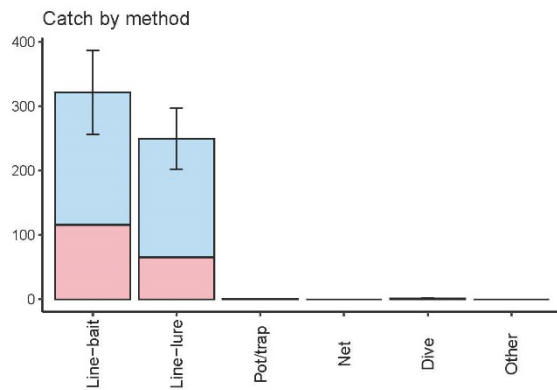
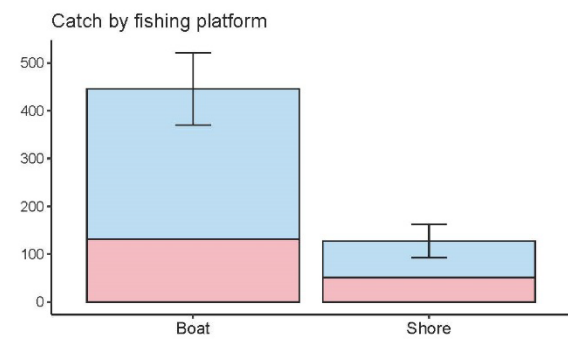
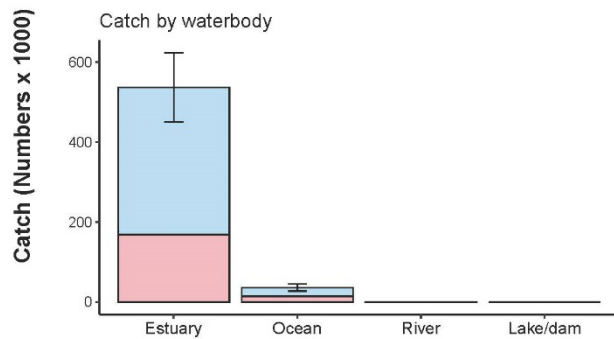
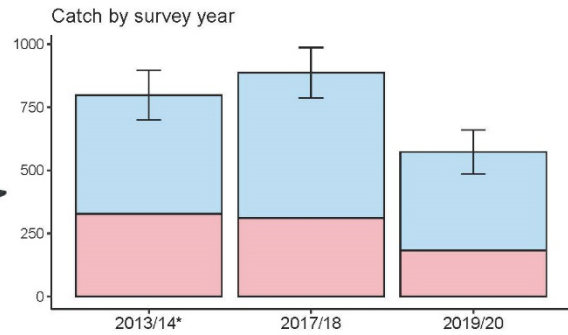


Kept Catch Released Catch

Dusky Flathead (*Platycephalus fuscus*)

Dusky Flathead

- Total state-wide catch was 572,822 (RSE = 15 %), with 32 % being kept and 68 % released during 2019/20.



Kept Catch Released Catch

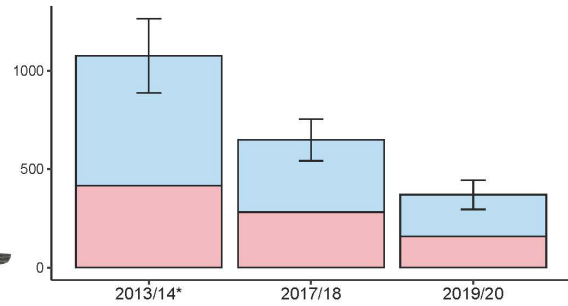
Sand Flathead - species complex

Sand Flathead

- 'Sand flathead' is a species complex of several *Platycephalidae* species, with Bluespotted Flathead dominating the state-wide catch for this group.
- Total state-wide catch was 370,182 (RSE = 20 %), with 43 % being kept and 57 % released during 2019/20.

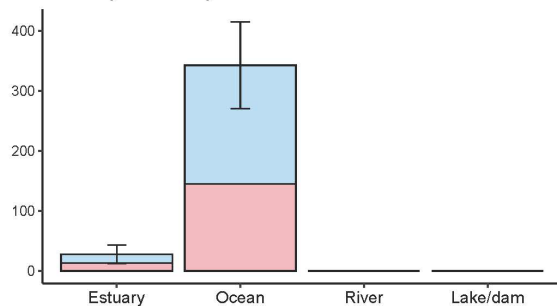


Catch by survey year

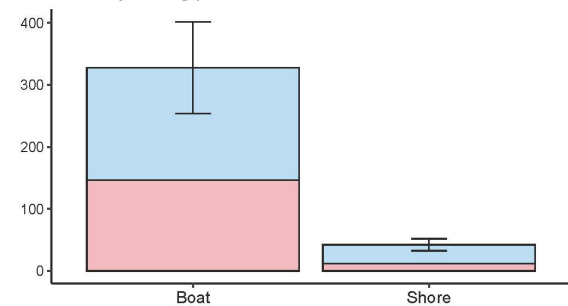


Catch (Numbers x 1000)

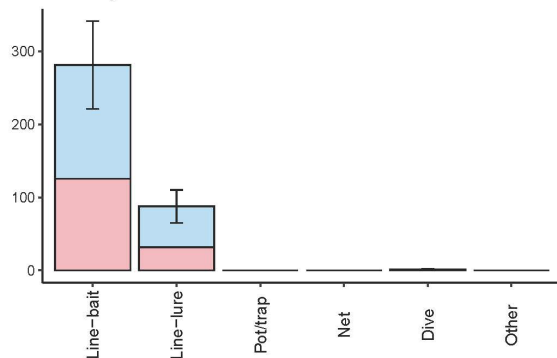
Catch by waterbody



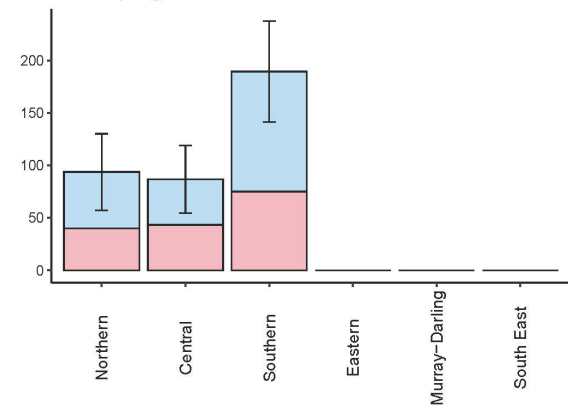
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

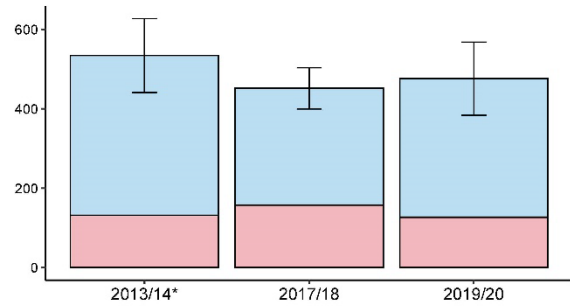
Snapper (*Chrysophrys auratus*)

Snapper

• Total state-wide catch was 475,753 (RSE = 19 %), with 27 % being kept and 73 % released during 2019/20.

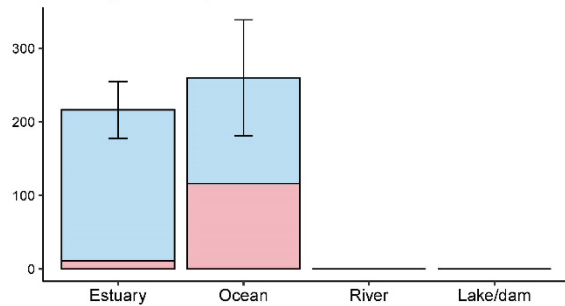


Catch by survey year

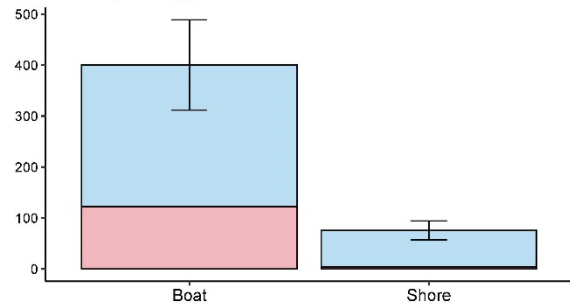


Catch (Numbers x 1000)

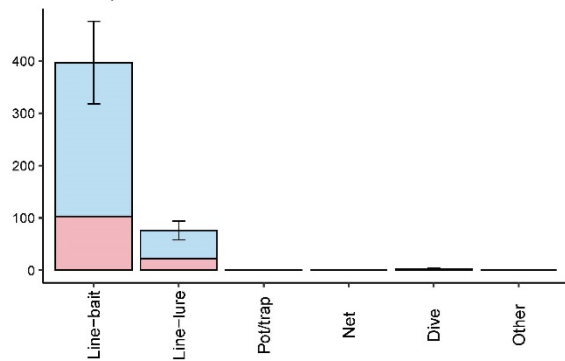
Catch by waterbody



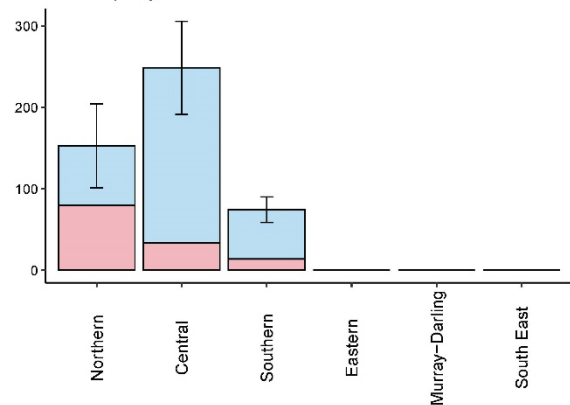
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

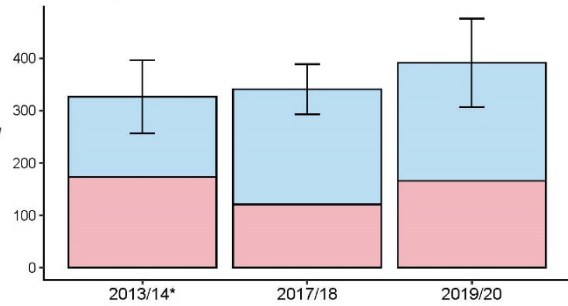
Sand Whiting (*Sillago ciliata*)

Sand Whiting

• Total state-wide catch was 391,146 (RSE = 22 %), with 42 % being kept and 58 % released during 2019/20.

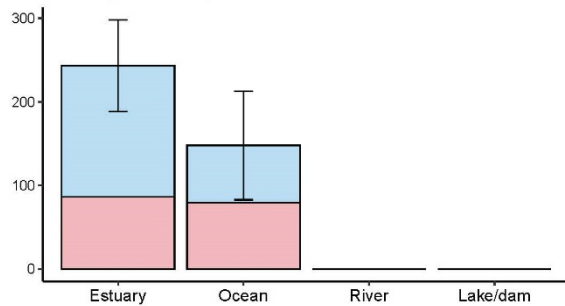


Catch by survey year

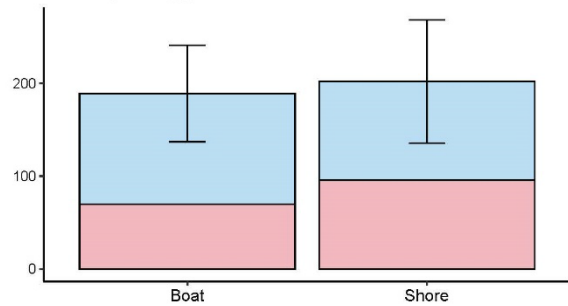


Catch (Numbers x 1000)

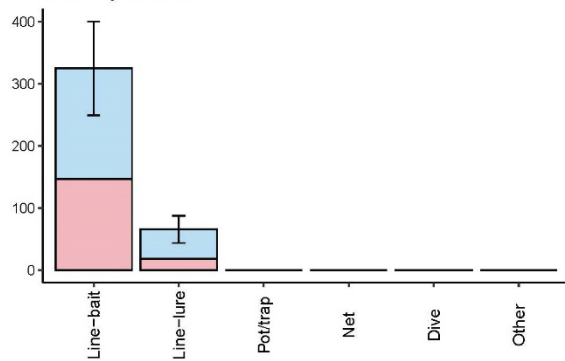
Catch by waterbody



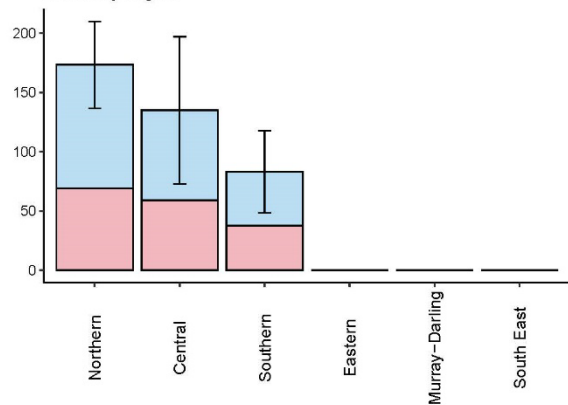
Catch by fishing platform



Catch by method



Catch by region

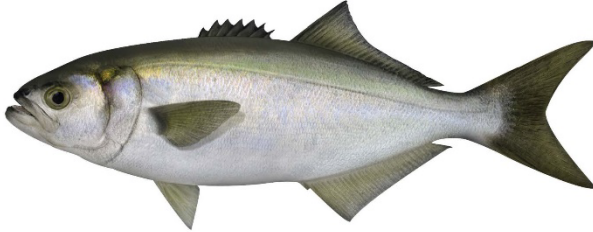


Kept Catch Released Catch

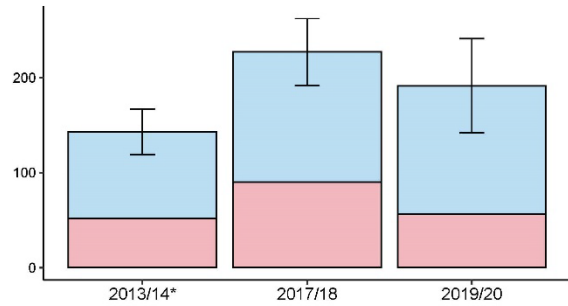
Tailor (*Pomatomus saltatrix*)

Tailor

• Total state-wide catch was 191,542 (RSE = 26 %), with 29 % being kept and 71 % released during 2019/20.

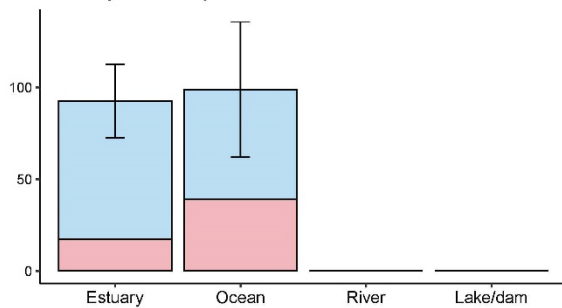


Catch by survey year

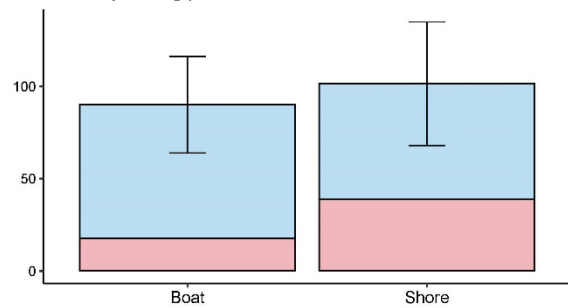


Catch (Numbers x 1000)

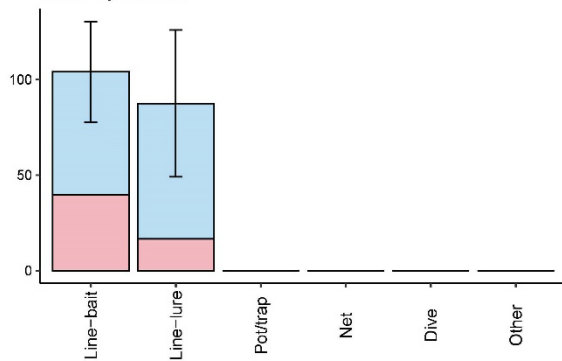
Catch by waterbody



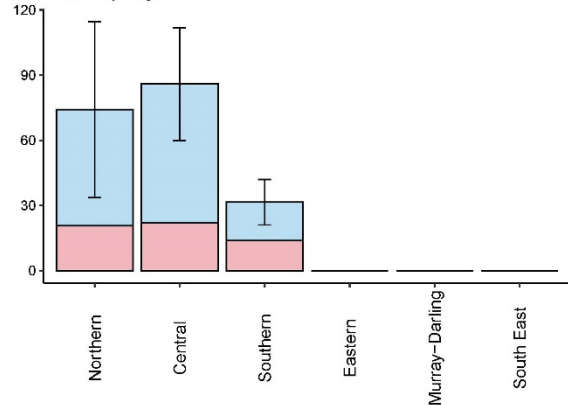
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

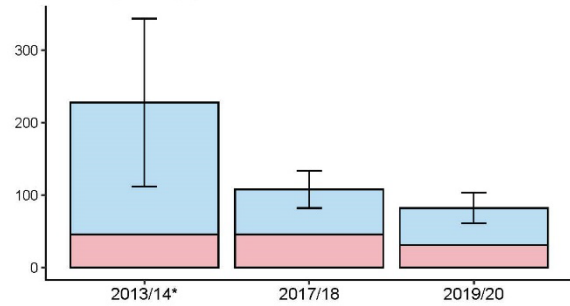
Yellowtail Kingfish (*Seriola lalandi*)

Yellowtail Kingfish

- Total state-wide catch was 82,025 (RSE = 26 %), with 38 % being kept and 62 % released during 2019/20.

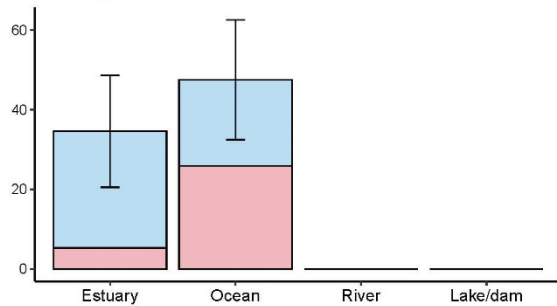


Catch by survey year

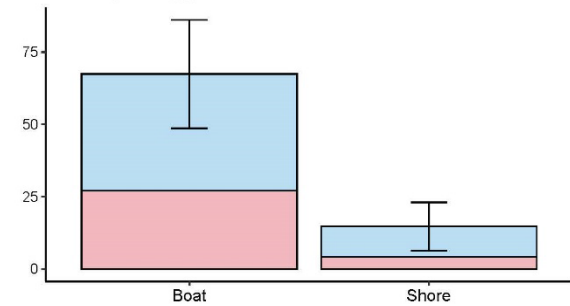


Catch (Numbers x 1000)

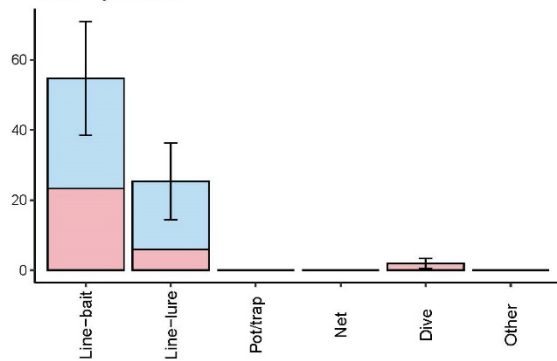
Catch by waterbody



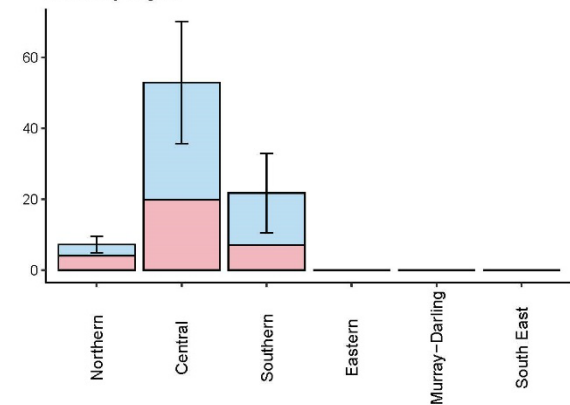
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

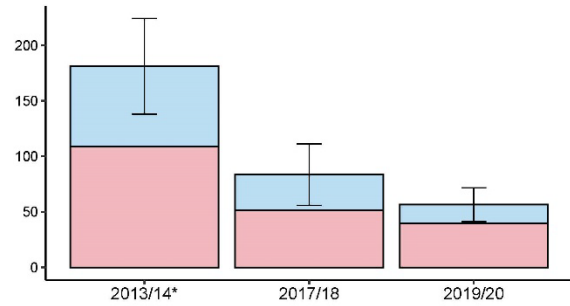
Luderick (*Girella tricuspidata*)

Luderick

- Total state-wide catch was 56,540 (RSE = 27 %), with 70 % being kept and 30 % released during 2019/20.

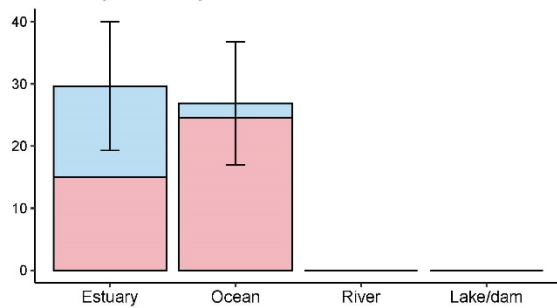


Catch by survey year

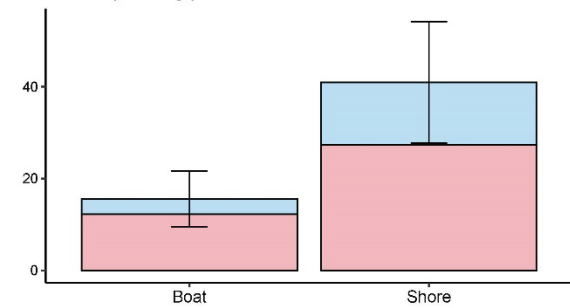


Catch (Numbers x 1000)

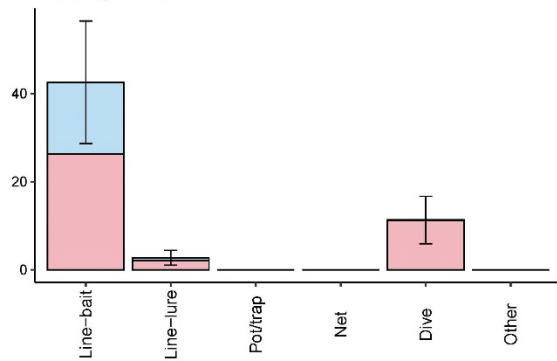
Catch by waterbody



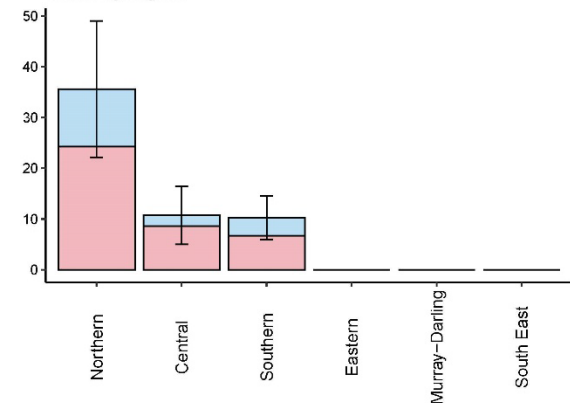
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

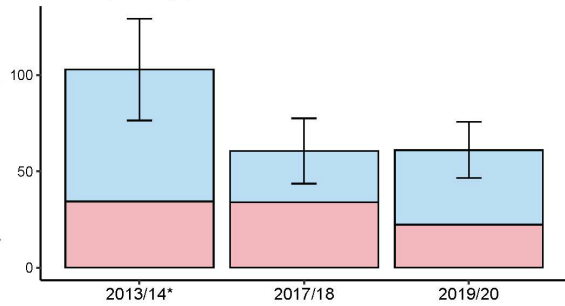
Australian Salmon (*Arripis trutta*)

Australian Salmon

- Total state-wide catch was 61,042 (RSE = 24 %), with 37 % being kept and 63 % released during 2019/20.

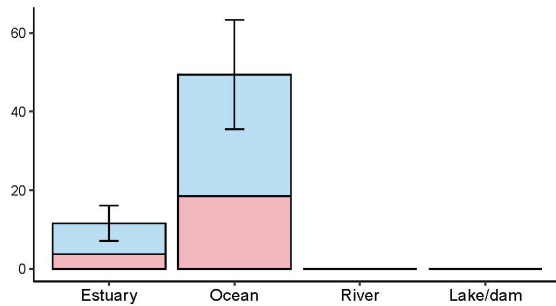


Catch by survey year

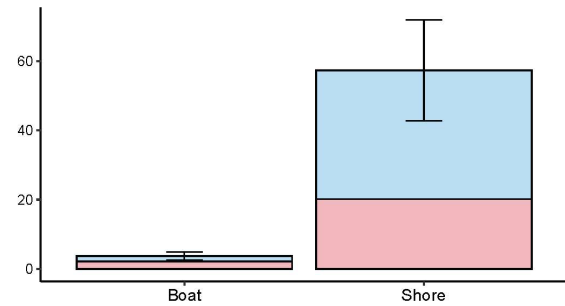


Catch (Numbers x 1000)

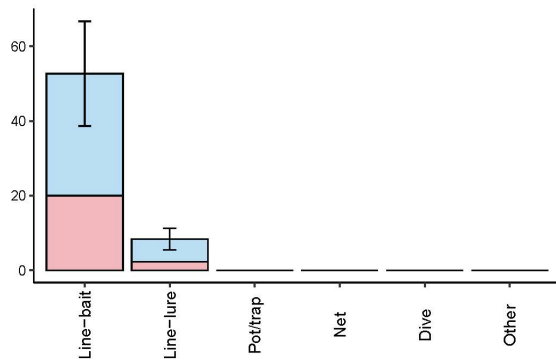
Catch by waterbody



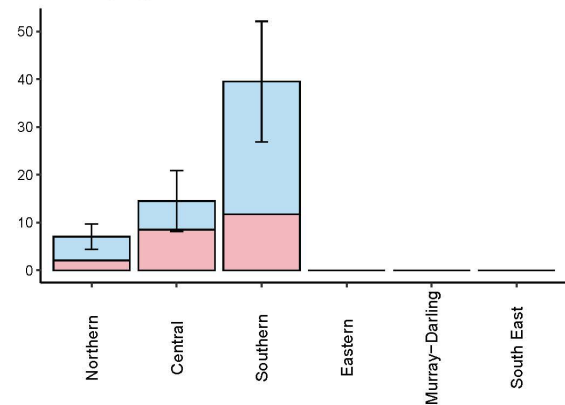
Catch by fishing platform



Catch by method



Catch by region

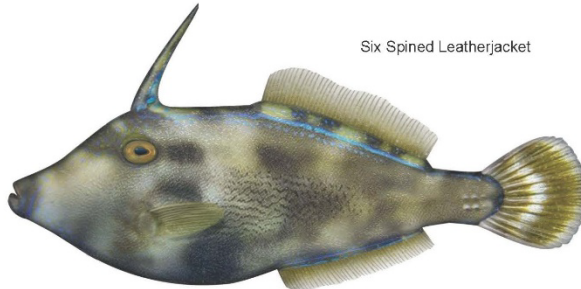


Kept Catch Released Catch

Leatherjacket - species complex

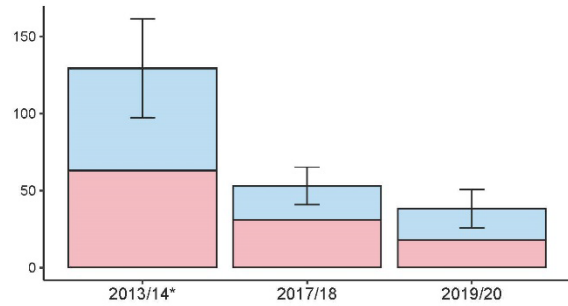
Leatherjacket

- 'Leatherjacket' is a species complex of several Balistidae and Monacanthidae species.
- Total state-wide catch was 38,111 (RSE = 33 %), with 48 % being kept and 52 % released during 2019/20.



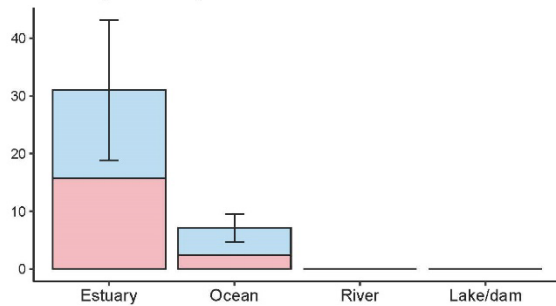
Six Spined Leatherjacket

Catch by survey year

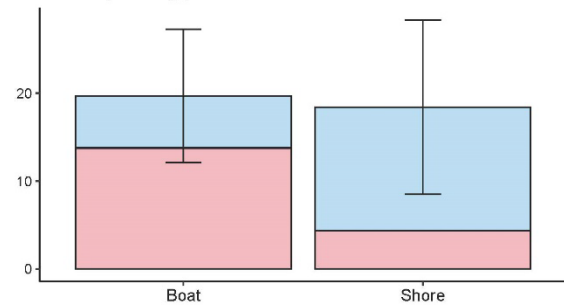


Catch (Numbers x 1000)

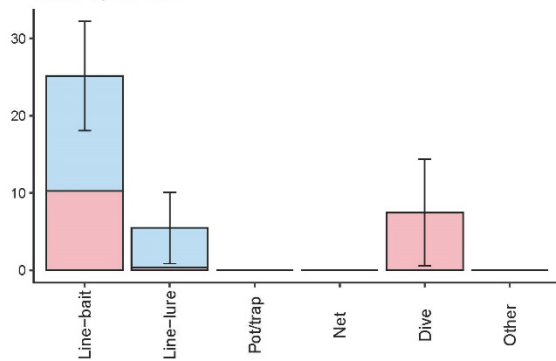
Catch by waterbody



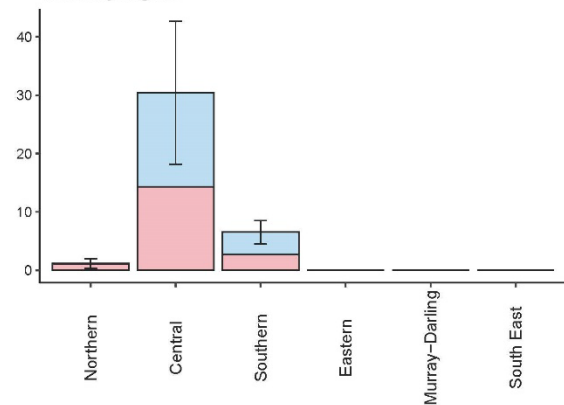
Catch by fishing platform



Catch by method



Catch by region

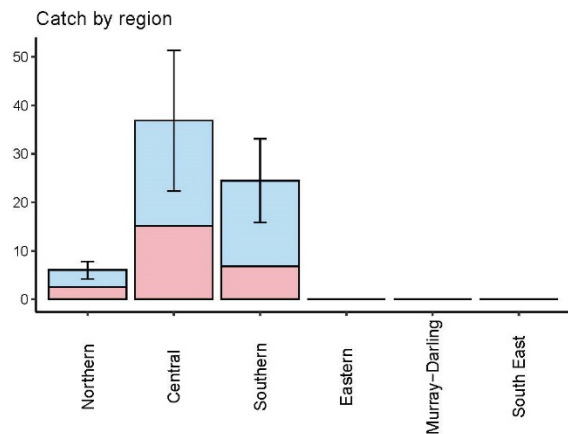
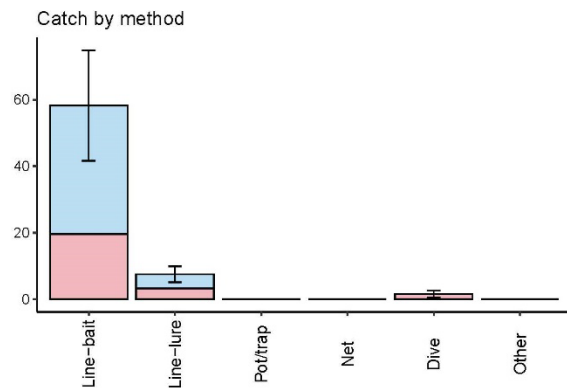
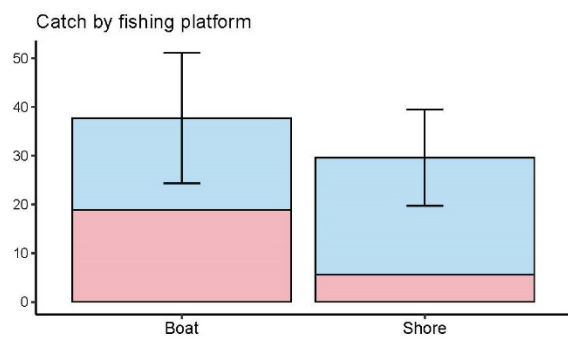
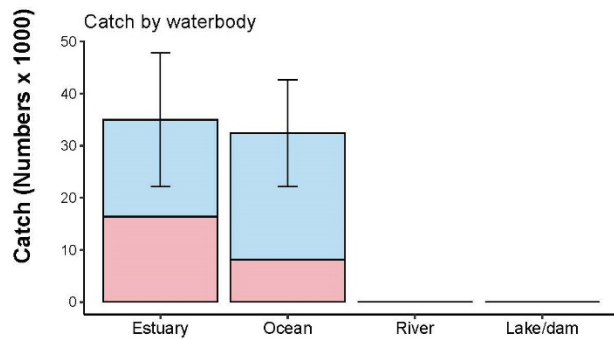
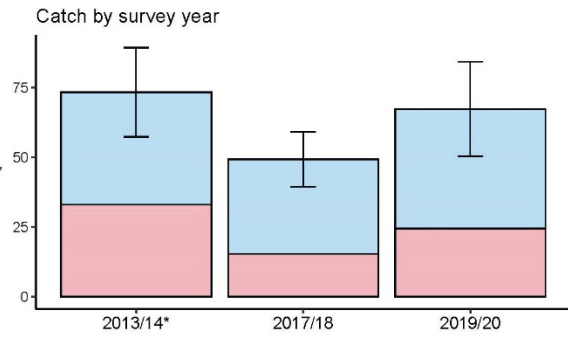


Kept Catch Released Catch

Silver Trevally (*Pseudocaranx georgianus*)

Silver Trevally

- Total state-wide catch was 67,360 (RSE = 25 %), with 36 % being kept and 64 % released during 2019/20.

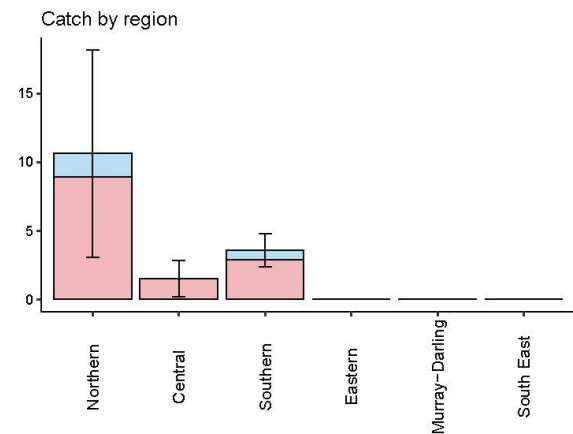
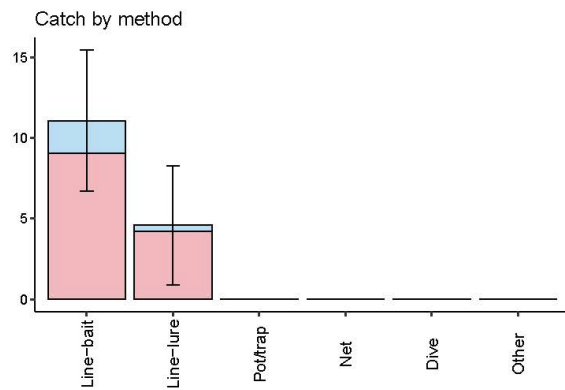
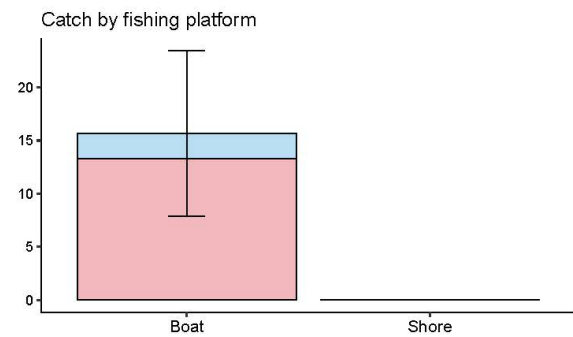
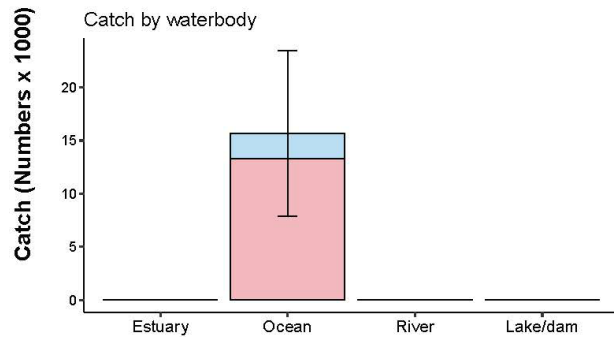
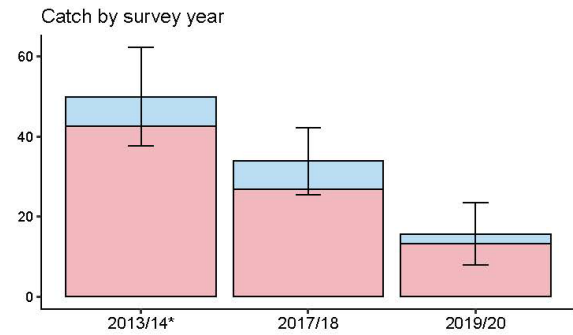


Kept Catch Released Catch

Grey Morwong (*Nemadactylus douglasii*)

Grey Morwong

• Total state-wide catch was 15,671 (RSE = 50 %), with 85 % being kept and 15 % released during 2019/20.

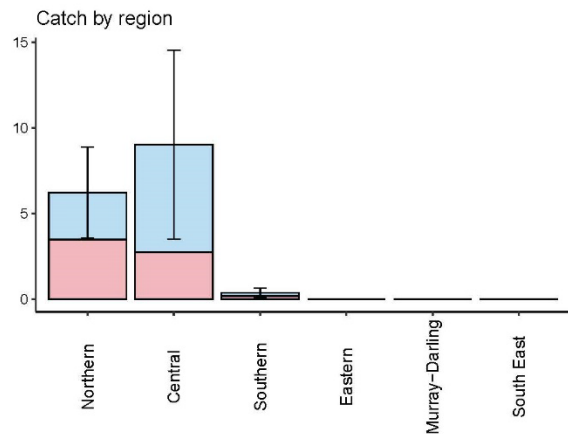
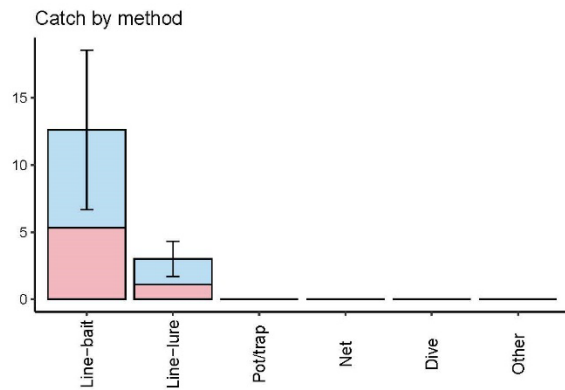
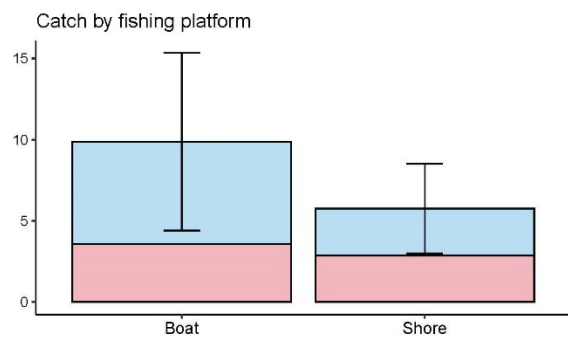
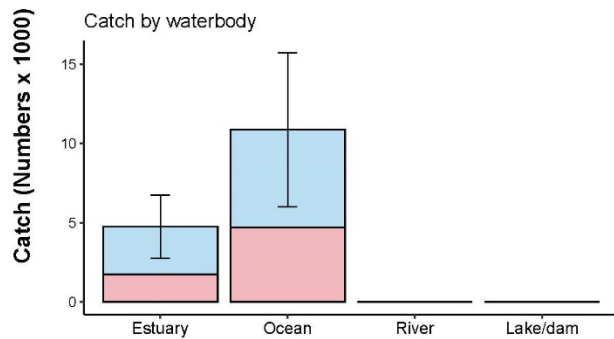
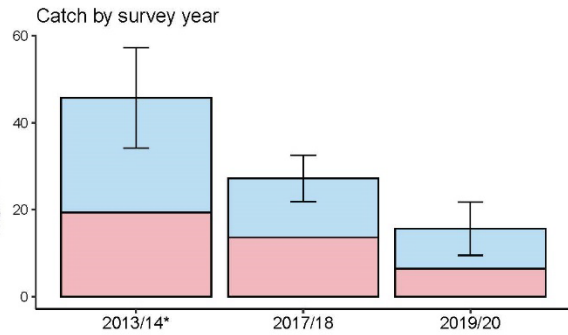


Kept Catch Released Catch

Mulloway (*Argyrosomus japonicus*)

Mulloway

- Total state-wide catch was 15,619 (RSE = 39 %), with 41 % being kept and 59 % released during 2019/20.

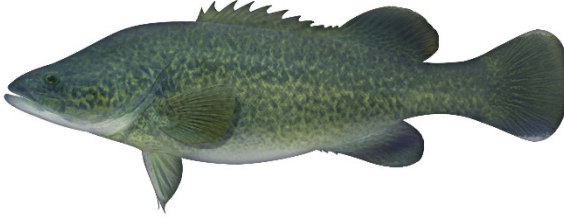


Kept Catch Released Catch

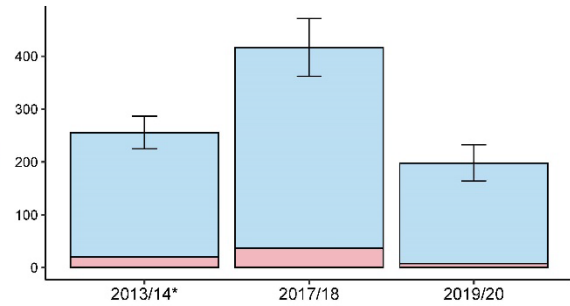
Murray Cod (*Maccullochella peelii*)

Murray Cod

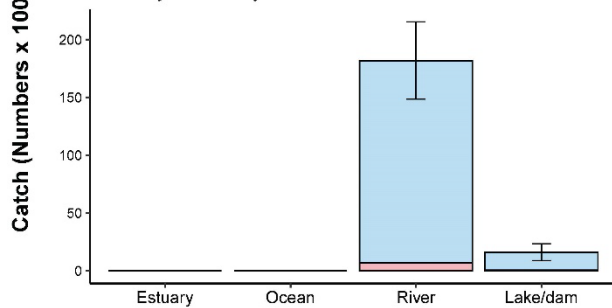
• Total state-wide catch was 198,045 (RSE = 17 %), with 4 % being kept and 96 % released during 2019/20.



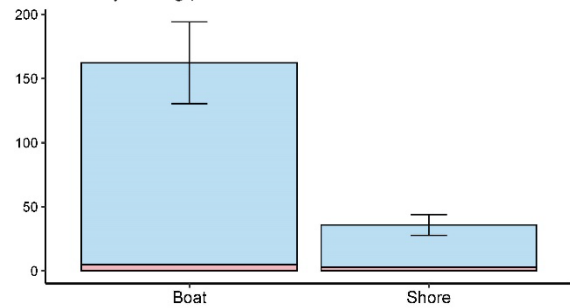
Catch by survey year



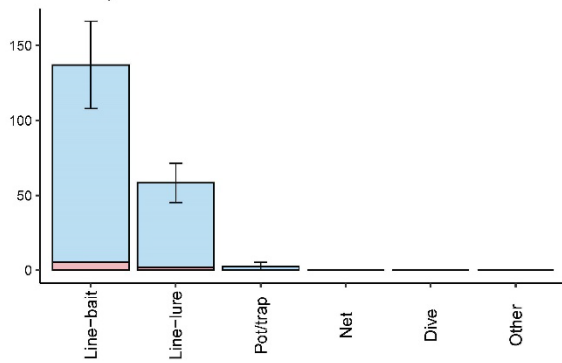
Catch by waterbody



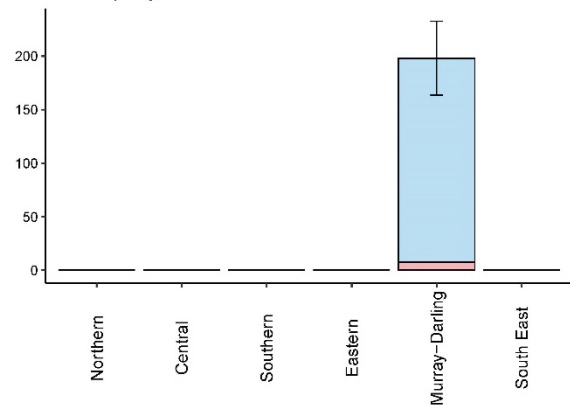
Catch by fishing platform



Catch by method



Catch by region

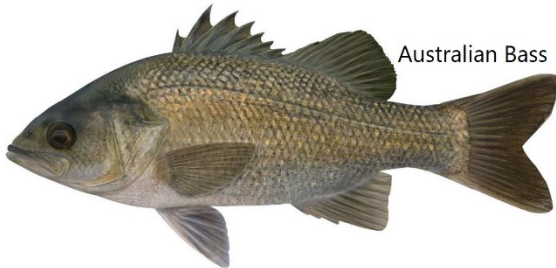


Kept Catch Released Catch

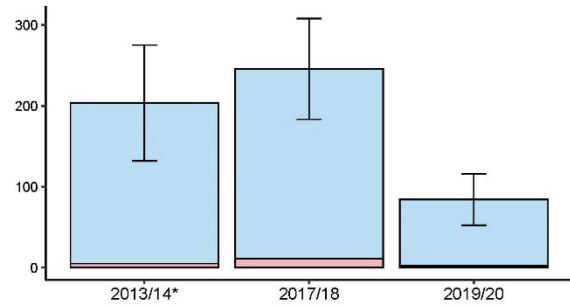
Australian Bass - species complex

Australian Bass

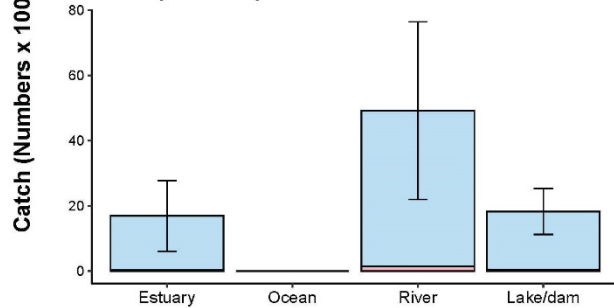
- 'Australian Bass' is a complex of two species, Australian Bass and Estuary Perch with the former dominating the state-wide catch for this group
- Total state-wide catch was 84,273 (RSE = 38 %), with 3 % being kept and 97 % released during 2019/20.



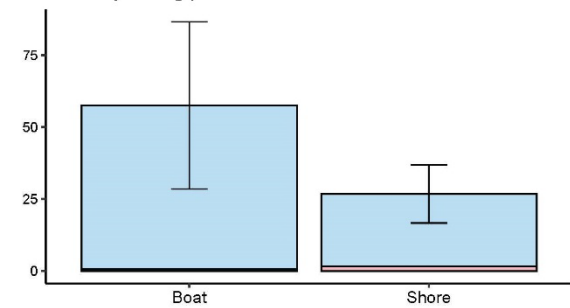
Catch by survey year



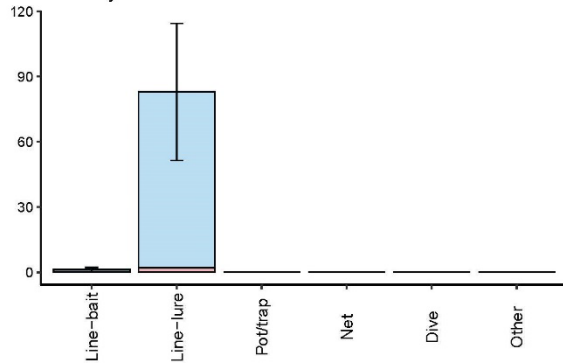
Catch by waterbody



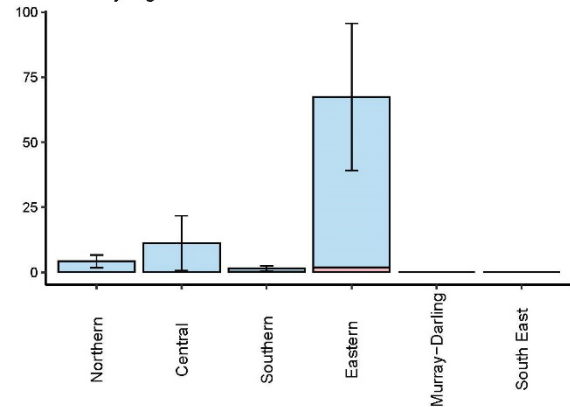
Catch by fishing platform



Catch by method



Catch by region

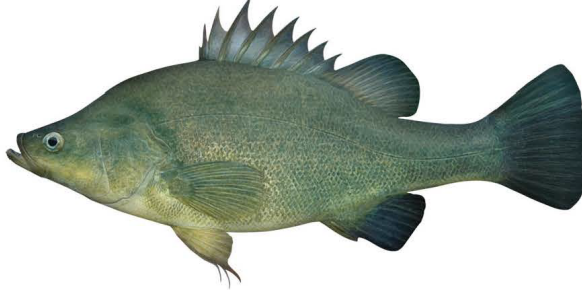


Kept Catch Released Catch

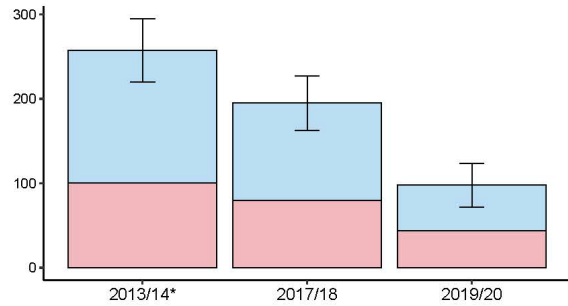
Golden Perch (*Macquaria ambigua*)

Golden Perch

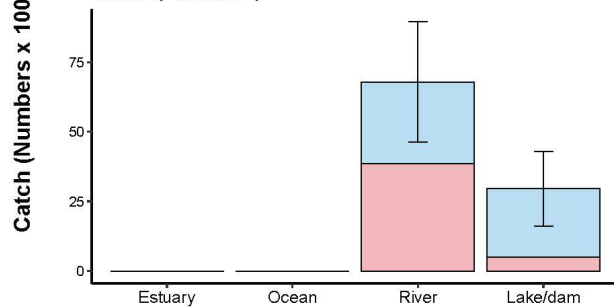
- Total state-wide catch was 97,543 (RSE = 27 %), with 45 % being kept and 55 % released during 2019/20.



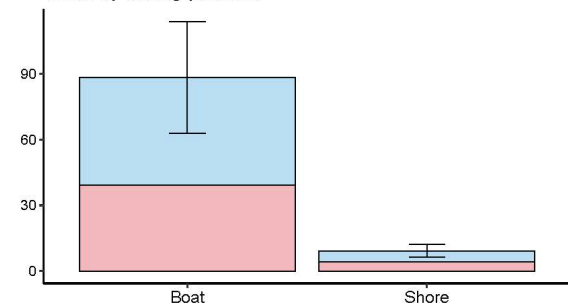
Catch by survey year



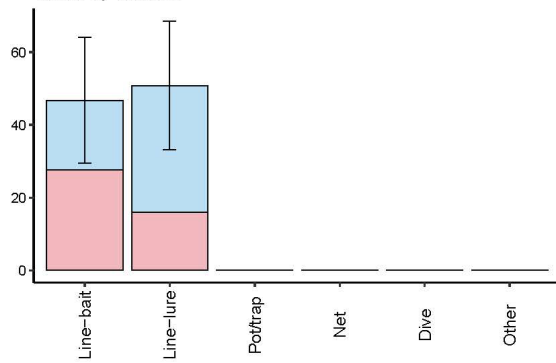
Catch by waterbody



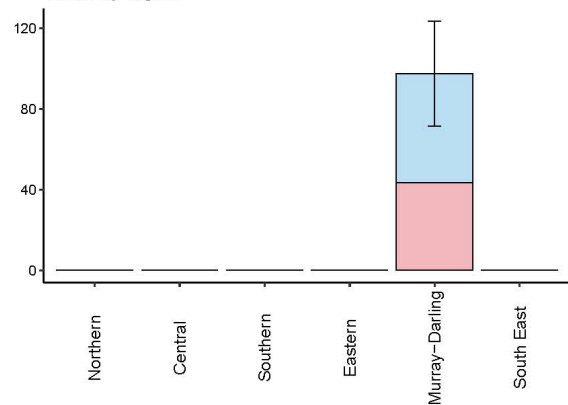
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

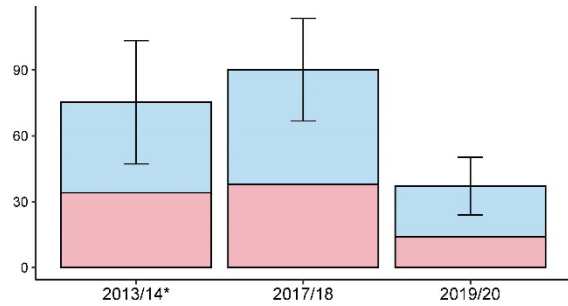
Brown Trout (*Salmo trutta*)

Brown Trout

- Total state-wide catch was 37,132 (RSE = 36 %), with 38 % being kept and 62 % released during 2019/20.

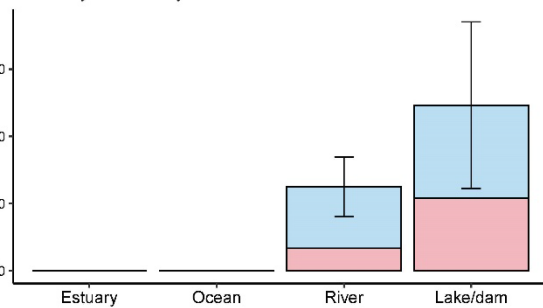


Catch by survey year

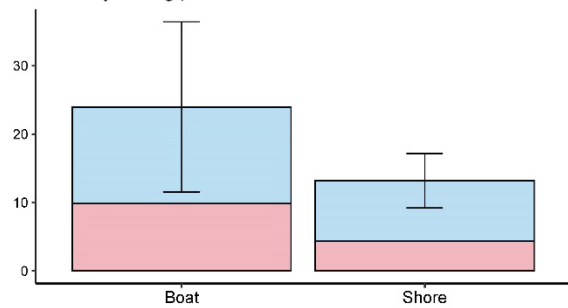


Catch (Numbers x 1000)

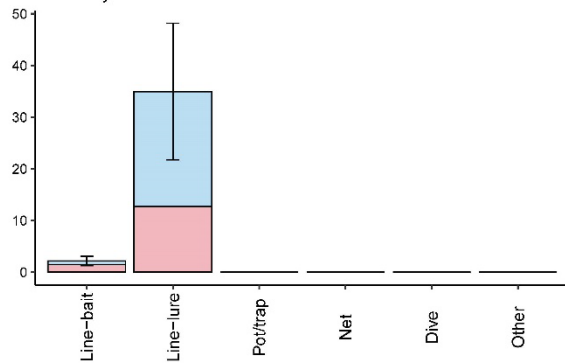
Catch by waterbody



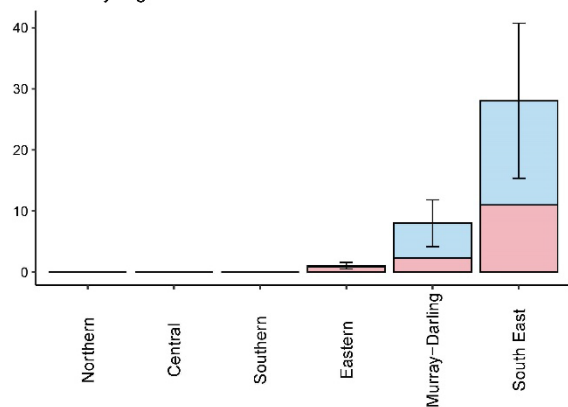
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

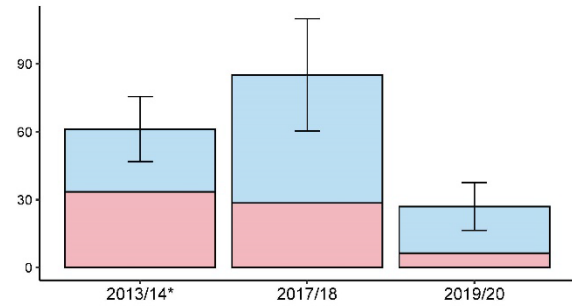
Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow Trout

- Total state-wide catch was 26,970 (RSE = 39 %), with 24 % being kept and 76 % released during 2019/20.

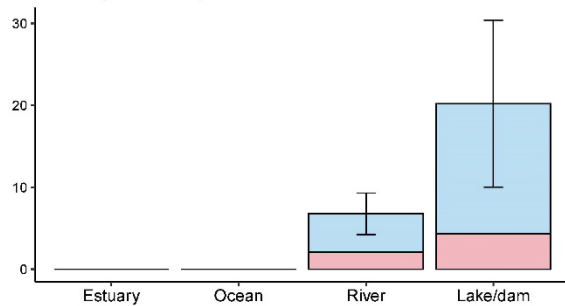


Catch by survey year

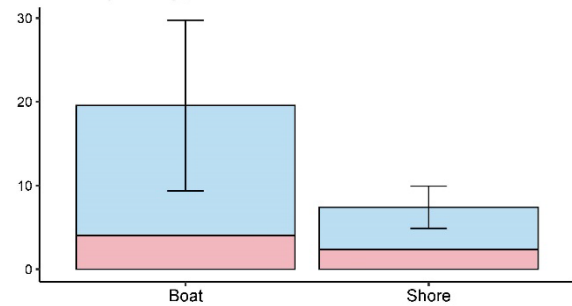


Catch (Numbers x 1000)

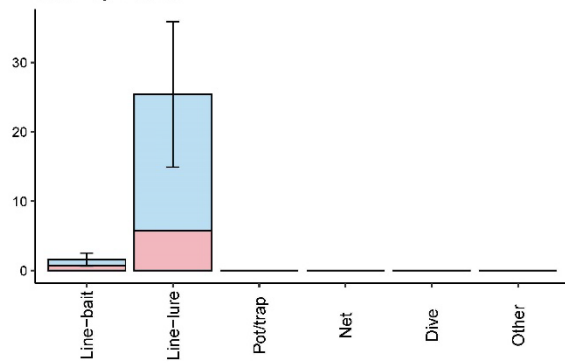
Catch by waterbody



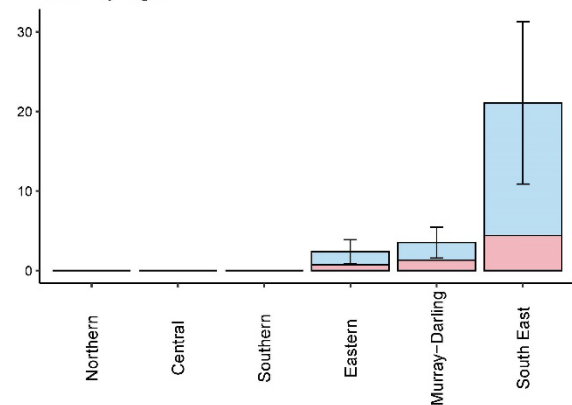
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

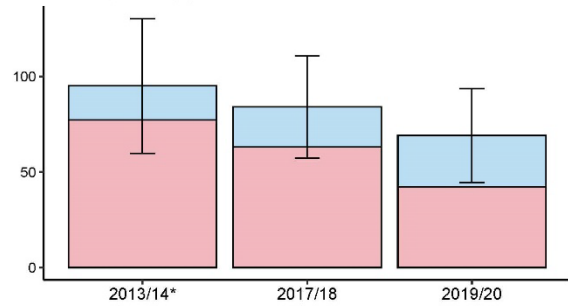
Blue Swimmer Crab (*Portunus armatus*)

Blue Swimmer crab

- Total state-wide catch was 69,116 (RSE = 36 %), with 61 % being kept and 39 % released during 2019/20.

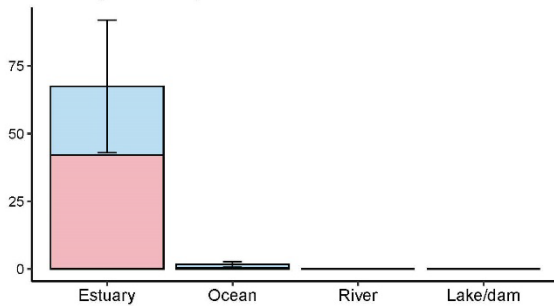


Catch by survey year

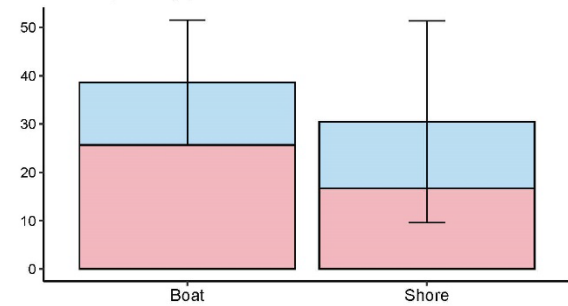


Catch (Numbers x 1000)

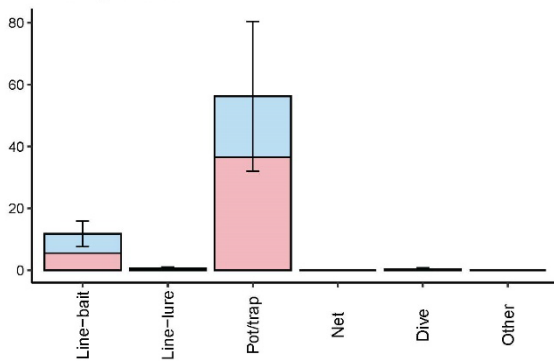
Catch by waterbody



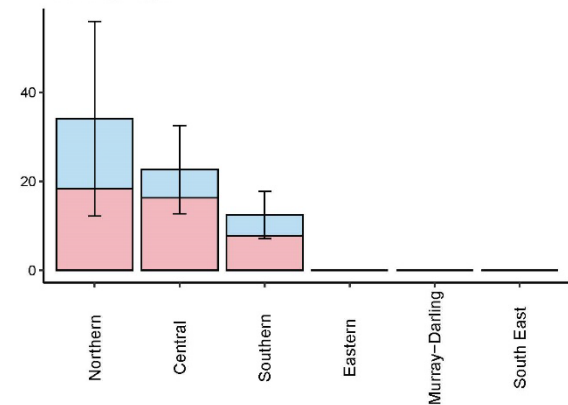
Catch by fishing platform



Catch by method



Catch by region

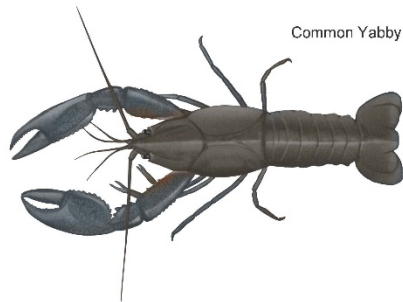


Kept Catch Released Catch

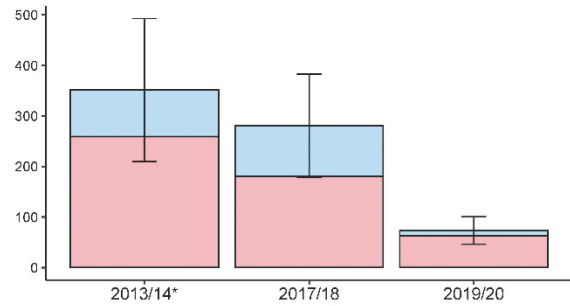
Yabbies - species complex

Yabbies (freshwater)

- 'Yabbies (freshwater)' is a species complex of several Parastacidae species, with the Common Yabby dominating the state-wide catch for this group.
- Total state-wide catch was 73,501 (RSE = 37 %), with 86 % being kept and 14 % released during 2019/20.

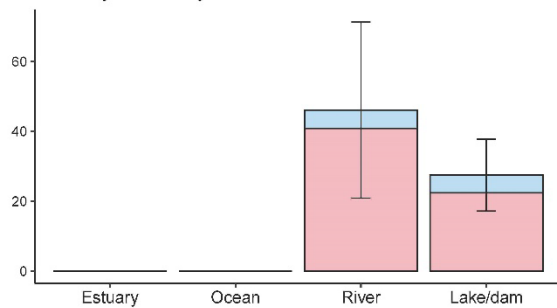


Catch by survey year

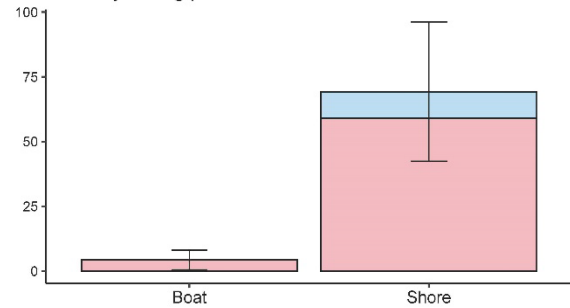


Catch (Numbers x 1000)

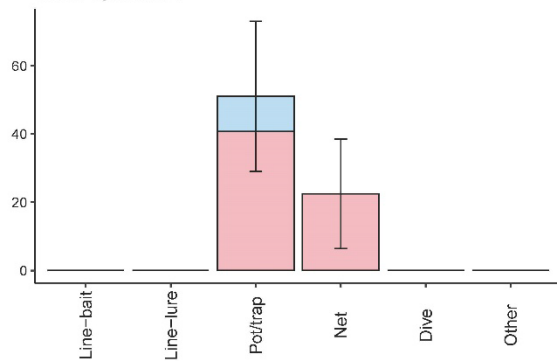
Catch by waterbody



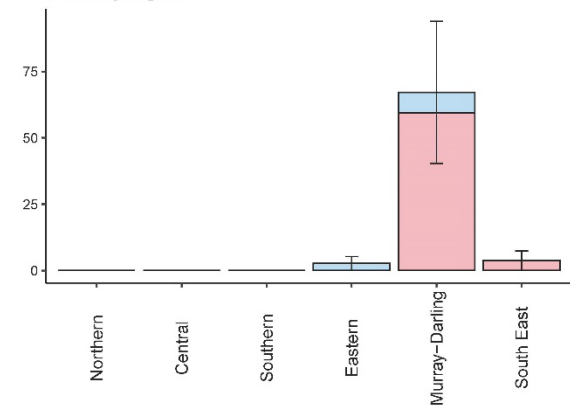
Catch by fishing platform



Catch by method



Catch by region



Kept Catch Released Catch

Discussion

When comparing trends in the recreational fishery over time, it is important to note that sample sizes were similar among surveys (between 1,900 and 2,000 RFL households for each survey year). Response rates remained high although a declining trend since 2013/14 is evident (from 89.6% in 2013/14, 82.6% in 2017/18 and 80.8% for 2019/20). Also, the proportions of eligible RFL households that completed the survey remained high among survey years with 92.0%, 95.8% and 92.9% of these RFL households completing the 12-month Diary Surveys for each of the three survey years. This consistency in response and completion rates among surveys allows for robust comparisons to be made. However, the issue of *inter-annual variability* among survey timepoints is a critical factor when interpreting any differences. These include environmental influences, natural changes in abundance, and socio-economic differences among survey years. Other factors that may also influence patterns include changes to fishing practices (e.g., increased usage of lures, increased preference for catch and release), targeting preferences, technology (e.g., GPS availability, improvements to sounders), and regulations (e.g., size and bag/possession limits).

The 2019/20 survey showed a decline in recreational fishing participation compared with previous survey years across both freshwater and saltwater fishing. Overall, participation in 2019/20 declined by ~18% compared with participation in 2017/18, and by ~27% compared with 2013/14. The magnitude of this trend was similar across participation by total persons, RFL holders, others within RFL households, and total households.

The 2019/20 survey also showed a decline in fishing effort and catch compared to previous survey years. Overall, fishing effort (fisher-days) by RFL households during 2019/20 were lower than in 2017/18 (by ~23%) and lower compared to 2013/14 levels (by ~31%). For catches of finfish and invertebrates, the catch composition and relative importance of key species was stable through time, though variation in catch levels for many species was evident, with lower catches for the majority of species in the 2019/20 survey.

Some common species showed higher catches in 2019/20 compared to 2017/18, such as Bream (14% higher), Snapper (5% higher), Sand Whiting (13% higher), and Silver Trevally (27% higher), whereas the catches of other common species were lower, such as Dusky Flathead (35% lower), Sand Flathead (43% lower), Grey Morwong (54% lower) and Mulloway (43% lower). Declines in catch estimates between 2017/18 and 2019/20 were most pronounced for freshwater species, including Murray Cod (52% lower), Golden Perch (50% lower), Australian Bass (66% lower) and Rainbow Trout (68% lower).

Licence sales figures for 2019/20 also showed a decrease from 2017/18 and 2013/14 – a decline of ~9.1% for all licence categories combined. Short-term licence sales contributed most to this drop in number (~20% lower). Long-term licence sales and renewals remained similar to previous years, but a drop in sales and renewals from 2017/18 to 2019/20 of ~8% was also observed. Fishers who possess a long-term licence are likely to renew their licences to keep them current for expected future fishing thus the relatively stable numbers between years. Whereas purchases of short-term licences are usually made close to the time of an intention to go fishing and can be more responsive to fluctuating social and environmental conditions at the time of purchase.

It is important to point out that the 2019/20 survey was conducted during a very challenging period, with extreme environmental and social events impacting people's movements and

ability to go recreational fishing throughout the survey year. During the 2019/20 survey period, and the lead-up to this period, NSW experienced some of the worst drought conditions on record, as well as an extreme fire season that affected much of the state. This was followed by extensive flooding, and the COVID-19 pandemic. Considering these events, the lower effort and catch are not at all surprising.

The 12-month survey period began in November 2019 which was towards the end of the most severe drought recorded in the European history of Australia. The rivers of the Murray–Darling Basin reached record low flows in December 2019 with very few of the northern Basin rivers flowing at all during December. The rivers in north-eastern NSW experienced the lowest flows on record (Bureau of Meteorology, 2020).

These drought conditions and associated declines in water quality that were exacerbated by high temperatures contributed to extensive fish kill events throughout the Murray–Darling Basin. During the summer of 2018/19, millions of native fish died in the Lower Darling–Baaka River adjacent to Menindee. From June 2019 to March 2020, further broader-scale fish kills occurred throughout the Darling–Baaka River as disconnected refuge pools contracted and water quality deteriorated. Fish stocks in affected rivers were found to be severely impacted (Stocks et al., 2021). This is likely to have impacted on both the natural populations, and people’s decisions to go fishing during the 2019/20 survey period.

During the 2019/20 spring and summer, extensive and severe bushfires heavily impacted on large areas of NSW. Known as the ‘Black Summer’ bushfires they burnt through more land than any other fires in the past 25 years, in addition to being the state’s worst bushfire season on record (Rural Fire Service, 2020). The fires occurred during the middle of the peak holiday season for NSW which is also the peak season for recreational fishing effort in the State. In response to an expected worsening of the fire situation over the new year period for the southern regions of the state, the NSW Government declared a seven-day state of emergency on 2 January 2020. A ‘tourist leave zone’ was declared for a 14,000-square-kilometre area between Nowra and the edge of Victoria’s northern border. This led to the largest mass relocation of people out of the region ever seen. Due to the widespread damage to regional areas by the fires, movement back to affected areas was limited for several months during 2020.

Following the bushfire emergency, widespread rains fell across NSW during late summer and autumn. This resulted in flooding in the Murray–Darling Basin, and many coastal locations experienced their highest daily rainfall on record, with extensive flooding in coastal drainages. The impact of this rainfall and flooding on the State’s waterways was further exacerbated by fire-affected runoff that polluted freshwater and estuarine waterways (Kemter et al., 2021; Smith et al., 2011). For the remainder of the survey year, much of NSW received well above average rainfall (Bureau of Meteorology, 2020).

COVID-19 began to spread throughout south-eastern Australia during early March 2020. To deal with the public health risk and minimise the spread of the disease, the NSW Government enacted a number of enforceable public Health Orders. These included imposing severe restrictions on people’s movement within NSW, as well as closure of international and state borders. These restrictions lasted for various timeframes and at different levels of severity throughout the remainder of the survey year during 2020 (Huveneers et al., 2021; Storen & Corrigan, 2020). Even so, recreational fishing was classified as ‘exercise’ and therefore a

permitted outdoor activity in some jurisdictions, albeit with several conditions that limited recreational fishing activities. For example, fishers had to remain within their Local Government Area (LGA) or within 5km of their home, fishing could be undertaken with one other person, or with other household members only. Interstate residents were effectively banned from fishing in NSW when interstate borders were closed. Anecdotally, towards mid-2020, there were some reports of localised increases in fishing activity, due mainly to people not being able to work or travel and using their time to go fishing in waterbodies that they were permitted to access. Extensive fishing effort has been shown to be imported into NSW regional areas by tourists from Sydney and adjacent states (Henry & Lyle, 2003; West et al., 2015), which was prevented during COVID-19 lockdown periods.

Any of the above mentioned events would, on their own, impact the levels of recreational fishing effort and catch for a period of time, but in combination, these events created a perfect storm of challenges for both fishers and the natural environment during 2019/20. Thus, interpretation of results from the 2019/20 survey should be considered within the context of the likely impacts of these events, especially when comparing results to those from previous survey years. Despite these impacts, the number of RFL households who completed the 12-month survey period remained high, with ~93% of those who began the survey providing information on their recreational fishing activities throughout the year, even when going fishing in NSW was difficult or not at all possible.

The major environmental and social impacts arising from the events outlined above highlights the importance of a consistent, on-going time-series of recreational fishing surveys, such as those undertaken within the RFMP. The data collected provides a robust insight into the impacts of such events on one of NSW's most important recreational activities. The time-series collected by the RFMP will aid government and industry in understanding the potential consequences of such events, and managing their impacts, into the future.

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Appendices

The below appendices can be found at:

https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/1393400/Appendices-1-10.-Survey-of-recreational-fishing-in-NSW-201920.pdf

Appendix 1. Annual recreational participation (numbers of persons*) by Waterbody, Platform, Method and Region for RFL households who fished in NSW waters during 2019/20.

Appendix 2. Annual recreational fishing effort (numbers of fisher-days*) by Waterbody, Waterbody and Platform, Method and Region for RFL households who fished in NSW waters during 2019/20.

Appendix 3. Annual recreational catch (total, kept and released numbers) for 20 key species/groups caught by RFL households in NSW waters for 3 survey years, 2013/14, 2017/18 and 2019/20.

Appendix 4. Annual state-wide recreational catch (total, kept and released numbers) for all species/groups caught by RFL households in NSW waters during 2019/20.

Appendix 5. Annual recreational catch (total, kept and released numbers) for 20 key species caught by RFL households in NSW waters during 2019/20 by Waterbody.

Appendix 6. Annual recreational catch (total, kept and released numbers) for 20 key species caught by RFL households in NSW waters during 2019/20 by Platform.

Appendix 7. Annual recreational catch (total, kept and released numbers) for 20 key species caught by RFL households in NSW waters during 2019/20 by Method.

Appendix 8. Annual recreational catch (total, kept and released numbers) for 20 key species caught by RFL households in NSW waters during 2019/20 by Region.

Appendix 9. The total released numbers for 20 key species caught by RFL households in NSW waters during 2019/20 and the reasons for release.

Appendix 10. Estimates of recreational harvest weight (tonnes) for key species/groups caught by RFL households in NSW waters during 2019/20 compared with harvest weights for the commercial fisheries sector, by ocean and estuarine waters.

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