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Offshore recreational fishing in Tasmania 2011/12

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EXECUTIVE SUMMARY

This study was undertaken to gain an understanding of the recreational offshore and game fisheries in Tasmania, particularly in relation to catch of tunas, pelagic sharks, Striped Trumpeter and Blue-eye Trevalla.

The study used a combination of survey methods, but was primarily based around an offsite telephone diary survey (PDS) to assess recreational catch and effort over a 12 month period (November 2011 – October 2012). This is also the first study to quantify seal induced mortality of recreational catch for key species. At the conclusion of the diary period survey participants were asked a series of questions relating to their motivations and attitudes to recreational fishing, the management of the fishery, interactions with seals and an assessment of their own expenditure on offshore recreational activities in the period under review.

An onsite survey was also conducted to assess catch of Southern Bluefin Tuna (SBT) at two key access points between March and July 2012. This method has been used previously to assess the recreational catch of SBT, but due to concerns over under-coverage of all access points only minimum catch estimates have been possible. By running the two independent survey methods concurrently it was possible to compare methods and calibrate results.

Charter boat catches of SBT were also monitored during 2012 with charter boat operators reported catches in a voluntary logbook, which was issued to operators likely to target the species.

Offshore recreational fishing survey

A stratified random sample of vessels registered on the Marine and Safety Tasmania (MAST) database was selected for the survey. A total of 1,431 owners of powered recreational vessels over 4.5 m participated in a screening survey conducted during October 2011. A third of respondents (510) indicated that they would be at least quite likely to use their boat for game or offshore fishing in the following 12 months. Of these, 92% (467) agreed to participate in the diary survey, with 88% (413) completing the 12 month survey. Just under two-thirds (289) of these respondents reported some form of game or offshore fishing using their vessel. Catch and effort information reported by respondents has been expanded to represent the offshore fishing activity of all private powered vessels over 4.5 m using the known proportion that the surveyed vessels represent of the total number of vessel registrations in Tasmania.

Effort
Offshore fishing, for the purpose of this survey, was categorised as: trolling for tuna, pelagic shark fishing, mid-depth reef fishing (depths ~50 – 250 m, where Striped Trumpeter are commonly caught) and deep sea fishing (depths greater than 250 m, where Blue-eye Trevalla are most commonly caught).

Trolling for game fish occurred between December and June, with effort (days fished) peaking in February and April; the February peak corresponded to effort targeted at Albacore and the April peak to effort targeting SBT. Trolling activity was reported exclusively off the East, Southeast and South coasts of Tasmania.

Most of the effort targeting pelagic shark occurred off the North coast, with some activity occurring along the East and Southeast coasts of Tasmania. A small amount of effort was also recorded from the mid-West coast. Effort peaked strongly in January, but ranged from November to April.

Mid-depth reef fishing activity was heaviest between November and January with a secondary peak in April, coinciding with Easter. Mid-depth reef fishing occurred all around Tasmania but the majority occurred off the East and Southeast coasts.

Deep sea fishing mainly occurred over the warmer months, between January and April, with relatively low activity at other times of the year. Effort was focused on the East coast, in particular the Northeast coast.

Catch

Albacore were the most commonly retained tuna species taken by trolling from private recreational vessels during the 2012 gamefishing season, with 8,290 individuals kept (retained weight was not estimated) and a further 1,406 (14% of total numbers) released. Skipjack tuna were the most commonly caught tuna species (total 11,955), however a much greater proportion of catch (68%) was released, resulting in an estimated 3,724 (11.2 t) retained. The retained catch of SBT, by number, was the lowest of the three species at 3,243, but it was the largest catch by weight (59.9 t). In addition to the harvested component, a further 1,035 (24%) SBT were released. With the inclusion of SBT taken by the charter boat sector, the combined estimated harvest of SBT for the recreational sector was at 75.8 t. Furthermore, if SBT lost to seals (assuming 100% mortality) prior to landing are also included, the total impact on the SBT stock by the Tasmanian recreational fishery was 103 t in 2012.

Shortfin Mako shark was the most commonly caught and retained pelagic shark, catches estimated at 317 individuals (21.5 t), with a further 39% caught and released. Far fewer Blue shark were caught, with less than 50 retained but around 2.5 times this number released.

A variety of species were commonly caught while mid-depth reef fishing, for several of these species the catch estimates presented in this report will only represent a minimum harvest estimate. Species such as Jackass Morwong, Wrasse, Gurnard, Cod and Ocean Perch are all caught in other forms of recreational fishing as well as offshore mid-depth reef fishing. Striped Trumpeter is an exception, although being caught very occasionally by recreational nets or in lobster pots, the vast majority of the recreational catch is taken by line fishing on mid-depth reef areas. An estimated 7,274 Striped Trumpeter were retained during the survey period, equating to 31.9 t, with a further 1,261 (15%) released. When fish lost to seals (assumed 100% mortality) prior to landing are included, the total impact on the Striped Trumpeter stock by private boat fishery in Tasmania was 35.5 t.

Blue-eye Trevalla was the most common catch taken while deep sea fishing, with a retained catch estimated at 1,961 or 12.5 t. Several other species were also caught but catch estimates were not calculated due to low sample sizes.

Motivations and attitudes

A questionnaire based survey conducted at the conclusion of the telephone diary survey provided insights into the motivations and attitudes of recreational fishers to a range of issues, including seal interactions, fisheries management options and general fishing satisfaction.

The majority of respondents agreed that the best way to avoid losing fish to seals was to avoid fishing in areas where seals are present. There was also strong agreement that using previously caught fish as a decoy only encourages seals to interact with fishers more. A majority of respondents did not agree that any fish lost to seals should be included in the personal bag limit.

In regard to a series of hypothetical management options, the strongest response was opposition to a proposal that SBT should be a catch and release species only. The second strongest response was objection to the introduction of a saltwater angling licence. There was majority support for a reduction in the possession limit of pelagic sharks to one per person as well as a catch and release only fishery for Striped Marlin. There was also majority support for boat limits for key offshore and game fish species as well as an increase in the size limit of Striped Trumpeter to match the size at 50% maturity.

The majority of respondents were quite satisfied with the offshore and game fisheries in Tasmania, with results indicating that fishers derive benefits from offshore recreational fishing that is unrelated to catching fish and the more experienced and active (avid) fishers were more likely to indicate that fishing could be satisfying even if no fish are caught or catch rates are low than less experienced or less avid fishers.

A simple economic assessment was also conducted, indicating that owners of motorized vessels greater than 4.5 m who expressed an intention to participate in offshore fishing during the survey period spent an estimated $25 million in direct and attributable expenditure on their recreational fishing activities.

Boat ramp SBT survey

Boat ramp surveys of vessels targeting SBT were conducted from March to July 2012 at Pirates Bay and Southport. A total of 834 interviews were conducted, 678 at the Pirates Bay boat ramp with 571 (84%) involving game fishing. A further 156 interviews were conducted at Southport, involving 72 (46%) game fishing trips.

The estimated number of SBT caught and retained on fishing trips originating at the two target boat ramps was 1,283, a further 501 were estimated to have been released and a further 605 lost to seals.

The estimated weight of SBT caught and retained on fishing trips originating from the two target boat ramps was 21.4 t. Fish lost to seals during the capture process (not landed) accounted for a further 9.9 t or 32% of combined mortality attributed to recreational fishing activity.

Comparison between boat ramp and diary survey catch estimates

The creel survey estimate of total catch (21.4 t) was significantly lower than the telephone diary survey estimate (59.9 t). The main reason for the underestimate of catch was the restricted coverage of potential access points by the boat ramp survey. Pirates Bay and Southport have traditionally been the main points of access to the SBT fishery, however, during 2012, trips originating from these ramps accounted for just 39% of the total catch reported to the diary survey.

To assess the comparability of the two independent survey methods, only data for trips originating from Pirates Bay were compared. Although catch estimates (retained, released and lost to seals) were lower for the diary survey, these differences were not statistically significant. The seasonal pattern in catches was similar between surveys.

Charter boat catch of SBT

The recreational charter fishery targeting SBT is spatially and temporally distinct within Tasmania. The majority of the effort and catch is restricted to south-eastern Tasmania adjacent to the Tasman Peninsula and is concentrated between March and July, by a small numbers of operators.

There were strong seasonal patterns in charter fishing with 272 game fishing trips undertaken between March and July. 94% of which involved the capture of at least one SBT. Overall, a total of 1090 SBT were caught, with 937 retained and 153 (14%) released. The total retained weight of SBT caught by the Tasmanian recreational charter sector during 2012 was 17.8 t, catch numbers peaking in April.

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1. GENERAL INTRODUCTION

Recreational fishing is a popular past time in Tasmania, with around 120,000 Tasmanians (over one in four persons) fishing at least once a year (Henry and Lyle 2003, Lyle et al. 2009).

Understanding of the impacts of commercial fishing has increased steadily over the past century, along with mechanisms for managing these impacts (Caddy 1999). Far less, however, is known about the impacts of recreational fishing. This is an important knowledge gap, given that the size of the catch from recreational fisheries can exceed commercial fisheries (Coleman et al. 2004, Cooke and Cowx 2004, Lyle et al. 2009, Ford and Gilmour 2013). As recreational fishing becomes more popular it is increasingly important to measure catch and effort, as well as develop an understanding of the socio-economic benefits of recreational fishing in Australia.

In recognition of the need to improve our understanding of the impacts and benefits of recreational fishing a national policy was developed in Australia, endorsing the principle that 'fisheries management decisions should be based on sound information including fish biology, fishing activity, catches and economic and social values of recreational fishing' (NRFWG, 1994). An important outcome of this policy was the development of a national survey of recreational fishing which occurred in 2000/01 (Henry and Lyle 2003). This survey provided a comprehensive but generalised assessment of recreational fishing in Australia. Since then most States and Territories have conducted surveys at least once. The national survey represents an important baseline against which trends in recreational activities and catch and effort can be assessed. At a jurisdictional level, these large-scale surveys are useful tools for management, providing information with which to manage recreational fisheries as well as understanding the drivers and attitudes of recreational fishers.

These surveys are designed to provide a 'big-picture' perspective of the recreational fishery. It is important, however, to recognise that comparatively rare or highly specialised activities, which within the context of the *overall* recreational fishery are minor components, may not be well represented in these surveys. In such instances estimates of catch and effort tend to be imprecise and alternative, targeted surveys are required to provide more reliable assessments of such activities (Lyle et al. 2009).

Offshore fishing activities are often the domain of many prized fisheries, particularly for reef species, which can grow to a large size (trophy fish) and are also often of excellent eating quality. Game fishing is also an important offshore activity, and some might say the elite realm of recreational fishing, where large trophy fish, including tunas, billfish and pelagic sharks are the target species. Game fishing has a reputation as being an expensive sport and for many recreational fishers the cost of participating in game fishing activities is a limiting factor.

Both offshore reef and game fisheries target species that are commercially and/or ecologically significant. The management of many of these species involve multiple jurisdictions (state, national and/or international) and although some are supported by robust stock assessments, recreational fisheries are generally lacking quality data and assessment. For example, tunas are a popular target of game fishers but very little is known about the recreational harvest of these species. Such an understanding is important on two levels, first to ensure that stock assessments account for all sources of fishing mortality, but also to ensure that the recreational sector is properly accounted for in the management of the fishery, in particular in respect to policy development around resource sharing and in managing the impacts of fishing in general.

1.1. SURVEY METHODOLOGY

Methods to estimate recreational harvest, released catch, and effort differ from that for commercial fisheries. Commercial fishery data is generally collected through mandatory reporting of catch and effort. Recreational fisheries require probability-based sample surveys commonly called angler or creel surveys (Jones and Pollock 2012). There are a range of survey techniques available to assess recreational fisheries (reviewed in Jones and Pollock 2012), with the specifics of the fishery determining the most appropriate method.

In this study we utilise three survey methodologies to assess offshore recreational fishing, or components thereof, in Tasmania. An offsite phone diary survey (PDS) is used to assess the catch and effort across several key species. We then present the results of an onsite creel survey (OCS) focusing on the recreational Southern Bluefin Tuna (SBT) fishery from two major access points where trailer vessels targeting SBT often launch. The latter approach has been used in previous surveys to assess the recreational fishery for SBT in Tasmania (Morton and Lyle 2003, Forbes et al. 2009). Finally, the catch of SBT from charter boats is assessed, based on data collected via a logbook program.

The PDS method has proven to be a very effective approach to gathering information on recreational fisheries (Lyle et al. 2009, Jones and Pollock 2012). The method is elaborated on in subsequent sections of this report, but involves the random selection of fishers from a sample frame, for example the white pages telephone directory listing (serving as a proxy for a listing of households) or the list of recreational licence-holders. Applications of the PDS method in Tasmania include the national survey (Henry and Lyle 2003), a survey of statewide recreational fishing in 2007/08 (Lyle et al. 2009), biennial surveys of Rock Lobster and Abalone fisheries (Lyle and Tracey 2010) and a survey of the recreational gillnet fishery (Lyle and Tracey 2011). For fishing activities that require recreational fishing licences, the licence database represents a very efficient sampling frame. For activities that are not subject to licensing but are considered to be specialised or relatively rare activities, such as fishing for offshore reef species and/or game fish, it would be necessary to screen a very large sample of the resident population (utilising a white pages search) to obtain an adequate sample of offshore and game fishers, a process which could prove to be cost ineffective. In this study we have explored an alternative approach to developing a sampling frame of offshore reef and game fishers in Tasmania.

By its very nature offshore fishing requires a boat to access fishing grounds. Boat-based fishing is very popular in Tasmania, with a high proportion of vessel ownership amongst Tasmanian households (Lyle et al. 2009). Over the past decade or so there has been a trend in the recreational sector towards larger and more expensive vessels, improved navigation and fish finding technology and fishing gear. This trend has been accompanied by an apparent expansion in offshore fishing activities, with a variety of tuna and pelagic shark species as well as deep water species such as Striped Trumpeter and Blue-eye Trevalla being targeted. In the context of the marine recreational fishery, this offshore fishery represents a relatively minor component of the total number of boat-days fished in Tasmania (Lyle et al. 2009) but it does target a number of iconic species and involves disproportionately high economic activity.

Previous targeted surveys of game fishing in Tasmania have been limited in spatial scope (e.g. Morton and Lyle 2003, Forbes et al. 2009), mainly due to logistic problems related to sampling participants in a cost effective manner. Recognising that the offshore fishery is boat-based and restricted to certain vessel classes (based on size and power), the registry of recreational vessels administered by Marine and Safety Tasmania (MAST) represents a potentially useful sample-frame from which offshore fishers (boat owners) could be sampled. Furthermore, because the number of vessels is known, the database provides information about the size of the 'population' against which surveyed fishing activity can be expanded.

Depending on the spatial scale of interest, onsite surveys can represent a cost effective approach relative to a PDS to collect detailed information about a fishery. With few access points to a particular fishery an OCS can be used to assess catch and effort, for example a recent survey of SBT harvest in Victoria, Australia (Green et al. 2012). However, when the spatial scale of a fishery is large and the number of access points is great an OCS will only provide a partial assessment of catch and effort of the target fishery as occurred in previous onsite surveys focusing on game fishing in Tasmania; with results from these surveys reported as minimum estimates as there was uncertainty about the coverage of the fishery using a limited number of access points (Morton and Lyle 2003, Forbes et al. 2009). In this study we compare catch and effort estimates for SBT based on the PDS and OCS to provide a partial validation of these independent survey methods.

1.2. Key species

The objective of this study is to focus on offshore species, specifically Striped Trumpeter (*Latris lineata*) and Blue-eye Trevalla (*Hyperoglyphe antarctica*), and game fish species, including Southern Bluefin Tuna (*Thunnus maccoyi*) and large pelagic sharks, specifically Shortfin Mako (*Isurus oxyrinchus*).

1.3. Objectives

This report covers two projects funded by the Fishwise Community Grants Scheme. The specific objectives of each study were:

1.3.1. Boat-based survey

1. Estimate the number of vessels involved in the offshore fishery (as defined) and their characteristics.

2. Provide reliable estimates of catch and effort, including release rates, by sub-fishery, key species, region and season.

3. Assess awareness and attitudes of boat fishers to issues of relevance to the offshore fisheries.

4. Assess economic activity in terms of direct expenditure and investment in the offshore fishery.

1.3.2. Onsite survey

1. Quantify the recreational SBT catch at key access points for the 2012 fishing season using an on-site survey method.

2. Compare and validate catch rates and size composition data from the on-site survey with those from an off-site phone/diary survey.

3. Quantify the size composition of the recreational SBT catch to convert harvested numbers to harvested weights.

1.3.3. Charter boat fishery for Southern Bluefin Tuna

While not a specific objective of the Fishwise funded projects, we provide an assessment of the catch and effort of the recreational charter sector in Tasmania specifically in regard to catch of SBT.

2. SURVEY OF OFFSHORE PRIVATE BOAT FISHING IN TASMANIA

2.1. METHODS

2.1.1. SURVEY DESIGN

An offsite phone diary survey (PDS) approach was used to assess the catch and effort from recreational fishing of key game and offshore fish species from private boats over a 12 month period, between November 2011 and October 2012. The survey involved a two-stage process; an initial telephone interview to establish eligibility and collect profiling information; and a follow-up telephone-diary survey in which boat based offshore recreational fishing and game fishing activities were monitored in detail over a twelve month period.

2.1.2. SURVEY SAMPLE

The survey sample was selected from the 2011 recreational vessel registration database administered by MAST. While the majority of registered vessel owners are Tasmanian residents, a small number of interstate residents also have vessels registered in Tasmania.

From the entire ‘population’ of registered recreational vessels a ‘targeted population’ was drawn based on a set of decision rules relating to the vessels perceived capability to participate in offshore recreational fishing. Specifically, yachts, personal water craft, inflatables, vessels with trade plates and vessels less than 4.5 m in length were excluded from the target population. This target population was then divided into five regional strata based on the postcode of the registered owner of the vessel. These regions corresponded to the ABS statistical divisions (SDs) of Greater Hobart, Southern, Northern and Mersey-Lyell. Interstate residents were grouped into a fifth ‘Interstate’ stratum. A random sample based on a constant sampling fraction (7%) was applied to each of the regional strata. The regional strata were further stratified by vessel size, with five strata recognised: (1) no vessel size recorded, (2) 4.5 – 5.5 m, (3) 5.6 – 8.5 m, (4) 8.6 – 11.5 m and (5) greater than 11.5 m. For size strata 1, 4 and 5, 40% of the vessels were randomly selected from each regional strata. Size strata 2 and 3 accounted for the vast majority of the overall target population (92% by number), accordingly the target sample fraction was reduced for these two strata to 10% and 20% respectively from each geographic strata.

2.1.3. SCREENING SURVEY

A random sample of registered vessel owners from the target population was contacted by telephone, on behalf of MAST, during September 2011 and asked whether they would give permission for the release of their contact details to the University of Tasmania for the purpose of a survey related to recreational vessel usage. This was to ensure adherence to the Privacy Act (Act No. 119) 1988. To avoid a biased response it was not revealed at that stage that the survey related to recreational fishing. Those owners that gave permission to be contacted were subsequently contacted by telephone in late September or early October to participate in the screening survey.

Respondents were asked if their selected vessel had been used for recreational fishing in the previous 12 months, and if so which of the following recreational fishing activities it had been used for by either themselves or others, categorised as: freshwater fishing, inshore/estuarine fishing (including potting and netting), game fishing (including the targeting of Mako Shark), offshore fishing (specifically at depths typical for the capture of species such as Striped Trumpeter or Blue-eye Trevalla), dive harvest or ‘other fishing’ in or adjacent to Tasmanian state waters. If either game fishing or offshore fishing was identified, respondents were asked to give their ‘best estimate’ of the number of days the vessel was used for each of these specific activities. All respondents, regardless of their response to the previous question, were then asked about the likelihood that their vessel would be used for recreational fishing during the 12 months commencing the 1st of November 2011. Then more specifically, respondents were asked about the likelihood that the vessel would be used for offshore recreational fishing or game fishing during the same period. If the response to this last question was ‘quite likely’ or ‘very likely’ the owner was invited to participate in a diary survey in which fishing activity was to be monitored for 12 months.

2.1.4. Telephone-diary survey

The telephone-diary survey commenced on the 1st of November 2011, coinciding with the opening of the Striped Trumpeter season in Tasmanian waters, and ran through to the 31st October 2012. By covering the full year the survey included the popular recreational fishing periods during summer and Easter as well as the recreational tuna season for Tasmania, which generally runs from February through to August.

Respondents who agreed to participate were mailed a simple fishing diary/logbook and a formal letter of introduction. Diarists were contacted by telephone shortly afterwards to confirm receipt of the diary and to have reporting requirements explained. Diarists were then contacted regularly by telephone throughout the diary period by survey interviewers who recorded details of any offshore or game fishing activities since last contact. The frequency of the contact was tailored to the needs and behaviour (level of fishing activity) of individual respondents and thus detailed information was routinely collected soon after each fishing event; minimising recall bias for any non-diarised data. By maintaining regular contact, interviewers were also able to immediately clarify any misunderstandings or inconsistencies at the time of the interview, thereby ensuring overall data quality and completeness. Most diarists were contacted at least once a month, even if no fishing activity was planned.

Information recorded for each fishing event included the date, fishing location, departure location, whether offshore bottom fishing or game fishing was the intention, the number of hooks used for bottom fishing or the number of lines used for game fishing, species targeted (up to two), start and finish times (including any significant breaks from fishing), catch composition by numbers kept (harvested) and numbers released or discarded. The reason or reasons for release/discarding was recorded for each species and each fishing event. Information on any interactions with wildlife with the fishing event was also recorded, including the number of fish lost to seals. Individual size measurements for key species, Striped Trumpeter and Southern Bluefin Tuna, were also provided by some respondents. Fishing locations were allocated into one of 12 coastal regions (Fig. 2.1).

By definition, a fishing event was described in terms of method (bottom fishing or game fishing), target species and fishing region. If more than one method was used or different regions were fished on a given day, separate events were recorded. For example, two separate events were recorded if a respondent bottom fished and game fished on the same day, with catch and effort information linked separately to each method.

Fig. 2.1. Map of Tasmania showing Australian Bureau of Statistics 'Statistical Divisions' on land and coastal regions as categorised for assessment throughout the telephone-diary survey. The locations of the two boat ramps targeted for the onsite creel survey are also shown.

2.1.5. DATA EXPANSION (CATCH, EFFORT AND EXPENDITURE)

Estimates of total effort and catch for the target population of registered boats were generated by expansion of responses provided during the PDS based on the effective sample fraction for each stratum (i.e. the total number of vessels in the stratum divided by the number which participated in the survey). Estimates of expenditure of the target population were generated by expansion of responses provided to the 'wash-up' survey (covered in Section 5). In the absence of a 'non-intending fisher follow up survey' to account for any vessels that were unexpectedly used for offshore or game fishing during the survey period it was assumed that all vessels for which respondents to the screening survey indicated no intention to fish offshore had in fact done no offshore fishing with the nominated vessel.

Non-parametric confidence intervals around mean catch and effort estimates were derived empirically through standard bootstrap methods (Haddon, 2001). Random samples were drawn, with replacement, from the sampled population 1000 times, taking account of the stratification used in selecting the sample. For each bootstrap sample, catch and effort datasets were constructed by selecting the complete set of fishing events for each vessel, for each of their occurrences in the bootstrap licensee sample. Similarly, the bootstrap dataset generated for expenditure selected the total expenditure for each respondent. The mean estimates and 95% confidence intervals were calculated from bootstrap catch datasets by species, by species and capture region, by species and capture month, and by species and region and month. Similarly, mean and 95% confidence intervals were calculated for effort datasets by region, by month, and by month and region.

2.1.6. Conversion of catch numbers to weights

Tuna species

Individual size measurements were compiled from three sources – the PDS, the OCS and research fishing investigating post-release survival of SBT. For the two fishery dependent surveys, individual fish sizes (length or weight) were either reported as being measured directly (using a tape or balance) or based on fisher estimates. The majority of individual fish sizes reported during the OCS were reported as lengths (both measured and estimated), and for the research fishing, lengths were routinely reported. For all data reported as lengths a length-weight conversion was applied (CCBST 1994). In all cases we have only used fish reported as being measured. If, for a given month there were fewer than ten individual fish measured then the weight distribution of all fish was applied for that month.

The monthly catch estimates (numbers kept) in addition to estimates of the numbers of fish lost to seals were converted to weights within the probability based bootstrap model described above, providing estimates of the biomass harvested and lost due to seal predation.

Only estimated weights were provided for Skipjack Tuna during the offsite survey (n = 268). To provide an estimate of harvested biomass an average individual weight was calculated from these estimated weights and multiplied by the total estimated catch (numbers).

A harvested biomass estimate was not calculated for Albacore. The size of Albacore available to the fishery varies significantly, and in any case the estimated weights reported by diarists appeared to be biased towards reporting of sizes for larger fish, that is respondents tended only to report numbers for the smaller fish.

Mid-depth reef species

Individual Striped Trumpeter lengths and/or weights were reported as either measured or estimated, with length recorded as either total or fork lengths. To estimate an average weight of Striped Trumpeter only measured fish were used (*n* = 329). Total length was converted to fork length using the equation reported by Tracey et al. (2011):

$$FL = \frac{TL - 7.94}{1.08}$$

and fork length (FL) was then converted to total weight (W) using the equation reported by Tracey and Lyle (2005):

$$W = 2 \text{ x } 10^{-5} \text{ x } FL^{3.0}$$

No size information was recorded during this survey regarding the size or weight of Jackass Morwong, Bearded Rock Cod or Wrasse; conversion of estimated catch numbers to weight for these species was based on average weights reported by Lyle et al. (2009). For other commonly reported species, namely Ocean Perch and Gurnard, information on average weights was not available.

Deep water species

There were no reports of the size of Blue-eye Trevalla caught. In order to convert the number of fish caught to a harvested biomass the average length of Blue-eye Trevalla recorded by observer measurements from the commercial catch in 2011 were used (Klaer 2012). The average weight of a fish was then calculated using a length-weight relationship with parameters sourced from Klaer (2012):

$$W = 0.018 \text{ x } L^{3.016}$$

2.2.RESULTS

2.2.1. Screening survey

The MAST recreational vessel registration database (population) contained 28,595 vessels when acquired by IMAS on the 8th of September 2011. Of these, 14,181 or 50% were deemed eligible (target population) for the survey on the basis of decision rules outlined in section 2.1.2 relating to the suitability of the vessel to participate in offshore fishing.

Vessels in the 4.5 – 5.5 m size class were the most common (62%) in the target population, given the large number of vessels in this group the sampling fraction was the lowest of all groups at 5%. Vessels in the 5.6 – 8.5 m size category were the second most common group (30%) and were considered the most likely size group to be used for offshore fishing, accordingly a higher sample fraction of 15% was applied in this category. Vessels 8.6 – 11.5 m and greater than11.5 m were less common, representing 3% and 2% respectively of the target population. Given the small number of vessels in these size classes it was possible to apply high sampling rates, equivalent to 29% for the former and 30% for the latter. A further 3% of vessels had no size information recorded in the MAST database (Table 2.1). A sampling fraction of 25% was achieved for this group and the size of each vessel confirmed with respondents. Based on the proportional representation by size class within this sample, the total number of vessels in each of size classes in the target population were adjusted upwards in accordance with the estimated number of vessels that did not have lengths reported in the database (Table 2.2).

Overall, 10% of all vessels in the target population were screened for eligibility to participate in the diary survey (Table 2.1)

Table 2.1. The size composition of boats in the target population, and the number of vessels contacted within each size category at pre-screening - to request permission to be surveyed and the number of fully responding vessel owners contacted during the screening survey and resulting sample fractions.

Size category	Target population	Sample contacted (pre-screening)	Sample fraction (pre-screening)	Full response (screening)	Effective sample fraction (screening)
No size reported	355	114	32%	88	25%
4.5 – 5.5 m	8,811	574	7%	462	5%
5.5 – 8.5 m	4,299	794	18%	665	15%
8.5 – 11.5 m	439	162	37%	129	29%
11.5 m +	277	100	36%	84	30%
Total	**14,181**	**1,744**	**12%**	**1,428**	**10%**

Table 2.2. The proportion of vessels reported to size categories during the screening survey of vessels where no vessel size was reported in the registration database.

Size category	Reported size	Percentage response
No size reported	7	-
< 4.5 m	46	57%
4.5 – 5.5 m	18	22%
5.5 – 8.5 m	14	17%
8.5 – 11.5 m	3	4%
≥11.5 m	0	0
Total	**88**	

2.2.2. Response rates

Prior to engaging respondents in the screening survey a sub-sample of 2,000 (14%) of registered vessel owners from the target population (14,181 vessels) were contacted on behalf of MAST to request permission for their contact details to be released to IMAS for the purpose of a survey on recreational boat usage. Contact was made with 1,744 (87%) of these registered vessel owners, with 256 un-contactable for a range of reasons including wrong and disconnected phone numbers or no answer. Of those contacted during the pre-screening permission call 1,533 (88%) gave their permission for their contact details to be passed on to IMAS.

Of the 1533 respondents who were contacted for the screening survey 1431 (93%) provided full responses (1 in 10 of all registered vessels in the target population), 19 (1.2%) refused to participate, one provided a partial response and 83 (5.5%) were non-contactable for a variety of reasons including, no answer after multiple attempts (59) and non-response due to other factors such as disconnected phone lines (24).

Results from the screening survey indicated that 510 vessels (33% of vessels from fully responding participants in the screening survey) were identified as eligible for the subsequent diary survey, determined by a response indicating a likelihood of the vessel participating in offshore and/or game fishing during the 2011/12 survey period. Of those vessels that were eligible, 467 (93%) of the registered boat owners agreed to participate in the 12 month diary survey (Fig. 2.2).

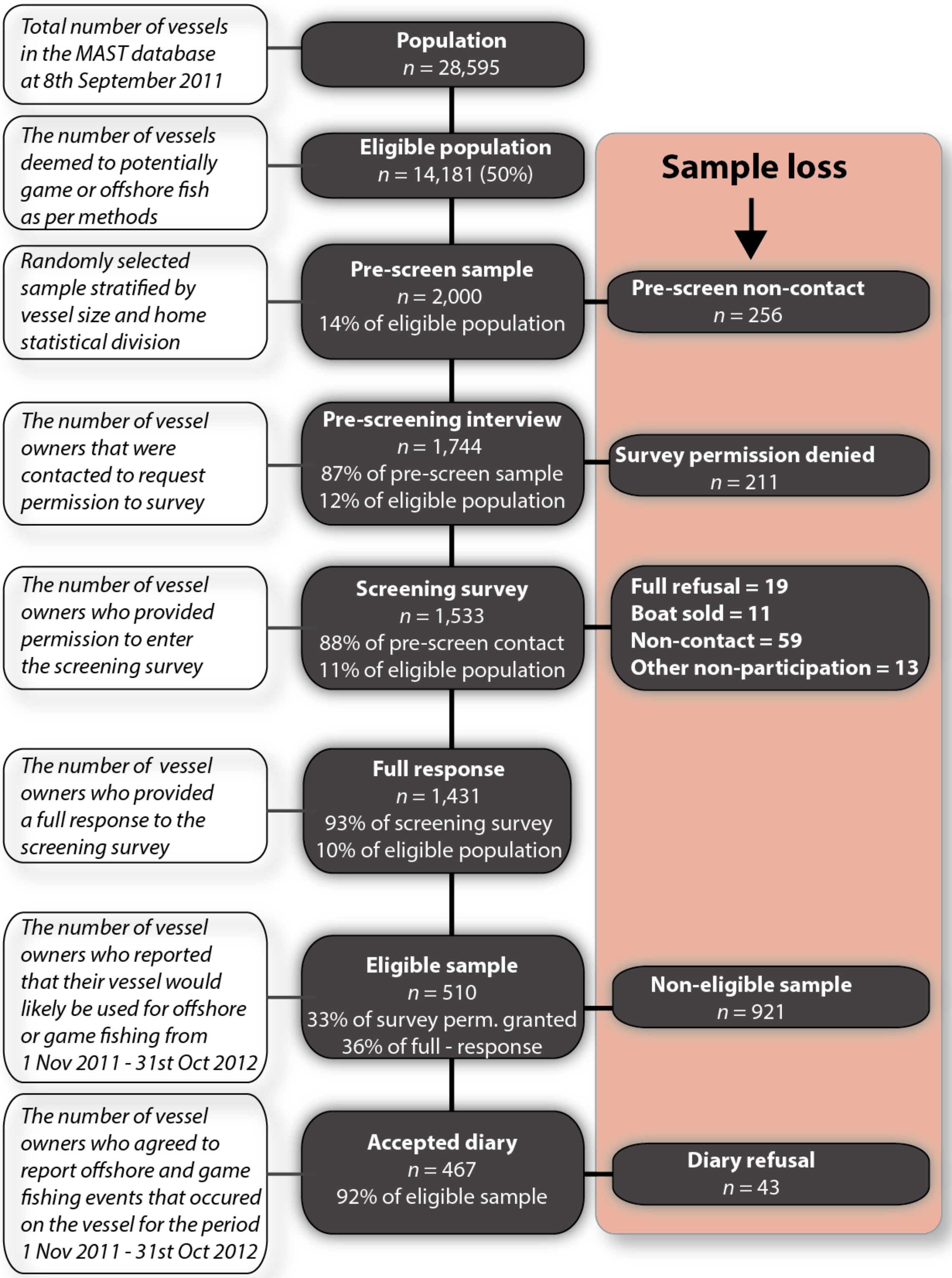

Fig. 2.2. Diagrammatic representation of the pre-screening, screening survey and longitudinal diary survey response profile (*n* is sample size).

2.2.3. *Recreational fishing activity reported during the screening survey*

A series of questions were asked during the screening survey to provide a profile of respondents fishing activity over the 12 months prior. The vast majority of the boats were used for recreational fishing at least once in the 12 months prior to screening (1160 vessels or 81% of the total sample). For the remaining vessels not used for fishing, many were identified as being unsuitable for fishing, such as racing and ski boats.

Inshore fishing, which included line fishing, netting and potting, was the most prevalent activity reported for vessels used for fishing (1090 vessels or 94% of the total), this was followed by game fishing (338 or 29% of fishing boats), dive harvest (313 or 27%), offshore fishing (290 or 25%), freshwater fishing (243 or 21%), and other fishing activities (17 or 1%) (Fig. 2.3).

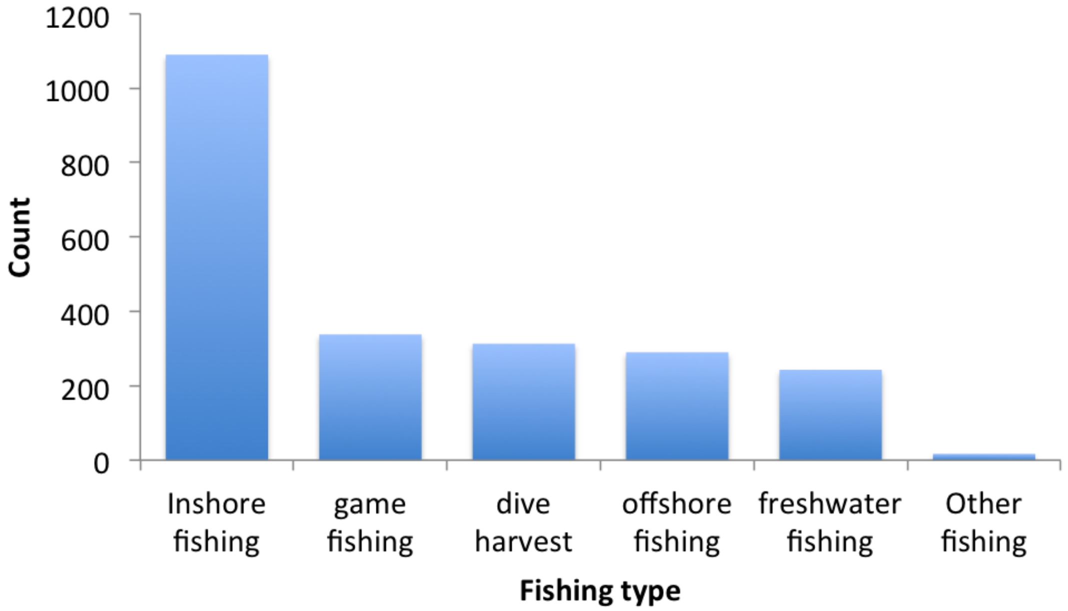

Fig. 2.3. Modes of fishing reported for the 12 months prior to the screening survey from 1160 boat owners who reported some form of recreational fishing from their vessel.

Respondents reported a combined total of 22,118 days boat fishing for the sampled vessels during the 12 month period prior to the screening, the vast majority reporting that the vessel was used for 20 or fewer days fishing during this period. Twenty two vessels (2%) were reported to have been used for 100 days or more (Fig. 2.4).

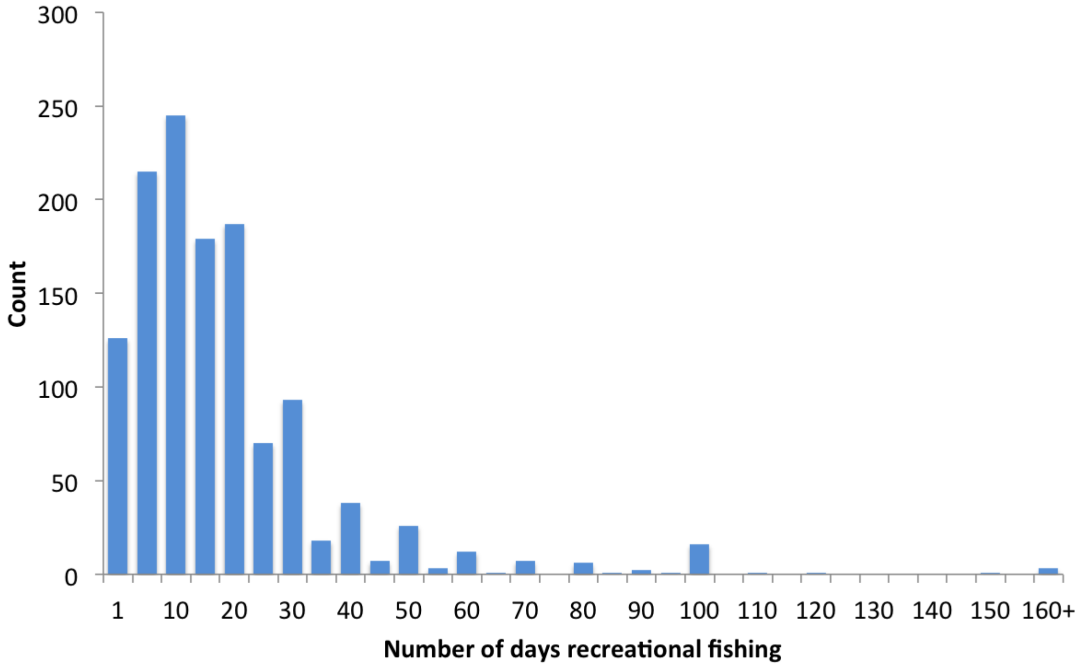

Fig. 2.4. The frequency of days reported recreational fishing for the 12 month period prior to the screening survey.

Game fishing

Of the 338 boats that were used for game fishing in the 12 months prior to the screening survey, 91% reported fishing on 10 or fewer days. Seven boats were reported to have game fished for 50 or greater days, including two that reportedly game fished for 90 days (Fig. 2.5).

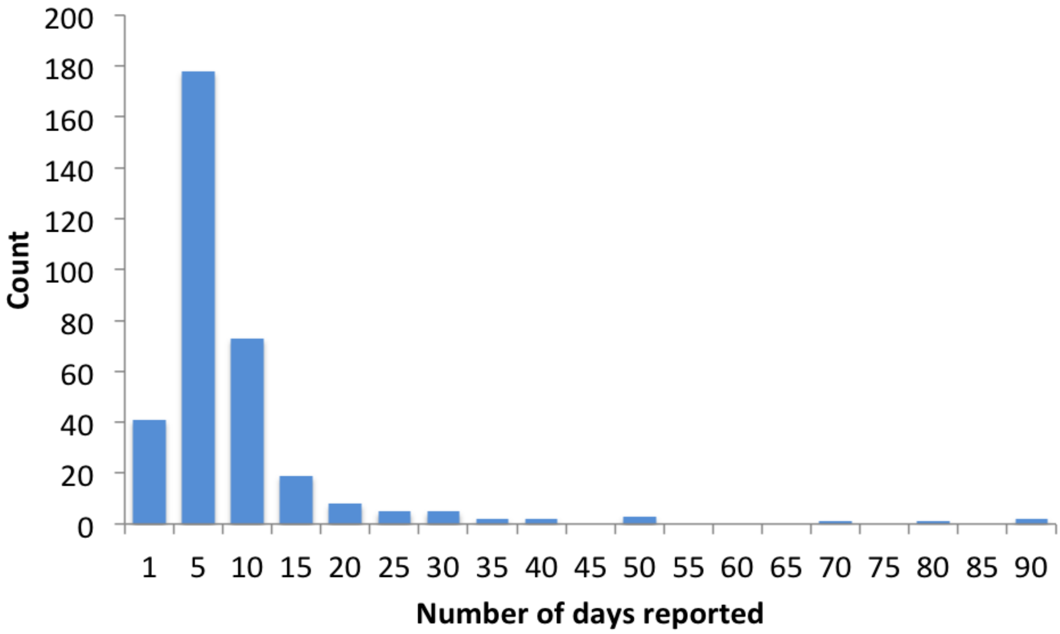

Fig. 2.5. The number of days reported recreational game fishing for the 12 month period prior to the screening survey.

Offshore fishing

Of the 290 boats that were used for offshore fishing in the 12 months prior to the screening survey, 90% reported 10 or fewer days offshore fishing. Four boats were reported to recreationally offshore fish for 50 or greater days, including one that reportedly fished for 90 days (Fig. 2.6).

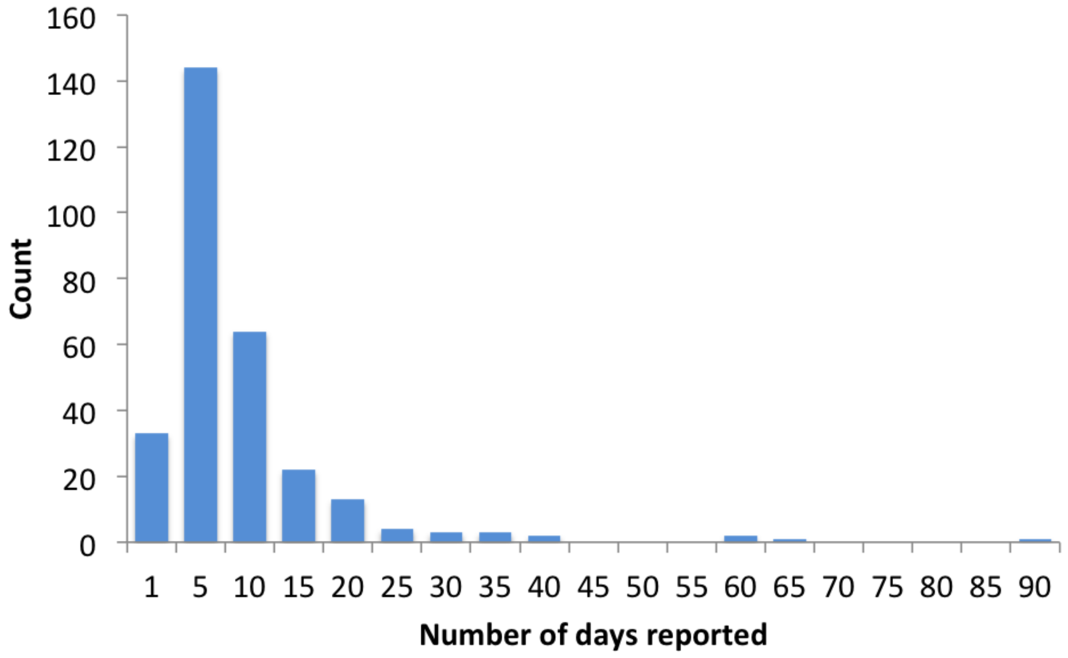

Fig. 2.6. The number of days reported recreational offshore reef fishing for the 12 month period prior to the screening survey.

2.2.4. LONGITUDINAL TELEPHONE-DIARY SURVEY

Retention of participants throughout the 12 month longitudinal survey period was high, with 413 diarists or 89% of respondents who accepted the diary participating for the entire survey period. Of the 51 participants who withdrew, 19 (37%) sold their boat during the survey, 14 (27%) became un-contactable (disconnected phones or calls not answered) and the remaining 18 (35%) withdrew for a variety of reasons including, moving interstate and a lack of interest in participating.

Of the responding participants, 289 (63%) reported at least one offshore or game fishing trip during the survey period, the remaining 165 reported no offshore or game fishing activity despite rating themselves as ‘quite likely’ or ‘very likely’ to do so. Given the high response rates, possible biases arising from non-response were not considered to be a significant issue in this study and analyses do not incorporate non-response adjustments.

Data for the diarists who partially responded (i.e. declined to participate for the full period or with whom contact was lost) were excluded from all analyses.

Fully responding diarists reported a total of 1,318 fishing events where trolling, pelagic shark fishing, mid-depth reef fishing, deep water offshore fishing or other fishing (targeting Snapper or Yellowtail Kingfish) occurred. Game fishing was split into trolling (672 events) and targeting pelagic shark (123 events), collectively accounting for over 60% of all events reported. Mid-depth reef fishing was also a significant activity (452 events), with deep-water offshore fishing (45 events), targeting Snapper (14 events) and targeting Yellowtail Kingfish (12) were minor activities.

Information reported in the following sections relates to analyses of diary survey data provided by fully responding registered recreational vessel owners, and is presented as expanded estimates to represent the activities of MAST registered, motorised recreational vessels (> 4.5 m) used for some form of offshore fishing, in particular mid-depth reef fishing for species such as Striped Trumpeter, deep water fishing for species such as Blue-eye Trevalla and game fishing for tuna and pelagic shark.

2.2.5. GAME FISHING – TUNA SPECIES

Effort

The vast majority of effort targeting tuna was conducted by trolling lures. An estimated 5,231(95% CI: 4,221 – 6,365) boat days of fishing effort were expended by private boats trolling for tuna during the survey period. The estimated lure hours of effort (number of lures multiplied by hours spent trolling) was 99,463 (95% CI: 77,356 – 127,356). The average number of lines trolled by a boat was 4.13 ± 0.12 (95% CI) and the average time spent trolling was 4.65 ± 0.17 (95% CI) hours per fishing day.

Trolling effort was highly seasonal; concentrated during the summer and autumn months, with a distinct peak between February and April (Fig. 2.7). Very little trolling activity was reported in November 2011 and between July and October 2012.

Trolling effort was concentrated off the east coast of Tasmania, in particular off the Tasman Peninsula followed by the region centered around St. Helens, in Storm Bay, the South Coast and the mid-East Coast. A small amount of trolling effort also occurred off the eastern North Coast, but was mainly focused on the area between Banks Strait and Eddystone Point (Fig. 2.10).

Vessels registered in the greater Hobart statistical division accounted for the greatest proportion of trolling effort (49%), followed by the Northern statistical division (26%). These two divisions encompass the large urban centers of Hobart and Launceston respectively. Vessels from the Southern and Mersey-Lyell statistical divisions contributed 14% and 11% of trolling effort respectively (Fig. 2.10).

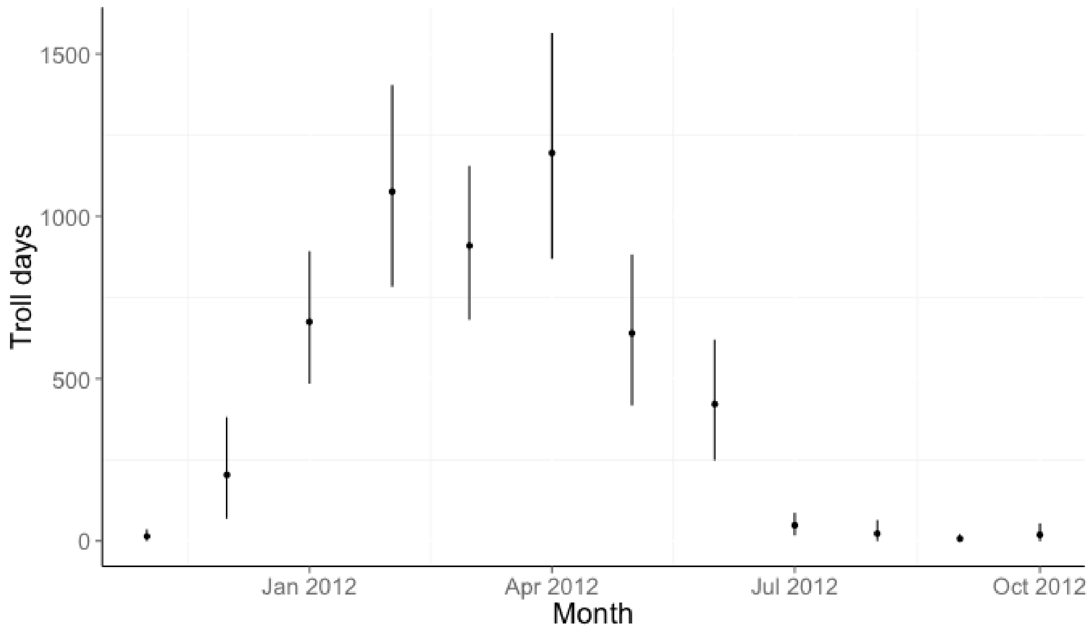

Fig. 2.7. The estimated number of boat days where trolling occurred by month. Error bars represent bootstrapped 95% confidence intervals.

Catch

Three species dominated the tuna catch in 2012, namely Skipjack Tuna, Albacore and Southern Bluefin Tuna (SBT). Yellowfin Tuna were also reported (six retained and one released) but due to the low sample size an expansion to a total catch was not conducted. This species composition is typical for Tasmanian waters with several previous surveys identifying the dominance of these species in recreational tuna catch (Morton and Lyle 2003, Forbes et al. 2009, Lyle et al. 2009).

The estimated catch of SBT taken by privately owned vessels in Tasmania was 4,278 (CI: 2,922 – 5,743) for the 2012 season, of which 3,242 (95% CI: 2,321 – 4,272) were retained and 1,035 (95% CI: 486 – 1,762) were released (Fig. 2.8).

Skipjack Tuna were the most commonly caught tuna species by number, with an estimated catch of 11,955 (95% CI: 7,616 – 16,993) individuals; 3,724 (95% CI: 2,575 – 5,078) being retained and 8,087 (95% CI: 4,475 – 12,927) released (Fig. 2.8).

Albacore was the second most commonly caught tuna with an estimated total catch of 9,722 (CI: 7,093 – 12,362) individuals; 8,290 (CI: 6,049 – 10,768) were retained and 1,406 (CI: 752 – 2,268) released (Fig. 2.8).

When harvested numbers are converted to weight, SBT had the largest harvested biomass at 59.9 *t* (95% CI: 42.8 – 78.9 *t*), reflecting the larger average size of these tunas (Table 2.3). In addition, an estimated 11.2 *t* (95% CI: 7.7 – 15.2 *t*) of Skipjack Tuna was retained, however, owing to the unavailability of a reliable average weight for Albacore catch weights were not estimated for this species.

Table 2.3. The total estimated number and weight from the respective populations of tuna species caught by recreational fishers in Tasmania during 2012. Note that totals may not be the sum of retained fish and fish lost to seals as each value is calculated separately during the bootstrap procedure. 95% confidence intervals are presented for all mean estimates.

Species	Number & weight retained	Number & weight of fish lost to seals	Total biomass removed from population
Southern Bluefin Tuna	3,242 [2,321, 4,272] **59.9 [42.8, 78.9] *t***	1,325 [749, 1,978] **24.9 [13.9, 38.0] *t***	4,633 [3,200, 6,371] **78.3 [53.7, 105.0] *t***
Albacore	8,290 [6,049, 10,768] ***weight not estimated***	141 [35, 267] ***weight not estimated***	8,431 [6,084, 11,035] ***weight not estimated***
Skipjack Tuna	3,724 [2,575, 5,078] **11.2 [7.7, 15.2] *t***	37 [0, 96] **1.1 [0, 2.89] *t***	3,762 [2,575, 5,173] **11.3 [7.8, 15.6] *t***

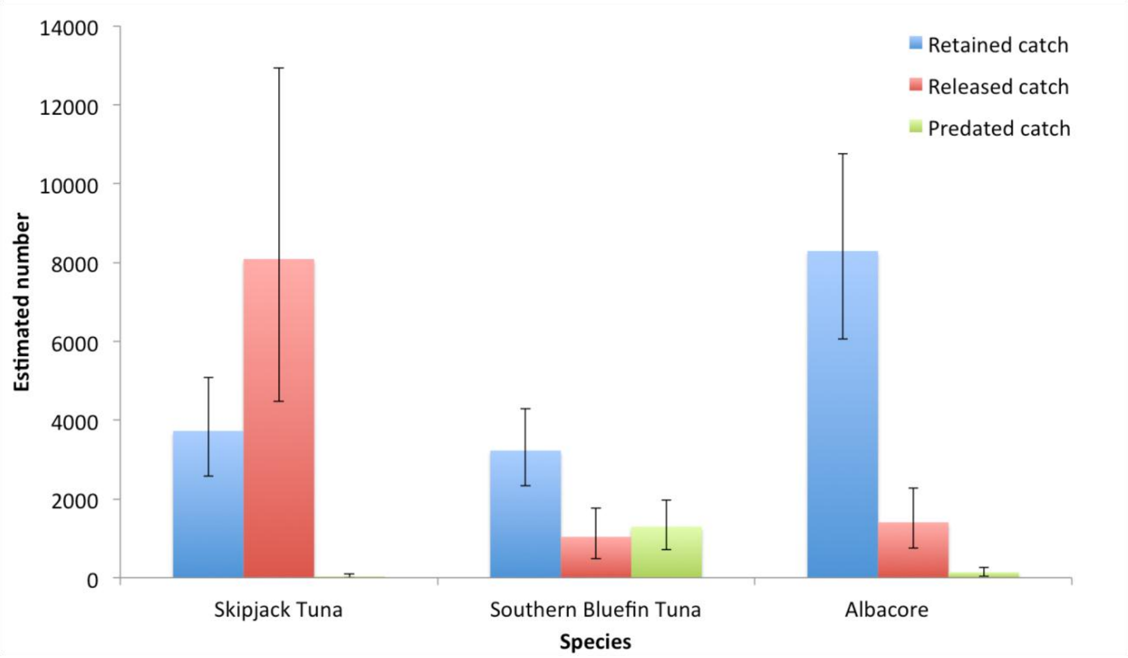

Fig. 2.8. The estimated number of fish caught and kept, caught and released and lost to seals during capture for the three main tuna species caught in Tasmania. Error bars represent 95% confidence intervals.

The survey revealed a distinct temporal pattern in catch composition of tunas. Albacore were the first of the tunas caught off the east coast of Tasmania, with low numbers taken as early as December after which catches increased sharply to a peak in February before declining to very low catch numbers by April. Skipjack Tuna were recorded in low numbers in January and then catches rose sharply in February to a peak in March before declining sharply to very small catches in May. The earliest catches of SBT were recorded in January but in very small numbers. Catches increased significantly in March and peaked in April before falling slightly in May and again in June. Very few SBT were captured during July and there were no catches of any tuna species reported between August and October (Fig. 2.9).

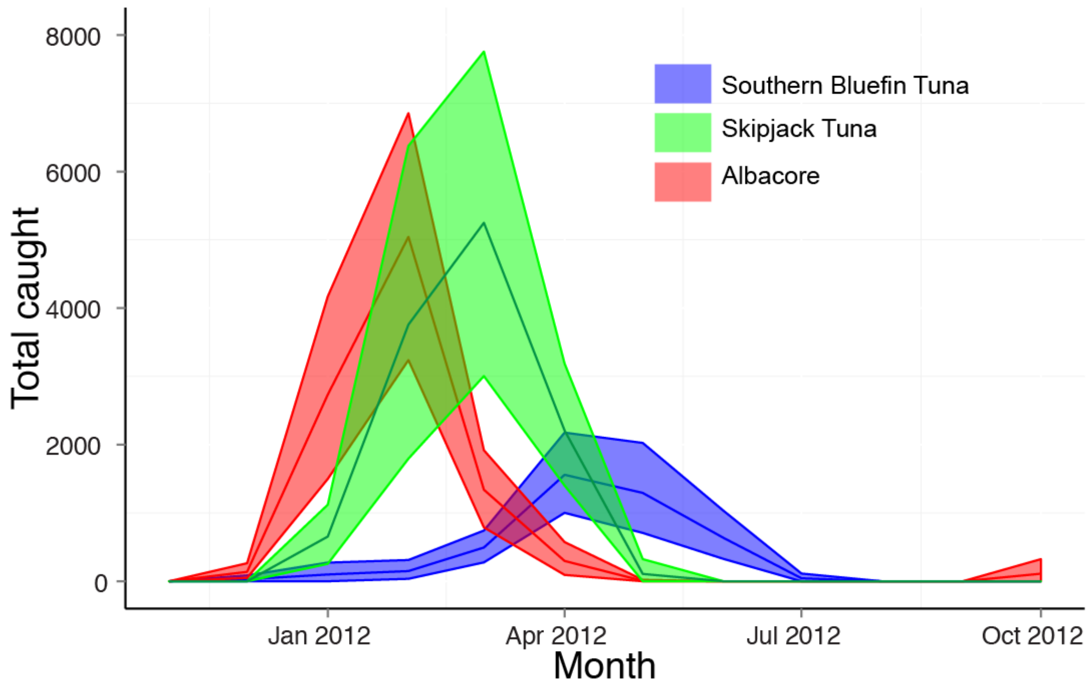

Fig. 2.9. The total monthly estimated catch (mean ± 95% CI bootstrap confidence intervals) of the main tuna species caught by the Tasmanian recreational fishery.

All tuna catches were reported from the east and south coasts of Tasmania, reflecting the spatial distribution of the fishing effort (Fig. 2.10). However, there was an obvious spatial pattern in the catch of the tunas. Skipjack Tuna and Albacore were caught in relatively high numbers from the northeast coast to the southeast tip of the Tasman Peninsula. A small number of Skipjack Tuna were also reported from Storm Bay (Fig. 2.10). Southern Bluefin Tuna were caught from the region east of Tasman Peninsula, Storm Bay and the South Coast of Tasmania (Fig. 2.10). The spatial and temporal distribution of tuna catch is likely related to the water temperature preferences of each species and the occurrence of the preferred water temperatures along the east and south coasts of Tasmania. Anecdotal reports indicate that SBT are present and occasionally taken from the west coast of Tasmania, but generally unfavorable weather conditions and the remoteness of the region has meant that targeted effort has traditionally been very low by comparison with the east coast.

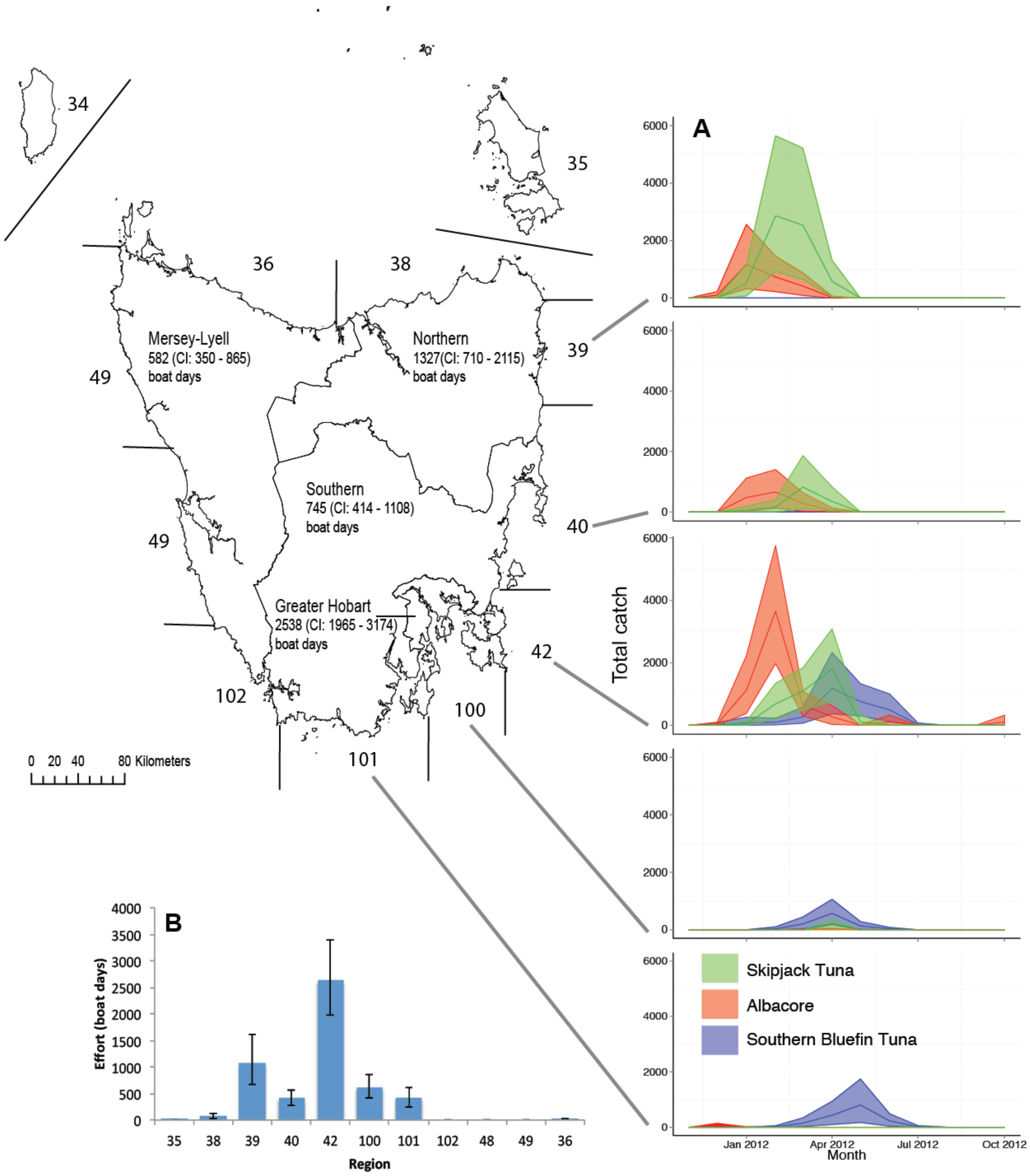

Fig. 2.10. Map of Tasmania showing the coastal regions as defined for this survey and ABS statistical divisions (on land). Values within the statistical divisions show the estimated trolling effort (boat days) from vessels registered in each statistical division. Panel (A) illustrates the monthly trends in total catch of key tuna species from each coastal region (shaded areas represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data). Panel (B) illustrates the trolling effort (boat days) within each coastal region (error bars represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data).

Skipjack Tuna had the highest reported release rate (68%) of all tuna species followed by SBT (24%) and Albacore (14%). The reasons for release varied between species, this variation being explained to some extent by responses to a wash-up survey question regarding usage of retained catch.

The most common reason for releasing Skipjack Tuna (65%) was that they were not a desired species, generally related to their perceived poor eating qualities (Fig. 2.11), a perception reinforced by the fact that two-thirds of the Skipjack Tuna retained was used as bait (Fig. 2.12). Ten percent of the released fish were because respondents had already retained a sufficient quantity to meet their needs. Seven percent were reportedly released as they were considered too small, while catch and release fishing was cited as a motive for releasing just 2% of the Skipjack Tuna. No reasons for release were provided for 13% of Skipjack Tuna that were released (Fig. 2.11).

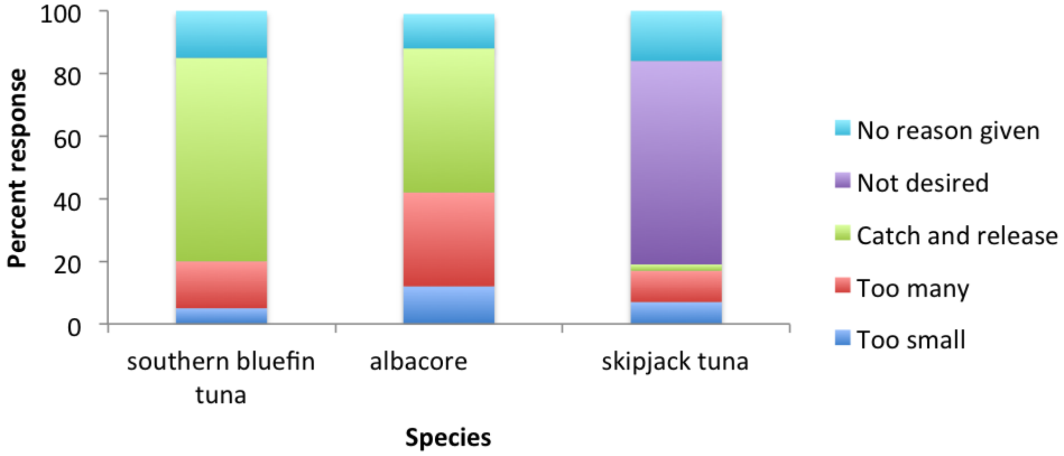

Fig. 2.11. Reasons given for the release of tuna species caught by surveyed recreational fishers in Tasmania.

The release rate for Albacore was substantially lower than for Skipjack Tuna, the species being the most popular of the tuna species for human consumption. Overall 68% of the retained Albacore was used for personal consumption (including immediate family), with a further 28% given away, presumably for human consumption. Only a very small proportion of Albacore catch was used for bait or other uses (Fig. 2.12).

Catch and release fishing accounted for 46% of the Albacore reported released. While there were no reports of fishers releasing fish due to the possession limit being reached, 30% of releases were due to fishers reporting they had kept enough to meet their needs. Twelve percent were reported released because the fishers considered they were too small to keep. For the remaining 11% no reasons for release were provided (Fig. 2.11).

Catch and release fishing was also the most commonly cited reason (65%) for the release of SBT (Fig. 2.11). Again it is interesting to note that apart from a single fishing event where a respondent indicated that the fish were released because the possession limit had been reached, around 15% of all SBT that were released were due to fishers reporting they had kept enough. Just 5% of fish were released because the fishers felt they were too small to retain. No reason for release was provided for the remaining 15% of the released catch (Fig. 2.11).

Compared to Albacore, a smaller proportion of retained SBT (58%) was consumed by the vessel owner or their immediate family, and a larger proportion was given away (37%), again presumably for human consumption. Only a small proportion was used for bait (3%) or other purposes (2%) (Fig. 2.12).

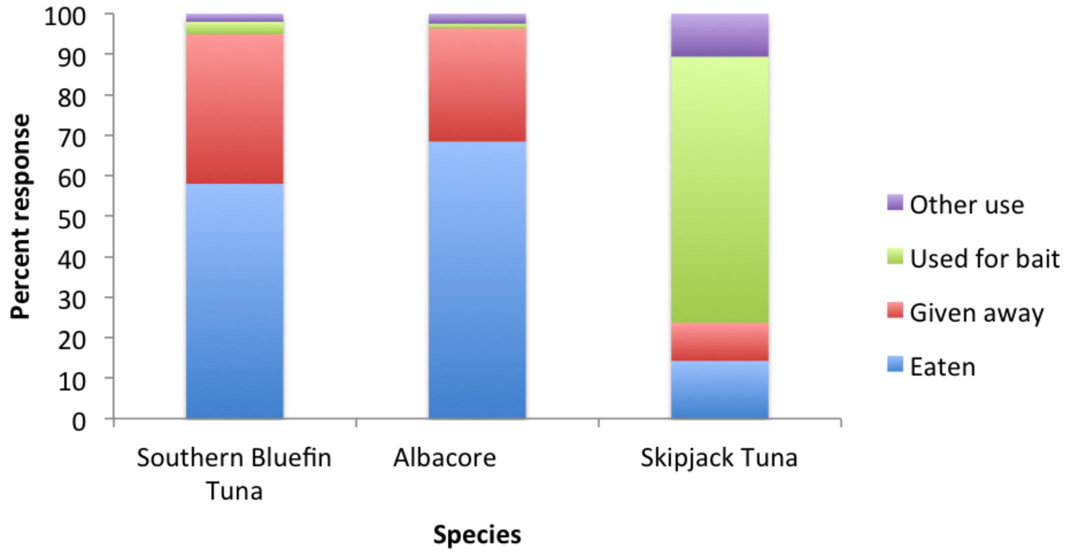

Fig. 2.12. The reported use of the retained catch of tuna species caught in Tasmania by participants in the PDS. These results are from a one-time 'wash up' questionnaire administered to participants at the conclusion of the PDS. Note that these responses relate to registered vessel owners and not the entire crew that may have participated in a given fishing event.

Losses due to seal interactions

Loss of tuna to seals during the capture process has become relatively common in Tasmania, particularly for SBT which are often caught in close proximity to seal haul-out areas around the Tasman Peninsula and southern Tasmania.

During 2012 an estimated 1,325 (95% CI: 749 – 1,978) hooked SBT were lost to seals (i.e. not landed), most commonly during retrieval of the fish (fight). Assuming that most if not all these fish do not survive the encounters, then these losses effectively represent an additional source of fishery induced mortality that should be combined to retained catches when considering the impacts of fishing on the target species. When combined with harvested catch numbers, such losses represented 29% of the total mortality of SBT attributed to recreational fishing in Tasmania and when converted to weight this additional mortality equated to 24.9 *t* (95% CI: 13.9 – 38.0 *t*) (Table 2.3). Note that this estimate does not include fish that may have been attacked and damaged by seals but landed, these fish are included in the retained catch estimate.

Reported losses of Skipjack Tuna and Albacore to seal predation were much lower than for SBT, with 37 (CI: 0 – 96) and 141 (CI: 35 – 267) estimated to have been lost to seals during the capture process respectively (Table 2.3). These losses represent <1% and 2% respectively of the total mortality of these species from recreational fishing in Tasmania. Possible explanations for the lower losses due to seal interactions for these species include the fact that both species are often caught in open water, away from geographic structures where seals reside, and these species are much smaller than SBT and as a consequence fish can be retrieved to the boat much more quickly thereby reducing the opportunity for successful seal attacks.

2.2.6. *GAME FISHING - PELAGIC SHARKS*

Effort

An estimated 904 (95% CI: 581 – 1,270) boat days of pelagic shark fishing effort was expended by private boat owners during the survey period. The estimated number of hours targeting pelagic sharks was 4,606 (95% CI: 2,760 – 6,994). Pelagic shark fishing by recreational fishers generally involves time spent 'burleying' the water until a shark is attracted to the boat and then a baited hook is presented to the shark.

Pelagic shark fishing was most common over the summer months, corresponding with warmer water temperatures which Mako Shark (the primary target) prefer. Effort increased steadily from November 2011 to a peak in January 2012. Very little pelagic shark fishing occurred from April to October 2012 (Fig. 2.13).

The majority of the effort targeting pelagic sharks was from recreational vessels registered in the Mersey-Lyell (460 boat days) and the Northern (321 boat days) statistical divisions (Fig. 2.15). Effort from boats registered within the Greater Hobart (97 boat days) and the Southern statistical division (23 boat days) were lower (Fig. 2.15). The focus of effort from boats registered in the north of the state is also reflected in the regional distribution of effort, with the vast majority concentrated off the North Coast in Bass Strait (regions 36 and 38) (Fig.2.15). The Tasman Peninsula had the next highest quantity of effort, again peaking in January followed by a minor peak in April. A small amount of effort was also reported from the mid-West Coast (region 48) in January (Fig. 2.15).

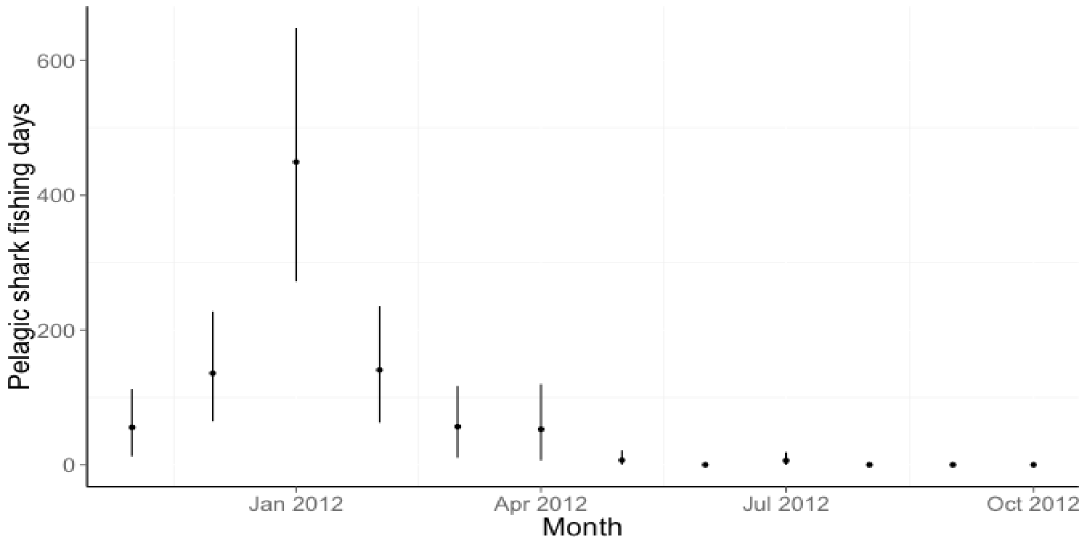

Fig. 2.13. The estimated number of boat days where pelagic shark fishing occurred by month. Error bars represent bootstrapped 95% confidence intervals.

Catch

Shortfin Mako and Blue Shark were the two species of pelagic shark caught by recreational fishers during the survey, with catches of both species peaking in January and a secondary smaller peak in April for Shortfin Mako shark (Fig. 2.14). The estimated total number of Shortfin Mako shark caught from Tasmania by recreational fishers during the 12 month survey period was 520, of which 317 (95% CI: 165 – 522) were retained and 203 (95% CI: 59 – 405) were released. The weight of Shortfin Mako reported ranged from 21 – 156 kg (n = 29), with an average weight of 68 kg. The estimated total retained weight of Shortfin Mako shark was 21.5 *t*. (95% CI: 11.2 – 35.4 *t*).

An estimated 153 Blue Shark were caught by recreational fishers during the 12 month survey period, of which 46 (95% CI: 7 – 98) were retained and 107 (95% CI: 28 – 201) released.

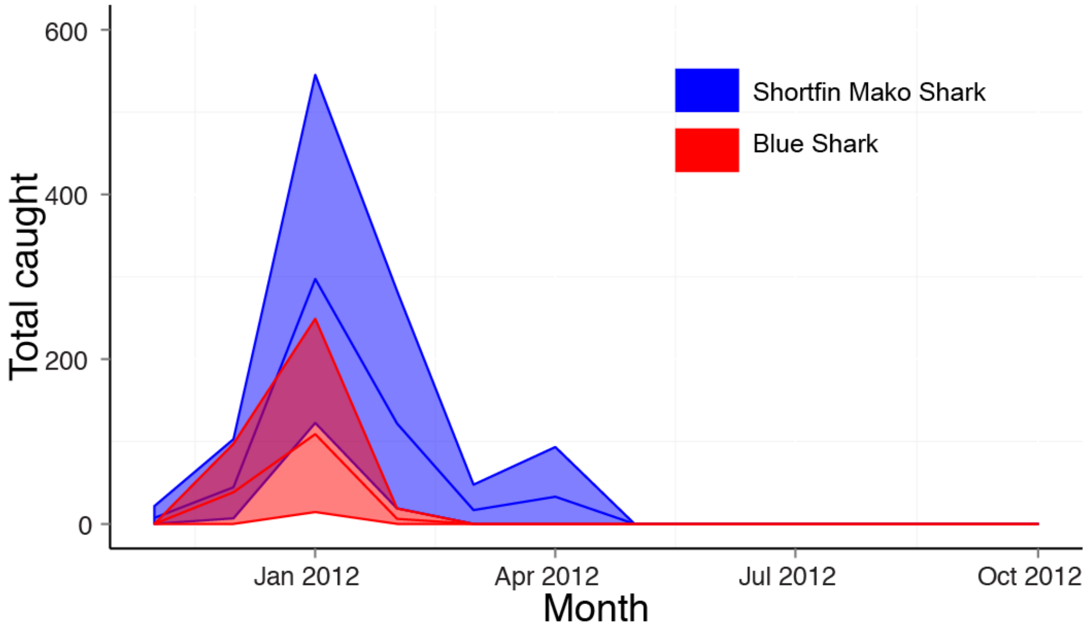

Fig. 2.14. The total monthly estimated catch (mean ± 95% bootstrap confidence intervals) of Shortfin Mako and Blue Shark caught by the Tasmanian recreational fishery.

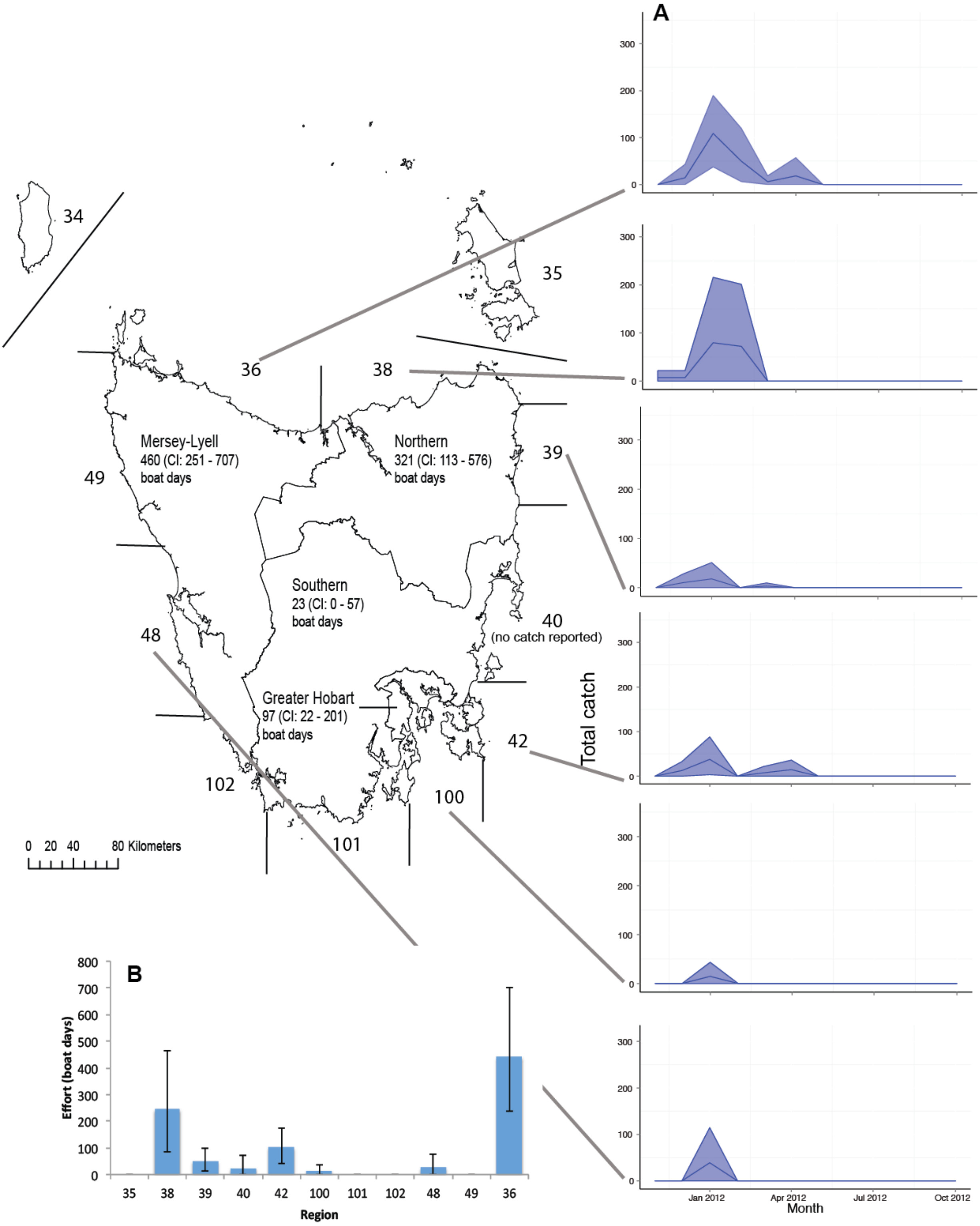

Fig. 2.15. Map of Tasmania showing the coastal regions as defined for this survey and ABS statistical divisions (on land). Values within the statistical divisions show the estimated effort (boat days) pelagic shark fishing from vessels registered in each statistical division. Panel (A) illustrates the monthly trends in total catch Shortfin Mako shark from each coastal region (shaded areas represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data). Panel (B) illustrates the effort (boat days) within each coastal region (error bars represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data).

Both shark species had relatively high release rates at 39% for Shortfin Mako and 70% for Blue Shark. For Shortfin Mako shark the reasons given for release were distributed equally between the shark deemed to be too small, the fishers decision that they had retained enough (in some instances this related to catches retained on previous trips) and catch and release fishing (Fig. 2.16). Shortfin Mako shark was highly desired for human consumption, with 61% of Mako Shark retained for human consumption and 31% given away, presumably for human consumption (Fig. 2.17). Blue Shark is a less desirable shark for human consumption, this is reflected in the reasons for release with 53% of Blue Shark released because they were not wanted and the remaining 47% reported as catch and release fishing (Fig. 2.16).

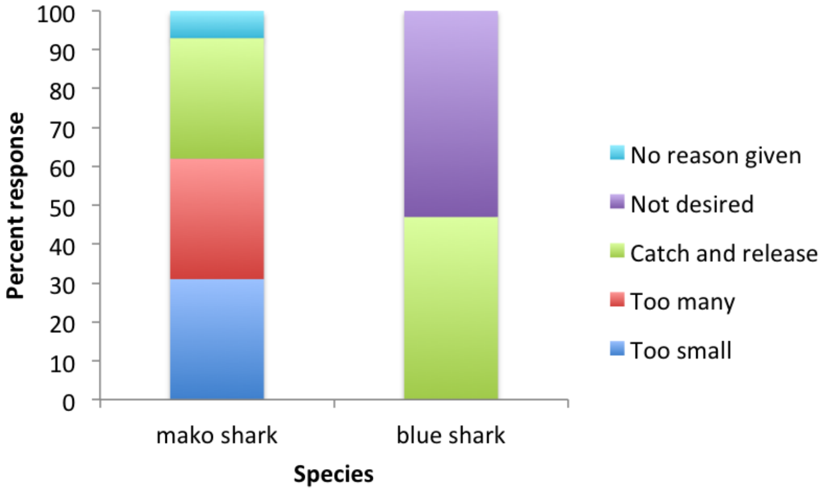

Fig. 2.16. Reasons given for the release of pelagic shark species caught by recreational fishers in Tasmania.

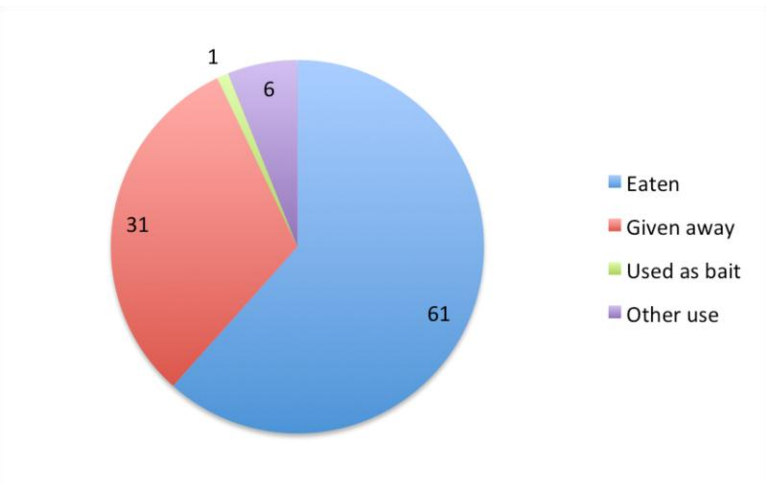

Fig. 2.17. The reported use of the retained catch of the Mako Shark caught in Tasmania. These results are from a one-time 'wash up' questionnaire administered to participants at the conclusion of the diary survey. Note that these responses relate to registered vessel owners and not the entire crew that may have participated in a given fishing event.

2.2.7. MID-DEPTH REEF FISHING

In this study we have defined mid-depth reef fishing as events that involved fishing for or capture of Striped Trumpeter, Jackass Morwong and/or Ocean Perch (generally depths of 50 – 250 m).

Effort

An estimated 3,378 (95% CI: 2,722 – 4,130) boat days of mid-depth reef fishing effort were expended by private boat owners during the study period. The estimated number of hook hours (number of hooks multiplied by fishing hours) for mid-depth reef fishing was 102,030 (95% CI: 79,528 – 129,289).

Recreational fishing activity directed at mid-depth reefs was lowest in September and October 2012. This was not unexpected as these months are closed to the harvest of Striped Trumpeter, the most commonly targeted species at these depths in Tasmanian waters. Effort was highest in late spring and summer (November and December 2011, with a peak in January 2012). Effort then dropped significantly in February 2012 before a small spike in April 2012, most likely related to activity associated with the Easter holiday period (Fig. 2.18).

Recreational fishing effort on mid-depth reefs was concentrated off the east coast of Tasmania. The greatest amount of effort was reported from the region on the eastern coast of the Tasman Peninsula, followed by the mid-East Coast and the Northeast Coast. There was also a reasonable level of effort focused on the South Coast of Tasmania, with relatively minor effort focused on the mid-West Coast, the Northwest Coast, Flinders Island, the far Northeast Coast and Storm Bay. Very little activity was reported from the upper-West and Southwest coasts (Fig. 2.19).

Regionally, vessels registered in the Northern statistical division (38%) accounted for the greatest proportion of the effort, followed closely by the greater Hobart statistical division (34%). Vessels from the Southern and Mersey-Lyell statistical division contributed 17% and 11% of effort respectively (Fig. 2.19).

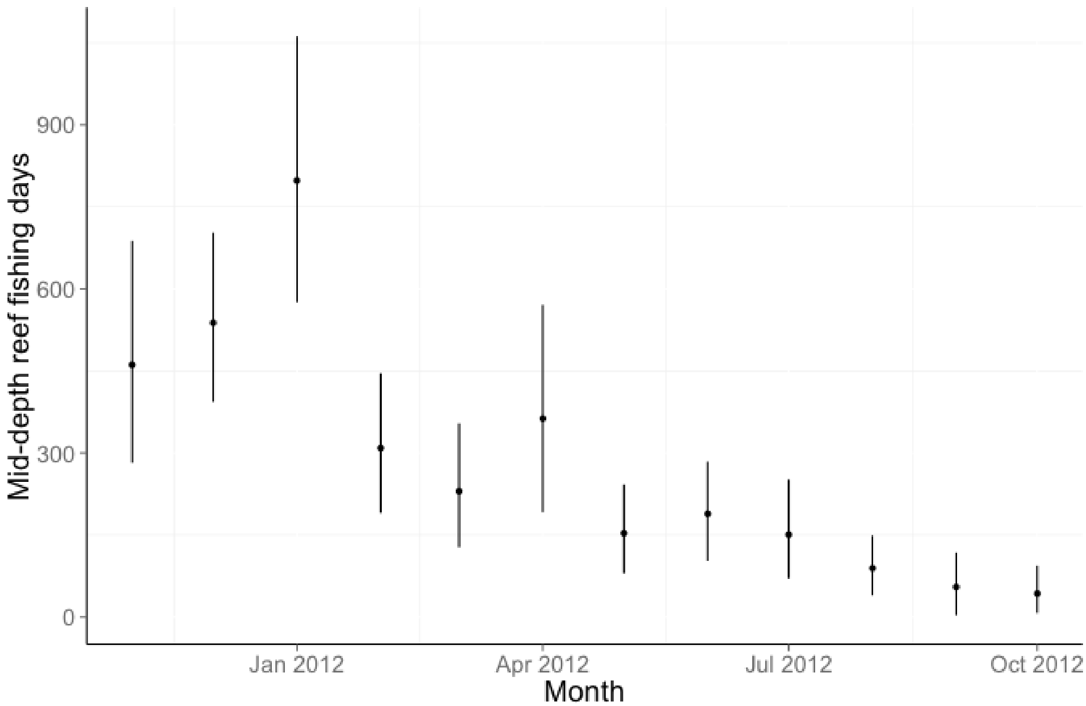

Fig. 2.18. The estimated number of boat days where mid-depth reef associated recreational fishing occurred by month. Error bars represent bootstrapped confidence intervals.

Catch

A range of species were caught by recreational fishers while mid-depth reef fishing, the most common being Ocean Perch, Jackass Morwong, Striped Trumpeter, Bearded Rock Cod, Gurnard and Wrasse. Catches of each of these species, apart from Striped Trumpeter, are likely to be underestimates since many are also caught while targeting other species in different habitats, including inshore reef fishing and fishing over sand and cobble bottom for species such as flathead.

While the relative composition of the catch was reasonably consistent off the east coast of Tasmania (regions 39, 40, 42), South Coast catches had proportionally fewer Jackass Morwong, the mid-West Coast catches were represented by very few fish other than Striped Trumpeter, and the Northwest and Northeast Coast catches included a relatively high representation of Wrasse (Fig. 2.19).

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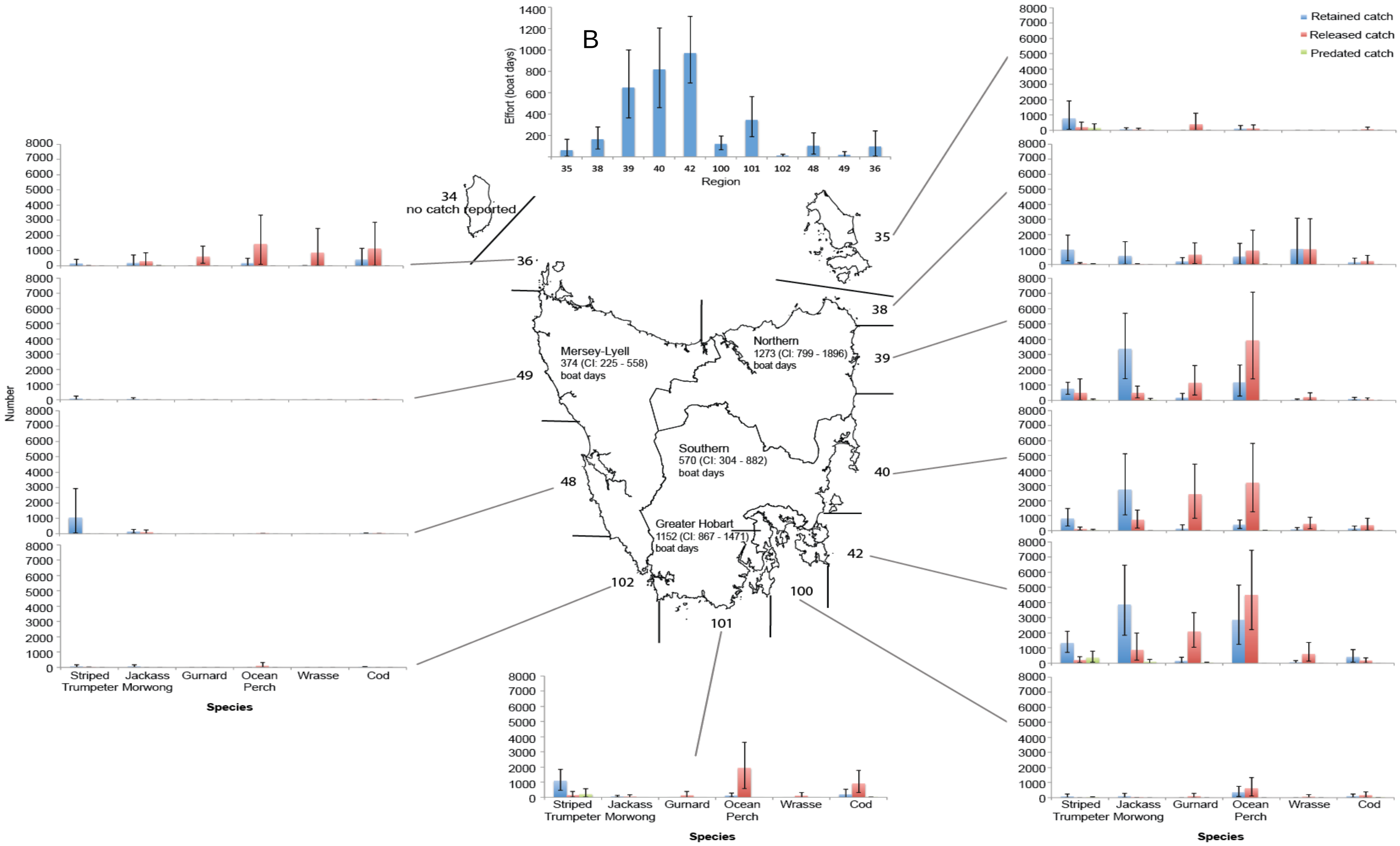

Fig. 2.19. Map of Tasmania showing the coastal regions as defined for this survey and ABS statistical divisions (on land). Values within the statistical divisions show the estimated effort (boat days) mid-depth reef fishing from vessels registered in each statistical division. Catch plots represent the regional catch composition of the main species caught. Panel (B) illustrates the effort (boat days) within each coastal region (error bars represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data).

An estimated 8,522 (95% CI: 5,724 – 11,979) Striped Trumpeter were caught over the survey period; 7,231 (95% CI: 4,677 – 10,269) were retained and 1,261 (95% CI: 520 – 2,378) released (Fig. 2.20). The average weight of Striped Trumpeter reported during the survey was 4.38 kg, suggesting that the total harvested weight was 31.9 tonnes (95% CI: 21.0 - 46.4) (Table 2.4).

An estimated 14,127 (95% CI: 9,890 – 18,966) Jackass Morwong were caught during the survey period; 11,377 (95% CI: 7,813 – 10,573) were retained and 2,749 (95% CI: 1,542 – 4,294) released (Fig. 2.20). The average weight of Jackass Morwong used in this report to convert catch numbers to weight was 0.68 kg. The estimated harvested weight for Jackass Morwong was 7.7 tonnes (95% CI: 5.3 – 10.4) (Table 2.4).

Ocean Perch were the most commonly reported species, by number, caught while mid-depth reef fishing in this survey. Gurnard are also caught but much less frequently. Anecdotal evidence suggests that these two species are commonly mis-classified by fisherswith both species commonly referred to as ‘Gurnards’, it is possible that a proportion of Gurnards reported were in fact Ocean Perch.

The total numbers of Ocean Perch and Gurnard caught during the survey were 23,203 (95% CI: 16,666 – 30,977) and 8,379 (95% CI: 5,534 – 11,462), respectively. An estimated 6,138 (95% CI: 3,599 – 9,200) and 690 (95% CI: 264 – 1,247) were retained and an estimated 17,064 (95% CI: 12,067 – 22,617) and 7,688 (95% CI: 4,998 – 10,689) released, respectively (Fig. 2.20).

Bearded Rock Cod and Wrasse are common species around Tasmania, associated with a range of inshore and mid-depth habitats. The estimated total catch of Bearded Rock Cod reported while mid-depth reef fishing was 4,686 (95% CI: 2,518 – 7,613), with 1,598 (95% CI: 701 – 2,690) retained and 3,088 (95% CI: 1,568 – 5,079) released (Fig. 2.20). The average weight of Bearded Rock Cod used in this report to convert catch numbers to weight was 0.58 kg. The estimated harvested weight for Bearded Rock Cod was 0.9 tonnes (95% CI: 0.4 - 1.6) (Table 2.4).

Several species of Wrasse are found in Tasmanian state waters, the two most commonly caught while fishing are Blue Throat Wrasse and Purple Wrasse. In this survey there was no discrimination between species, and results are reported generically as Wrasse. The estimated total number of Wrasse caught while mid-depth reef fishing was 4,632 (95% CI: 1,463 – 9,883), with 1,238 (95% CI: 82 – 3,413) retained and 3,395 (95% CI: 1,234 – 6,581) released (Fig. 2.20). The average weight of Wrasse used in this report to convert catch numbers to weight was 0.88 kg. The estimated harvested weight for Wrasse caught by recreational fishers while mid-depth reef fishing was 1.1 tonnes (95% CI: 0.1 - 3.0) (Table 2.4).

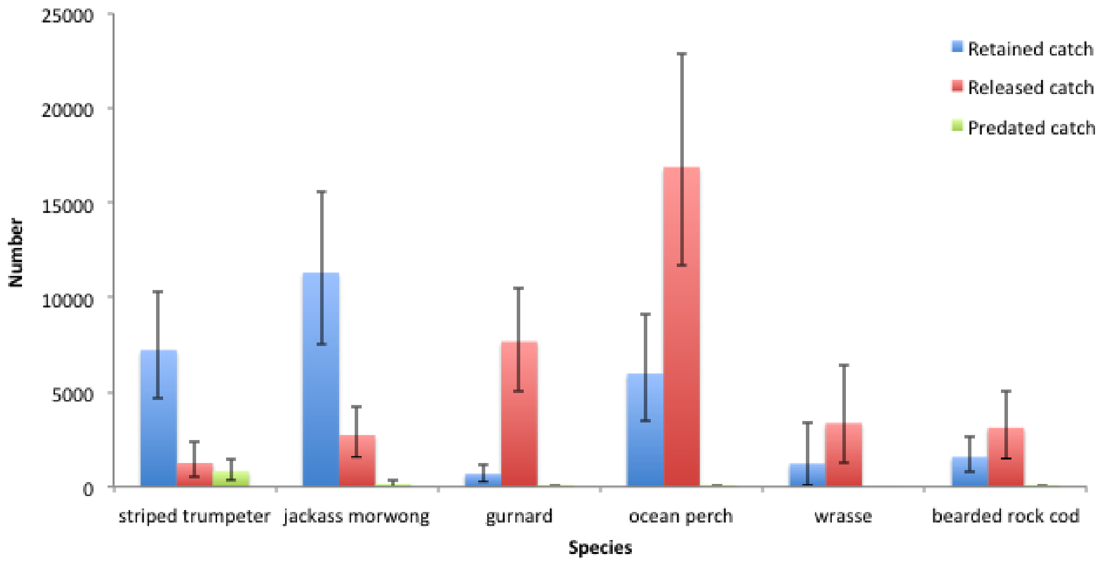

Fig. 2.20. Catch summary of the main species reported from mid-depth (50-250 m) reef fishing by recreational fishers over a 12 month period from November 2011 through October 2012. 95% confidence intervals are shown.

Table 2.4. The total number and weight (in some cases) retained as well as the number and weight of lost to seals for the main species caught by recreational fishers from mid-depth reefs in Tasmania during 2012.

Species	Number & weight retained	Number & weight of fish lost to seals
Striped Trumpeter	7,274 (4,779 - 10,573) **31.9 (21.0 - 46.4) *t***	826 (336 - 1,440) **3.6 (1.5 - 6.3) *t***
Jackass Morwong	11,377 (7,813 - 15,272) **7.7 (5.3 - 10.4) *t***	149 (6 - 328) **0.1 (0 - 0.2) *t***
Ocean Perch	6,138 (3,599 - 9,200) ***weight not estimated***	negligible
Bearded Rock Cod	1,598 (701 - 2,690) **0.9 (0.4 - 1.5) *t***	negligible
Wrasse *sp.*	1,238 (CI: 82 – 3,413) **1.1 (0.1 - 3.0) *t***	0

Striped Trumpeter had the lowest reported release rate (15%) of all the main species that were caught while fishing over mid-depth reefs. This finding is not unexpected given that this species is highly regarded for its excellent eating qualities. This is reflected in the usage of retained fish with over 85% of Striped Trumpeter retained for human consumption. Only 13% of retained Striped Trumpeter was given away, but again presumably for human consumption (Fig. 2.22).

The reasons for release of Striped Trumpeter were varied. Approximately half of the fish were released because they were considered to be too small (not necessarily in response to the minimum size limit) and a further 19% were released because the fishers had retained a sufficient quantity to meet their needs (possibly having reached the possession limit). Catch and release fishing was cited as a minor reason (8%) for release. Fish released explicitly in response to regulatory requirements accounted for 19% of the total; 15% reported as being undersize, 2% in excess of the possession limit and 2% due to incidental capture during the closed season (Fig. 2.21).

Jackass Morwong also had a low release rate at 21%. Again, this species is popular for human consumption, with 78% retained for consumption along with a further 13% which was given away, presumably to be consumed (Fig. 2.22).

The main reasons for the release of Jackass Morwong were small size (37%) and that sufficient numbers had been caught (29%). Twenty six percent were released as a species that was not desired by the fishers. Catch and release fishing accounted for only 3% of the released catch while releases in response to regulatory requirements was low, with 3% reported as being undersized (Fig. 2.21).

Ocean Perch, Gurnard and Bearded Rock Cod all had high release rates at 70%, 84% and 60%, respectively. These species are not generally regarded highly for their eating qualities; although 66% of the Ocean Perch retained by respondents was consumed (Fig. 2.22). While the quality of Ocean Perch flesh is good, many fishers are put off by the small fillet size and the chance of getting spiked by the large spines associated with Ocean Perch (and Gurnard).

The most common reason for the release of Ocean Perch (54%) and Bearded Rock Cod (53%) was that they were not a desired catch. A small proportion of both species were released as fishers determined that they either were too small (19 and 12%, respectively), or they had retained a sufficient quantity to meet their needs (11 and 6%, respectively). No reason for release was given for 16% of Ocean Perch and 26% of Bearded Rock Cod (Fig. 2.21).

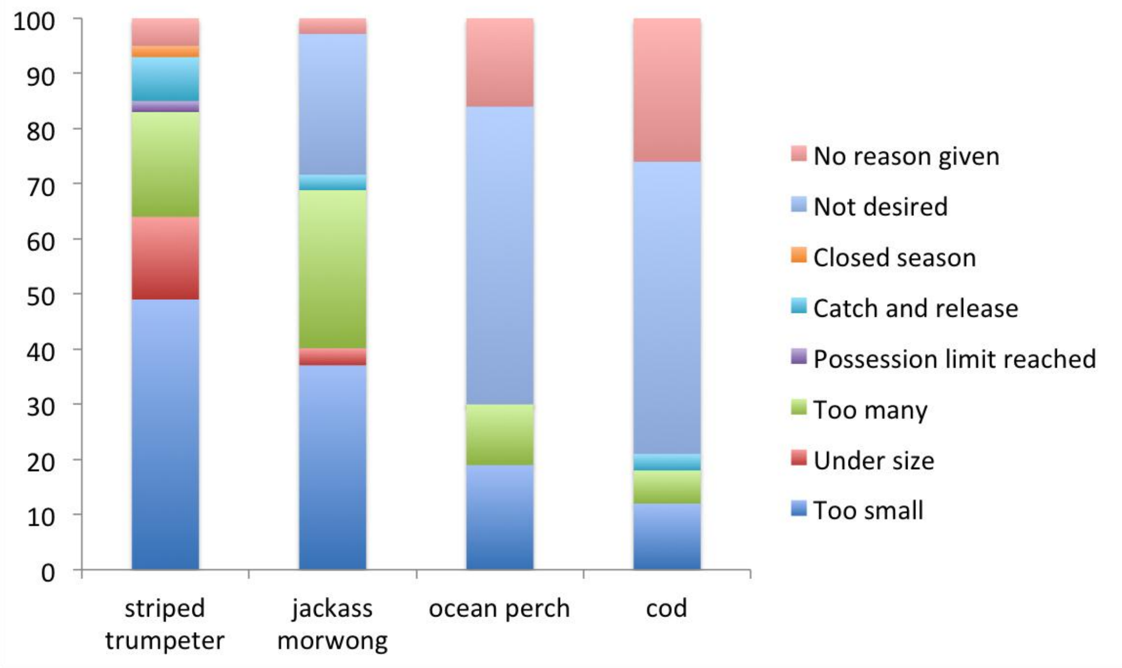

Fig. 2.21. Reasons given for the release of the most caught mid-reef species by recreational fishers in Tasmania.

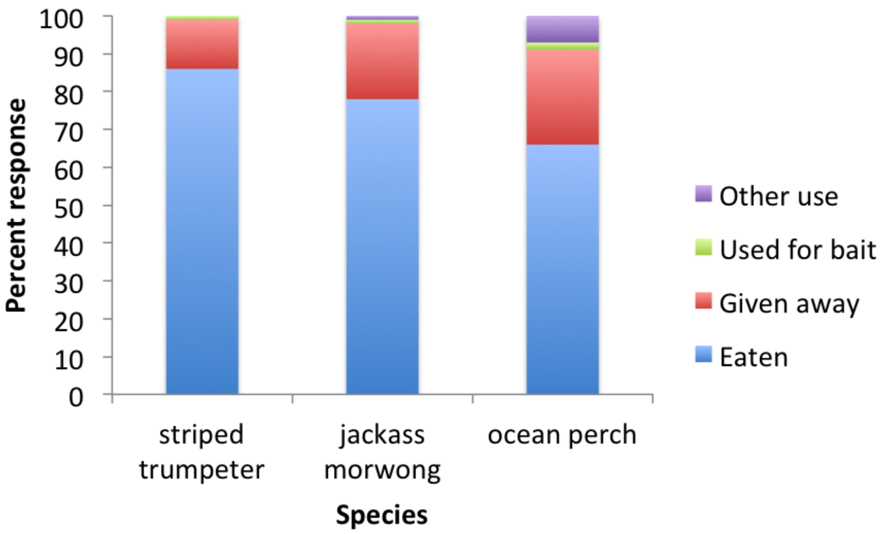

Fig. 2.22. The reported use of the retained catch of the primary most commonly caught species whilst mid-depth reef fishing in Tasmania. These results are from a one-time 'wash up' questionnaire administered to participants at the conclusion of the diary survey. Note that these responses relate to registered vessel owners and not the entire crew that may have participated in a given fishing event.

Losses due to seal interactions

Seal interactions while mid-depth reef fishing have become a relatively common occurrence in some areas of Tasmania. The highest numbers of fish lost due to seal predation occurred in southeast Tasmania (region 42) followed by southern Tasmania (region101) and Flinders Island (region 35). The most commonly reported species lost to seals being Striped Trumpeter.

A total of 826 (95% CI: 336 – 1,440) Striped Trumpeter were estimated to have been taken from lines by seals. When combined with the harvested component of the catch this implies that seals contributed 10% of the total mortality associated with the recreational fishery. When converted to weight, seals accounted for 3.6 *t* (95% CI: 1.5 – 6.3 *t*) of the fishery related mortality (Table 2.4).

Reports of seal interactions for other key mid-depth reef species were minimal but possibly reflect under-reporting since the expected focus of fishers is on the primary target species (Striped Trumpeter) (Table 2.4).

2.2.8. DEEP SEA FISHING

In this study we have defined deep sea fishing as events that have occurred where Blue-eye Trevalla, Blue Grenadier and Pink Ling are commonly caught (generally depths of 350 – 650 m).

Effort

The estimated number of boat days where deep sea fishing occurred was 329 (95% CI: 184 – 492). The estimated number of hook hours (number of hooks multiplied by fishing hours) deep sea fishing was 37,565 (95% CI: 30,135 – 45,567).

Recreational fishing effort for deep water species was greatest in the months of January through April. Effort decreased in May with no deep water fishing reported in the winter – early spring months (June through September), with the exception of a small amount of effort in July (Fig. 2.23).

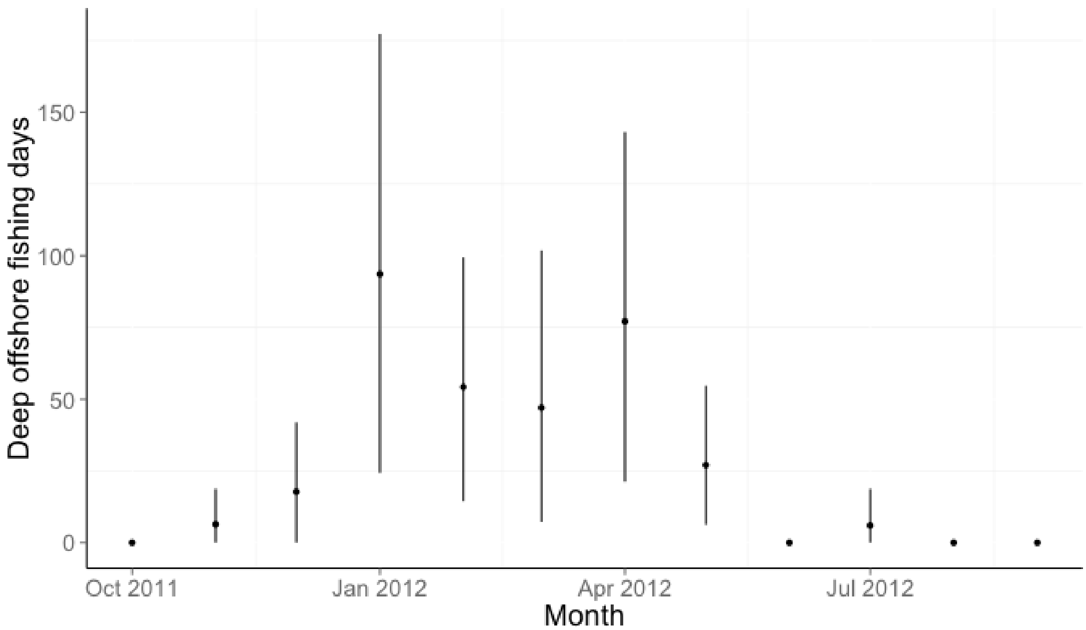

Fig. 2.23. Monthly trend in recreational fishing effort (boat days) targeting deep sea species (error bars represent 95% upper and lower confidence bounds of bootstrap re-sampling of the survey data).

The recreational fishing effort targeting deep sea species was focused off the East Coast of Tasmania and in particular off the Northeast Coast (regions 38 and 39). Effort was also reported from the mid-East and Southeast Coasts and to a lesser extent Storm Bay. On the West Coast effort was only reported from the mid-West Coast (Fig. 2.24).

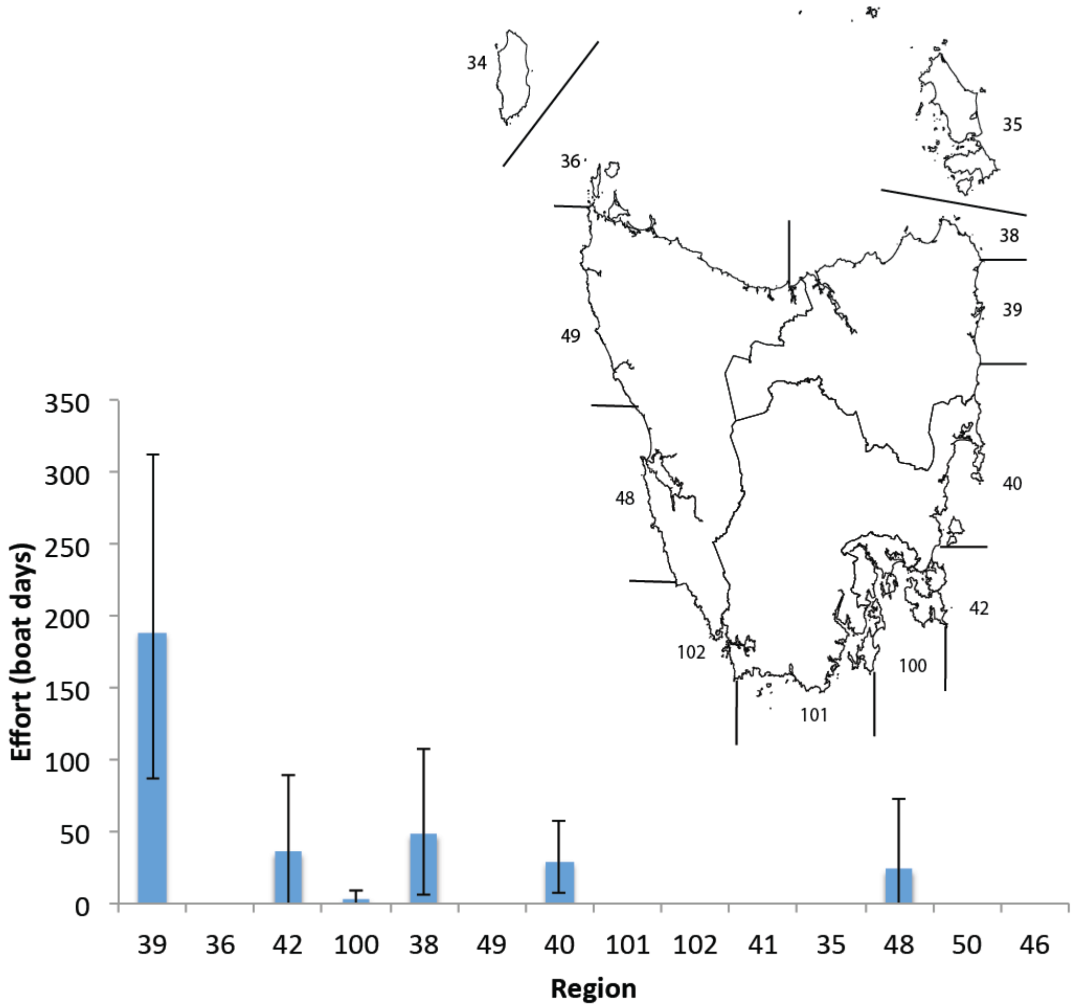

Fig. 2.24. Spatial trend in recreational fishing effort (boat days) targeting deep water bottom dwelling species within each coastal region (error bars represent upper and lower confidence bounds of bootstrap re-sampling of the survey data).

Catch

Blue-eye Trevalla is commonly the primary target species when deep sea fishing in Tasmania, other species also caught include Gemfish, Hapuku, Blue Grenadier and Pink Ling.

An estimated 1,961 (95% CI: 835 – 3,373) Blue-eye Trevalla were caught during the survey period, the entire catch being retained. The average length of Blue-eye Trevalla reported from commercial catch sampling in 2011 was 59.8 cm (Klaer 2012), this equates to an estimated average weight of 6.4 kg. This value, when used to convert the recreational catch to an estimated harvested biomass, equates to 12.5 *t* (95% CI: 5.3 – 21.6 *t*).

It was also estimated that 38 (95% CI: 0 – 78) Blue-eye Trevalla were lost to seals during the capture process, this accounts for 1.7% of the total fishing mortality (harvest plus loss to seals) attributed to the recreational fishery.

In addition, an estimated 548 (95% CI: 155 – 1,069) Gemfish were caught, all of which were retained. Expanded catch estimates for Hapuku (a single fish reported), Blue Grenadier (three fish reported) and ling (seven fish reported) have not been calculated due to the low numbers of fish reported by respondents.

Of the retained Blue-eye Trevalla, 79% was kept for consupmtion (as reported by participating vessel owners in the wash up survey), and the remaining 21% was given away, presumably for human consumption (Fig. 2.25).

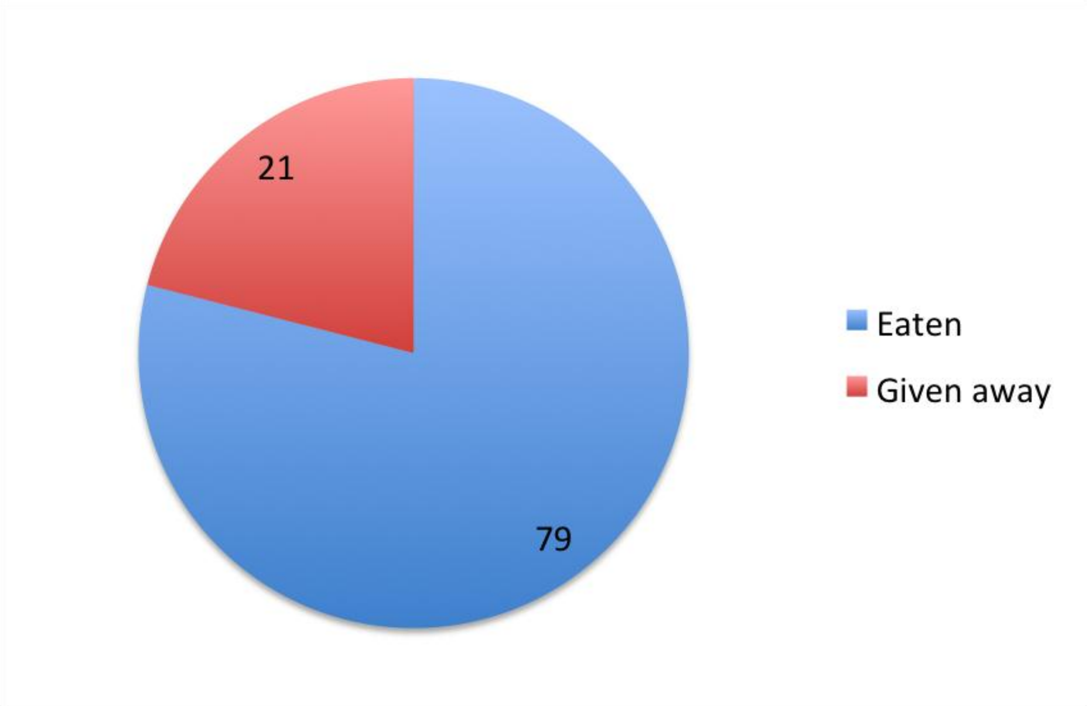

Fig. 2.25. The reported use of the retained catch of Blue-Eye Trevalla caught in Tasmania. These results are from a one-time 'wash up' questionnaire administered to participants at the conclusion of the diary survey. Note that these responses relate to registered vessel owners and not the entire crew that may have participated in a given fishing event.

2.2.9. *OTHER KEY SPECIES*

Yellowtail Kingfish

While not a primary focus of the survey, some effort and catch for Yellowtail Kingfish was reported. This species has traditionally been caught in small numbers around Tasmania, particularly along the north and east coasts, but it is a species of interest given the expectation that its abundance and hence catches will rise as ocean temperatures warm around Tasmania.

A total of 52 Yellowtail Kingfish were reported caught and retained with a further 30 released. Expanded catch estimates have not been produced since fewer than five vessels reported catching the species. Catches were restricted to the north and northeast coasts of Tasmania (regions 35, 38 and 39), although the species is known to have been caught by recreational fishers along the entire east coast and including the Derwent River (www.REDMAP.org.au).

Pink Snapper

Like Yellowtail Kingfish, Pink Snapper were not a focus of this study, but some catches of this species were reported. Snapper have traditionally been caught along the north coast of Tasmania in low numbers. As ocean temperatures rise it is expected that the species will increase its presence in Tasmanian waters and will become increasingly popular as a target for recreational fishers.

A total of 48 Snapper were reported retained during the survey with a further seven individuals released. Expanded estimates were not calculated due to the small number of vessels (five only) that reported the species. The majority of the reported catch was from the north coast of Tasmania, in particular the western region of the north coast (region 36). One event where snapper were caught was also reported from Flinders Island.

While not evident in this survey Snapper have been reported caught on the northeast coast of Tasmania, around St. Helens, and as far south as the Derwent River (www.REDMAP.org.au). As Tasmanian fishers become more aware of the presence of Yellowtail Kingfish and Snapper and increasingly target these species it would be expected that catch of these species will increase in Tasmanian waters.

3. WASH-UP SURVEY OF OFFSHORE BOAT BASED FISHING IN TASMANIA 2011-12

3.1. INTRODUCTION

The ‘wash-up survey’ was a one-off questionnaire conducted with vessel owners that had completed the 12-month telephone/diary survey. It was designed to collect data on attitudes and awareness of recreational fishers to issues relevant to offshore and game fishing in Tasmania as well as a basic assessment of direct expenditure on boat based recreational fishing.

The expenditure analysis is not designed to provide a comprehensive assessment, rather is indicative of expenditure from a subset of the Tasmanian recreational fishery. The sub-setting was prescribed through the overall sample design. For instance the survey uses a targeted subset of registered vessels, with an assumption that the following vessel types were unlikely to be used for offshore fishing: vessels less than 4.5 m in length, yachts, personal water craft, vessels with trade plates, etc. Secondly, as vessels were selected as the primary sampling unit, all survey respondents were owners of registered recreational vessels, who will have different expenditure profiles to fishers who may participate in game or offshore fishing but do not own such a vessel themselves.

This economic assessment is not exhaustive, a more comprehensive survey would have lengthened the ‘wash-up’ survey to a point that it would have become too onerous for respondents and response rates would have been compromised.

Understanding the attitudes of recreational fisheries to various issues and incorporating these insights within the decision making process, has gained recognition over recent years. A key principle of the National Policy for Recreational Fishing 1994 states that “fisheries management decisions should be based on sound information including fish biology, fishing activity, catches and economic and social values of recreational fishing” (NRFWG, 1994).

3.2. METHODS

The ‘wash up’ interview was conducted by telephone with diarists at the end of the phone diary survey period (November 2012).

3.2.1. FOCUS AREAS

Attitudes towards fishing

To assess the respondents attitudes towards various aspects related to recreational fishing a series of questions broadly relating to perceptions around ‘catching at least something’, ‘preferences towards catching large fish’, ‘preferences towards retaining fish’ and ‘preferences towards the variety of fish caught’ were asked. These questions are often referred to as an index of the consumptive orientation of fishers (Graefe 1980). For each of the 10 statements used in this study respondents indicated a level of agreement on a scale from 1 (strongly disagree) to 5 (strongly agree). In a few instances respondents indicated they were unsure what their response was to a given question, these cases were excluded from subsequent analysis.

Attitudes towards seal interactions and strategies to minimize fish loss

The PDS and OCS presented in this report are the first in Tasmania to explicitly estimate fish mortality related to seal interactions with recreational fishing. It was shown that seal induced mortality of SBT and to a lesser extent Striped Trumpeter was significant, noting that these are the two most popular targets for recreational game fishing and offshore reef fishing respectively.

A series of questions relating to seal interactions were asked during the 'wash-up' survey to assess attitudes towards strategies that may or may not reduce fish losses due to seal interactions. A question was also asked to determine attitudes towards including seal damaged fish as part of the possession limits.

Attitudes towards resource management options relating to game and offshore fishing in Tasmania

A series of questions relating to potential management options for key species caught while game and/or offshore fishing in Tasmania were asked to gauge the respondent's attitudes to potential resource management changes. The management options are not necessarily being considered currently as viable options.

Satisfaction with game and offshore fishing in Tasmania

Respondents were asked to rate their satisfaction with the overall quality of game fishing, and separately, the overall quality of offshore fishing in Tasmania, by providing a satisfaction score from 1 – 5, with one being the most satisfied and five being the least satisfied. Furthermore respondents were asked an open ended question relating to their perception of the biggest issue facing offshore recreational fishing in Tasmania.

3.2.2. Data analysis

Respondents were stratified by four grouping factors: residential area (statistical division), avidity, game fishing experience, and offshore fishing experience (excluding game fishing). Experience being determined by the number of years (not necessarily consecutive years) they had participated in each of these modes of recreational fishing.

Residential area

Respondents were categorized by their residential address (residence where the vessel included in the survey was registered to) at the time of the screening survey (October 2011). The registration address was allocated to one of four Australian Bureau of Statistics (ABS) Tasmanian Statistical Divisions (SDs): Greater Hobart, Southern, Northern and Mersey-Lyell (Fig. 2.1).

Avidity

Six avidity categories were applied according to the number of days the respondent reported offshore or game fishing from their registered vessel during the 12 month diary survey period (i.e. days fished per year). The categories where characterized as: 0 days, 1 – 4 days, 5 – 9 days, 10 – 14 days, 15 – 19 days and 20 plus days.

Game fishing experience

A question in the 'wash-up' survey asked respondents how many years they had actively participated (fished at least once in a given year) in game fishing. Six game fishing experience categories were applied based on the responses: 0 years, 1 – 4 years, 5 – 9 years, 10 – 14 years, 15 – 19 years and 20 plus years.

Offshore fishing experience (excluding game fishing)

Respondents were also asked how many years they had actively participated (fished at least once in a given year) in offshore fishing (other than game fishing). Six offshore fishing experience categories were applied based on the responses: 0 years, 1 – 4 years, 5 – 9 years, 10 – 14 years, 15 – 19 years and 20 plus years.

Statistical comparisons between categories

Ordinal cumulative link regression models were used to examine whether factors related to the area of residence, avidity and/or previous fishing experience influence responses. For factors that were allocated as a continuum of responses (i.e. avidity and game fishing experience) each category was tested against the category that reported zero days fishing in regard to avidity and zero years in the case of experience. For the statistical division factor the Southern, Northern and Mersey-Lyell SDs were compared against respondents from Greater Hobart. Cumulative link models are a powerful model class for such data as observations are treated as categorical and the ordered nature of responses is fully incorporated.

For all analyses, differences were assessed according to three levels of significance: $p < 0.05$ (*); $p < 0.01$ (**), and; $p < 0.001$ (***).

3.2.3. EXPENDITURE ASSESSMENT

Depreciation of capital items

To determine an annual cost of vessel ownership participants were asked the purchase price as well as the age of their boat. From this information an annual depreciation (D_A) cost of each vessel included in the survey was calculated as:

$$D_A = C(1-d)^{t-1} - C(1-d)^t$$

Where C is the purchase price of the vessel, d is the depreciation rate (here assumed to be 15%) and t is the years since the vessel was purchased. The depreciation model is a declining balance function so the depreciation rate was set at twice the value reported

(7.5%) for recreational vessels by Ernst and Young (2004) who applied a linear depreciation model.

A question was asked of the respondent regarding the proportion of time that their vessel was used for recreational fishing relative to other activities conducted from the vessel (p_f). The proportion of D_A that is directly related to recreational fishing (D_A^f) can then be calculated as:

$$D_A^f = D_A \times \rho_f$$

Other capital expenses related to vessel ownership relate to upgrading various components of the vessel. Respondents were asked if they had upgraded their vessel trailer since purchasing the boat and if so the cost and years since it was upgraded. The same question was asked in relation to significant electronics upgrades, such as: GPS units, echo sounders, radars, etc. Annual depreciation cost was calculated for each of these upgrades, if applicable, using the same equations described above for depreciation of vessel costs. An item that was not included, that is a large upgrade expense, was the replacement of vessel motors. The exclusion of this item means that the reported cost of depreciation of capital items will be under-estimated.

Vessel ownership related expenses

A series of questions were asked relating to common vessel related expenses. Respondents were asked to provide an estimate of expenditure over the 12 month period covered during the PDS. The cost of each of the following items was multiplied by the proportion of time that the vessel was used for recreational fishing relative to other activities conducted from the vessel (p_f):

- Special clothing (e.g. wet weather gear)
- Safety equipment (e.g. life jackets, flares, etc)
- Boat and/or trailer insurance
- Boat and/or trailer registration fees
- Boat mooring/storage fees
- Boat fittings and/or modifications
- Boat and/or trailer maintenance

Offshore fishing related expenses

A further series of questions were asked relating to expenses directly related to offshore fishing. Respondents were asked to provide an estimate of expenditure over the 12 month period covered during the PDS for the following items:

- Fishing tackle purchases
- Fishing tackle maintenance
- Ice
- Bait and Burley
- Fishing books and magazines

- Fishing club fees
- Fishing competition fees
- Boat fuel and oil

This list is not comprehensive and travel related expenses (e.g. tow vehicle travel costs, accommodation, meals, etc) have not been included for reasons mentioned previously. It is also assumed that for this analysis all fishing related expenses were incurred by the vessel owner. This is potentially unrealistic as expenses such as fuel, ice and bait are often shared between the owner and crew for a given trip. Therefore estimates for these items are likely to be over-inflated.

3.3. RESULTS

3.3.1. Response rates

A total of 413 respondents were called to participate in the wash-up survey, with 393 (95%) fully responding. Six respondents refused to participate and 14 were not contactable for a variety of reasons.

3.3.2. Avidity

The distribution of reported avidity was weighted towards the less avid end of the continuum. The proportion of respondents within the avidity categories were: 0 days (33%), 1 – 4 days (44%), 5 – 9 days (16%), 10 – 14 days (14%), 15 – 19 days (2%) and 20 plus days (1%) (Fig. 3.1). Given the low sample size for the latter three categories they were pooled into a new category (10+ days) for subsequent analyses.

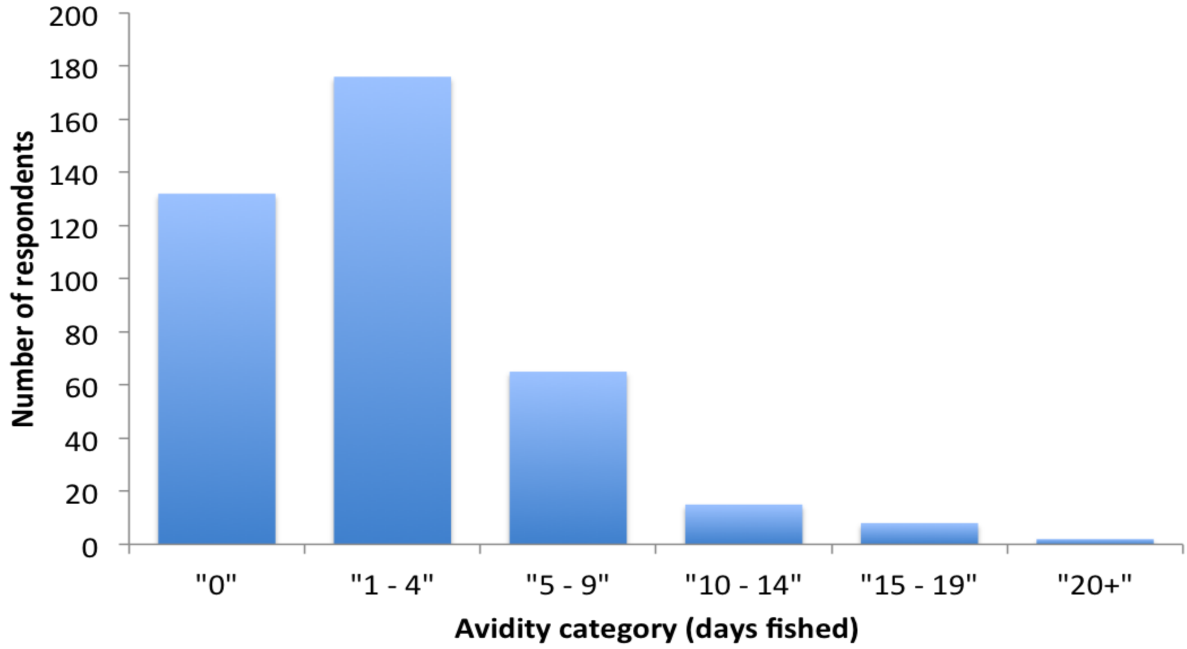

Fig. 3.1. The number of respondents who were categorized into avidity categories based on the number of days they reported game or offshore fishing during the 12 month telephone-diary survey.

3.3.3. *GAME FISH EXPERIENCE*

The distribution profile relating to game fishing experience was weighted towards fewer years fished. The number of respondents fishing greater than five years was still significant however, with a long tail in responses up to 50 years participation, and one individual indicating that they had participated in game fishing for 57 years (Fig. 3.3). When allocated to game fishing experience categories the proportional responses were: 0 years (7%), 1 – 4 years (23%), 5 – 9 years (17%), 10 – 14 years (13%), 15 – 19 years (10%) and 20 plus years (30%).

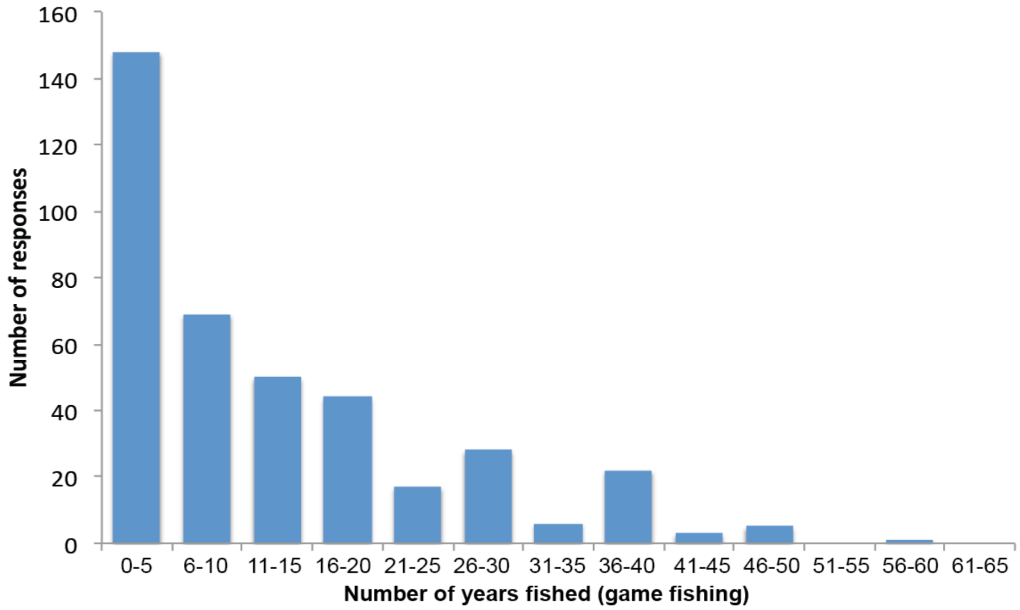

Fig. 3.2. The frequency of years game fishing by respondents in Tasmania as reported during the wash up survey.

3.3.4. *OFFSHORE FISHING EXPERIENCE*

The response profile of offshore fishing was similar to that of game fishing experience, being weighted towards less years fishing, but again with a long tail to 57 years offshore fishing experience (Fig. 3.3). When allocated to offshore fishing experience categories the proportional responses were: 0 years (8%), 1 – 4 years (21%), 5 – 9 years (17%), 10 – 14 years (15%), 15 – 19 years (9%) and 20 plus years (30%). There was a significant correlation in the proportional responses within the categorical groups between game fishing and offshore fishing experience (Pearson coefficient: 0.98, $p < 0.001$). Offshore fishing was therefore excluded as a factor in subsequent analysis to avoid over-parameterisation in the regression models.

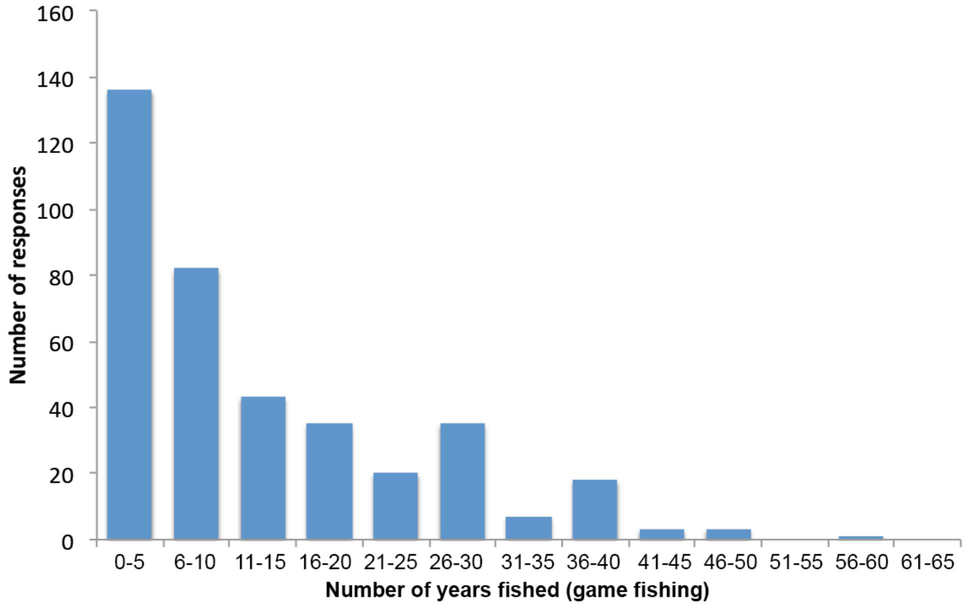

Fig. 3.3. The frequency of years offshore fishing as reported by respondents during the wash up survey.

3.3.5. Attitudes towards fishing

Catching something

There was general agreement that a day's fishing could be successful even if no fish were caught, this question was ranked number one in terms of strength of response and agreement between respondents (Fig. 3.4). The average response of those who fished 10 or more days during the survey was significantly more supportive of this statement than respondents who had not fished during the season (Table 3.1). There was also strong agreement between respondents to the question – 'If I thought I would not catch fish I would not go fishing', with 70% of respondents disagreeing with this statement (Fig. 3.4). Respondents who had fished for 1 – 4 days during the survey disagreed with this statement significantly more than those who did not fish during the survey (Table 3.1). The questions 'I'm not satisfied unless I catch at least something' and ' the more fish I catch the happier I am' were ranked lower in terms of coherence between respondents (6 and 7 respectively) but on average both were still weighted towards disagreeing with the statements (Fig. 3.4). Respondents with the most game fishing experience disagreed significantly more to the statement 'The more fish I catch the happier I am' than those who reported no game fishing experience (Table 3.1).

The responses to these four questions indicate that fishers derive benefits from offshore recreational fishing that is unrelated to catching fish. When assessing factors such as avidity and game fishing experience it would appear that more experienced and avid fishers feel that fishing can be satisfying even if no fish are caught or catch rates are low.

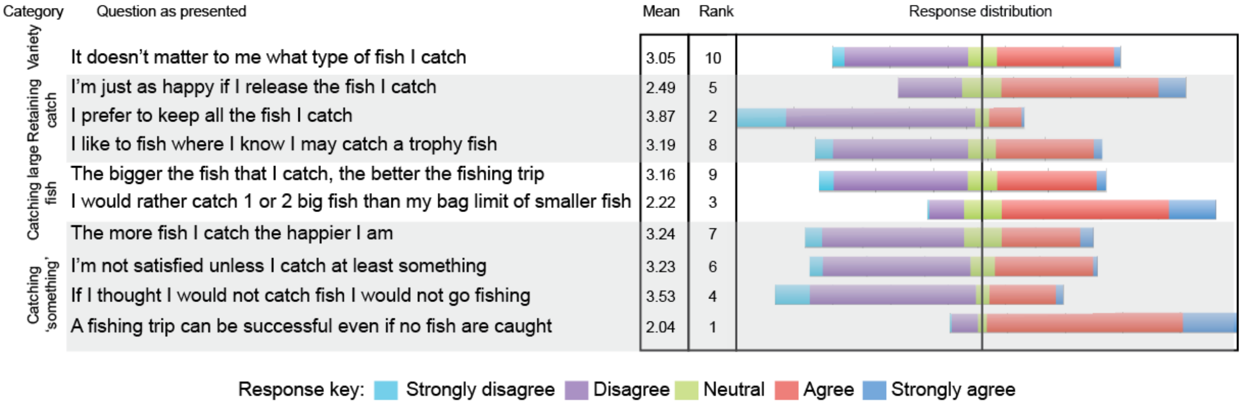

Fig. 3.4. Mean scores and response distribution for the responses to questions relating to general attitudes to recreational fishing by respondents. A mean score closer to one indicates greater agreement with a statement, while a mean score of three indicates a neutral response and a mean score closer to five indicates greater disagreement with the statement. Responses are ranked in terms of the strength of agreement between respondents.

Catching large fish

The responses to questions relating to catching large fish were polarized, with the questions 'I like to fish where I know I may catch a trophy fish' and 'The bigger the fish that I catch, the better the fishing trip' ranked eighth and ninth respectively (Fig. 3.4). The average response to both statements however, was skewed slightly towards disagreement, indicating that overall respondents were not motivated by the need to catch larger (trophy) fish (Fig. 3.4). The response from respondents who had fished on 10 or more days during the survey was, however, significantly different to those who did not participate in offshore fishing during the season, suggesting that the more avid fishers expressed a greater preference to target 'trophy' fish (Table 3.1). In contrast, the response to the question 'I would rather catch 1 or 2 big fish than my bag limit of smaller fish was highly ranked (3 of 10) in terms of respondent coherence with 74% agreeing with this statement (Fig. 3.4). Game fishing experience had a significant effect on the response to this question with respondents who reported five or more years' experience (which includes four categorical groups) reporting a response significantly more agreeable with this statement that the group that had no experience game fishing (Table 3.1). It is probable that the contrast between these two statements is related to the introduction of the term 'bag limit' in the latter question and thus perceived to relate to the retention of fish (for consumption).

Retention of catch

There were strong indications that the majority of respondents were just as satisfied when releasing catch as retaining it. The question 'I prefer to keep all the fish I catch' ranked 2nd of 10 in regard to coherence between respondents, with 83% disagreeing with this statement (Fig. 3.4). A majority of respondents (64%) also agreed with the statement 'I'm just as happy to release the fish I catch' (Fig. 3.4). No significant differences were identified in responses between categories from the three factors tested relating to retention of catch.

Variety in catch

Only one question was asked relating to preferences regarding catch composition – 'It doesn't matter to me what type of fish I catch'. This question provided the most polarized response, with approximately half of respondents agreeing and half disagreeing with the statement (Fig. 3.4). No significant differences were identified in responses between categories from the three factors tested for this question.

Table 3.1. Results of the ordinal cumulative link regression analyses to determine factors influencing responses related to questions on general attitudes to recreational fishing by respondents. Significant results are represented by positive (+) and negative (-) signs, with the former indicating a directional preference towards stronger agreement with the statement and the latter a preference towards disagreement with the statement. The degree of significance is represented as: *p*<0.05 (+/-), *p*<0.01 (++/--). Non-significant results are not presented.

	Region				Avidity				Game fish experience					
	Greater Hobart	Southern	Northern	Mersey-Lyell	0	1-4	5-9	10+	0	1-4	5-9	10-14	15-19	20+
It doesn't matter to me what type of fish I catch														
I'm just as happy if I release the fish I catch														
I prefer to keep all the fish I catch														
I like to fish where I may catch a trophy fish								++						
The bigger the fish that I catch, the better the fishing trip														
I would rather catch 1 or 2 big fish than my bag limit of smaller fish											+	+	+	+
The more fish I catch the happier I am														-
I am not satisfied unless I catch at least something						-								
If I thought I would not catch fish I would not go fishing														
A fishing trip can be successful even if no fish are caught								+						

3.3.6. *ATTITUDES TOWARDS SEAL INTERACTIONS AND STRATEGIES TO MINIMIZE FISH LOSS*

The greatest agreement between respondents in regard to strategies to reduce losses to seal interactions was to avoid fishing in areas where there are more seals, with 81% of respondents agreeing with this statement (Fig. 3.5). Respondents from the Northern SD, however, were significantly less likely to agree with this statement than respondents from the Greater Hobart SD (Table 3.2). There was also strong agreement (79% respondents) that using previously caught fish as a decoy is encouraging seals to interact with recreational fishers (Fig. 3.5), although significantly fewer respondents who had fished 1 – 4 days compared with those who did not fish during the survey were in agreement with this statement (Table 3.2). A small majority of respondents (53%)

disagreed that the use of previously caught fish was an effective method of distracting seals when attempting to land a fish (Fig. 3.5), with respondents from the Southern SD having a significantly stronger negative opinion about this than those from the Greater Hobart SD. Respondents with 15 years or more experience in game fishing were also more likely to disagree with the statement than fishers with no prior years of experience game fishing (Table 3.2). The majority of respondents (68%) also thought that is was a bad idea to release fish when seals were around the boat (Fig. 3.5).

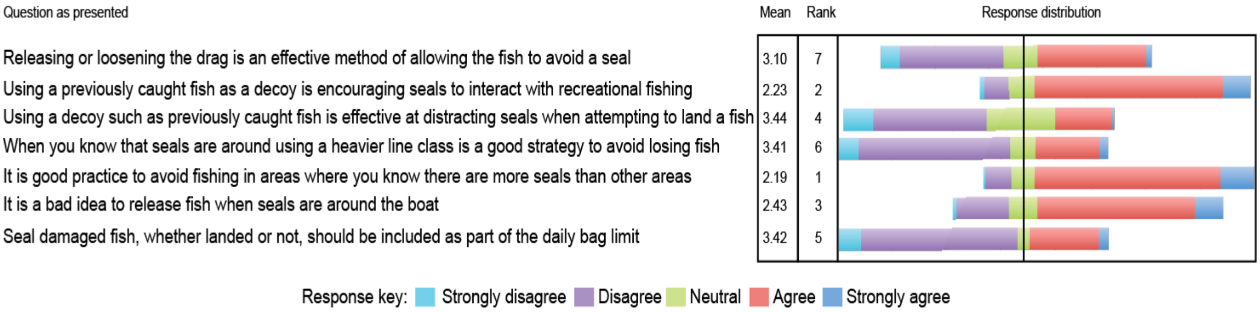

Fig. 3.5. Mean scores and response distribution to questions relating to seal interactions with the offshore recreational fishery in Tasmania. A mean score closer to (1) indicates greater agreement with a statement, while a mean score of (3) indicates a neutral response and a mean score closer to (5) indicates greater disagreement with the statement. Responses are ranked in terms of the strength of agreement between respondents.

Using heavier gauge fishing line in order to retrieve fish to the boat quickly has been proposed as a strategy to reduce the likelihood of seal interactions. The majority of respondents (64%), however, disagreed that this method is effective (Fig. 3.5). Another method that has been suggested as an effective way to reduce the chance of seals interacting with fish once they have been hooked is to release the drag on the fishing reel so the fish has a greater ability to avoid the seal of its own accord. This strategy polarized the respondents with 42% agreeing and 46% disagreeing (remaining percentage reported a neutral response) that this strategy was effective (Fig. 3.5).

It is relevant to note that respondents were not asked if they had practiced any of these strategies and thus it is unclear whether responses are based on experience or perception. In order to properly assess the effectiveness of these (or other) approaches, a statistically based test design would be required.

The majority of respondents (67%) disagreed with the statement that seal damaged fish, whether landed or not, should be included as part of the daily bag limit (Fig. 3.5). Respondents from the Northern SD however, were significantly less disagreeable to this statement than those from the Greater Hobart SD (Table 3.2).

Table 3.2. Results of the ordinal cumulative link regression analyses to determine factors influencing responses related to questions on seal interactions with the recreational offshore fishery. Significant results are represented by positive (+) and negative (-) signs, with the former indicating a directional preference towards more agreement with the statement and the latter a preference towards disagreement with the statement. The degree of significance is represented as: p<0.05 (+/-), p<0.01 (++/--). Non-significant results are not presented.

	Region				Avidity				Game fish experience					
	Greater Hobart	Southern	Northern	Mersey-Lyell	0	1-4	5-9	10-14	0	1-4	5-9	10-14	15-19	20+
Releasing or loosening the drag is an effective method of allowing the fish to avoid a seal														
Using a previously caught fish as a decoy is encouraging seals to interact with recreational fishing						--								
Using a decoy such as previously caught fish is effective at distracting seals when attempting to land a fish		-											-	-
When you know that seals are around using a heavier line class is a good strategy to avoid losing fish														
It is good practice to avoid fishing in areas where you know there are more seals than other areas			-											
It is a bad idea to release fish when seals are around the boat														
Seal damaged fish, whether landed or not, should be included as part of the daily bag limit			+											

3.3.7. ATTITUDES TOWARDS HYPOTHETICAL MANAGEMENT OPTIONS RELEVANT TO GAME AND OFFSHORE FISHING IN TASMANIA

The majority of respondents (82%) strongly disagreed with the statement that SBT should be catch and release only (Fig. 3.6). With the most avid fishers, and fishers with greater than 5 years game fishing experience, disagreeing to this statement significantly more than respondents who had not fished during the survey period or those with no previous game fishing experience (Table 3.3). Respondents from the Northern SD did not disagree to this statement to the same extent as those from the Greater Hobart SD (Table 3.3). As previously mentioned SBT is one of the most popular targets for game fishing in Tasmania, with the center of activity for this fishery occurring in the south and southeast of the state. In contrast, the majority of respondents (69%) agreed that Striped Marlin should be catch and release only (Fig. 3.6), particularly those that fished for 1 – 4 days during the survey (Table 3.3). Striped marlin is a rare catch in Tasmania, migrating down the coast of Australia with warm water currents during the summer months. There is the potential that they may become more available in Tasmania in the future if the current trend of warming waters continues.

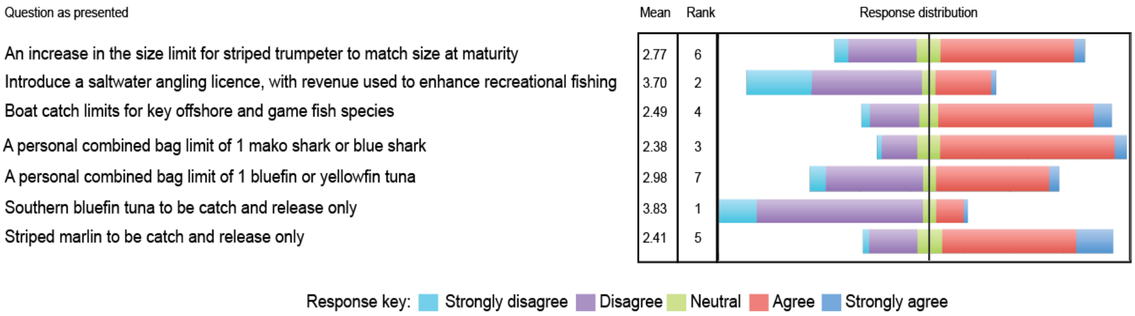

Fig. 3.6. Mean scores and response distribution to questions relating to attitudes of respondents toward potential management options for key offshore recreational species. A mean score closer to (1) indicates greater agreement with a statement, while a mean score of (3) indicates a neutral response and a mean score closer to (5) indicates greater disagreement with the statement. Responses are ranked in terms of the strength of agreement between respondents.

A question relating to reducing the current combined limit of two Southern Bluefin Tuna, Yellowfin Tuna or Bigeye Tuna to a combined limit of one fish elicited a polarized response, with 49% of respondents agreeing that this should occur and 46% disagreeing (the remaining percentage reported a neutral response) (Fig. 3.6). In contrast, the majority of respondents (75%) agreed that the combined daily bag limit for Mako and Blue Shark should be reduced from two to one (Fig. 3.6), with respondents who fished for 10 or more days during the survey significantly more supportive of this statement, whereas respondents from the Northern SD were less supportive than respondents from the Great Hobart region (Table 3.3). There was strong coherence between respondents that boat catch limits should be implemented for key offshore and game fish species, with 69% agreeing with this statement (Fig. 3.6), particularly those respondents who fished for 1 – 4 days during the survey (Table 3.3). It is worth noting that this question was not asked in relation to charter operators for whom boat limits would have a greater impact.

There was also support for increasing the minimum size limit of Striped Trumpeter to match the estimated size at maturity for the species, with 58% of respondents agreeing that this should occur (Fig. 3.6).

The question regarding the introduction of a saltwater angling license in Tasmania, with the revenue generated used to enhance recreational fishing was opposed by the majority of respondents (70%) and of all questions this elicited the greatest proportion of responses categorized as strongly disagree (Fig. 3.6). Respondents from the Southern SD were significantly less supportive of this management option (Table 3.3).

Table 3.3. Results of the ordinal cumulative link regression analyses to determine factors influencing responses by respondents related to questions on attitudes to potential management options for key offshore recreational species. Significant results are represented by positive (+) and negative (-) signs, with the former indicating a directional preference towards more agreement with the statement and the latter a preference towards disagreement with the statement. The degree of significance is represented as: p<0.05 (+/-), p<0.01 (++/--). Non-significant results are not presented.

	Region				Avidity				Game fish experience					
	Greater Hobart	Southern	Northern	Mersey-Lyell	0	1-4	5-9	10+	0	1-4	5-9	10-14	15-19	20+
An increase in the size limit for Striped Trumpeter to match size at maturity														
Introduction of saltwater angling licences, with revenue used to enhance recreational fisheries		-												
Boat catch limits for key offshore and game fish species						+								
A personal combined bag limit of 1 Mako shark or blue shark			-					+						
A personal combined bag limit of 1 bluefin or Yellowfin Tuna														
Southern Bluefin Tuna to be catch and release only			+					--			-		--	-
Striped Marlin to be catch and release only						++								

3.3.8. *Satisfaction with game and offshore fishing in Tasmania*

Excluding respondents who were unsure, the average score of all respondents for satisfaction with game fishing in Tasmania was 2.21, indicating that the majority of fishers were, in general, satisfied with game fishing in Tasmania (Fig. 3.7). Respondents from the Mersey-Lyell SD were significantly less satisfied with game fishing in Tasmania compared to respondents from the Greater Hobart SD ($p < 0.01$). There was also general satisfaction with offshore fishing in Tasmania with a mean score of 2.27 (Fig. 3.8).

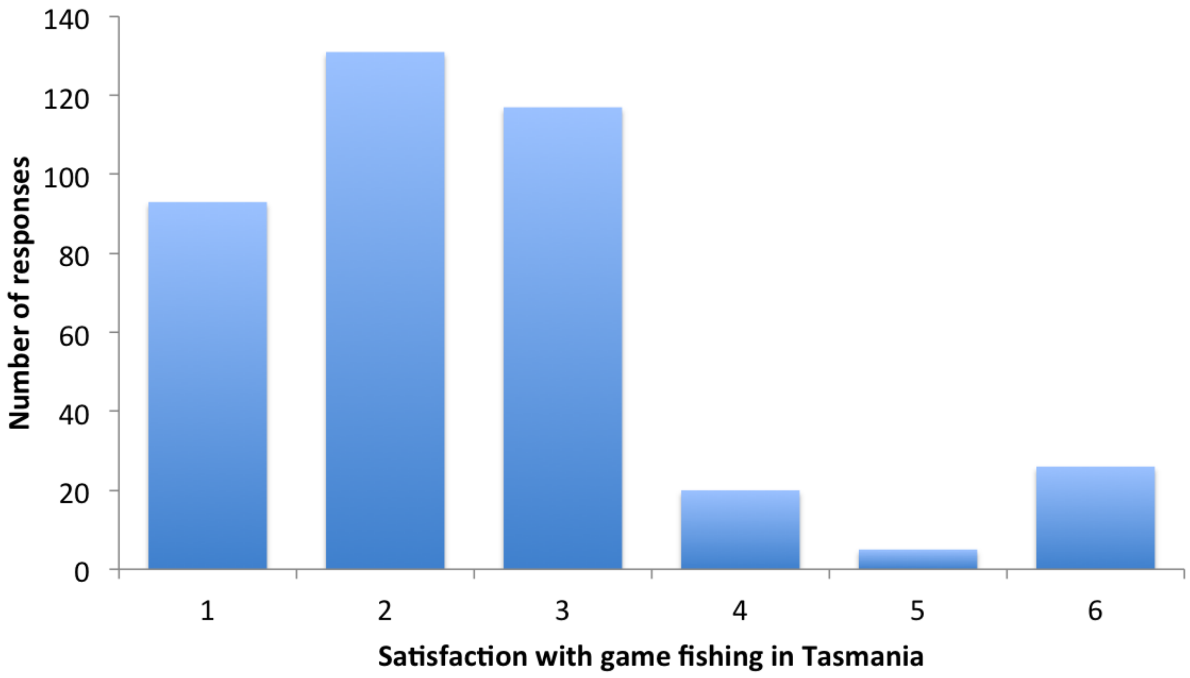

Fig. 3.7. Response distribution for satisfaction with game fishing in Tasmania, where (1) indicates a high degree of satisfaction and (5) indicates a high degree of dissatisfaction. Response code (6) indicates the number of respondents that provided a response stating they were 'Unsure'.

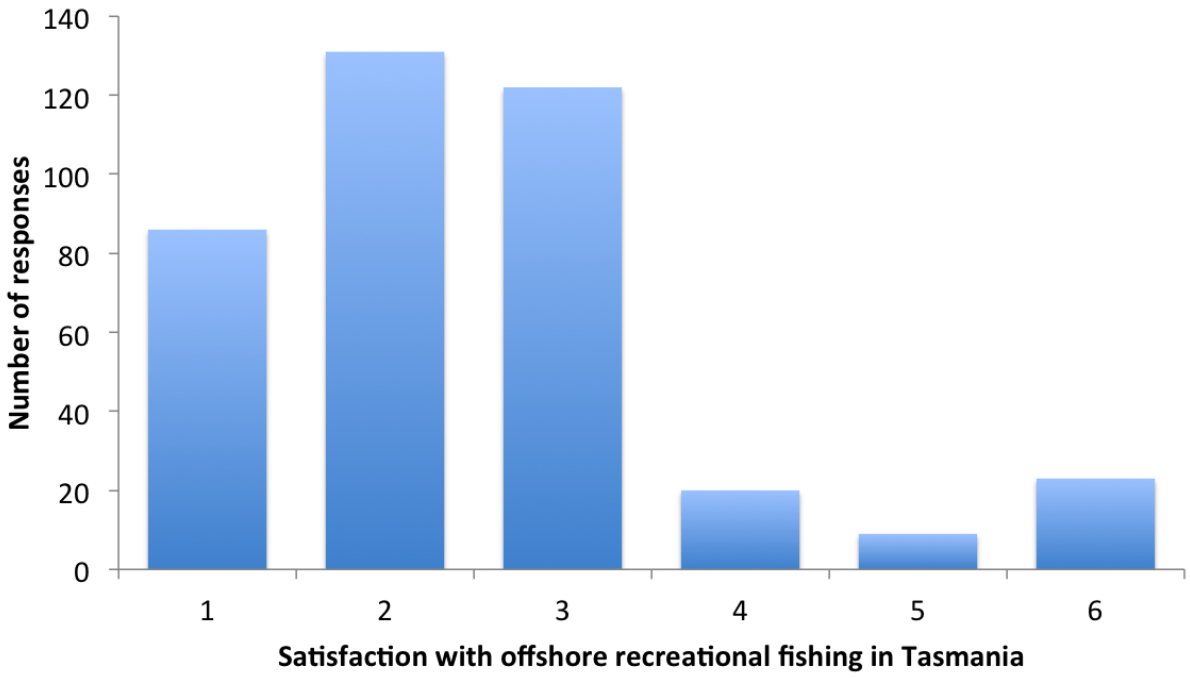

Fig. 3.8. Response distribution for satisfaction with offshore fishing in Tasmania, where (1) indicates a high degree of satisfaction and (5) indicates a high degree of dissatisfaction. Response code (6) indicates the number of respondents that provided a response stating they were 'Unsure'.

3.3.9. *BIGGEST ISSUES FACING OFFSHORE RECREATIONAL FISHING IN TASMANIA*

Respondents were asked an open ended question in relation to what they perceived as the biggest issue facing offshore recreational fishing in Tasmania. The open ended nature of the question meant that they were free to state a response as they saw fit, without being tied to specific options. The 324 responses that were provided could be categorized into one of five broad topics: commercial fishing, fisher safety, seal interactions, sustainable management and compliance with regulations.

The greatest response related to commercial fishing with 42% of respondents stating that this is what they considered the biggest issue facing offshore recreational fishing in Tasmania (Fig. 3.9), most commonly related to perceived or historically realised overfishing by the commercial sector. The magnitude of the response was possibly influenced by events occurring in the months prior to the 'wash-up' survey, namely the arrival of the super trawler 'Margiris' in Australian waters. In fact, over half (57%) of the responses that related to commercial fishing made explicit mention of the super trawler. The second most common response category related to sustainable management (particularly the need to ensure sustainable fishing practices across all fishing sectors), with 31% of respondents stating that this was the biggest issue (Fig. 3.9). Fisher safety (most commonly a concern over the size and sea worthiness of some boats that participate in offshore fishing) and seal interactions were the next most important issues (each about 11% of respondents) (Fig. 3.9). Compliance to current regulations was reported as the biggest issue by 5% of respondents (Fig. 3.9).

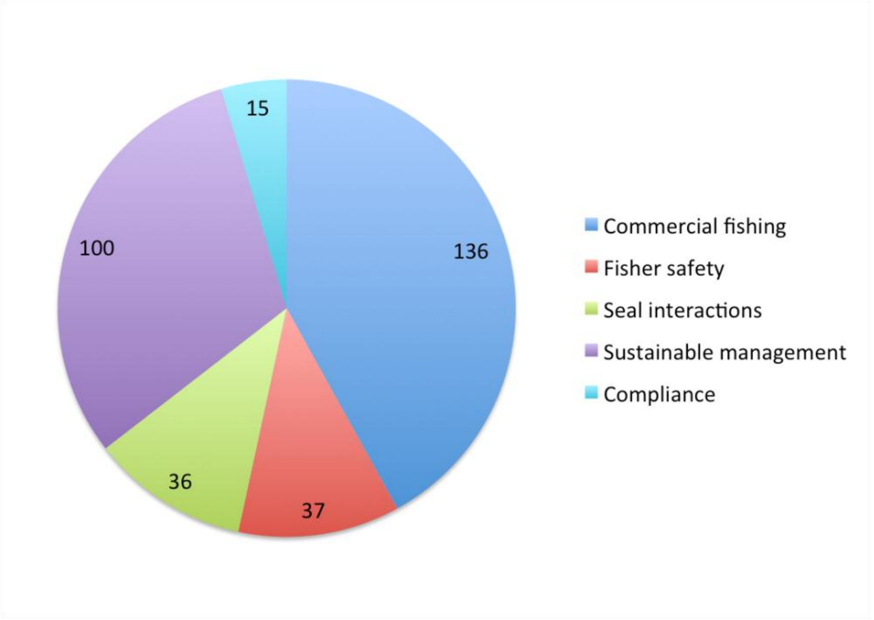

Fig. 3.9. The distribution of the 'biggest' issues facing offshore recreational fisheries in Tasmania as perceived by respondents. The categories have been generated based on responses to an open ended question.

3.3.10. EXPENDITURE ASSESSMENT

Overall, more than $25M in direct attributed costs were related to recreational fishing for owners of private vessels greater than 4.5m that had intention to use their vessel for offshore fishing during the survey period (whether they fished or not) (Table 3.4). The calculated depreciation cost of vessels represented the greatest expense, accounting for 40% of all costs considered in this study. Other significant expenses included boat modifications and/or fittings, fuel and oil for the boat used on offshore fishing trips, and fishing tackle purchases, each accounting for approximately 10% of the total costs incurred when recreationally fishing offshore. It is not surprising that boat fuel and fishing tackle are major expenses associated with offshore fishing. Large quantities of fuel are typically required to travel to offshore fishing grounds and/or when trolling for game fish, and specialist and expensive tackle is required for offshore and game fishing. Boat insurance and boat/trailer maintenance costs each accounted for approximately 7% of the overall costs, the remainder was spread across items as outlined in Table 3.4.

Table 3.4. The estimated annual cost (±95% CI) of a range of expenses common to offshore recreational fishing in Tasmania.

Expense items	Estimated	Lower	Upper
Offshore fishing expenses			
Fishing tackle purchases	$2,498,763	$2,025,424	$3,033,510
Fishing tackle maintenance	$376,110	$281,401	$492,119
Ice	$108,164	$82,509	$140,570
Bait and Burley	$174,065	$136,763	$216,381
Books and magazines	$239,815	$183,668	$301,427
Club fees	$49,816	$32,671	$68,851
Competition entry fees	$79,076	$49,721	$114,865
Fuel and oil for boat	$2,732,367	$2,026,795	$3,640,005
Vessel ownership expenses			
Special clothing	$344,870	$248,452	$454,828
Safety equipment	$853,357	$666,902	$1,081,383
Boat insurance	$1,611,029	$1,423,840	$1,814,936
Boat and/or trailer registration	$381,887	$339,985	$429,229
Mooring and storage fees	$412,676	$252,791	$599,206
Boat modifications and/or fittings	$2,828,428	$1,796,666	$3,942,237
Boat and/or trailer maintenance	$1,554,859	$1,269,645	$1,889,214
Annual depreciation cost of capital expenses			
Annual depreciation (boat)	$10,183,591	$8,642,128	$12,074,264
Annual depreciation (trailer)*	$128,638	$77,224	$187,788
Annual depreciation (electronics)*	$583,756	$476,539	$707,911
Total expense of items considered	**$25,168,110**	**$21,861,976**	**$28,674,645**

*Only new trailers or electronic items that were purchased sometime after the initial purchase of the boat are included (i.e. the items had been replaced or upgraded).

4. Onsite creel survey of Southern Bluefin Tuna catch and effort from two key boat ramps in south east Tasmania

4.1. METHODS

4.1.1. Survey period

The on-site creel survey (OCS) was implemented to cover the period when most fishing for Southern Bluefin Tuna (SBT) was anticipated (1st March to 31st July 2012), and was conducted at the Pirates Bay and Southport boat ramps (Fig. 2.1). These ramps have traditionally represented key access points for fishers targeting SBT (Morton and Lyle 2003, Forbes et al. 2009).

4.1.2. Survey design

The survey involved a stratified random sampling design, with the two sampling sites (boat ramps) considered independently in the allocation of sampling effort and for analysis. For each boat ramp the survey period was divided into two strata; viz (i) weekdays and (ii) weekends and public holidays. For the weekday stratum the target sampling rate was 30%. As most fishing effort typically occurs on weekends and public holidays (Forbes et al. 2009), a higher target sampling rate of approximately 50% was applied for this strata. Two sanctioned competitions where SBT were targeted were given 100% coverage and treated as a separate stratum, one was based at Pirates Bay in April and the other based at Southport in May, each event ran for two days. Club rally days were not treated as a separate stratum. Each sampling session was intended to account for all of the game fishing activity on that day by trailer boats operating from the boat ramp, however on some days, when there was a high degree of activity at the boat ramp a small proportion of boats were not interviewed (referred to as ‘interviews missed’). All surveys were conducted during the day, with the creel clerks arriving at the boat ramp at approximately 10:30 am and leaving when all boats were off the water, or when it was moving into the evening and only one or two boats were still out (referred to as ‘trailers left at end of day’). Day was used as the primary sampling unit.

On a survey day, in addition to counting the number of trailers in the car park at the start of the session, any boats being launched were noted, where possible it was determined whether these vessels were likely to participate in game or offshore reef fishing, and hence ‘in scope’ for the survey. At the end of each session the number of boats that had been retrieved, number of trailers remaining in the car park, and the number of interviews conducted were recorded.

A representative from each boat was interviewed at the boat ramp upon completion of their fishing trip. The interviews were structured, with the type of fishing activities undertaken from the vessel established at the outset. If the representative had not been game fishing or offshore reef fishing, the type of activity was classified and the interview terminated. For game fishing and/or offshore reef fishing trips, regardless of whether any fish were caught or not, the following information was recorded:

- Number and gender of all fishers aboard the vessel
- Whether each member of the crew was a member of a game fishing club
- Whether the trip was undertaken as part of a fishing competition
- Whether the vessel was chartered for a fishing trip
- The time spent fishing (soak time)
- General fishing location
- Fishing method (bait, lures or both)
- Hook configuration of lures used (game fishing only)
- Number of fish caught by species (kept, released and tagged)
- Number of fish hooked that were lost to seals during retrieval
- Number of landed fish damaged by seals
- Number of fish attacked by seals post-release

4.1.3. AUXILIARY DATA

Trailer counts

The number of trailers present in the car park of each boat ramp were counted on most days between the 1st of March and the 31st July, whether the day was flagged as a survey day or not. This information provided a proxy of potential fishing effort which could be used as a predictive variable to estimate the effort on days when trailers were not counted. Trailer counts on non-survey days occurred between 9:30 and 10:30 am.

Commercial abalone boats

Commercial abalone boats (trailer boats) regularly utilise both the Pirates Bay and the Southport boat ramps. Data was provided by the DPIPWE on the number of abalone boats that reported unloading their catch at each of the survey ramps during the survey period. This data was then subtracted from the total trailer counts for each day to provide a more precise representation of recreational fishing effort from each boat ramp.

Weather conditions

Weather observations from the Bureau of Meteorology (BOM) were obtained from 1st March to 31st July 2012 to provide predictive variables to estimate effort on days when trailers were not counted. Hobart airport and Cape Bruny were the specific weather stations used, the latter representing weather conditions for southern Tasmania where the majority of vessels launching from Southport were expected to fish and the former representing weather conditions on the Tasman Peninsula where the majority of vessels launching from Pirates Bay would be expected to fish. The Tasman Island weather station was the preferred option to represent weather conditions for Pirates Bay but it was out of commission for approximately one month during the peak activity of SBT fishing. Environmental variables were taken from the 09:00 reading and included wind speed (knots), direction (compass points), ambient temperature and barometric pressure.

Using both wind speed and wind direction we calculated a value of westerly wind stress as follows:

wind stress = wind speed(cos(2*3.142*(wind direction-90)/360))*

Wind stress values become more negative the more westerly the wind and the greater the wind speed in the westerly quadrant. This was also tested as a factor in the trailer count prediction model.

4.1.4. OTHER FISHING ACTIVITIES

Respondents were asked what types of fishing activity they had participated in on a given day. The responses were categorised as game fishing, offshore reef fishing, other line fishing, netting, dive harvest or potting. While respondents could report multiple fishing types for a given day; detailed questions regarding fishing activity were only asked if they had participated in game fishing or offshore reef fishing. The other modes of fishing are reported to show the spread of fishing activities based out of the survey boat ramps.

4.1.5. PARTICIPANT DEMOGRAPHICS

As part of the interview the number of fishers on a boat on a given day was recorded, including information on the gender and membership status to game fishing clubs for each fisher.

4.1.6. EFFORT

A negative binomial Generalized Linear Model (nb.GLM) was used to test the significance of a suite of explanatory variables on the total number of trailers present in the car park of a boat ramp on a given day. This model was chosen over a Poisson Regression due to over dispersion of the data; the model choice was supported on the basis of a highly significant (<0.001) likelihood ratio test when compared to the Poisson regression. The model varied by site with appropriate model selection based on the lowest Akaike Information Criterion (AIC) value. For Pirates Bay the following model configuration was used:

$$\log(Total\ trailers) = Strata + WS + T + BP + WWS + \varepsilon$$

where $\varepsilon = NB(r;p)$ or simply a negative binomial error term, *Strata* = weekend versus holiday strata type, *WS* = wind speed, *T* = ambient temperature, *BP* = barometric pressure, and *WWS* = westerly wind stress.

For the model used to test effort at Southport the factors *BP* and *WWS* were removed as they were not significant. A factor for ‘Month’ was added as an interactive term with Strata. This model produced a better fit according to a lower AIC value.

$$\log(Total\ trailers) = Strata + WS + T + factor(Month) + \varepsilon$$

These models were then used to predict the number of trailers that would be present on days when no trailer counts were conducted. Substituting these predictions into the observed trailer count data provided a complete temporal assessment of the number of boat trailers that were present or predicted for each boat ramp for each day throughout the survey period.

The proportion of boat trailers participating in game fishing was estimated from those that were interviewed after adjusting for the number of commercial abalone boats. This proportion was calculated separately for each boat ramp and used to adjust the trailer counts to provide an estimate for game fishing effort.

Information reported from the two sanctioned competition events were not included in the models as they had 100% coverage (with the exception of a small number of missed interviews – see below) and their inclusion negatively affected the model fit. The absolute number of vessels game fishing on these days were added to the estimated total game fishing effort to provide a total effort estimate, and again ‘missed interviews’ were allocated as game fishing or not based on a pro rata of vessels confirmed game fishing relative to potential vessels participating in game fishing.

4.1.7. Catch

The survey was designed to focus primarily on catch of Southern Bluefin Tuna (SBT). Catch estimates for SBT on non-survey days were predicted using the reported catch on survey days and the recreational vessels participating in game fishing events (both reported and predicted) on a given day. A negative binomial generalized linear model was used to account for over-dispersion in the data. The lowest AIC value was achieved by the following model configuration:

$$\log(catch) = potential\ fishing\ vessels + \varepsilon$$

$where\ \varepsilon = NB(r; p).$

The assumptions for this model were tested using diagnostic plots and a chi-squared goodness of fit test.

For vessels that were recorded as ‘missed interviews’ or ‘trailers left at end of day’ a predicted catch was pro-rated from the estimated daily catch rate per boat. It was assumed that, in the absence of any information to the contrary, that the activities of vessels that were surveyed were representative of these vessels.

Predicted catches were added to the observed catches providing a daily catch estimate through the study period.

The catch from the sanctioned competition days had 100% coverage and, the numbers of fish caught on these days were included in the total catch estimates.

Analyses were conducted independently for each of the boat ramps.

4.1.8. *Error estimation*

A modified bootstrap procedure was used to calculate confidence intervals for the regression estimates that were used to predict effort and catch. The method involved bootstrapping the response-variable regressors for each observation, by resampling the observations and re-computing the regression estimator for each of the resulting bootstrap samples a 1000 times (Fox 2008). The predicted catch was based on the median value returned from the 1000 bootstrap iterations, as the error distribution was asymmetric.

4.1.9. *Catch of SBT prior to survey period*

When possible, all persons within the fishing party were interviewed individually and asked whether they had already participated in the survey during 2012 and if not, they were asked about any SBT catches taken during 2012 and prior to 1st March 2012. This information provides a provisional estimate of catch prior to the survey, although it is subject to several positive and negative biases.

- There is potential for duplication of reporting, although each person interviewed was asked if they had answered the question previously in 2012. If they responded in the affirmative the information was not subsequently recorded.
- The information was related to all areas around Tasmania, so is not therefore reflective of catches from particular boat ramps but rather a total minimum estimate of SBT catches from Tasmania.
- There is no way to determine what proportion of the catch that occurred in January or February 2012 was actually reported and therefore no way to calculate estimates of error. Therefore the estimates presented should only be taken as minimum indicative value.
- Estimates are based on recalled activity and may therefore be subject to memory bias.
- Estimates pertain only to those fishers who were interviewed and thus represent an unknown subset of all persons who may have fished for SBT prior to 1st March.

4.1.10. *Size composition of SBT*

Size composition data for SBT collected during the onsite survey was supplemented with information from research fishing, undertaken as part of a complementary study of post-release survival of SBT. The fishing methods and the areas fished in the latter study were the same as those used by recreational game fishers and hence provided representative data to increase the sample size of measured fish.

Data on the size of individuals was recorded in one of four ways during an interview. If the fish was weighed at the boat ramp (on reliable scales) this weight was recorded, if fish were available the creel clerk would measure them for fork length and a seasonally and regionally specific length-weight relationship was used to convert lengths to weights (CCSBT, 1994). If the fish was not available, fishers were asked to estimate the weight and if they were unable to do this then to estimate the length, which was subsequently converted to an estimated weight using the method described above for measured fish. These four modes of reporting were grouped as being ‘measured’ (weighed or measured length converted to weight) or ‘estimated’ (estimated weight or estimated length converted to estimated weight) for the purposes of subsequent analyses.

An ANOVA of a linear model was used to test whether there was a significant difference between estimated and measured weights. Fish greater than 40kg, whether estimated or measured, were excluded from this analysis on the basis that they represent outliers and if included would bias the comparison. This information is useful to determine whether estimated weights are a reasonable proxy for the actual weight of fish harvested in the recreational SBT fishery.

4.1.11. TACKLE PREFERENCES

Game fishing respondents were asked about the hook configuration of the lures that they had used most commonly on the day they were interviewed. The categories were, single J hook, single treble hook, two J hooks, two treble hooks or other hook configuration.

4.2. RESULTS

4.2.1. SURVEY IMPLEMENTATION

Survey coverage of weekdays across the study period averaged 24% for Pirates Bay and 22% for Southport. The inclusion of non-surveyed days where auxiliary data was collected on the number of trailers present increased the average coverage to 94% for Pirates Bay and 89% for Southport. The proportion of weekend/public holiday days surveyed during the study period averaged 48% for Pirates Bay and 47% for Southport. When non-survey days where auxiliary trailer counts were available are included, the averages increased to 93% for Pirates Bay and 92% for Southport. Survey coverage of competition days was 100% (Table. 4.1).

From a total of 834 attempted interviews, 92% of the boating parties fully participated. A further 4% provided partial responses whereby not all of the required information was collected, although in most of these instances catch and effort information was reported (and has been included in subsequent analyses). The remaining 4% of boating parties intercepted refused to provide any information.

Table 4.1. Summary of coverage for an on-site creel survey of game and offshore reef fishing at Pirates Bay and Southport boat ramps from the 1st March to the 31st July 2012.

Site	Month	Strata	Number of Days in Strata	Survey Days	Percent surveyed	Trailer count days	Total days covered	Total interviews	Gamefish interviews
Pirates Bay	March	Week day	21	6	29%	12	86%	32	25
	March	Weekend/public holiday	10	5	50%	4	90%	81	74
	April	Week day	17	4	24%	10	82%	34	31
	April	Weekend/public holiday*	11	6	54%	5	100%	81	61
	April	Competition day	2	2	100%	-	100%	139	126
	May	Week day	23	7	30%	16	100%	60	54
	May	Weekend/public holiday	8	4	50%	4	100%	79	72
	June	Week day	20	4	20%	14	100%	6	3
	June	Weekend/public holiday	10	7	70%	5	100%	133	108
	July	Week day	22	4	18%	16	100%	10	8
	July	Weekend/public holiday	9	4	44%	4	88%	23	14
		Pirates Bay total	**153**	**53**		**90**		**678**	**576**
Southport	March	Week day	21	6	29%	7	62%	0	0
	March	Weekend/public holiday	10	5	50%	4	90%	41	11
	April	Week day	18	3	17%	15	100%	31	1
	April	Weekend/public holiday	12	6	50%	5	92%	11	5
	May	Week day	23	7	30%	16	100%	3	1
	May	Weekend/public holiday*	6	2	33%	4	100%	5	3
	May	Competition day	2	2	100%	-	100%	25	22
	June	Week day	20	4	20%	14	90%	0	0
	June	Weekend/public holiday	10	6	60%	3	90%	37	29
	July	Week day	22	3	14%	16	86%	0	0
	July	Weekend/public holiday	9	4	44%	5	100%	3	0
		Southport total		**48**		**89**		**156**	**72**
		Grand total		**101**		**180**		**834**	**648**

A total of 1548 trailers were counted at Pirates Bay during the survey period. On scheduled interview days a total of 825 (750 after the removal of commercial Abalone boats [40] and vessels launched that were out of scope [35]) trailers were counted, with a further 723 (654 after the removal of commercial Abalone boats) counted on non-interview days.

A total of 931 trailers were counted at Southport during the survey period. On the scheduled interview days 296 (184 after removal of commercial abalone boats [110] and vessels launched that were out of scope [2]) trailers were counted, with a further 635 (147 after removal of commercial abalone boats [488]) counted on non-interview days.

Interviews were conducted with 678 boating parties at the Pirates Bay boat ramp, 576 (84%) involved in game fishing and 63 (9%) involved offshore fishing. At Southport, 156 interviews were conducted with 72 (46%) involving game fishing and 30 where offshore fishing was reported.

Other fishing activities

Overall, line fishing for inshore and coastal species such as flathead and squid, was the second most commonly reported activity after game fishing. Offshore line fishing, potting, netting and diving followed in declining importance amongst the boat fishers interviewed (Fig. 4.1). The proportion of other line fishing, potting and diving relative to all fishing reported was higher at Southport, this is most likely due to access to the sheltered waters as well as offshore waters whereas Pirates Bay is more commonly used for access to offshore waters, particularly during the game fishing season.

It is also possible that the reporting of fishing modes such as potting is under-represented due to the time the surveys were conducted. Checking of recreational pot is often undertaken early in the morning, with boats returning to launch sites prior to the commencement of the creel survey shifts.

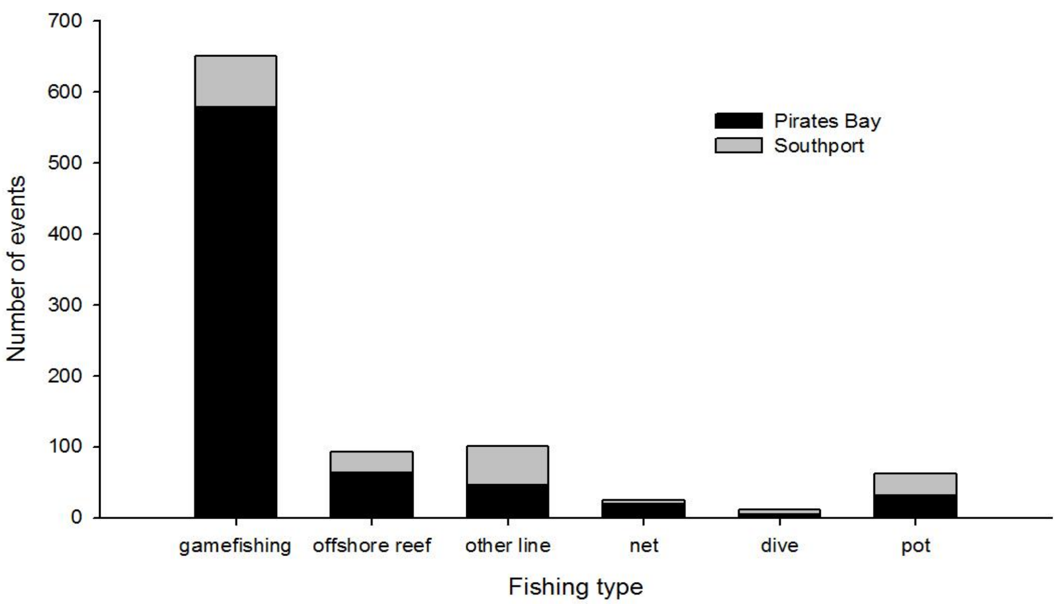

Fig. 4.1. Profile of fishing modes reported by respondents to the onsite creel survey conducted between the 1st March and 31st July 2012 at Pirates Bay and Southport boat ramps.

Fishing trips often included multiple fishing activities. Game fishing was the dominate mode of fishing conducted and co-occurred on trips where offshore fishing (65%), netting (52%) and potting (32%) was conducted. The co-occurrence of game fishing and offshore fishing is most likely related to vessels being in the vicinity of offshore fishing grounds while game fishing. Anecdotally it is known that recreational fishers will commonly switch to offshore fishing if they are not catching game fish species. Potting and netting are passive modes of fishing and the gear is typically set along the coast when boats are travelling to game fish and retrieved on the way back to the boat ramp.

Game fishing also co-occurred, but to a lesser extent, with other line fishing (21%) and diving (16%). We expect that these modes of fishing are generally focused around calmer waters.

4.2.2. PARTICIPANT DEMOGRAPHICS

A total of 2,036 fishers participated in game fishing on survey days across both boat ramps (Table 4.2), noting however, that this and subsequent numbers reported represent a cumulative measure of fisher interviews and not the number of individuals, since individuals may have been interviewed on more than one occasion. A far greater number of game fishers were reported from Pirates Bay (88%) compared to the Southport boat ramp, this was expected as more trips were conducted from the former.

A relatively large proportion (24%) of the interviews at Pirates Bay occurred on the two day sanctioned game fishing competition in April. On these two days the proportion of game fishers who were game fishing club members was high (86%), which is to be expected as club membership is a condition of participation in Game Fishing Association of Australia (GFAA) sanctioned competitions. For the remainder of survey days, the proportion of game fishers interviewed who reported game fishing club membership was 19%.

A similar trend was observed at Southport with 23% of all game fishers reported on survey days at the Southport boat ramp attributed to a two day GFAA sanctioned competition in May. Three-quarters of these game fishers were members of a game fishing club. On the remaining survey days at Southport the percentage of all game fishers reported to have game club membership was 20%.

There was a strong gender bias towards males in both game club affiliated and non-affiliated fishers, with females representing just 5% of fishers. Female participation was slightly lower on boats launching from Southport (3.5%) in comparison to Pirates Bay (5.5%). The percentage of game club affiliated fishers that were female was 3.0%, while the percentage of non-affiliated fishers that were female was 6.3%.

Table 4.2. The number of game fishers present on all survey days.

	club affiliated males	club affiliated females	non-affiliated males	non-affiliated females
Pirates Bay	579	20	1101	77
Southport	91	1	159	8

4.2.3. *EFFORT*

Gear and soak time measures of effort

For game fishing events originating from Pirates Bay boat ramp the average fishing time (lines in the water) was 5.8 ± 0.2 (95%CI) hours, with an average of 4.5 ± 0.1 (95%CI) lines being trolled. The average soak time for game fishing events originating from Southport was shorter 4.3 ± 0.5 (95%CI), but the average number of lines trolled was similar, 4.4 ± 0.3 (95%CI).

Daily effort – Pirates Bay boat ramp

The initial model parameterisation to estimate the number of trailers that would be present on a day when no trailer counts were conducted at Pirates Bay included the explanatory variables, strata (weekday or weekend/holiday), wind speed, ambient temperature, barometric pressure and westerly wind stress, all of which were found to be highly significant and were therefore retained in the model (Table 4.3).

Table 4.3. Results of negative binomial generalised linear model relating the number of trailers counted to a suite of variables at Pirates Bay boat ramp between 1st March and 31 July 2012.

Variable	Coefficient estimate	Standard Error	z value	Pr(>|z|)
(Intercept)	-31.265	9.291	-3.365	<0.001***
Strata weekday	-1.327	0.160	-8.251	<0.001***
Wind Speed	-0.035	0.013	-2.732	0.006**
Temperature	0.098	0.025	3.826	0.0001***
Barometic Pressure	0.032	0.009	3.620	<0.001***
Wind stress	0.061	0.023	2.607	0.009**

The model results were not unexpected, indicating that significantly more trailers were present on weekend/holidays and when there was a higher ambient temperature, higher barometric pressure and lower wind speeds.

The number of potential recreational fishing boats had a highly significant effect (p<0.001) on the number of boats confirmed game fishing on a given day (Fig. 4.2), indicating that an expected 85% of vessels (excluding commercial Abalone boats, missed interviews and trailers left at the end of a day) launched at Pirates Bay during the survey period would participate in game fishing. The good fit of the model to the data (R^2_{adj} = 0.97) is representative of a relatively consistent proportion of boats participating in game fishing throughout the survey period.

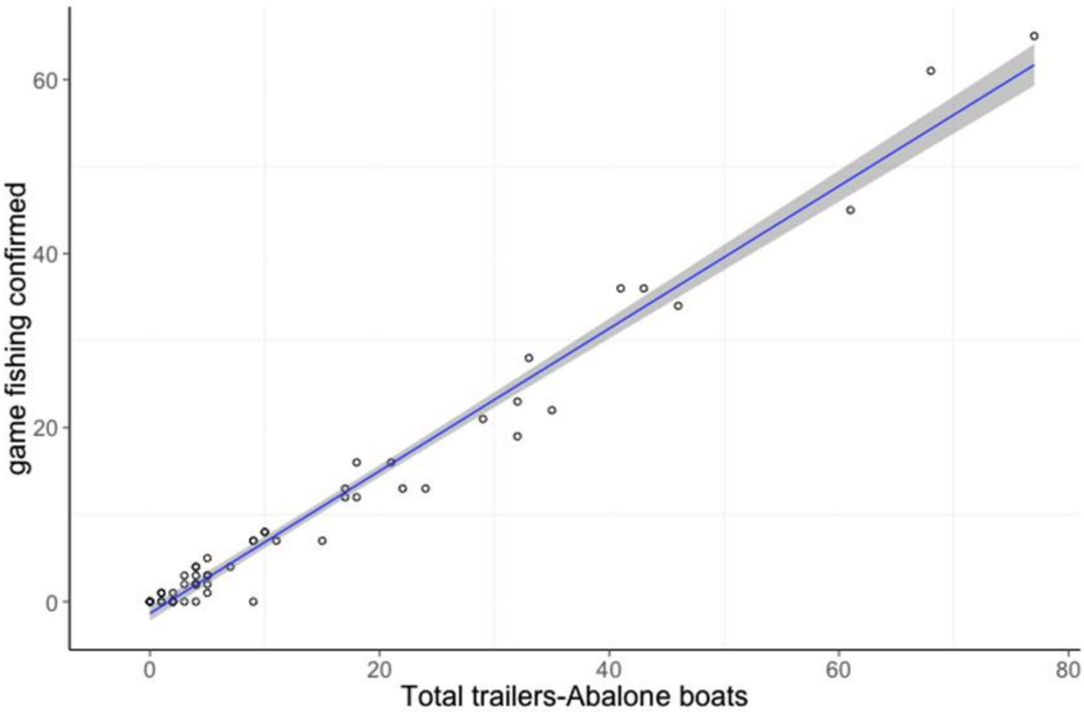

Fig. 4.2. The relationship between potential game fishing vessels and vessels where game fishing was confirmed on survey days at Pirates Bay. Shaded area represents 95% confidence intervals.

It was estimated that a total of 1340 (95% CI: 1325 – 1356) trailer vessel launches (excluding commercial abalone boats) occurred at the Pirates Bay boat ramp during the survey period. When multiplied by the proportion predicted to be game fishing the total game fishing effort by trailer boats launched from Pirates Bay during the survey period was 1139 (95% CI: 1126 – 1153) boat days.

Daily effort – Southport boat ramp

The initial model parameterisation to estimate the number of trailers that would be present on a day when no trailer counts were conducted at Southport included the explanatory variables, strata (weekday or weekend/holiday), strata-month interaction, wind speed and ambient temperature. Of these variables strata, wind speed, ambient temperature and the interaction terms between strata and each month were all highly significant (Table 4.4). The results were again as expected with higher trailer counts predicted on weekends and days with lower wind speed and higher ambient temperatures.

Table 4.4. Results of negative binomial generalised linear model relating the number of trailers counted to a suite of variables at Southport boat ramp between 1st March and 31 July 2012.

Variable	Coefficient estimate	Standard Error	z value	Pr(>|z|)
(Intercept)	1.223	0.541	2.259	0.023*
Strataweekday	-1.926	0.367	-5.243	<0.001***
factor(Month)4	-0.098	0.321	-0.307	0.759
factor(Month)5	-0.360	0.460	-0.784	0.433
factor(Month)6	0.469	0.383	1.223	0.221
factor(Month)7	0.162	0.428	0.379	0.705
Wind Speed	-0.023	0.007	-3.041	0.002**
Ambient temperature	0.107	0.032	3.330	<0.001***
Strataweekday:factor(April)	2.038	0.454	4.488	<0.001***
Strataweekday:factor(May)	2.220	0.535	4.144	<0.001***
Strataweekday:factor(June)	1.730	0.495	3.490	<0.001***
Strataweekday:factor(July)	2.219	0.494	4.489	<0.001***

The number of potential recreational boats (commercial abalone boats excluded) had a highly significant effect ($F=9.901_{1,18}$, p=0.006) on the number of boats game fishing on a given day (Fig. 4.3), indicating that an expected 38% of vessels launched at Southport during the survey period participated in game fishing. In contrast to the strong relationship between potential game fishing boats and vessels confirmed game fishing at Pirates Bay the relationship at Southport was not as strong (R^2_{adj} = 0.32), having implications for the degree of statistical uncertainty associated with catch estimates.

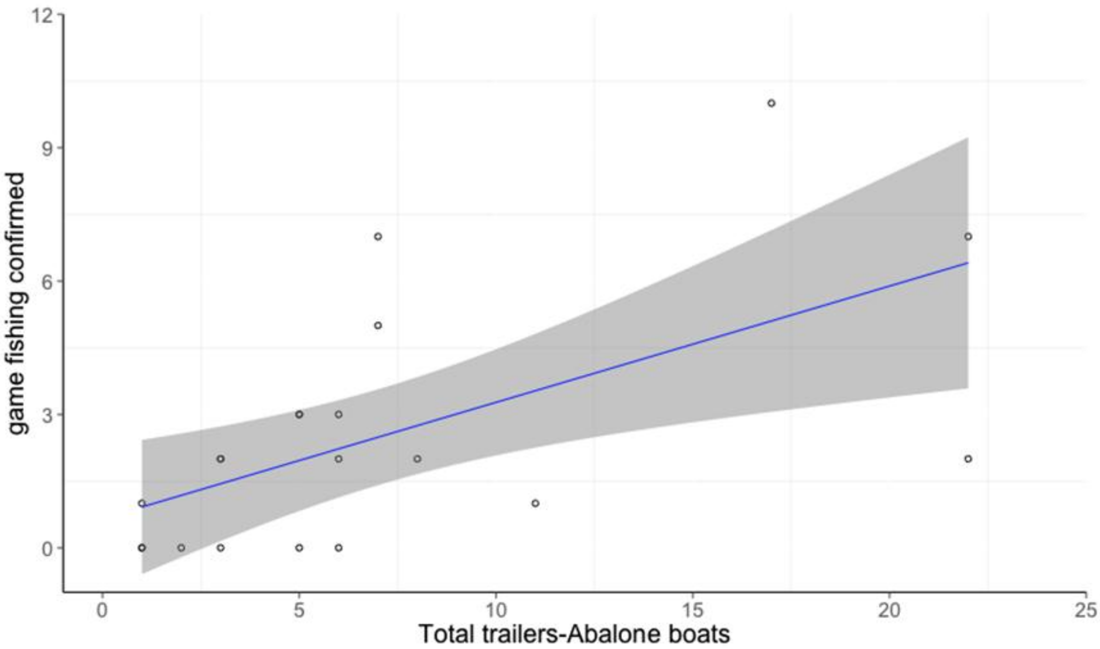

Fig. 4.3. The relationship between potential game fishing vessels and vessels where game fishing was confirmed on survey days at Southport. Shaded area represents 95% confidence intervals.

It was estimated that a total of 439 (CI: 418 – 462) vessels (excluding commercial abalone boats) used Southport boat ramp during the survey period. When multiplied by the proportion of vessels predicted to be game fishing the total game fishing effort from Southport during the survey period was 167 (CI: 159 – 176) boat days.

4.2.4. SOUTHERN BLUEFIN TUNA SIZE COMPOSITION

Measured versus estimated size data

A linear model of estimated weight versus measured weight was initially tested with factors: month and weight and an interaction term between the two. The fish weight values were log transformed to satisfy assumptions of linear models. The interaction term was found to be non-significant ($F = 1.77$, $df = 4$, $p = 0.14$). Given that the interaction term was insignificant, the model was re-run without the interaction term. ANOVA of this model indicated a highly significant difference between measured and estimated weights ($F = 32.31$, $df = 1$, $p < 0.0001$). Taking the exponential of the model coefficient relating to measured vs estimated weight revealed that, on average, the estimated weights were 12.5% greater than the measured weights. This value could be used to adjust estimated weights to provide a more accurate measure of fish weight in the absence of measured weights.

Size composition

The vast majority of SBT caught from southeast Tasmania during 2012 were between 10 and 30 kg and are commonly referred to as ‘school fish’ or ‘schoolies’. The average size of SBT decreased significantly ($F = 16.85$, $df = 4$, $p < 0.0001$) as the season progressed with the largest school fish caught during March and the smallest on average caught in June, noting that July also saw smaller fish reported but there were too few measured to provide a robust estimate of size in this month (Table 4.5 & Fig. 4.5). Both the measured and estimated weights by month illustrated the decrease in fish size, although the decline in the measured estimates was more pronounced (Table 4.5).

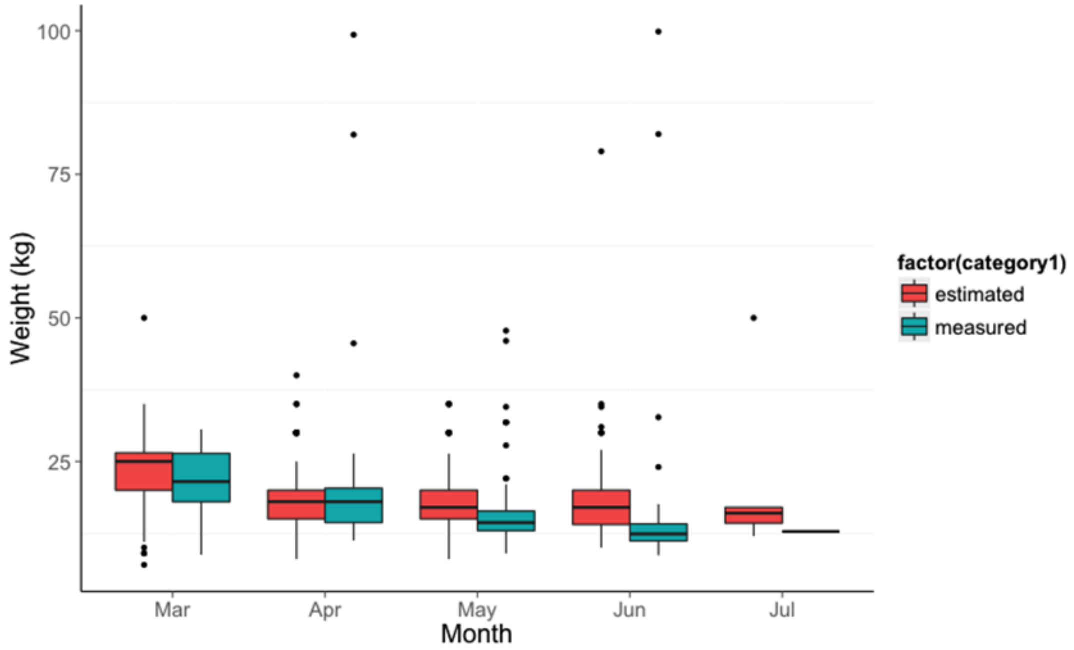

Fig. 4.4. Boxplots of measured and estimated weight of SBT, by month.

Only a small number of large SBT were reported caught during the onsite survey; seven SBT were between 40 and 50 kg (3 estimated, 4 measured) and five over 80 kg (2 in April and 3 in June, and all reported from the Tasman Peninsula) four of which were measured (including a fish taken as part of the post release survival study) and one estimated.

Table 4.5. Summary statistics of the measured and estimated weights of SBT recorded by month. The mean weight estimates, standard errors and counts do not include fish over 40 kg. The measured size data includes research fishing.

Category	Measure	March	April	May	June
Measured size	Mean ±s.e.	21.3 ± 5.9	17.2 ± 3.6	15.2 ± 4.8	13.7 ± 4.9
	count	40	56	94	26
	range	8.7 – 30.5	11.2 – 99.3	5.9 – 47.8	8.7 – 99.9
Estimated size	Mean ±s.e.	22.4 ± 6.4	19.3 ± 6.0	18.0 ± 4.9	17.4 ± 5.2
	Count	53	88	166	109
	range	7 – 50	8 – 40	8 – 35	10 – 79

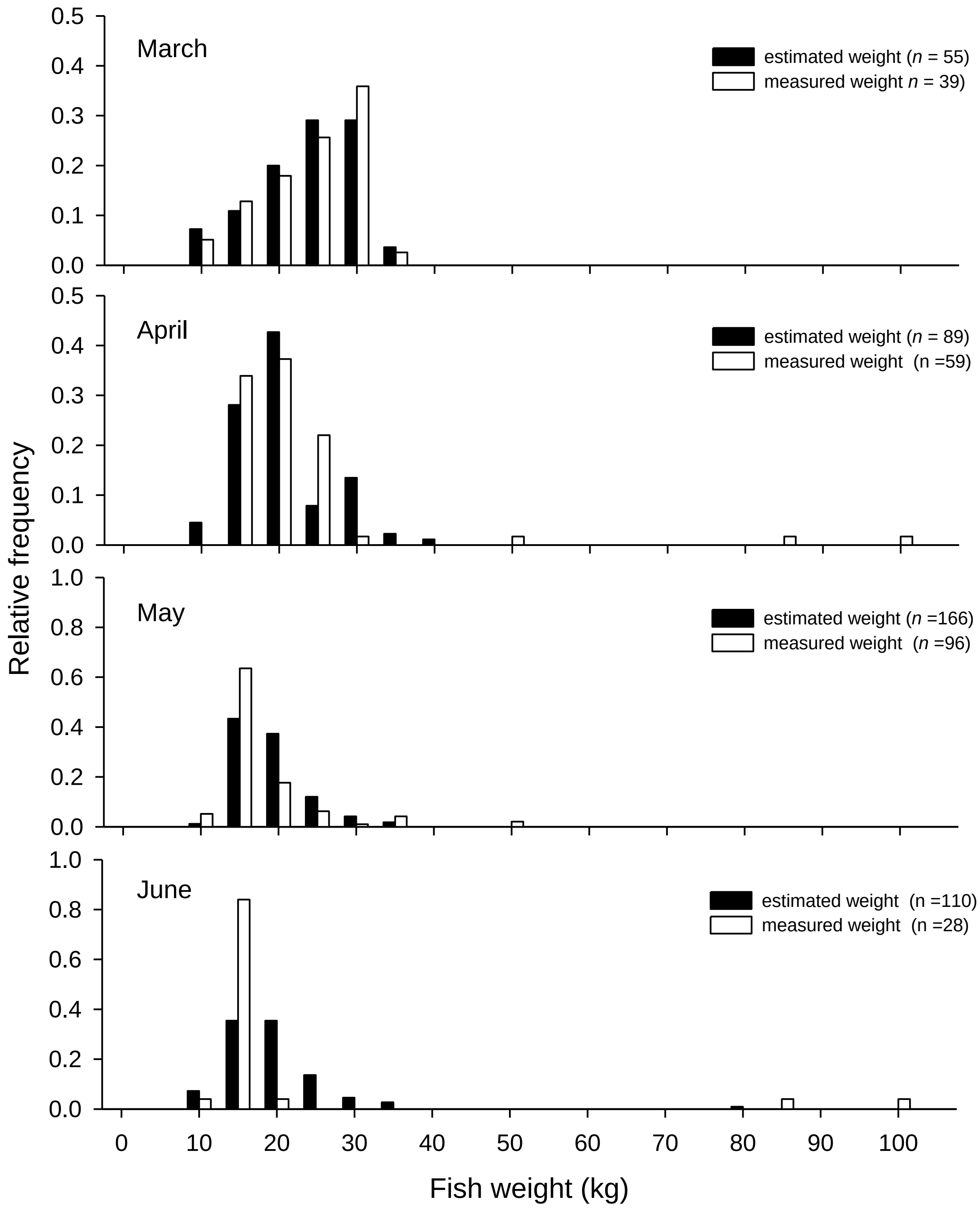

Fig. 4.5. Weight frequency of SBT caught during 2012 from southeast Tasmania by month (areas combined).

4.2.5. Southern Bluefin Tuna catch – Pirates Bay boat ramp

A total of 1662 SBT were estimated to be caught from boats launching and returning to Pirates Bay boat ramp. Of these, 975 (95% CI: 860 – 1,116) were retained, 155 (95% CI: 107 – 221) released and 532 (95% CI: 429 – 674) lost to seals. Based on the observed data, the release rate was 14%. The total estimated weight of SBT landed at Pirates Bay was 15.9 tonnes, with a further 8.7 tonnes lost to seals (Table 4.5).

Table 4.5. The estimated catch of SBT from an onsite survey at Pirates Bay and Southport boat ramps.

Boat ramp	Month	Catch retained (*n*) [95% CI range]	Catch retained (*t*) [95% CI range]	Catch released (*n*) [95% CI range]	Seal mortality (*n*) [95% CI range]	Seal mortality (*t*) [95% CI range]
Pirates Bay	March	187 [151,253]	3.98 [3.22, 5.39]	29 [17, 47]	87 [63,119]	1.85 [1.34, 2.53]
	April	256 [217,333]*	4.40 [3.73, 5.73]*	39 [27, 60]*	148 [125,181]*	2.54 [2.15, 3.11]*
	May	259 [241,279]	3.94 [3.66, 4.24]	50 [42, 62]	156 [137,183]	2.37 [2.08, 2.78]
	June	207 [188,228]	2.83 [2.58, 3.12]	25 [16,36]	93 [73,120]	1.27 [1.00, 1.64]
	July	57 [42,78]	0.78 [0.58, 1.07]	11 [3,24]	48 [27,79]	0.66 [0.37, 1.08]
	Total	975 [860,1116]	15.94 [13.76, 19.55]	155 [107, 221]	532 [429,674]	8.70 [6.94, 11.16]
Southport	March	120 [39, 777]	2.56 [0.83, 16.55]	90 [5, 825]	21 [9, 508]	0.37 [0.14, 8.74]
	April	43 [16, 423]	0.74 [0.28, 7.27]	39 [4, 411]	8 [4, 97]	0.12 [0.05, 1.48]
	May	54 [49, 65]*	0.82 [0.74, 0.98]*	153 [151, 163]*	23 [21, 24]*	0.31 [0.29, 0.34]*
	June	80 [51, 396]	1.10 [0.70, 5.43]	77 [46, 313]	16 [11, 71]	0.34 [0.25, 1.51]
	July	15 [5, 45	0.21 [0.07, 0.62]	10 [2, 39]	3 [1, 9]	0.04 [0.01, 0.12]
	Total	308 [168, 888]	5.42 [2.62, 30.86]	346 [207, 920]	73 [48, 591]	1.18 [0.74, 12.19]

*Competition days were not estimated in the model as there was 100% coverage for this strata. The information relating to game fishing trips occurring on competition days has been added to the estimated totals for respective columns.

The number of SBT caught and retained increased steadily between March and May before dropping away through to July (Fig. 4.6 & Table 4.5). Anecdotal reports suggest that very few SBT were caught by recreational fishers in August from the Tasman Peninsula.

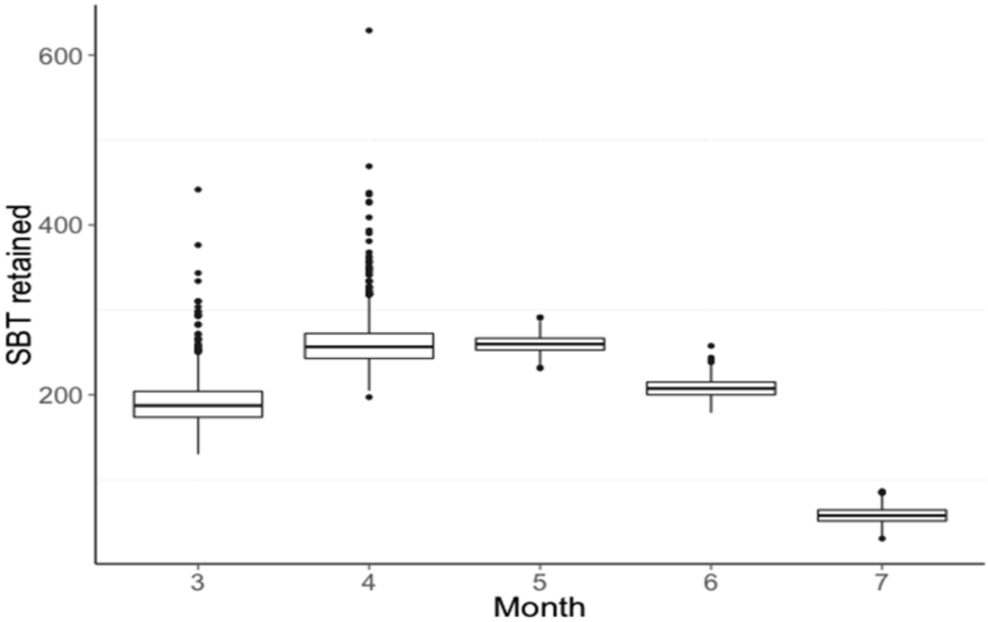

Fig. 4.6. Predicted retained catch of Southern Bluefin Tuna landed at Pirates Bay boat ramp between the 1st March and 31st July 2012.

4.2.6. Southern Bluefin Tuna catch – Southport boat ramp

A total of 727 SBT were estimated to be caught from boats launching and returning to Pirates Bay boat ramp. Of these, 308 (95% CI: 168 – 888) were retained, 346 (95% CI: 207 – 920) released and 73 (95% CI: 48 – 591) lost to seals. The total estimated weight of SBT landed at Pirates Bay was 5.42 tonnes, with a further 1.18 tonnes lost to seals (Table 4.5).

The large upper 95% confidence interval for estimates from Southport are due to the poor fit of the recreational trailer prediction model, on occasions a bootstrap iteration would predict a large number of vessels on a given day and associate it with a day of high catch rates. The variance in March was particularly high as this month had the greatest proportion of days where the number of recreational fishing boats were predicted rather than counted.

The number of SBT caught and retained was highest in March and June and lowest in July (Table 4.5 & Fig. 4.7). Anecdotal reports suggest that very few SBT were caught by recreational fishers in August from southern Tasmania. The number of SBT caught and released was highest in May with most of these fish released during the tuna fishing competition (147 fish were released during the two day competition). Based on reported data (not expanded estimates), when the data from the competition is excluded the overall release rate equates to 13%, similar to that for the Pirates Bay fishery. With the inclusion of the fish released during the competition the release rate was 38%.

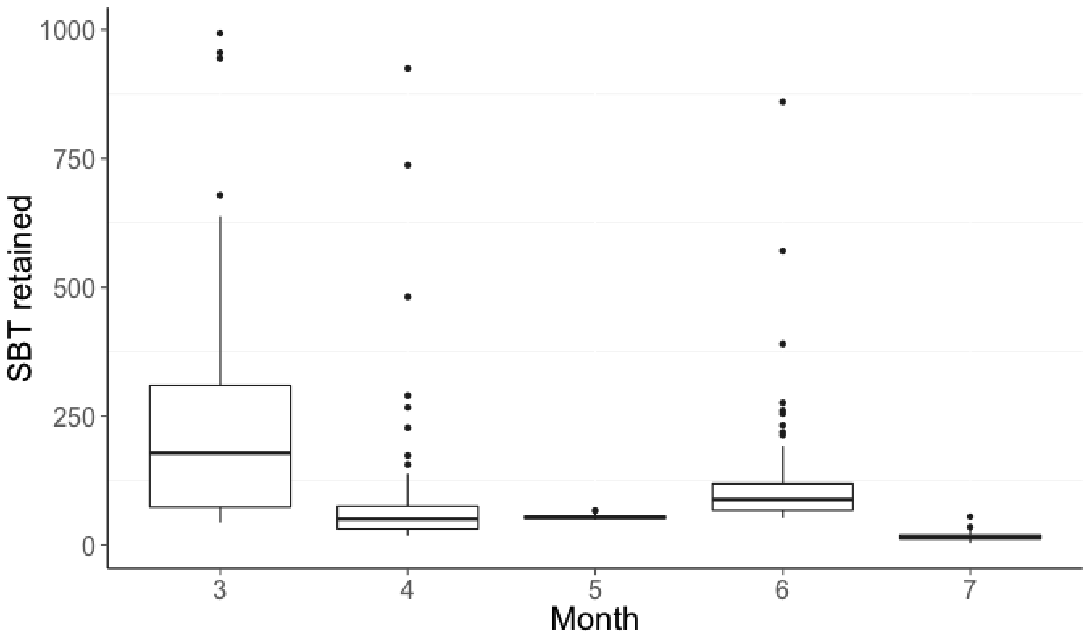

Fig. 4.7. Predicted retained catch of Southern Bluefin Tuna landed at Southport boat ramp between the 1st March and 31st July 2012.

4.2.7. CATCH OF SOUTHERN BLUEFIN TUNA PRIOR TO THE SURVEY PERIOD

A total of 75 SBT were reported caught and kept in January 2012 and 202 in February. An estimated weight range was provided for all fish caught and by converting numbers to weights it was estimated that 1.45 tonnes was harvested in January and 3.65 tonnes in February. Note, these estimates are not limited to SBT caught from the surveyed boat ramps. There are several caveats listed in the methods section that mean the estimates provided are indicative rather than a comprehensive catch estimates for these months.

4.2.8. TACKLE PREFERENCES

Hook configurations of lures used to target game fish were reported for 650 fishing parties. Lures with single J hooks were the most the common in use (1863), these were followed by lures with two treble hooks (712), lures with two J hooks (100), lures with one treble hook (40) and lures with other hook configurations/ combinations (60).

5. COMPARISON BETWEEN ONSITE BOAT RAMP AND TELEPHONE DIARY SURVEY CATCH ESTIMATES

Onsite surveys have been used in Tasmania (Morton and Lyle 2003, Forbes et al. 2009) and Victoria (Green et al. 2012) to provide catch and effort estimates for SBT. While the study in Victoria was considered successful due to the limited number of access points in the region that SBT were caught (western Victoria), the two access points surveyed in this study (and previous studies) represent an unknown fraction of the entire recreational fishery for SBT in Tasmania and therefore the on-site survey estimates will be negatively biased.

Conducting the onsite surveys at the key boat ramps in conjunction with the offsite diary survey provides an opportunity to compare results for two independent methodologies in terms of catch estimates and overall fishery coverage.

5.1. BOAT RAMP (ACCESS POINT) COVERAGE FOR SOUTHERN BLUEFIN TUNA CATCH REPORTING

The onsite survey was conducted at Pirates Bay boat ramp on the Tasman Peninsula and Southport boat ramp in the far south of Tasmania. These boat ramps have traditionally been considered major access points to the areas where SBT are targeted in Tasmania.

As part of the diary survey the departure location was recorded for each fishing event. This provided a means to assess the range of access points that were used when SBT were captured.

To aid interpretation, boat ramps have been grouped into regional access points – Tasman Peninsula, South Coast and Bruny Island, Hobart regional, mid-East Coast (Marion Bay to Great Oyster Bay) and Northeast Tasmania.

During the diary survey five boat ramps located on the Tasman Peninsula were recorded for events in which SBT were caught. While 54% of these events originated from the Pirates Bay boat ramp, other access pointed included Fortescue Bay (28% of events), Port Arthur (8%), White Beach (6%) and Nubeena (3%). This implies that coverage of effort for SBT available to the onsite survey was in the order of half of that for the Tasman Peninsula region (Table 5.1).

Access to SBT off the south coast of Tasmania occurred from a range of boat ramps (11), with most located on the South coast and Bruny Island regions. Southport boat ramp, the focus of the onsite survey, accounted for just 23% of the events reported for the area during the diary survey. Margate also accounted for 23% of events, with boats launching from this ramp and fishing south of Tasmania as well as in Storm Bay. Cockle Creek boat ramp accounted for 15% of events followed by Catamaran (9%) and Recherche Bay (7%). Gordon, Kettering and Adventure Bay accounted for 6% of events each and Charlotte’s Cove, Cygnet and Dover a further for 2% each. The broad range of ramps used in this area indicate that an onsite survey based at Southport alone significantly under-represented catch and effort off southern Tasmania (Table 5.1).

Five boat ramps around the Hobart region were also reported as launching sites for events in which SBT were caught. Most of these events involved targeting SBT in Storm Bay, an area that has not traditionally been important for SBT. In 2012, however, Storm Bay proved to be an important area for the fishery, highlighting an issue in the planning of onsite surveys, specifically the need to be adaptive or flexible in sampling to account for unforeseen developments in the fishery of interest (Table 5.1).

A small amount of SBT effort originated from boat ramps on the East and Northeast coasts. While such effort was minimal, future onsite surveys may need to consider some coverage of these ramps should SBT availability (and targeting of the species) increase in adjacent areas (Table 5.1).

Overall, 39% of fishing events reported in the diary survey that involved the capture of SBT originated from one of the two boat ramps surveyed in the on-site survey. This clearly indicates that reliance on the on-site survey as implemented has significantly underestimated the catch and effort for SBT in Tasmania.

Table 5.1. The number of boat ramps from where boats launched who reported catching Southern Bluefin Tuna during the offsite survey.

Region	Boat ramp	Number of events
Tasman Peninsula	Pirates Bay	72
	Fortescue Bay	38
	Port Arthur	10
	White Beach	8
	Nubeena	4
South coast and Bruny Island	Southport	12
	Margate	12
	Cockle Creek	8
	Catamaran	5
	Recherche Bay	4
	Gordon	3
	Kettering	3
	Adventure Bay	3
	Charlotte's Cove	1
	Cygnet	1
	Dover	1
Hobart Regional	Hobart	7
	Lindisfarne	5
	South Arm	4
	Dodges Ferry	3
	Cremorne	2
Marion Bay to Great Oyster Bay	Lewisham	3
	Coles Bay	1
	Orford	1
	Boomer Bay	1
North-east Tasmania	Burns Bay	1

5.2. Comparison of survey catch estimates for Pirates Bay

In order to provide a valid comparison of catch estimates for the two survey approaches, it was necessary to consider only data from the PDS that match the spatial and temporal scope of the OCS. In this case, we have focused on catch originating from the Pirates Bay boat ramp.

For Pirates Bay, the harvest estimate of 817 (95% CI: 503 – 1186) fish for the PDS was lower and less precise than the OCS estimate of 975 (95% CI: 860 – 1116) fish. The wider confidence interval for the PDS estimate did however fully overlap the onsite survey value. The estimated number of seal mortalities from events originating from Pirates Bay was also lower for the phone/diary survey but the estimated numbers of released fish were very similar between surveys (Fig. 5.1).

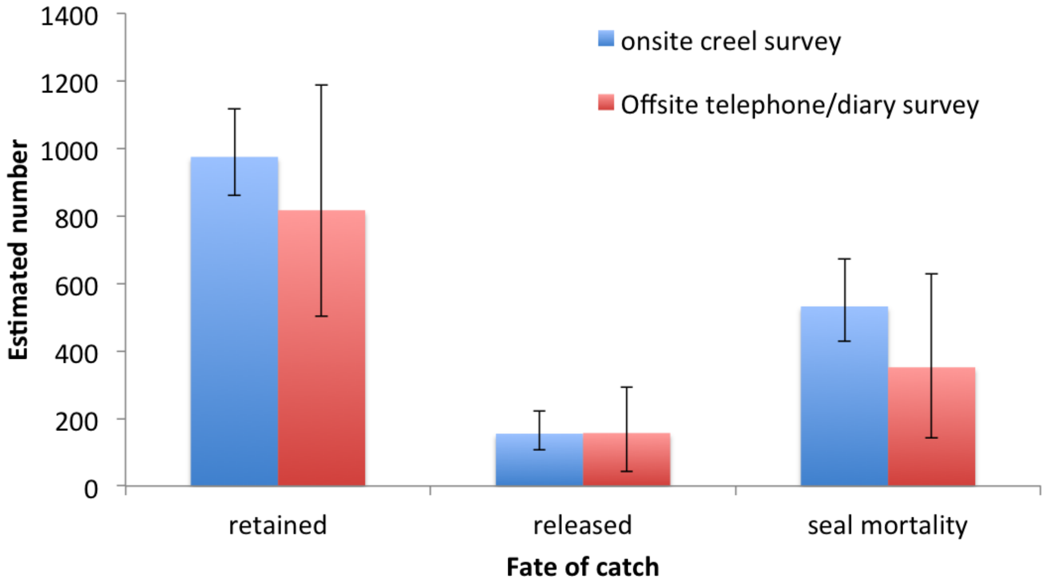

Fig. 5.1. Estimated catch (retained and released) and seal mortality of SBT caught from Pirates Bay boat ramp. Blue columns represent estimates from an onsite creel survey and red columns represent estimates from a statewide offsite telephone diary survey. Error bars are 95% confidence intervals.

The monthly pattern in retained catches was similar for both surveys with catches peaking in May. The mean catch estimates for the PDS for each month were, however, significantly less (p = 0.05) than those reported by the OCS. The 95% confidence intervals from the PDS were also much broader than those reported for the OCS, reflecting to a large extent the different spatial scales of the two surveys, the PDS designed to provide big picture information and the OCS to provide detail at a very localized scale (Fig. 5.2).

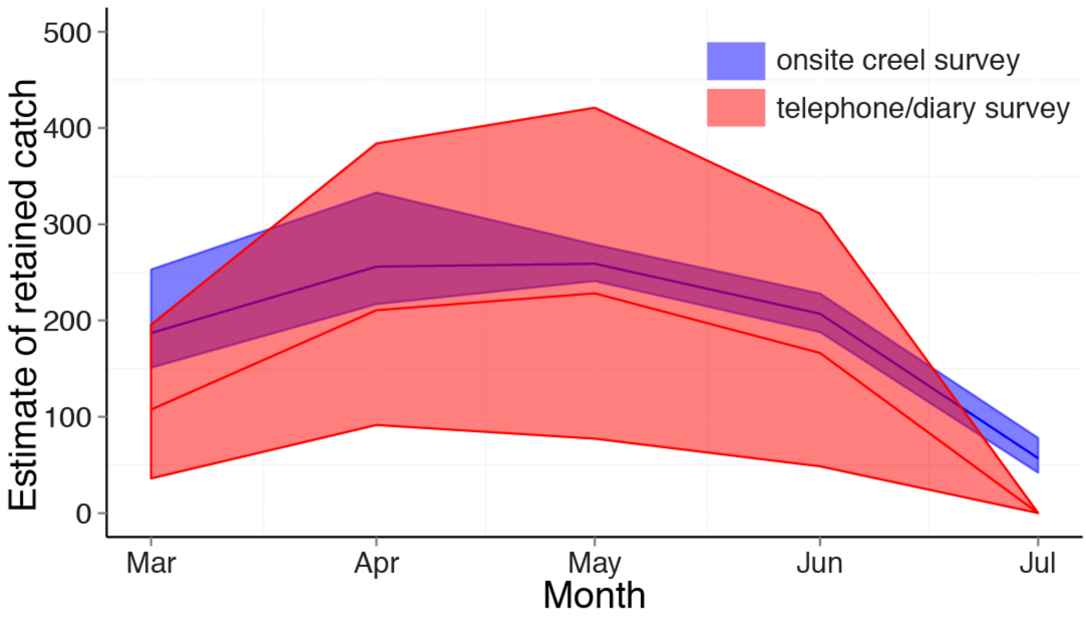

Fig. 5.2. Estimated monthly retained catch of SBT caught from Pirates Bay boat ramp. Blue lines represent estimates from an onsite creel survey and red lines represent estimates from a statewide offsite telephone diary survey. Shaded areas are 95% confidence intervals.

The two surveys generally align well in terms of the temporal pattern of catch and overall estimates.

5.3. Discussion

A comparison of the two survey methods when used to provide a catch estimate of the recreational SBT fishery in Tasmania found that an onsite survey under-estimated the total catch due to insufficient coverage of access points to the fishery. To overcome this problem more access points could be covered during the survey, however this would significantly increase the cost of delivering an onsite survey.

Given that the SBT fishery is accessed from a number of access points in Tasmania that would render an onsite survey cost ineffective the offsite phone-diary survey would be the most appropriate method to provide an estimate of SBT catch and effort. The offsite survey, in this case, also provided catch and effort data on a range of key recreational species, further enhancing the cost-effectiveness of this survey method.

In delivering offsite phone diary surveys in the future it is important to consider that an accurate estimate of fish weights would be required to convert catch numbers to catch weights. This could be achieved by training diary participants to measure fish accurately, or a supplementary onsite survey where trained staff measure fish that are landed at key boat ramps.

Considering potential sample frames will also further enhance the PDS methodology. In this case the recreational vessel registration database was used, but a large number of vessels were excluded due to perceived ineligibility, and there were also a proportion of vessel owners contacted who indicated that their vessels were not suitable for fishing, although this was not clear in the registration database. If a general marine recreational fishing permit existed in Tasmania this could be cross-referenced with the vessel registration database to ‘narrow-down’ potential offshore recreational fishers. In doing so reducing the number of screening survey participants required and possibly increasing the sample fraction by being more selective of likely candidates.

6. CHARTER BOAT CATCH OF SOUTHERN BLUEFIN TUNA IN TASMANIA DURING THE 2012 SEASON

6.1. INTRODUCTION

The aim of the charter boat survey was to generate a total catch estimate for Southern Bluefin Tuna (SBT) taken by the charter boat sector. The survey was focused on the months when SBT are most commonly caught in Tasmania (March – July), although discussions with individual operators confirmed small catches outside this period. Data were also collected on effort, catch rates, and the number of days fishing that were impacted by seal interactions.

6.2. METHODS

A total of 25 charter boat operators were contacted in February 2012. The operators were identified initially by a telephone directory search and secondly by asking identified operators if they knew of others in their area. The list is believed to be comprehensive and includes operators from throughout Tasmania, including Flinders Island. Each operator was initially asked whether they intended to run game fishing charters during 2012. If they indicated that there was a possibility that they would engage in game fishing charters they were invited to fill out a voluntary charter boat logbook reporting only when game fishing was undertaken. Based on eligibility and the spatial extent of the SBT fishery, only operators based in the south and south east of Tasmania were included in the survey.

6.2.1. Voluntary charter boat logbook

The charter boat logbook was designed in the early 2000s by the Sea Charter Boat Operators of Tasmania, and has been used in conjunction with previous surveys focused on estimating the charter boat catches of SBT (Morton et al. 2003, Forbes et al. 2009). The logbook records information relating to a fishing trip including the date, general fishing area, fishery type, time spent fishing and amount of gear used and the number and/or weight of fish retained and released. For this study charter operators were asked to focus on the reporting of SBT catches (including zero catch days) and as a consequence catches of other species are incomplete. The decision to focus on game fishing was taken to promote a high rate of returns by not burdening operators with details about all captures. The logbook also provided provision for operators to record interactions with wildlife.

6.2.2. Effort

Effort was reported in two ways. The first used specific effort information from a given trip including the number of fishing lines that were trolled and the total soak time (hours). The second was simply counting the number of days game fishing occurred in areas where SBT are likely to be caught. The number of clients on a boat on a given day was also reported but is less relevant in the context of effort as fishing only occurs with trolled lines not individual fishing lines.

6.2.3. CATCH

For operators who returned logbook datasheets daily catch was reported as the number of fish caught (kept and released) on that day. Zero catch days when game fishing occurred in areas where SBT could have been caught were also logged by skippers to provide an accurate estimate of CPUE. Weights of fish and total daily catches were estimated by charter skippers. For 63% of the catch records total estimated weight retained was reported. For trips where a total weight was not reported the average monthly individual fish weight, calculated by dividing total estimated weight retained by the number of fish retained for each fully reported charter trip, was multiplied by the number of fish retained. Individual fish weights were reported in all cases where larger SBT (>90kg) were caught. These events were excluded from the calculation of fish weights so as not to over-estimate average weights. On all occasions where only catch numbers were reported, operators confirmed that no SBT over 50 kg had been caught.

6.2.4. CATCH RATE

Daily catch per unit of effort (CPUE) for each operator was calculated in two forms; the first uses specific effort characteristics:

$$CPUE_{sh} = \frac{Number\ of\ fish\ caught}{Number\ of\ fishing\ lines\ \times Soak\ time}$$

and the second uses effort as boat days fished:

$$CPUE_{df} = \frac{Number\ of\ fish\ caught}{Number\ of\ boat\ days}$$

In generating catch rate statistics, the geometric mean rather than the arithmetic mean of all valid individual daily catch records where game fishing for tuna occurred was calculated. This method was chosen as it provides a better fit to catch rate data that are typically log-normally distributed. The geometric mean is calculated as the n^{th} root of the product of the individual rates (Y_i):

$$GM_{\bar{y}} = \sqrt[n]{\prod y_i}$$

It should be noted that catch rates calculated in this manner may differ slightly from the more simplistic approach of dividing total catch by total effort or using the arithmetic mean. The geometric mean has the advantage of being less affected by the few observations that are highly skewed, as often occurs with log-normally distributed data.

6.2.5. SEAL INTERACTIONS

Logbooks had provision to record interactions with wildlife during a fishing trip. Seven of eight operators who returned logbooks routinely completed this section. The vast majority of interaction records related to the Fur Seals (*Arctocephalus* spp.). This information provides data to calculate the proportion of fishing days where charter boat operators interacted with Fur Seals while game fishing. Commonly interactions result in hooked tuna being attacked or taken by seals. The data provided, however, did not indicate the fate of fish during the interaction nor the number of interactions occurring on a given day.

6.3. RESULTS

6.3.1. EFFORT

Of the 25 charter operators contacted, ten engaged in charters where SBT were targeted and/or caught during 2012. These operators were all based in the south east of Tasmania. Completed logbooks were returned from eight of these operators. The logbooks provided data on 250 charter trips between March and July 2012, 242 originating from Pirates Bay, seven from Southport and one from Hobart. The two other operators reported total number of trips and total number of SBT caught for the season, this information was pro-rated evenly between March and April, the two months these operators indicated that they had operated. This brought the total days fished to 272.

One charter trip in January from Southport reported catches of SBT, however this was the only trip undertaken until March when SBT were again reported. Noting that January and February are the main months when Albacore are caught, many of the operators out of Pirates Bay were engaged in game fishing at this time targeting Albacore but none reported trips involving the capture of SBT. The number of charter days fished increased from March to April, before decreasing in May and June, with very few trips reported in July and no game fishing charters reported during August (Fig. 6.1).

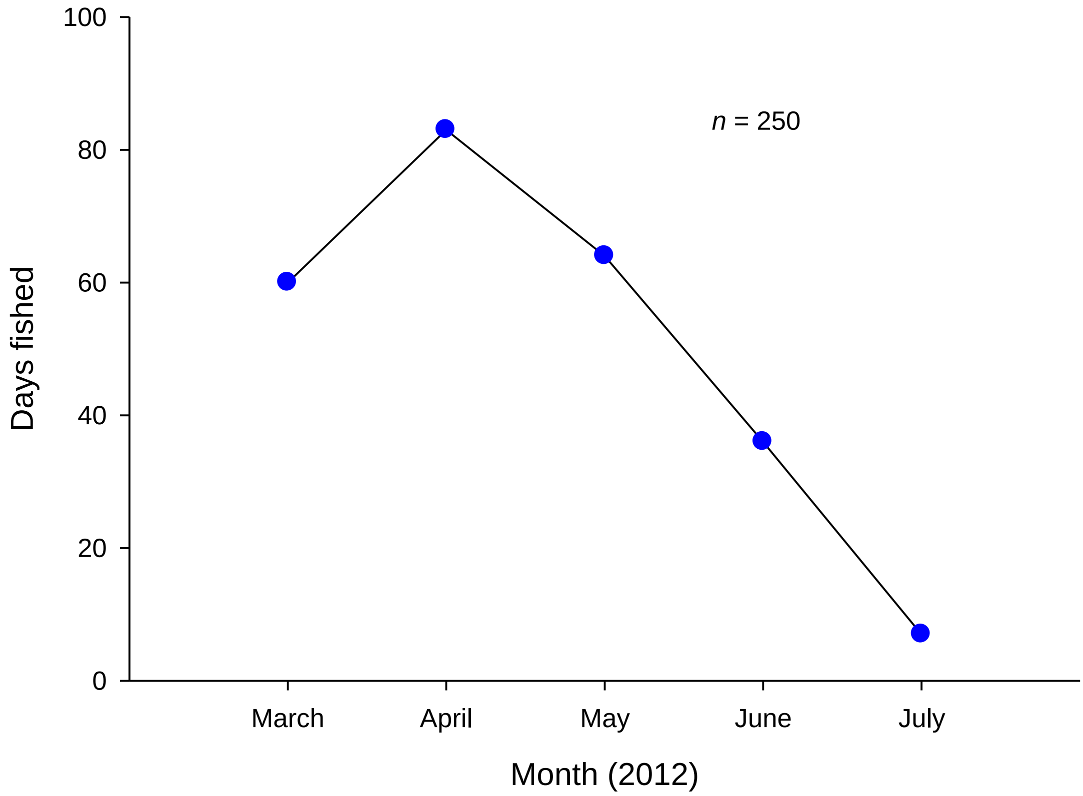

Fig. 6.1. The number of game fishing charter trips by month. This figure excludes trips from two operators who reported a total number of trips for the season.

Soak time and the number of lines trolled were reported for all trips recorded in the logbook from the Tasman Peninsula. The average soak time was 6.4 ± 0.2 (95% CI) hours and the number of lines used on a given trip was 5.2 ± 0.07 (95% CI).

6.3.2. CATCH

Southern Bluefin Tuna were caught on 235 individual charter trips or 94% of trips between March and July. A total of 1090 (kept = 937, released = 153) SBT were reported caught by charter operators in 2012. Operators who only reported total trip and catch numbers indicated that they only caught school sized fish so the monthly average estimated weight of fish caught by the charter fleet was allocated to their catches.

Table 6.1. The number of SBT retained, the average estimated weight of SBT retained and the calculated total weight of SBT caught by the recreational charter sector by month.

Month	Number of SBT retained	Average estimated weight of retained SBT (kg)	Total retained weight of SBT (t)
January	12	24.0	0.29
February	0	-	0
March	230	19.3	4.60
April	287	18.8	5.78
May	263	17.1	4.55
June	136	17.5	2.35
July	9	19.1	0.18
Total	937		17.75

Charter operators reported seven SBT greater than 90kg (94 – 106kg) captured during 2012, all from the Tasman Peninsula. Six of these fish were caught over a one month period between late March and late April, and the other fish was caught in late June.

The total retained weight of SBT caught by the Tasmanian recreational charter sector during 2012 was 17.75 t. Catch weights peaked in April and then fell away with very few fish caught in July (Table 6.1 & Fig. 6.2). The trend in retained catch reflected the trend in effort.

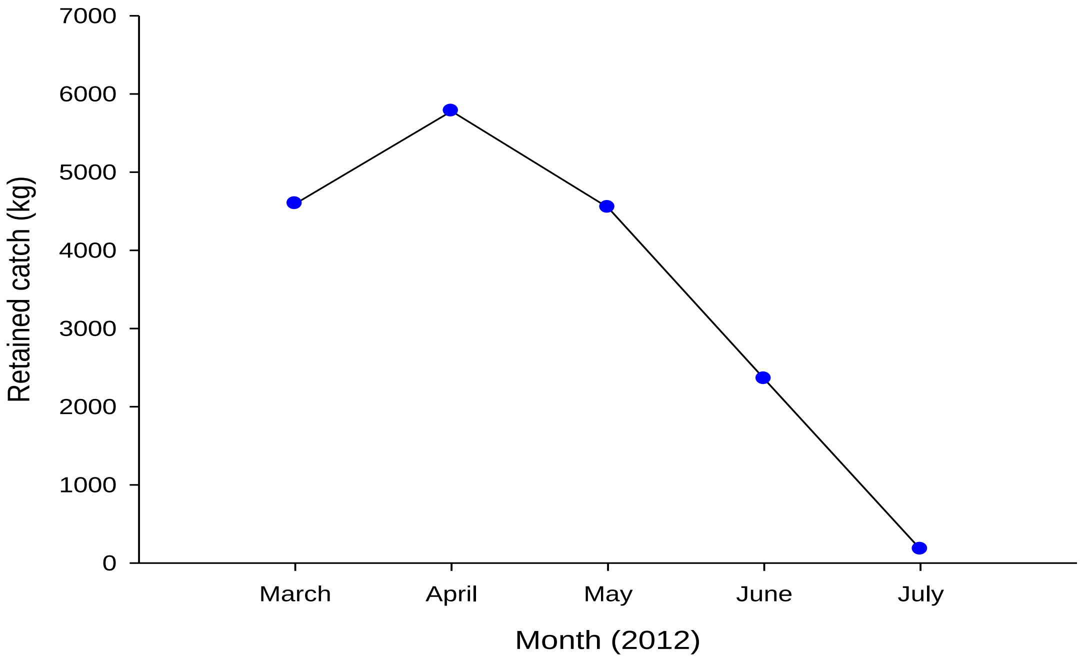

Fig. 6.2. The estimated total retained catch (kg) of SBT from the recreational charter sector in Tasmania from March to July 2012.

6.3.3. *RELEASE RATES*

Two operators did not report numbers of fish released, therefore the total number of fish released will be underestimated. Landed catches by these operators were therefore excluded when calculating release rates.

The release rate for the charter sector was estimated to be 15%, although if catches from the south coast are excluded, the effective rate for the main area of the charter fishery (Tasman Peninsula) was just 12%. Particularly high catch rates off the south coast meant that bag limits had a greater influence on the proportion of fish released which was 29% for that area.

Of 36 charter trips where SBT were released the combined bag limit of all clients was reached on 18 occasions. The reported rate of ‘bagging out’ was 6.3% for trips originating from Pirates Bay and 62.5% for trips originating from Southport. Bagging out accounted for the release of 100 SBT, or 65% of the released fish, implying that the remaining 35% were released for reasons other than legislative requirement.

6.3.4. Catch rates

Catch rate data in this case provides a relative index in the availability of SBT to the charter sector. Catch rates increased steadily from March from just under 0.5 SBT per trip to approximately three SBT per trip in June. The catch rate then declined significantly in July (0.1 SBT per trip) indicating that the SBT had moved away from the areas fished by the Tasmanian recreational charter sector (Fig. 6.3).

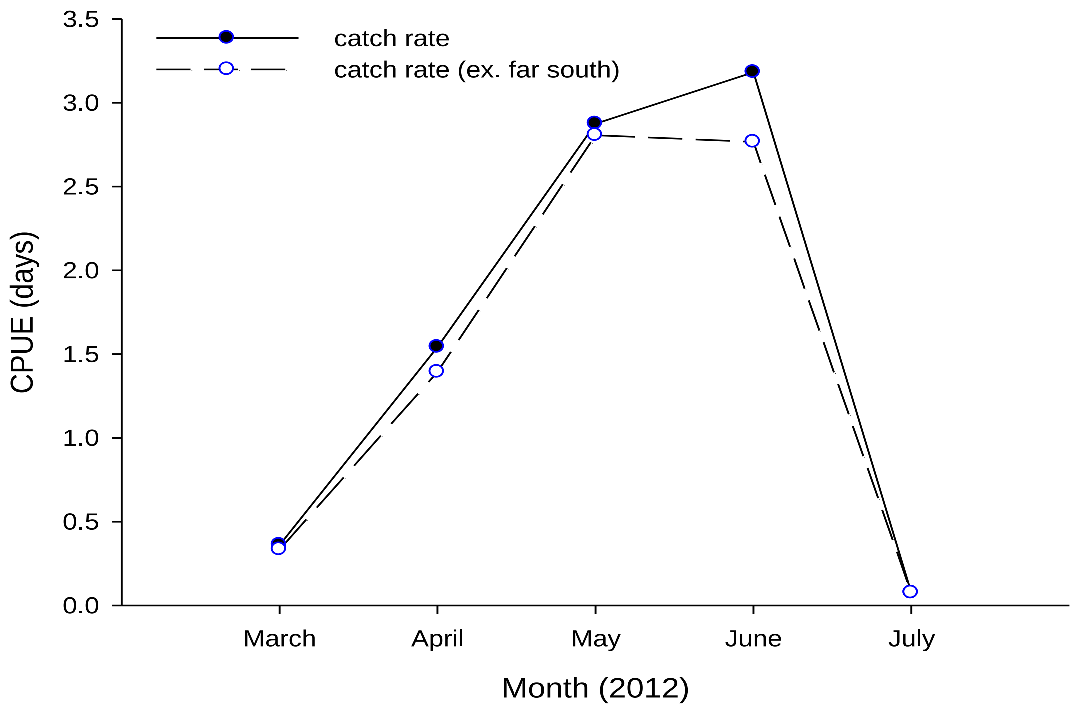

Fig. 6.3. Catch per unit of effort (days fished) for SBT caught by the Tasmanian recreational charter sector from March to July 2012.

6.3.5. Seal interactions

Seal interactions were reported on 75% of all game fishing trips reported by charter operators. Individually, the interaction rate varied between 51 – 100% of the fishing days, depending on the vessel.

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- Offshore recreational fishing in Tasmania, with emphasis on game fish and deep water reef-fish species (FWCG: 2010/105)
- An on-site survey of recreational SBT fishing to cross-validate catch rates and catch size contribution with results from an off-site survey boat based survey (FWCG: 2011/127)

Kelly Bolch provided invaluable assistance with the management of the telephone survey and our team of proficient and committed telephone interviewers - Sandra Halliwell, Jennie Holmes, Shirley Lines, Elizabeth McNally, Helen Patterson, Elizabeth Ruthven, Patricia Smith and Sheelagh Wegman - contributed to the success of the survey, encouraging the co-operation of fishers and maximising response rates, as well as ensuring data quality and completeness.

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8. REFERENCES

Caddy J (1999) Fisheries management in the twenty-first century: will new paradigms apply? *Reviews in Fish Biology and Fisheries* 9: 1 – 41.

Coleman F, Figueira W, Ueland J and Crowder L (2004) The impact of United States recreational fisheries on marine fish populations. *Science* 305: 1958 – 1960.

Cooke S and Cowx I (2004) The role of recreational fishing in global fish crises. *BioScience* 54: 857 – 859.

Ernst and Young (2004) Economic impact of the NSW striped marlin fishery. Report to NSW Fisheries, Cronulla, 124p.

Forbes E, Tracey S and Lyle J (2009) Assessment of the 2008 recreational gamefish fishery of southeast Tasmania, with particular reference to Southern Bluefin Tuna. Tasmanian Aquaculture and Fisheries Institute. Internal Report, 23p.

Ford J and Gilmour P (2013) The state of recreational fishing in Victoria: a review of ecological sustainability and management options. Victorian National Parks Association, Melbourne, 76p.

Graefe, AR (1980) The relationship between level of participation and selected aspects of specialisation in recreational fishing. Doctoral Dissertation, Texas A&M University, College Station.

Green C, Brown P, Giri K, Bell J, Conron S (2012) Quantifying the recreational catch of southern bluefin tuna off the Victorian coast. Recreational Fishing Grant Program – Research Report. Department of Primary Industries, Victoria, 29p.

Haddon M. (2001) Modelling and quantitative methods in fisheries. Chapman & Hall/CRC, 435p.

Henry GW and Lyle JM (2003) The national recreational and indigenous fishing survey. Final Report to the Fisheries Research and Development Corporation, Project 99/158. NSW Fisheries Final Report Series No. 40, 188p.

Jones CM and Pollock KH (2012) Recreational Angler Survey Methods. Chapter 19 in Fisheries Techniques Manual, Third Edition. American Fisheries Society.

Klaer NL (In press) Yield, total mortality values and Tier 3 estimates for selected shelf and slope species in the SESSF. In: Tuck GN (ed.) Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery 2012. Part 2. Australian Fisheries Management Authority and CSIRO Marine and Atmospheric Research, Hobart, 56p.

Lyle JM, Tracey SR, Stark KE and Wotherspoon S (2009) 2007-08 survey of recreational fishing in Tasmania. Tasmanian Aquaculture and Fisheries. Internal Report, 107p.

Lyle JM and Tracey SR (2010) Tasmanian recreational rock lobster and abalone fisheries: 2008-09 fishing season. Tasmanian Aquaculture and Fisheries. Internal Report Internal Report, 35p.

Lyle JM and Tracey SR (2011) Recreational gillnetting in Tasmania – An evaluation of fishing practices and catch and effort. Institute for Marine and Antarctic Studies. Internal Report, 56p.

Morton AJ and Lyle JM (2003) Preliminary assessment of the recreational gamefish fishery in Tasmania, with particular reference to southern bluefin tuna. Tasmanian Aquaculture and Fisheries. Technical Report No. 21, 33p.

Tracey SR, Ewing, GE and Lyle JM (2011) Spawning dynamics and age structure of wild caught Tasmanian Striped Trumpeter during the 2010 spawning season. . Institute for Marine and Antarctic Studies. Internal Report, 17p.

Tracey SR and Lyle JM (2005) Age validation, growth modeling, and mortality estimates for Striped Trumpeter (*Latris lineata*) from southeastern Australia: making the most of patchy data. *Fishery Bulletin* 103: 169 – 182.

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