Offshore Recreational Fishing in Tasmania 2018/19

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Executive Summary

This study investigated the game and offshore recreational fishing activities of Tasmanian fishers between December 2018 and November 2019 inclusive. Species of interest included Striped Trumpeter, Blue-eye Trevalla, tunas (specifically Southern Bluefin Tuna, Albacore and Striped Tuna), billfish and pelagic sharks. This study is the second specific recreational offshore fishing survey conducted in Tasmania, with the first conducted in 2011/12.

This survey replicated the methods employed during the 2011/12 survey using a two-phase longitudinal telephone diary survey (TDS) design. A stratified random sample of vessels registered on the Marine and Safety Tasmania (MAST) database was selected for the survey. A total of 2,207 owners of powered recreational vessels over 4.5 m participated in a screening survey conducted during November and December 2018. A third of respondents ($n = 641$) 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, 94% ($n = 600$) agreed to participate in the diary survey, with 97% ($n = 581$) completing the 12-month survey. 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.

Tasmanian charter boat operators that were identified as likely to conduct offshore fishing as part of their services were contacted and asked to participate in a voluntary logbook which was used to report catch of key species from this sector.

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

Compared to the 2011/12 survey, both effort and catch declined for tuna fishing and mid-depth reef associated species, effort targeting pelagic sharks also decreased, but the catch remained stable. Conversely, there was a significant increase in the amount of effort targeting deep-water shelf-edge associated species, and a resultant increase in catch of the target species.

Tunas

Trolling for game fish was reported in each month of the survey year, with an estimated 4,581 (± 383 SE) troll fishing days conducted. Effort (days fished) increased through the summer months before peaking in April, and declined through to July with only low levels of effort for the remaining survey months. Trolling activity was reported predominantly on the east coast, particularly the South East region, while lower levels of effort were also reported along the south coast, including Pedra Branca, and a low level of effort was reported from the west coast.

The highest estimated catch of the tuna species reported was for Albacore with 5,715 (± 762 SE) individuals caught, of which 84% were caught from private vessels and the remainder caught from charter boats. An estimated 16% of the Albacore catch was released. An estimated small number (25 ± 16 SE) of Albacore were also reported to have been depredated by seals during the capture process. Southern Bluefin Tuna (SBT) was the next most commonly caught species with an estimated 4,207 (± 400 SE) individuals caught. Private boats accounted for 80% of the catch, with charter boats catching the remainder. An estimated 29% of the SBT caught were released and the rest were harvested, equating to a harvested biomass of 48.4 tonnes. A further 20.1 tonnes was estimated to have been depredated by seals during the capture process. Very few Skipjack Tuna were reportedly caught during the survey period, estimated at 188 (± 95 SE) individuals, with the vast majority caught from private vessels and over 90% released.

Pelagic sharks

The majority of the estimated 683 (± 92 SE) pelagic shark fishing days occurred along the east coast, with some activity on the north coast. A small amount of effort was also recorded on the south and north west coasts. Effort peaked in January, with most of the effort occurring from December 2018 to April 2019, and low levels of effort reported in May, June and November 2019.

An estimated total of 455 (± 88 SE) Mako Shark were caught during the survey period, with 95% caught from private vessels and the remainder from charter vessels, and 47% of the total catch released. Very few Blue Shark were reported caught during the survey period.

Mid-depth reef associated species

It was estimated that 2,428 (± 251 SE) days were spent targeting mid-depth reef associated species by private vessels, with the greatest effort occurring from December to June with a sharp peak in January. Mid-depth reef associated fishing occurred all around Tasmania, but most occurred off the east and southeast coasts.

The primary target species in these areas was Striped Trumpeter. An estimated 4,366 (± 520 SE) were caught, with 95% of the catch caught from private vessels and the remainder caught by charter boats. Based on the average size of fish reported, the harvested catch equated to 18.1 tonnes, with a further 17% of the catch released. Depredation of Striped Trumpeter by seals was also reported by private vessel owners and estimated as 291 (± 120 SE) individual fish. Other species reported associated with catch of Striped Trumpeter included Jackass Morwong and Ocean Perch/Gurnard. Catch estimates reported for both should be considered minimum estimates, as there is likely under-reporting from the charter sector and the species can be caught in other modes of fishing not covered in this survey.

Deep-sea shelf-edge associated species

Deep-water shelf-edge associated fishing increased significantly from the last offshore fishing survey undertaken in Tasmania in 2011/12. An estimated 1,092 (± 189 SE) fishing days were spent deep-sea fishing. The timing of activity through the survey year was similar to mid-depth reef fishing, with most effort conducted from December 2018 to June 2019 with a sharp peak in January. Effort was focused on the east coast, with a small amount of effort reported from the south coast.

The most commonly reported species caught while deep-sea fishing was Blue-eye Trevalla. An estimated 2,547 (± 573 SE) were caught, with 99% reported caught from private vessels and the remainder from charter vessels. Other species caught included Gemfish, Blue Grenadier and Pink Ling.

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1. General Introduction

Recreational fishing is an important pastime for many Tasmanians, with an estimated quarter of the population undertaking some form of recreational fishing each year (Henry and Lyle 2003, Lyle et al. 2009, Lyle et al. 2019). An important component of this recreational fishing is offshore reef and game fishing, where boats travel further offshore to target larger prized species. Offshore fishing targets mid-depth reef associated species such as Striped Trumpeter (*Latris lineata*) and deep-water shelf-edge associated species such as Blue-eye Trevalla (*Hyperoglyphe antarctica*), while game fishing activities target species such as tunas, including Southern Bluefin Tuna (*Thunnus maccoyii*) and pelagic sharks such as Mako sharks (*Isurus oxyrinchus*) (Tracey et al. 2013).

State-wide surveys of recreational fishing in Tasmania have been conducted regularly since the early-2000s (Henry and Lyle 2003, Lyle et al. 2009, Lyle et al. 2014, Lyle et al. 2019). These 'big picture' studies investigated recreational fishing in general, however the offshore and game components of the recreational fishery tend to be specialised, with lower rates of participation due to high investment costs. Consequently, it is difficult to gain accurate estimates of catch and effort based on surveys of general fishing activity, due to the low frequency of these modes of fishing in the community used as the sampling frame for general recreational fishing surveys. As a result, estimates of catch and effort of these more specialised recreational fishing activities are often less precise than those achieved in a more targeted survey.

Targeted surveys using refined sample frames have been used for almost two decades to provide more statistically robust estimates of Southern Rock Lobster and Abalone, both high value species in Tasmania (Lyle et al. 2019). Specific gear-type surveys using refined sample frames have also been conducted, including the recreational gillnet fishery (Lyle and Tracey 2012) and the setline fishery (Lyle and Tracey 2012). All of these surveys have used the Tasmanian recreational fishing licence database as a targeted sample frame, as a licence is required to target Rock Lobster and Abalone and use some specific gear types such as gillnets and set lines. However, general rod and line fishing in Tasmania does not require a fishing licence, so other sample frames are required.

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 useful sample frame from which offshore fishers (boat owners) can be sampled (Tracey et al. 2013). In this study, we replicate the design used by Tracey et al. (2013) to provide results for the catch and effort of key offshore and game fishing species in Tasmania.

The fundamental method used for all of these surveys is a standard off-site probability-based survey design, specifically modified for recreational fishing surveys. In particular, the telephone-diary methodology was first used as the delivery method for the National Recreational and Indigenous fishing survey in 2000/01 (Henry and Lyle 2003). Since that time, this method has been the basis of most recreational fishing surveys in Tasmania and many recreational fishing surveys around Australia (Lyle et al. 2009, Giri and Hall 2015, West et al. 2015, Lyle et al. 2019, Ryan et al. 2019).

Charter fishing is also an important contributor to recreational fishing catch and effort in Tasmania. Charter operators offer services allowing recreational fishers access to fishing activities they may not be able to access themselves due to lack of experience or equipment, such as offshore and game fishing. Charter operators in Tasmania do not have to keep a mandatory logbook, as required by some other states. The exception to this is a small number of operators, where a mandatory logbook is one of the conditions permitting them a higher boat limit for SBT. Previous charter fishing activity surveys have shown that the use of voluntary logbooks was successful for the Tasmanian charter boat sector, providing a cost-effective method of monitoring catch and effort. As such, voluntary charter boat logbooks are employed during this study, to collect information on key recreational offshore and game fish species caught by the charter boat sector during the survey period.

Understanding the ecological impacts of fishing has been an important component of fisheries research for many years, but far less is known about the impact of recreational fishing compared to commercial fishing. Ongoing recreational fishing studies are important to understand the effects of fishing on stock levels and local marine environments.

The primary objective of this survey was to quantify recreational fishing activity for key game and offshore species from private recreational and charter vessels in Tasmania, specifically:

- annual fishing effort
- annual catch – retained, released and depredated
- seasonal and spatial presentation of catch and effort.

2. Methods

2.1. Survey design

An off-site telephone-diary survey (TDS) approach was used to assess the catch and effort from recreational fishing for key game fish and offshore species from private boats in Tasmania between December 2018 and November 2019, inclusive. The survey involved a two-phase design (Lyle et al. 2010) of an initial screening interview conducted by telephone, to establish eligibility and collect profiling information, and a longitudinal diary phase conducted by telephone interview for eligible respondents, in which boat-based game and offshore fishing activities were monitored in detail over the survey period.

The survey 'population' consisted of all registered recreational vessels contained in the recreational vessel registration database administered by MAST. Fishing charter vessels are not listed in this database as they are registered commercial vessels. While it is possible for commercial fishing vessels to temporarily 'de-register' to conduct a recreational fishing trip, it is likely to be a rare event and any resultant catch be negligible in the context of that taken by private vessels.

A 'target population' was drawn from the entire list of registered recreational vessels, based on criteria relating to the perceived capability of the vessel to be used safely for offshore game fishing activity. All vessels other than yachts, personal watercraft, inflatables, vessels with trade plates (new boats registered for sale by merchants) and vessels less than 4.5 m in length were included in the target population. The primary sampling unit (PSU) was the registered vessel.

2.1.1. Stratification

The target population was divided into five regional strata based on the postcode of the registered owner of the vessel. These regions corresponded to the Australian Bureau of Statistics (ABS) statistical areas (SA4) of Hobart, South East, West & North West and Launceston & North East. Interstate residents were grouped into a fifth 'interstate' stratum.

A stratified random sample approach was applied, where between 22 and 24% of all target population vessels were selected from each region in Tasmania and 30% of interstate vessels were selected (Table 1). The sample was also stratified by vessel size, with five strata recognised, including 'no vessel size recorded in the MAST database', 4.5–5.5 m, 5.6–8.5 m, 8.6–11.5 m and greater than 11.6 m (Table 1).

Table 1. *Sample fraction matrix showing sample numbers from the target population of recreational vessels in Tasmania by Australian Bureau of Statistics – Statistical Level 4 (SA4) and vessel size categories – defined in main body of text.*

Size class	Hobart	Launceston & North East	South East	West & North West	Interstate	Total per size class
No vessel size	53	69	25	42	2	*191*
4.5 – 5.5 m	573	458	189	330	8	*1,558*
5.6 – 8.5 m	524	365	182	246	9	*1,326*
8.6 – 11.5 m	122	38	47	28	9	*244*
11.6 m +	96	31	31	12	14	*184*
Total per region	1,368	961	474	658	42	

Vessels in the 4.5–5.5 m size class were the most common (64%) in the target population and, given the large number of vessels in this group, the sampling fraction was the lowest of all groups at 16% (Table 1). Vessels in the 5.6–8.5 m size class were the second most common group (29%). This category was considered the most likely size of vessel to be used for offshore fishing, so a higher sample fraction of 30% was applied (Table 1). Vessels 8.6–11.5 m and greater than 11.6 m were less common, representing 3% and 2% of the target population, respectively. Given the small number of vessels in these size classes, it was possible to achieve high sampling rates, equivalent to 51%. A further 2% of vessels had no size information recorded in the MAST database. A sampling fraction of 59% was applied for this group, and the size of each vessel was confirmed where possible.

2.2. Interview structure

Due to privacy requirements, it was initially necessary to contact the random sample of vessel owners by telephone on behalf of MAST, to request permission for the release of their contact details to the University of Tasmania for the purpose of a survey of recreational vessel usage. This was to ensure adherence to the Privacy Act (Act No. 119) 1988. To eliminate subject relevancy bias, it was not revealed at this stage that the survey related to recreational fishing. Vessel owners who gave permission to be contacted were subsequently contacted by telephone during November and early December 2018 to participate in the screening survey.

Phase one (screening) respondents were asked if their selected vessel (some respondents owned multiple vessels) had been used for recreational fishing in the previous 12 months and, if so, what types of fishing activities it had been used for either by themselves or others. The activities were categorised as freshwater fishing, inshore/estuarine fishing (including potting and netting), game fishing (including targeting tunas, billfish or Mako Shark *Isurus oxyrinchus*), offshore fishing (specifically at depths typical for the capture of species such as Striped Trumpeter *Latris lineata* or Blue-eye Trevalla *Hyperoglyphe antarctica*), dive harvest, or 'other fishing' in or adjacent to Tasmanian State waters.

If either game fishing or offshore fishing were identified, respondents were asked to give their 'best estimate' of the number of days the vessel was used for each of these specific activities in the preceding 12 months. 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 1 December 2018. Respondents were then asked more specifically 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 question was 'quite likely' or 'very likely', the owner was invited to participate in the longitudinal component of the study in which their offshore and game fishing activity was monitored for 12 months, from December 2018 to November 2019 inclusive.

Phase two (longitudinal component) commenced on 1 December 2018 and ran through to 30 November 2019. Respondents who agreed to participate were mailed a simple fishing diary/logbook and a formal letter of introduction. Respondents were contacted by telephone shortly afterwards to confirm receipt of the diary and to have reporting requirements explained. Respondents were contacted regularly by telephone throughout the 12-month study period by trained survey interviewers, who recorded details of any game fishing or offshore fishing activities conducted from the selected vessel since last contact.

The frequency of contact was tailored to the amount of in-scope fishing activity undertaken by the vessel. Owners of vessels used more frequently were contacted more regularly, so detailed information could be routinely collected soon after each fishing event. This was designed to minimise recall bias for any information that was not recorded in the diary. 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 respondents were contacted at least once a month, even if no fishing activity was planned. The owners of all eligible boats were encouraged to participate in the diary survey.

Information recorded for each in-scope fishing event included the trip date, fishing location, departure location, whether game and/or offshore fishing was the intention, the number of hooks used or the number of lines used depending on the fishing mode, the primary target species (up to two), start and finish times (including any significant breaks from fishing), catch composition by numbers kept (harvested) and numbers released or discarded.

Information on any interactions with wildlife during the fishing event was also recorded, including the number of fish lost to predators, the number of retained fish damaged by predators and any observed predation of released fish. Individual size measurements for SBT and Striped Trumpeter were reported by some respondents in a number of formats, including weight or fork length and a combination of estimated or measured sizes. In each case, the measurement category was recorded. Fishing locations were allocated into one of 10 coastal regions (Figure 1).

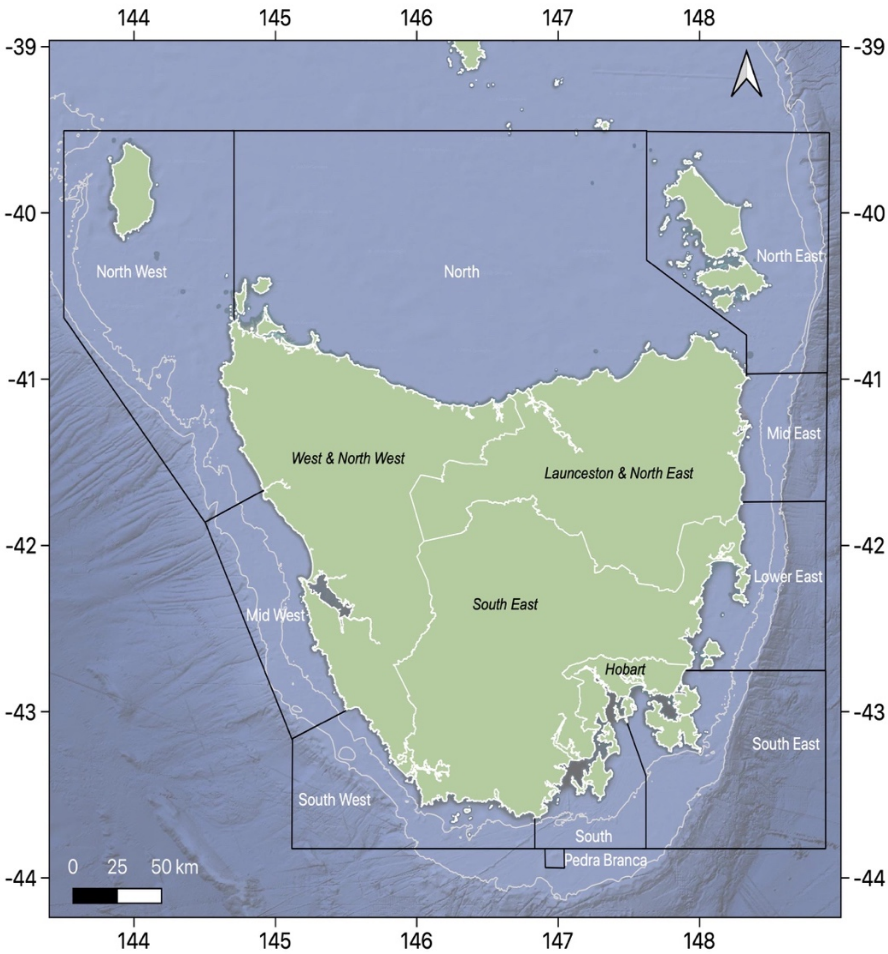

Figure 1. *Map of Tasmania showing Australian Bureau of Statistics 'Statistical Divisions' on land and coastal regions as categorised for assessment throughout the longitudinal recreational game fishing survey.*

2.2.1. Non-intending vessel survey

A non-intending vessel survey was conducted after the completion of the longitudinal survey phase in December 2019. The purpose of this survey was to identify whether any vessels that were reported as unlikely to be used for game or offshore fishing during phase one (screening) did in fact participate in any of the in-scope fishing activities during the survey period and, if so, the number of days fished. This information was used to correct effort and catch estimates, by accounting for the activities of these 'drop-in' vessels.

2.2.2. Analysis

The telephone survey data was analysed using a model-based approach, using the 'survey' package (Lumley 2004, Lumley 2010) in R version 3.6.1 (R Core Team 2019). A calibrated, stratified two-phase design was used to expand the sample data to generate estimates of effort and catch for the 12-month survey period.

Initial sampling weights were determined from the target population totals by stratum, where stratum comprised the combination of the residential region for the vessel owner and the vessel size category. An adjustment to these weights was made within a generalised regression (GREG) calibration model (Särndal et al. 1992, Lumley 2010) to account for non-intending or drop-in vessel fishing activity. Vessels in the longitudinal phase were re-weighted based on the avidity profile of diarists at screening, with avidity reported by non-intending respondents.

Some of the vessels in the MAST database did not have details regarding the vessel size. A sample of these unknown size vessels was included in the original gross sample, and the vessel size determined with the owner at screening. A proportion of these vessels were identified as too small (< 4.5 m), so were not in-scope and were removed from the sample. The relative proportions of allocation to the size stratum categories determined from this sample were applied to the unknown size vessels in the target population, including a reduction in the target population to account for the proportion of vessels that were classified as too small (out of scope).

2.2.3. Conversion of catch numbers to biomass harvest

2.2.3.1.Southern Bluefin Tuna

The majority of the SBT reported caught in Tasmania during the survey were 'school fish' (less than 135 cm FL), but some large fish were also reported. Given the strong bimodality between these size classes, expanded retained catch estimates were derived for school and large fish separately. This facilitated the application of an appropriate cohort-specific average size to both school and large fish, rather than an unrealistic average size of all fish, which would impact both estimates and the precision of the estimates, as size variance is reported in the error structure of total harvest by weight for SBT.

To classify the number of school fish relative to large fish, it is assumed that size information was reported for all large fish, so any unmeasured fish were in the school fish size category. This assumption was made because catching a large tuna is a memorable experience and respondents take pride in reporting this catch.

An analysis of variance (ANOVA) was conducted to test if there was a difference between the size of school fish reported by the diarists and those measured by the creel clerk. This analysis indicated that the fisher-reported lengths were substantially larger than those obtained by the creel clerk ($F = 25.9_{(1,119)}$, $P < 0.0001$), suggesting bias in the respondent-reported data. Consequently, the conversion of catch numbers to weight for the school fish was based on size composition data collected independently by the creel clerk.

However, as no large fish were measured by the creel clerk, it was necessary to use respondent-reported data for this group. This is justified as the larger fish tend to be 'weighed in' once the vessel returns to a boat ramp, and are thus considered an accurate measurement. All fish reported lost to seals or predated on after release (depredated) were assumed to be school fish and, accordingly, the average weight of school fish for Tasmania was applied to convert numbers to biomass.

2.2.3.2.Other tuna species

Harvest weight was not calculated for Albacore or Skipjack Tuna. Most Albacore size information reported during the survey was estimated rather than measured rendering it unreliable. There is also strong bimodality in the size of Albacore reported with fish either generally less than 5 kg or greater than 20 kg (up to approximately 25 kg). This further complicates generating a weight estimate as only a proportion of the catch has estimated size information, and it is unlikely that the proportion of large fish to small fish reported represents the actual catch composition. No size information was reported for the small number of Skipjack Tuna reported caught during the survey period.

2.2.3.3.Pelagic sharks

Harvest weight was not calculated for pelagic sharks, as the size measurements were estimated rather than measured for the majority of sharks reported. The variation in size further complicates producing an accurate estimate of harvest weight. Estimated reported weights ranged from 80–260 kg.

2.2.3.4.Mid-depth reef associated species

Individual Striped Trumpeter lengths and/or weights were reported as either measured or estimated, with length recorded as either total or fork length. To estimate an average weight of Striped Trumpeter, only measured fish were used ($n = 129$). The total length (TL) was converted to fork length (FL) using the equation reported by Tracey et al. (2011):

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

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

$$W = 2x10^{-5} \text{ x } FL^{3.0}$$

No size information was recorded during this survey for Jackass Morwong or Ocean Perch.

2.2.3.5.Deep-water shelf-edge associated species

No size information was available for deep-water species.

3. Results

The MAST recreational vessel registration database contained 30,968 vessels when acquired by IMAS on 24 September 2018. Of these, 15,323 or 49% were deemed eligible for the survey and constitute the 'target population' (Figure 2). This was based on the criteria outlined in the methods, relating to the suitability of the vessel to participate in offshore or game fishing. Overall, 3,503 (22%) of all vessels in the target population were selected to be contacted and constituted the gross sample (Table 3).

3.1. Response rates

The owners of 2,719 (78%) vessels randomly selected in the gross sample were contacted on behalf of MAST, to request permission for their contact details to be made available to the University of Tasmania for the purpose of the survey. Sample loss due to no valid telephone number associated with the registered vessel accounted for 10% and, despite at least 10 attempts, no contact was made with the remaining 12% of registered vessel owners selected in the gross sample (Figure 2).

Of the 2,719 respondents that were contacted, 63 (2%) no longer owned the vessel and 59 (2%) were not eligible after the size of their vessel was revealed to be less than 4.5 m. Of the remaining 2,597 respondents, 2,207 (85%) agreed to have their contact details passed on, while 393 (15%) declined (Figure 2).

A total of 2,053 were contacted for the screening survey, with 2,011 (98%) providing full responses (representing 13% of all registered vessels in the target population), 42 (2%) declining to participate and 147 (7%) non-contactable for a variety of reasons (Figure 2).

Results from the screening survey indicated that 641 vessels (32% of vessels from fully-responding participants in the screening survey) were identified as eligible for the subsequent diary survey. This was determined by a response indicating a likelihood of the vessel participating in offshore and/or game fishing during the 2018/19 survey period. Of those eligible vessels, 600 (94%) of the registered boat owners agreed to participate in the 12-month longitudinal study, with the remaining 6% declining to participate (Figure 2).

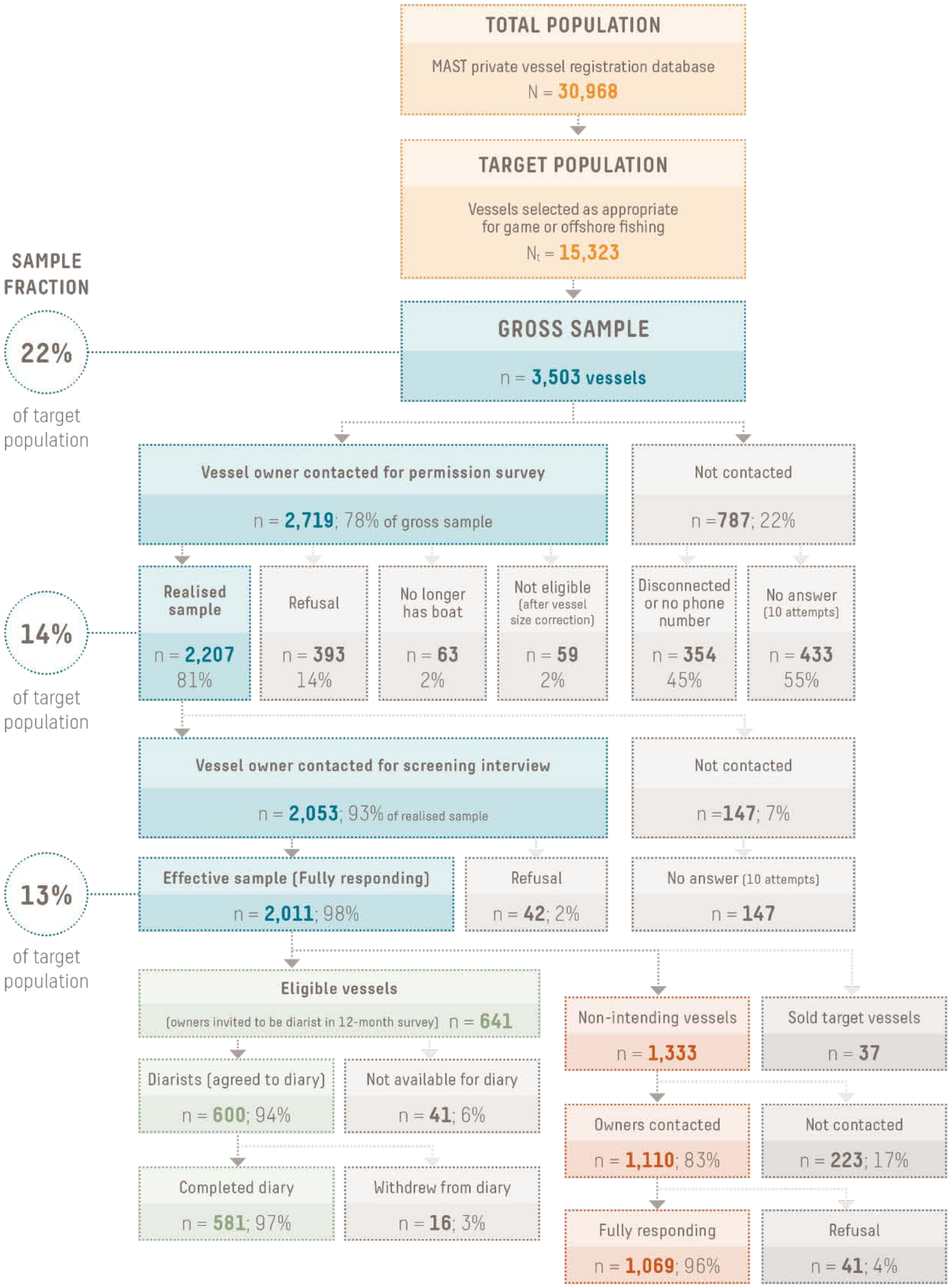

Figure 2. Pre-screening, screening and longitudinal diary survey response profile.

3.2. Population and sample correction

Of the 326 vessels in the target population where no size information was provided, a gross sample of 191 (59%) was randomly selected. Of these, a full response was achieved from 116 or 61% of the gross sample, representing 36% of this stratum in the target population. The vessels where size information was provided were added to the sample in the appropriate size category (Table 2).

From this updated information, the percentage of each vessel size category was used to proportionally allocate the remaining vessels in the database into a size category. This included those vessels in the database that were not selected in the sample, and those that were in the sample but could not be contacted or were unable to provide size information (Table 2). Fifty-one per cent of the vessels where size data was provided were identified as out-of-scope as the vessel size was reported as less than 4.5 m (Table 2).

Table 2. *Percentage of vessels for each size category reported by owners during the 'permission call', for vessels where no size information was reported in the MAST registration database. Four owners provided information on the size of their selected vessel but did not give permission to be contacted for the screening survey, hence the discrepancy between the total number here and the 'realised sample' size for this size category in Table 3.*

Vessel size category	Owners reporting vessel size (n)	Percentage response
< 4.5 m	59	51%
4.5 – 5.5 m	30	26%
5.6 – 8.5 m	24	21%
8.6 – 11.5 m	2	2%
11.6 m +	1	1%
Total	**116**	

This resulted in a correction to the target population, reducing the number of target vessels from 15,323 to 15,158, as well as the effective sample numbers for each vessel size category (Table 3). For seven vessels, the listed owner was unsure whether the boat was longer than 4.5 m. Accordingly, these vessels were considered sample loss and retrospectively removed from the adjusted realised sample. Three of these were reported as sold boats, so were not considered in the effective sample. The remaining four were considered as part of the effective sample, and were included in the screening survey to verify if the vessel was used for in-scope fishing activities. These vessels account for the discrepancies in the final realised and effective sample numbers between Figure 2 and Table 3.

Table 3. *Size composition of boats in the target population, the gross sample, and the effective sample – adjusted to correct for updated vessel size information missing from MAST database. Percentages represent sample relative to size category target population.*

Vessel size category	Target population	Gross Sample	Adjusted effective sample
No size reported	326	191 (59%)	
4.5 – 5.5 m	9,739	1,558 (16%)	886 (9%)
5.6 – 8.5 m	4,418	1,326 (30%)	847 (19%)
8.6 – 11.5 m	479	244 (51%)	157 (32%)
11.6 m +	361	184 (51%)	118 (33%)
Total	**15,323**	**3,503 (22%)**	**2,008 (13%)**

3.3. Fisher profiling during the screening survey

An estimated 12,404 (± 134 SE) vessels, or 82% of the target population, were used for some form of recreational fishing in the 12 months preceding the screening survey. Over this period an estimated 228,901 (± 6,970 SE) days fishing occurred from these vessels. Inshore fishing, which included line fishing, netting and potting, was the most prevalent activity reported, followed by offshore fishing, game fishing, freshwater fishing and dive harvest (Figure 3).

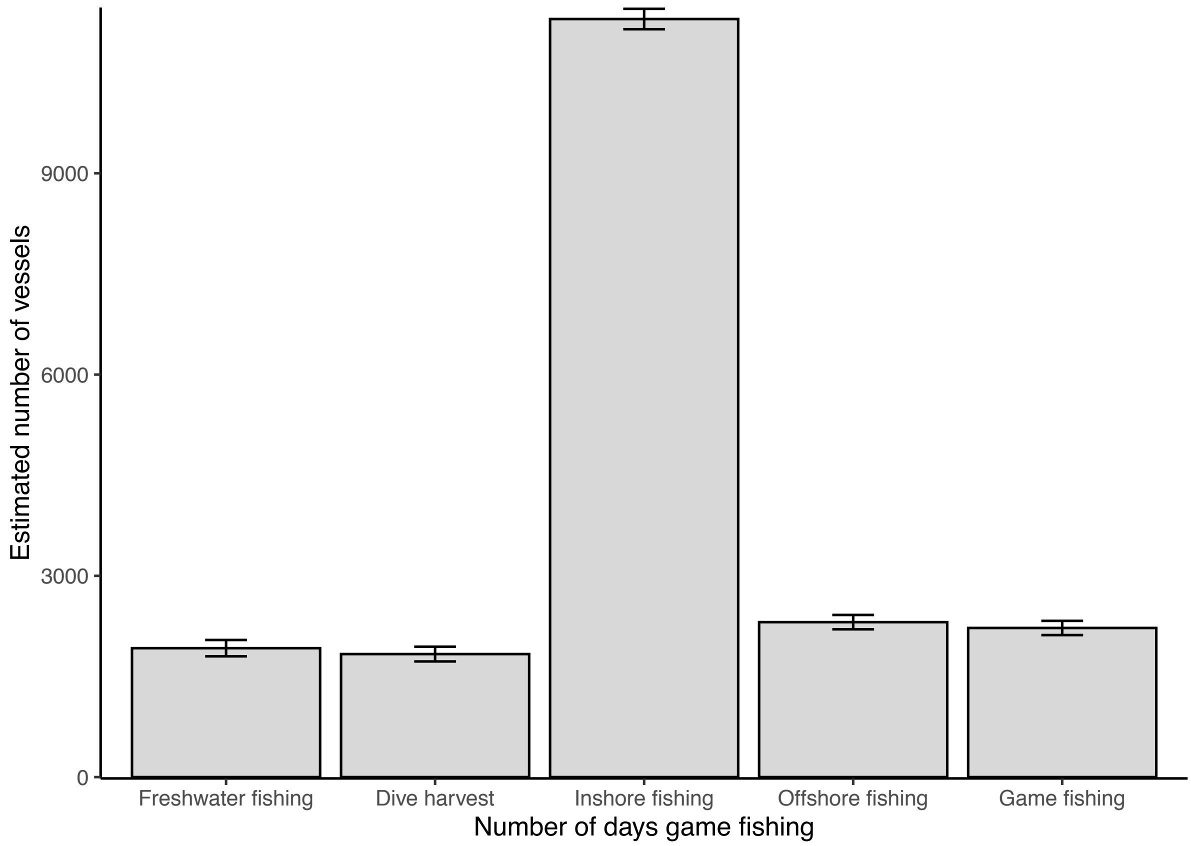

***Figure 3**. Estimated number of motorised recreational vessels greater than 4.5 m participating in various modes of fishing in Tasmania, expanded from the screening responses for the 12-months prior to 1 December 2019.*

Based on responses during the screening survey, it was estimated that 2,223 (± 106 SE) vessels, or 15% of the target population, were used for game fishing during the 12 months preceding the survey period. These vessels were estimated to have conducted 16,932 (± 1,386 SE) days game fishing over this time.

Of the boats used for game fishing in the 12 months prior to the screening survey, 72% were reportedly used for game fishing on 10 or fewer days, 20% for 11–20 days, and the remaining 8% for game fishing for more than 21 days (Figure 4).

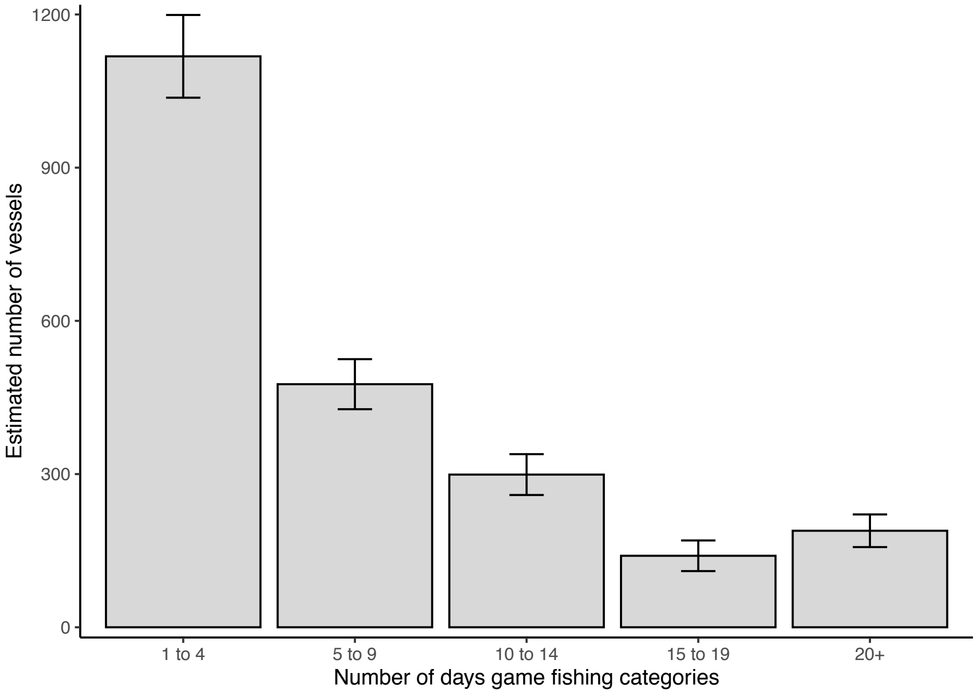

Figure 4. *Estimated number of days spent game fishing by motorised recreational vessels greater than 4.5 m in Tasmania expanded from the screening responses for the 12-months prior to 1 December 2018.*

A similar number of vessels were estimated to have been used for offshore demersal fishing, 2,310 (± 107 SE), again representing 15% of the target population of vessels. An estimated 18,971 (± 1,221 SE) days of offshore fishing were reported from these vessels. It is worth noting that 1,483 (± 87 SE) vessels were estimated, based on responses during the screening survey, to have been used for both game and offshore fishing.

Of the boats used for offshore reef fishing in the 12 months prior to the screening survey, 69% were reportedly used for offshore fishing on 10 or fewer days, 20% for 11–20 days, and the remaining 11% for offshore fishing for more than 21 days (Figure 5).

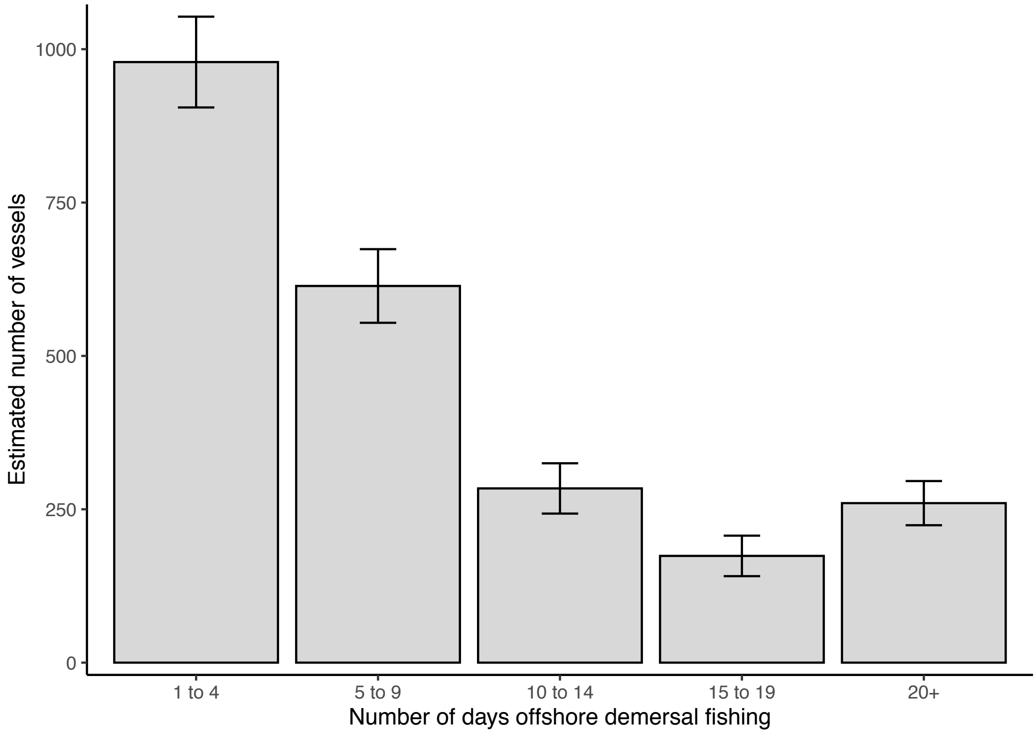

Figure 5. *Estimated number of days spent offshore demersal fishing by motorised recreational vessels greater than 4.5 m in Tasmania, expanded from the screening responses for the 12-months prior to 1 December 2018.*

3.3.1. Longitudinal telephone diary survey

Retention of participants throughout the 12-month longitudinal survey period was high, with 581 diarists or 97% of respondents who accepted the diary participating for the entire survey period. Of the 16 participants who withdrew, 11 (69%) sold their boat during the survey, one vessel sunk and the remaining four (25%) withdrew for a variety of reasons including health issues and a lack of interest in participating. Given the high completion 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, either as they sold the vessel during the survey or declined to participate for the full period, were excluded from all analyses.

3.3.2. Non-intending vessel survey

A total of 1,333 vessel owners indicated at screening that they did not intend to use their vessel for game or offshore fishing during the survey period. An attempt was made to contact all of the owners at the end of the longitudinal survey to confirm if this was the case. A total of 83% of owners were contacted with the remaining 17% not contacted as their number had become disconnected or they did not answer their telephone after 10 contact attempts. Of those contacted, 1,069 (96%) provided a full response to the non-intending vessel interview, with the remainder declining to participate (Figure 13). Respondents reported that 66 (6%) of the vessels had been sold during the survey period. Of the remainder 938 (94%) confirmed that they did not do any game fishing, and 968 (97%) confirmed they did not fish offshore. For the remainder, the effort and catch expansions for game fishing and offshore fishing were calibrated according to the description in the methods.

3.3.3. Game fishing

Information reported in this and following sections relates to diary survey data provided by fully responding vessel owners, and is presented as expanded estimates representative of the activities of all vessels participating in game or offshore fishing between 1 December 2018 and 31 December 2019.

It was estimated that 2,027 (± 383 SE) vessels participated in some form of game fishing in Tasmania during the survey period, representing 13% of the target population of vessels. This was slightly lower than the estimate based on the screening survey of 2,223 (± 106 SE) participating in game fishing in the 12 months prior to the survey period, although this difference was not significant at a 95% confidence level.

The estimated amount of effort during the survey period, reported as boat days game fishing, was 5,175 (± 407 SE) days, equating to an average of just under three days game fishing per vessel. This was significantly different to the estimate from the screening survey, as the amount of effort reported by respondents for the 12 months prior to the survey period was estimated at 16,932 (± 1,386 SE) days, or just under eight days per vessel. While it is possible the amount of game fishing days decreased over this period, it is highly likely that the screening-based estimate is strongly influenced by recall bias, which tends to result in significant over-estimates of fishing activity, especially when the recall period is greater than a few weeks. In contrast, during the diary phase of the survey, activity was either recorded in the diary shortly after it had occurred or, if not diarised, was collected by an interviewer generally within one-month of the activity.

3.3.4. Game fishing – Tuna species

3.3.4.1.Effort

Trolling for tuna was the dominant game fishing method reported in Tasmania during the survey period, with 93% of the vessels used for game fishing participating in troll fishing for tuna and occurring on 89% of reported game fishing boat days. Private vessels fished for tuna on an estimated 4,581 (± 383 SE) boat days around Tasmania during the 12-month survey period. Overall, 50% of troll fishing days resulted in at least one tuna caught, 32% of troll fishing days resulted in at least one SBT reported caught and 20% of troll fishing days resulted in at least one Albacore being caught. Skipjack were estimated to have been caught on about one per cent of troll fishing days during the survey period.

Tuna fishing was highly seasonal, with activity concentrated in the summer through to the early winter period, with a marked peak in effort during March and April (Figure 6). Relatively infrequent tuna fishing effort was reported between September and November. However, it is worth noting that three species of tuna are commonly available to game fishers in Tasmania – SBT, Albacore and Skipjack Tuna. The timing of the availability of these species varies throughout the year and in turn influences seasonal fishing effort (Tracey et al. 2013). Therefore, the seasonal pattern in tuna fishing effort presented here does not solely reflect the targeting of any one species.

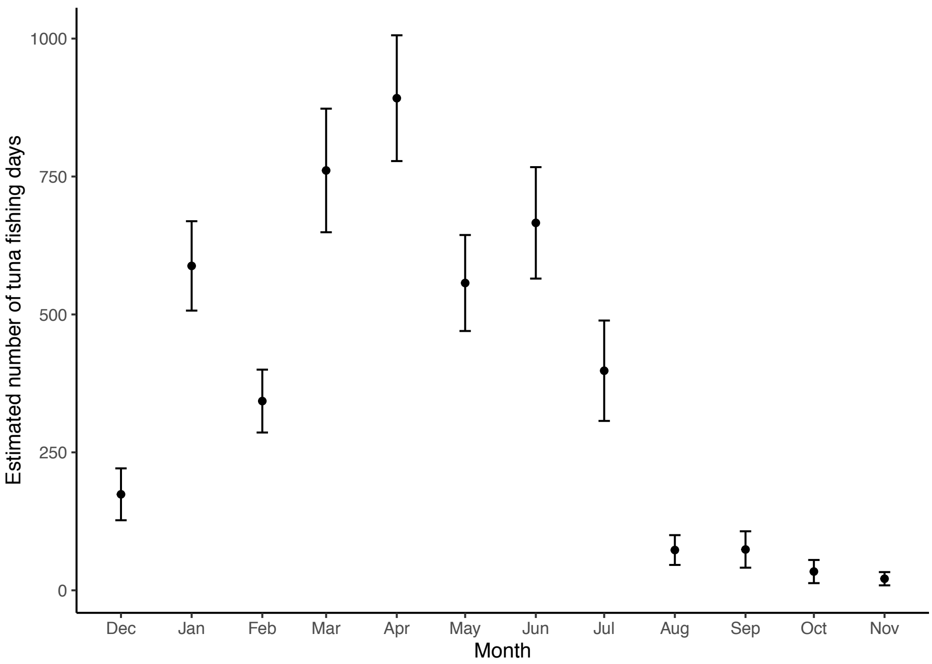

Figure 6. *Monthly estimates of the number of tuna fishing boat days (± SE) in Tasmania.*

Tuna fishing effort was heavily concentrated in the waters adjacent to the Tasman Peninsula in southeast Tasmania (Figure 7). The lower east coast, mid-east coast, south coast and Pedra Branca were also important areas for tuna fishing, with effort dropping away in the remote south west of Tasmania. There was limited fishing effort on the mid-west coast originating from Strahan, negligible effort on the north west coast, and no tuna fishing was reported on north or far-north east coastlines (Figure 7).

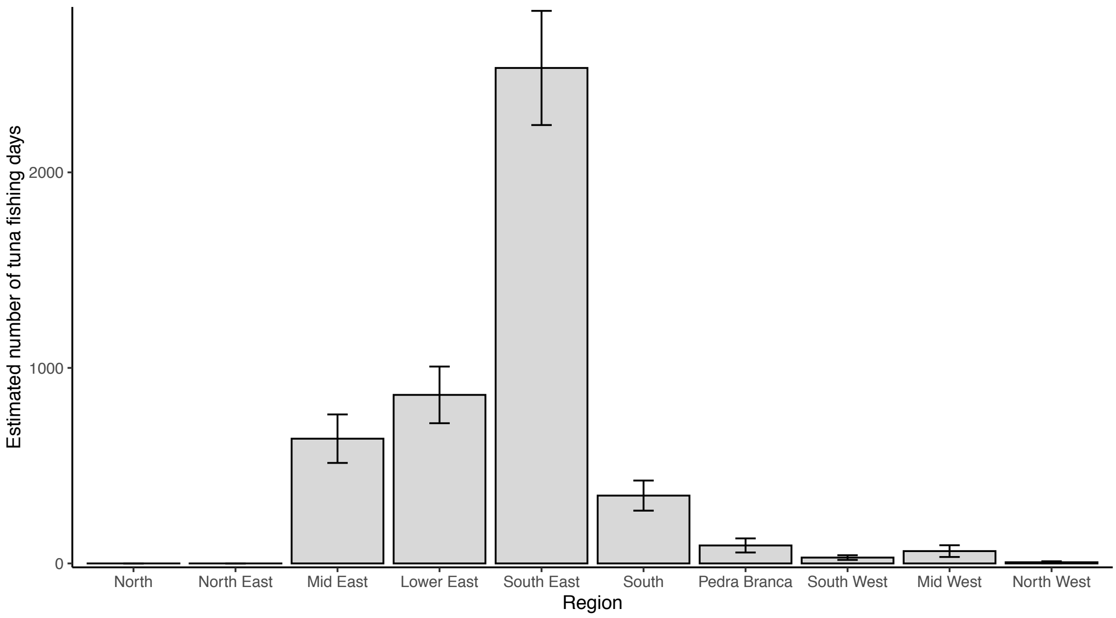

Figure 7. *Regional estimates of the number of tuna fishing boat days (± standard error) in Tasmania (see Figure 1 for locations).*

Vessels registered in the Hobart region accounted for 2,047 (± 244 SE) boat days of tuna fishing effort, with the Launceston and North East region of secondary importance, with vessels contributing a further

1,240 (± 199 SE) boat days. Effort linked to vessels registered in the South East and West & North West regions were similar in magnitude, at 626 (± 164 SE) and 648 (± 142 SE) boat days respectively. Interstate-owned vessels accounted for negligible tuna fishing effort (20 ± 17 SE boat days).

3.3.4.1.1. Catch

Albacore were the most commonly caught tuna species with 4,816 (± 857 SE) caught. They accounted for 60% of the estimated retained catch by number and the lowest release rate of all the species (22%) (Table 4). SBT were the second most common with 3,348 (± 469 SE) caught, accounting for 40% of the estimated retained catch by number and a release rate of 26% (Table 4). Very few Skipjack Tuna were taken in the survey year. However, for the few caught, the estimated release rate was very high (93%) (Table 4). Depredation was significant for SBT, with a further 1,111 (± 248 SE) attacked by seals during retrieval to the boat and not landed (Table 4). This is because the seal typically pulls the fish from the hook or occasionally the fishing line will break. Assuming each lost fish resulted in a mortality, these losses would have added a further 30% by number to the total removals of SBT from the population attributed to recreational fishing activity in Tasmania. Assuming the vast majority of these losses were school fish, then seal depredation is likely to have contributed an additional 16.8 t (± 3.8 SE) of fishery-related mortality. Depredation was negligible for Albacore and not reported for Skipjack Tuna.

Table 4. *Estimates of catch and release of tuna species (± standard error) from private recreational vessels in Tasmania, for the 12-month survey period. Numbers in bold indicate that the relative standard error for the estimate is greater than 0.30.*

Species	Total catch	Number retained	Weight retained (t)	Number released
Southern Bluefin Tuna	3,348 ± 469	2,479 ± 328	40.4 ± 5.4	869 ± 230
Albacore	4,816 ± 857	3,766 ± 696	Not calculated	1,050 ± 311
Skipjack Tuna	**184 ± 96**	**13 ± 9**	Not calculated	**171 ± 95**

There was distinct seasonality in the catch of all three tuna species reported. Albacore were most commonly caught in summer and autumn with peaks through January to March, catches then declined significantly in April, with a small peak in June. No Albacore catches were reported from July to the end of the survey in November 2019 (Figure 8). The few Skipjack tuna caught were reported in March 2019 (Figure 8). A small 'summer run' of SBT was reported through December 2018 to February 2019. Catches of SBT then peaked from March through June before declining through July and August, with very few caught for the rest of the survey period (Figure 8).

Depredation of hooked SBT by seals was experienced by fishers on the south east coast, lower east coast and Pedra Branca, with the highest relative predation rate (34%) around the Tasman Peninsula in the south east, followed by the lower east coast (14%) and Pedra Branca (12%). Depredation due to seals were also reported for Albacore but in much smaller numbers, estimated at 25 (± 16 SE) fish.

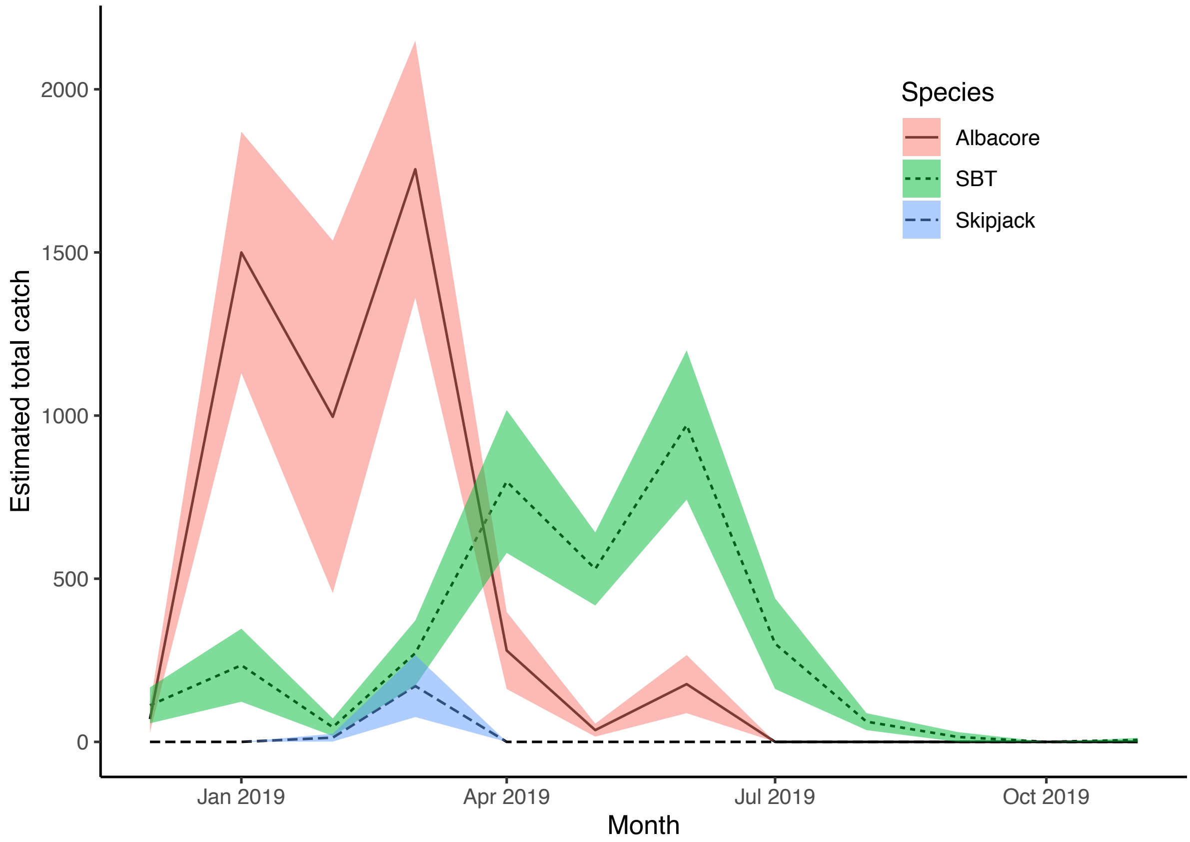

Figure 8. *Monthly total catch estimates (lines) for tuna species caught between December 2018 through November 2019. The coloured ribbons around the catch estimate lines indicated the standard error.*

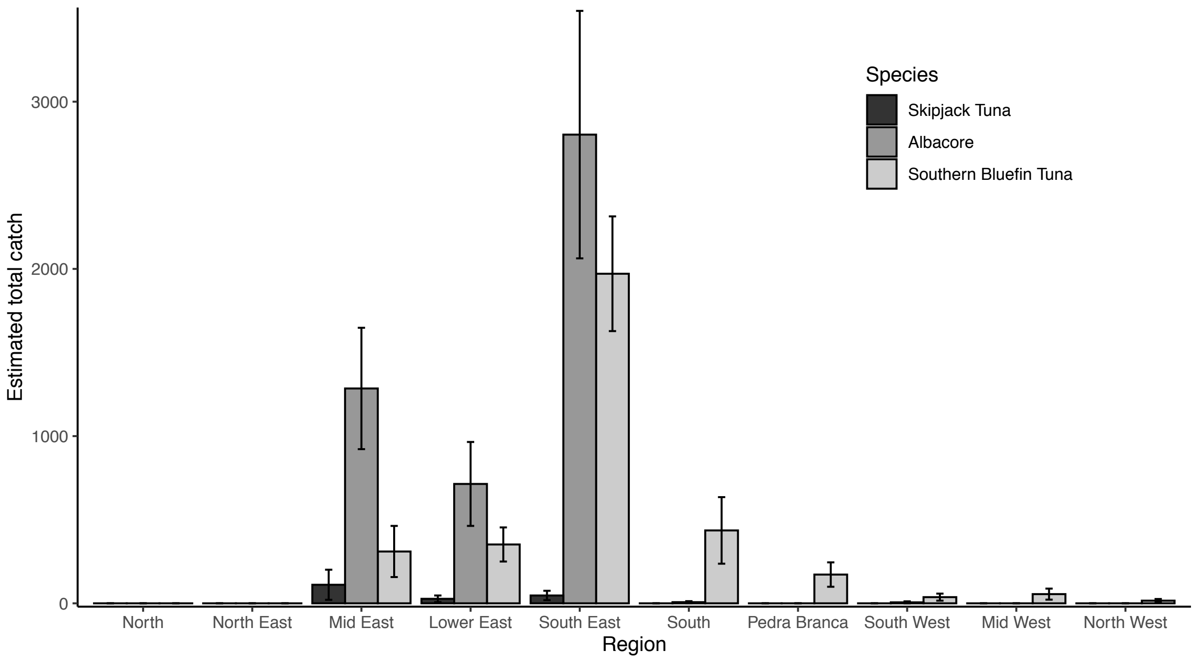

Figure 9. *Estimated total number of Southern Bluefin Tuna, Albacore and Skipjack Tuna caught from private recreational vessels within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

3.3.4.2. Reasons for release of tuna

Release rates varied between species, with 22% of Albacore, 26% of SBT and 93% of Skipjack Tuna caught being released. Based on expanded catch data, a total of 3% of all trips targeting tuna reached the SBT catch limit for the State (individual bag limit of two fish per person to a maximum boat limit of four SBT per day), with 8% of all trips where at least one SBT was caught reaching the catch limit. A similar response was reported for Albacore, with 2% of all tuna trips reaching the State bag limit (five fish per person per day). Of those trips where at least one Albacore was caught, 8% reached the catch limit. No fishers reported taking the State bag limit for Skipjack Tuna, which is 10 fish per person per day.

When respondents were asked what the reason was for releasing Skipjack Tuna, 57% said they were 'catch and release' fishing and 8% said the fish were too small. The 35% stating 'other reasons' explained they did not want the fish for consumption as it was not nice to eat (Figure 10).

The most commonly reported reason for release of Albacore was that they were 'too small' (45%), while 35% indicated that they had 'too many', 6% indicated they were 'catch and release' fishing and 14% provided another reason (Figure 10). The predominant 'other reason' was that they did not want to keep them and one fisher indicated the fish were 'too big'.

The main reason reported for releasing SBT was 'catch and release' fishing (57%), while 17% indicated they had 'too many' noting this is an indication of personal choice rather than a regulatory requirement. A total of 9% reported they released fish because they already had their catch limit, 2% indicated the fish were 'too small', while a further 2% indicated 'other reasons', which included 'tag and release' and the fish being 'too big'. No reason was provided for 13% of the SBT released (Figure 10).

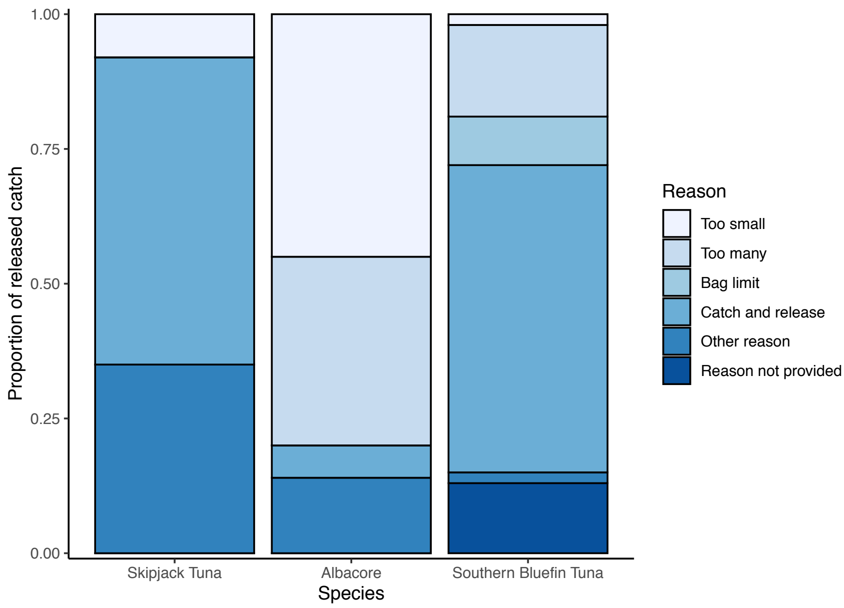

Figure 10. *Reason for release reported for the three main tuna species caught in Tasmania.*

3.3.5. Game fishing – Pelagic sharks

3.3.5.1.Effort

Fishing for pelagic shark constituted a relatively small proportion of all game fishing effort in Tasmania during the survey period, with 22% of the game fishing vessels reporting they participated in pelagic shark fishing. The activity occurred on 13% of all game fishing boat days, with private vessels fishing for pelagic sharks on an estimated 683 (± 92 SE) boat days around Tasmania during the 12-month survey period. Overall, 49% of pelagic shark fishing days resulted in at least one pelagic shark caught. Targeted effort for pelagic sharks was highest in the summer months, peaking in January (Figure 11). Effort declined dramatically in May and June, followed by a period of no reported effort from July through October (Figure 11).

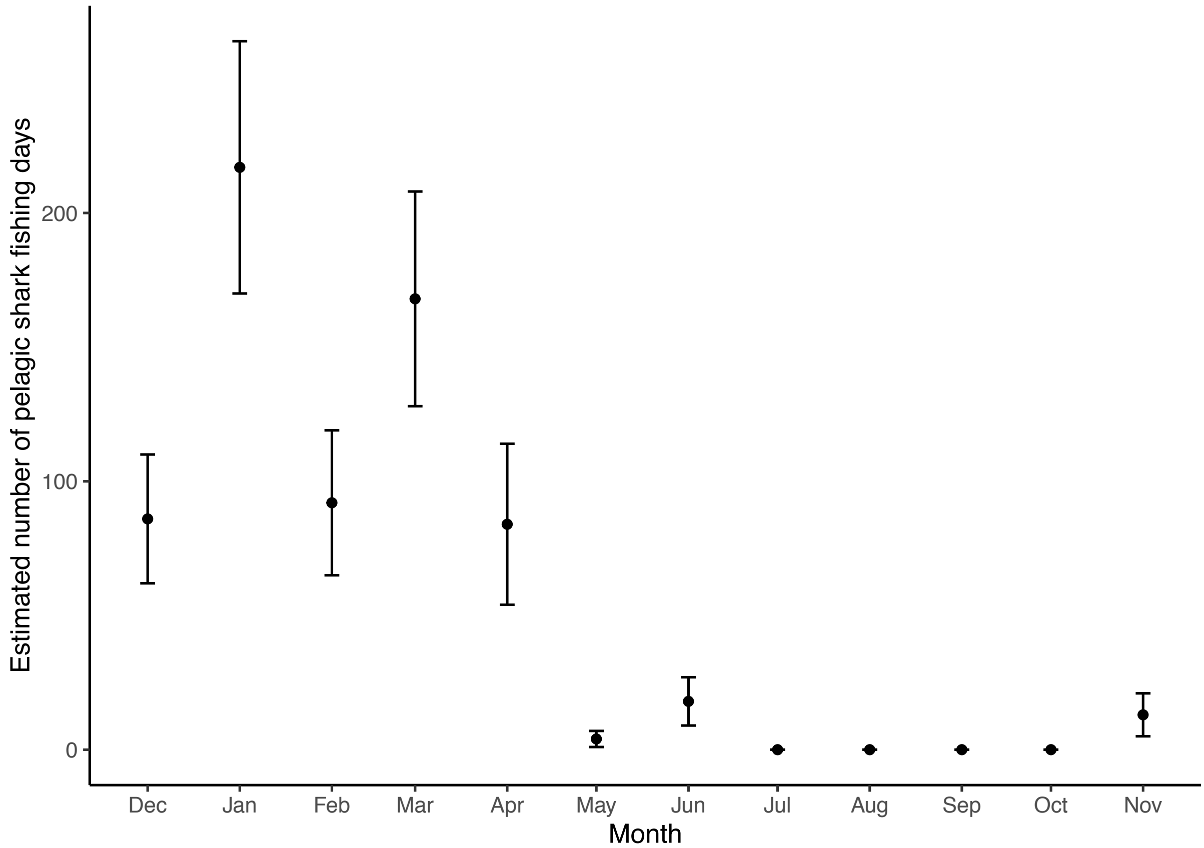

Figure 11. *Monthly estimates of the number of fishing boat days (± standard error) targeting pelagic sharks from private recreational vessels in Tasmania.*

The greatest amount of effort targeted at pelagic sharks was reported from the east coast, with a lesser degree of effort reported on the north coast and a small amount of effort reported in the south and north west (Figure 12).

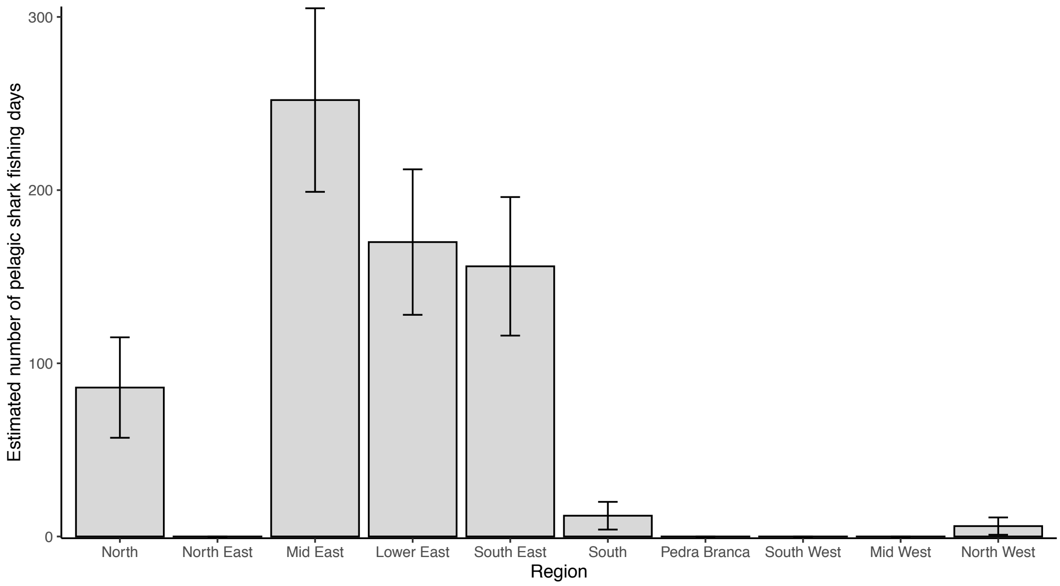

Figure 12. *Estimated total number of days fishing (SE) targeting pelagic sharks within each coastal region of Tasmania from private recreational vessels for the 12-month survey period (see Figure 1 map for locations).*

3.3.5.2. Catch

An estimated total of 455 (± 88 SE) Mako Shark were caught during the survey period, of which 243 (± 51 SE) were retained, indicating a release rate of 47% (Table 5). In addition, an estimated 43 (± 17 SE) Blue Shark were caught, with all released (Table 5).

Table 5. Estimates of catch of pelagic sharks (± standard error) from private recreational vessels in Tasmania, for the 12-month survey period. Numbers in bold indicate that the relative standard error for the estimate is greater than 0.30.

Species	Total caught	Number retained	Number released
Mako Shark	455 ± 88	243 ± 51	212 ± 53
Blue Shark	**43 ± 17**	0	**43 ± 17**

The catch of Mako Shark was highly seasonal and concentrated between December and April, with a marked peak in January and a secondary peak in March 2019. Catches outside of this period were small (Figure 13).

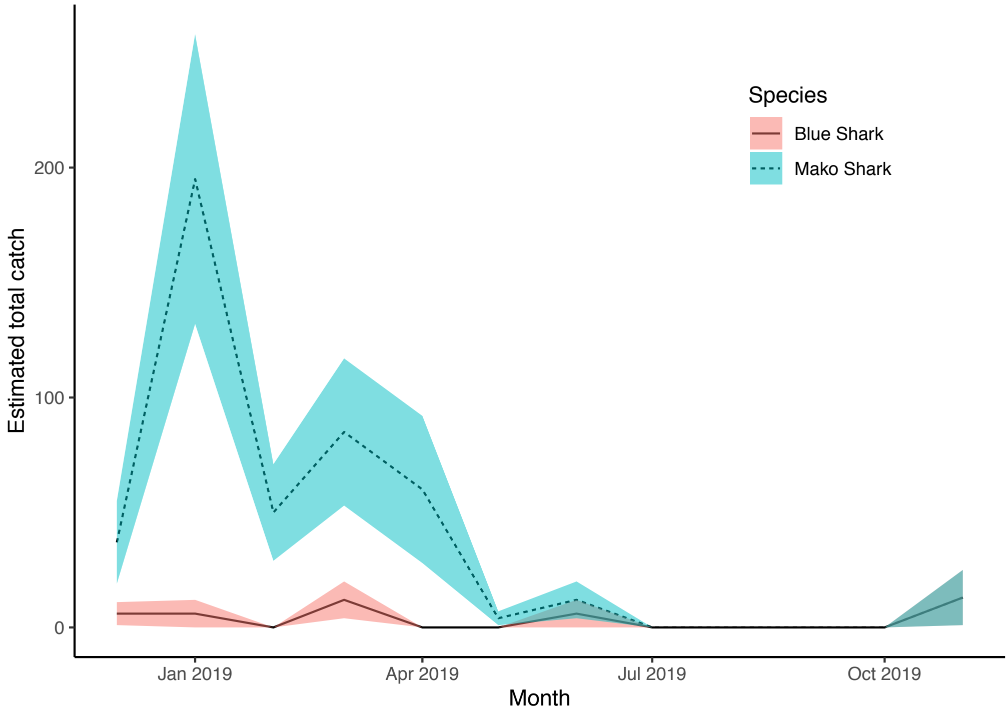

Figure 13. *Monthly total catch estimates (lines) for Mako and Blue Shark caught from private recreational vessels between December 2018 through November 2019. The coloured ribbons around the catch estimate lines indicated the standard error.*

Following a similar trend in the fishing effort for pelagic sharks, the vast majority of catch was reported on the east coast, particularly the mid-east coast which included the waters off St Helens. The north coast had the next greatest amount of catch, followed by small catches reported in the south and north west (Figure 14).

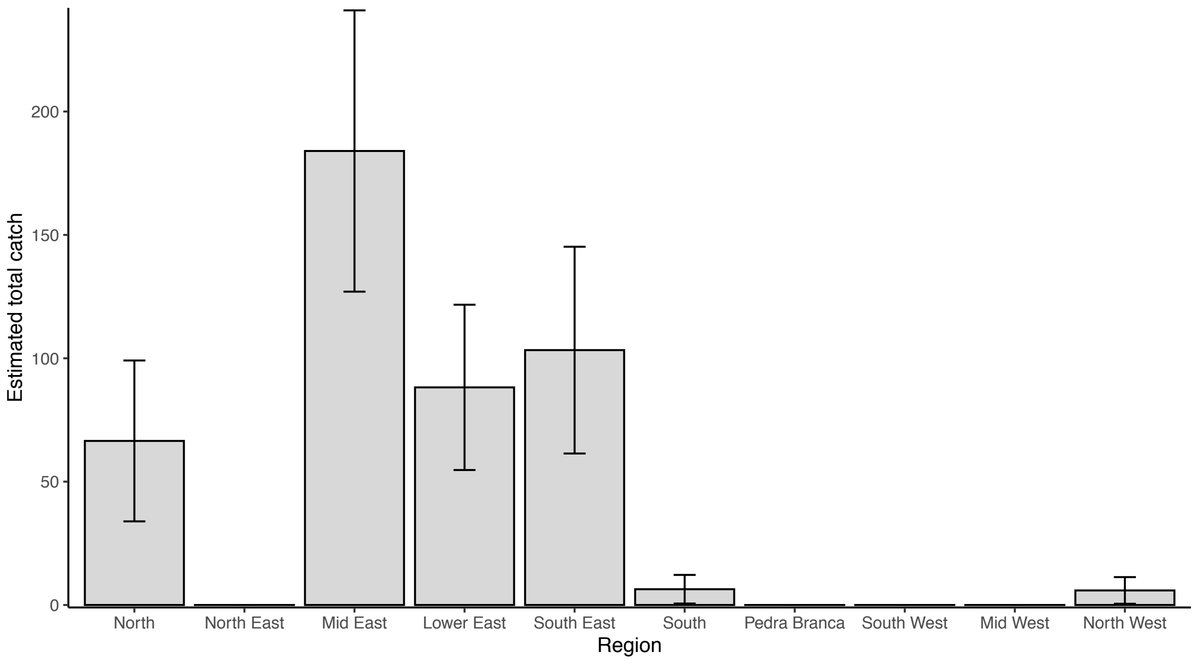

Figure 14*. Estimated total number (SE) of Mako Shark caught from private recreational vessels within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

3.3.5.1. Reasons for release of Pelagic Sharks

Mako Shark were the most commonly caught pelagic shark, with an estimated 47% released. Based on expanded catch data, a total of 5% of all trips targeting pelagic shark reported reaching the catch limit for the State (individual bag limit of one Mako Shark or Blue Shark per person to a maximum boat limit of two sharks per day), with 10% of all trips where at least one pelagic shark was caught reaching the catch limit.

The main reason provided by the respondents for release of Mako Shark were 'catch and release' fishing (72%), with 13% reporting the fish were released as they were 'too small' and 9% indicating they released the shark as keeping it would have meant they had 'too many'. For 4% of the released Mako Shark, respondents reported 'other reasons' for release, including that it was not the species they were targeting and one respondent indicating they did not want to bring the shark aboard due to risk of damage (Figure 15).

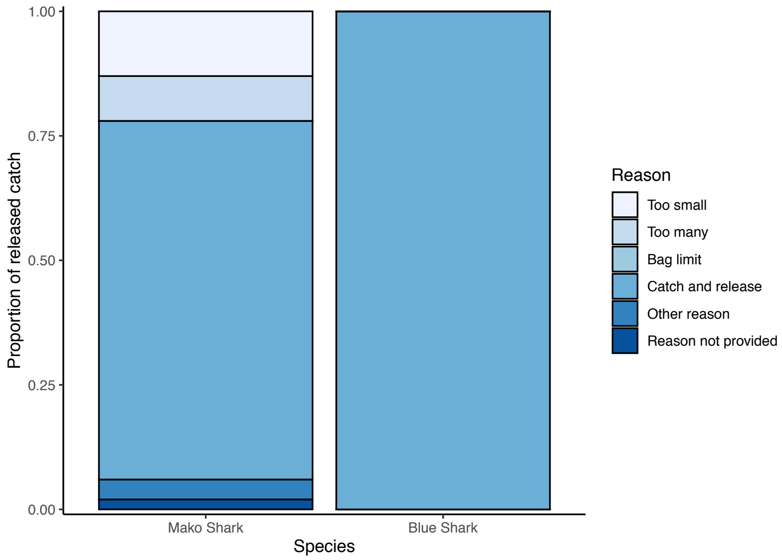

***Figure 15**. Reason for release reported for the two main pelagic sharks caught in Tasmania.*

3.3.6. Other game fish species

The only other species of game fish reported during the survey was Swordfish. An estimated 38 (± 30 SE) were caught and retained, with a further 6 (± 6 SE) released. Note that the rare nature of Swordfish catches reported means that the relative standard errors are high, indicating low confidence in reliability of these estimates.

3.3.7. Offshore demersal fishing

It was estimated that 1,635 (± 122 SE) vessels participated in some form of offshore demersal fishing during the survey period in Tasmania, representing 11% of the target population of vessels. This was significantly lower than the estimate based on the screening survey of 2,310 (± 106 SE) participating in offshore demersal fishing in the 12 months prior to the survey period.

The estimated amount of effort, reported as boat days offshore fishing, during the survey period was 3,360 (± 342 SE) days, equating to an average of just over two days per vessel that fished offshore for demersal species. This differed significantly from estimates in the screening survey, where the amount of effort reported by respondents for the 12 months prior to the survey period was estimated at 18,849 (± 1,221 SE) days, or just over eight days per vessel.

While it is possible the amount of offshore fishing days decreased over this period, it is highly likely that the result based on the screening response is strongly influenced by recall bias, as the respondents had to recall their activity over a 12-month period. This is compared to the diary phase of the survey, where the average recall period would be approximately one month, depending on the rate of contact by the interviewer.

3.3.8. Mid-depth offshore reef fishing

3.3.8.1.Effort

Private vessels fished mid-depth reefs on an estimated 2,428 (± 251 SE) boat days around Tasmania during the 12-month survey period. While fishing at mid-depth reefs for species such as Striped Trumpeter and Jackass Morwong occurred in all months of the year, there was a seasonal trend with activity concentrated in the summer through to the early winter period, and a marked peak in effort during January (Figure 16).

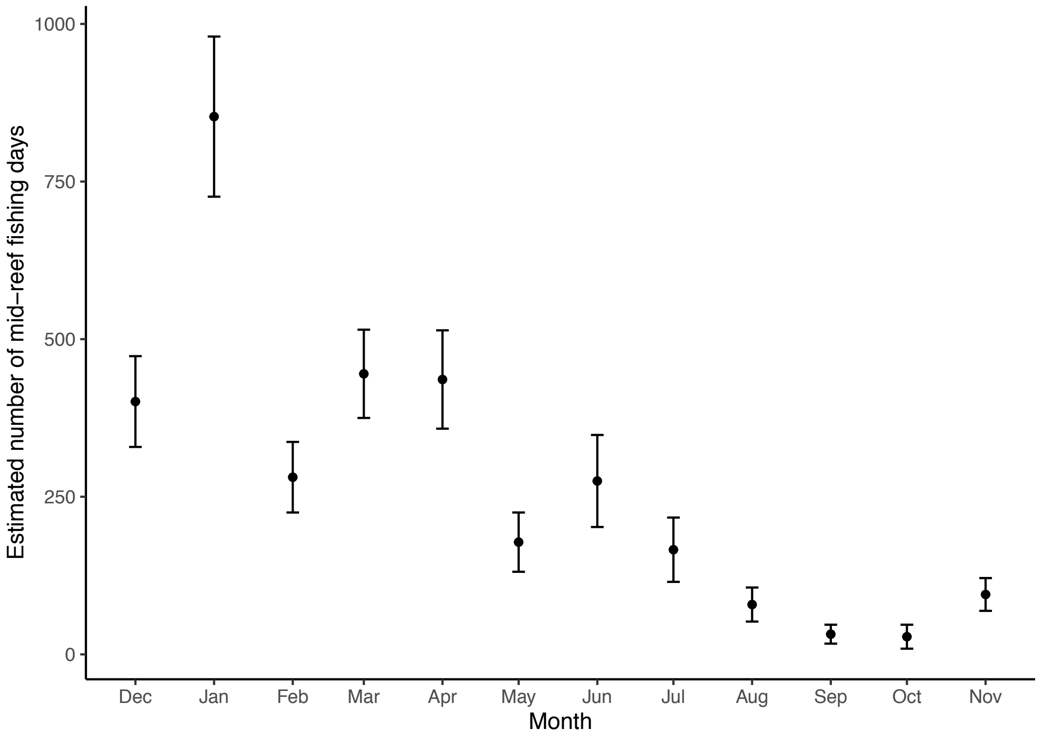

Figure 16. *Monthly estimates of the number of fishing boat days (± standard error) targeting mid-depth reef species in Tasmania.*

The estimated number of fishing days targeting mid-depth reefs was greatest along the east coast, with the estimated number of days increasing moving north to south. The south coast and Pedra Branca were also important regions for mid-depth reef fishing, while lower levels of effort were reported in the north east and along the west coast (Figure 17).

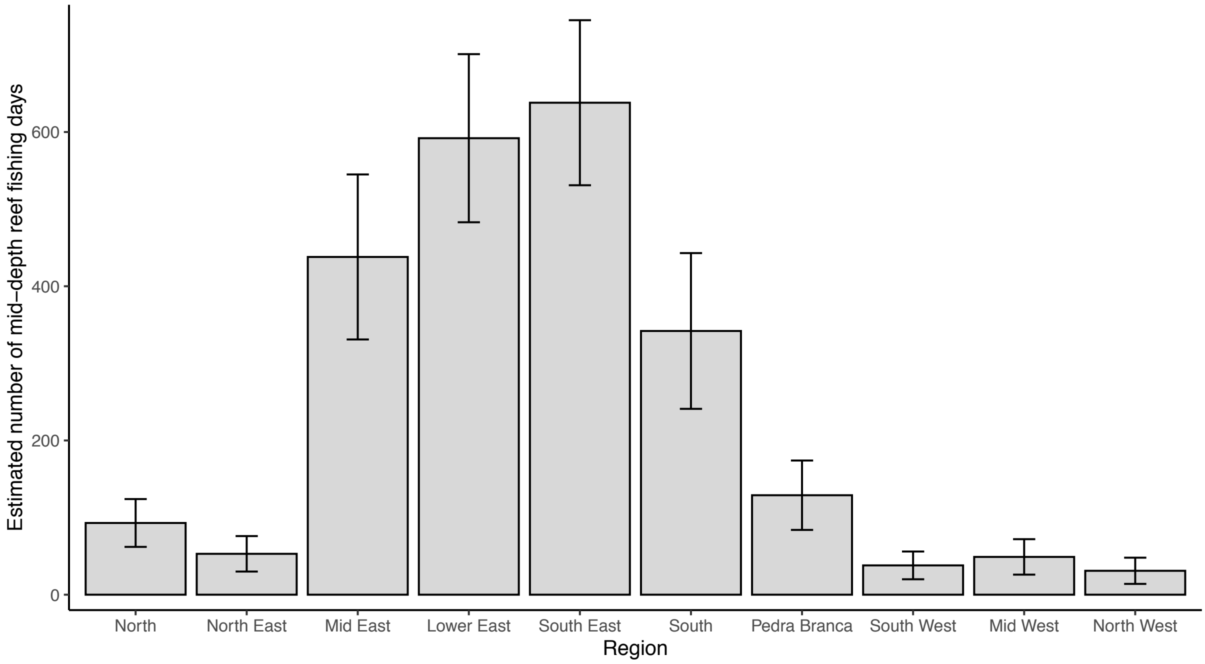

Figure 17. *Estimated total number of days fishing targeting mid-depth reefs within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

3.3.8.2.Catch

The mid-depth reef category is focused on the fishery for Striped Trumpeter as well as other species caught in this depth and habitat, including Jackass Morwong and Ocean Perch. An estimated 3,462 (± 486 SE) Striped Trumpeter were caught and retained, equating to 18.1 (± 2.5 SE) tonnes, based on an average weight of 5.23 kilograms per fish. A further 691 (± 186 SE) Striped Trumpeter were estimated to have been caught and released, resulting in a release rate of 17% (Table 6).

An estimated 2,804 (± 793 SE) Jackass Morwong were reported caught and retained on mid-depth reef fishing trips, with a further 1,438 (± 598 SE) released, resulting in a release rate of 34% (Table 6). Ocean Perch (often confused with Gurnard – and as such both species are reported together) is a common bycatch when targeting Striped Trumpeter, with an estimated 19,934 (± 3,242 SE) estimated caught of which 66% were released (Table 6).

Depredation of all three species by seals was reported. The highest rate was for Striped Trumpeter, estimated to be 291 (± 120 SE) individuals, equating to approximately 5% of all known fishing induced mortality (harvest + depredation). A far smaller number and subsequently proportion of Jackass Morwong and Ocean Perch/Gurnard were reportedly depredated by seals, estimated at 114 (± 86 SE) and 48 (± 44 SE) individuals respectively.

Table 6. *Estimates of catch and release (± standard error) of mid-depth reef associated species from private recreational vessels in Tasmania, for the 12-month survey period. Numbers in bold indicate that the relative standard error for the estimate is greater than 0.30.*

Species	Total caught	Number retained	Weight retained (t)	Number released
Striped Trumpeter	4,153 ± 599	3,462 ± 486	18.1 ± 2.5	691 ± 186
Jackass Morwong	4,242 ± 1,106	2,804 ± 793	Not calculated	1,438 ± 598
Ocean Perch/Gurnard	19,934 ± 3,242	6,728 ± 1,660	Not calculated	13,206 ± 2,330

Catches of Striped Trumpeter were highest in December 2018 and then followed a general declining trend for the year, with the exception of spikes in March, August and November 2019 (Figure 18). The peak either side of September and October may be related to the spawning season closure for Striped Trumpeter in Tasmania, although this is not evident in concurrent peaks in effort. Catches of Jackass Morwong fluctuated throughout the year, with peaks in January, March, June, July and August (Figure 18).

The greatest catches of Striped Trumpeter were reported from the east coast, particularly the Lower East and Mid-East regions and to a lesser extent the South East and North East regions (Figure 19). The south coast and Pedra Branca were also important for catches of Striped Trumpeter, with catches also reported from the west coast but in far smaller numbers (Figure 19).

The greatest catches of Jackass Morwong also occurred on the east coast but, in contrast to Striped Trumpeter, many more fish were caught in the South East region and secondly the lower east region than the mid-east region (Figure 19). Catches of Jackass Morwong were also reported from the north east and small catches from the south, Pedra Branca and the north coast region (Figure 19).

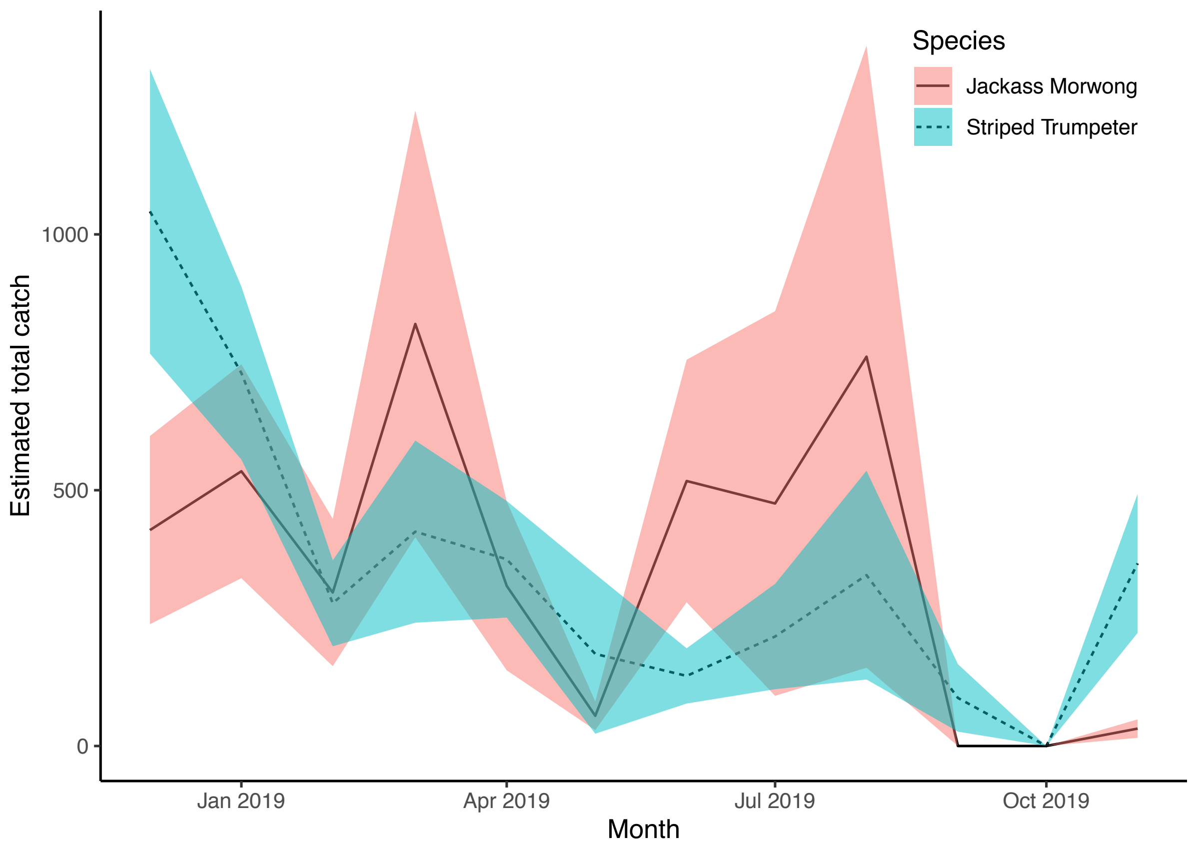

Figure 18. *Monthly catch estimates (lines) for Striped Trumpeter and Jackass Morwong caught from private recreational vessels between December 2018 through November 2019. The coloured ribbons around the catch estimate lines indicated the standard error.*

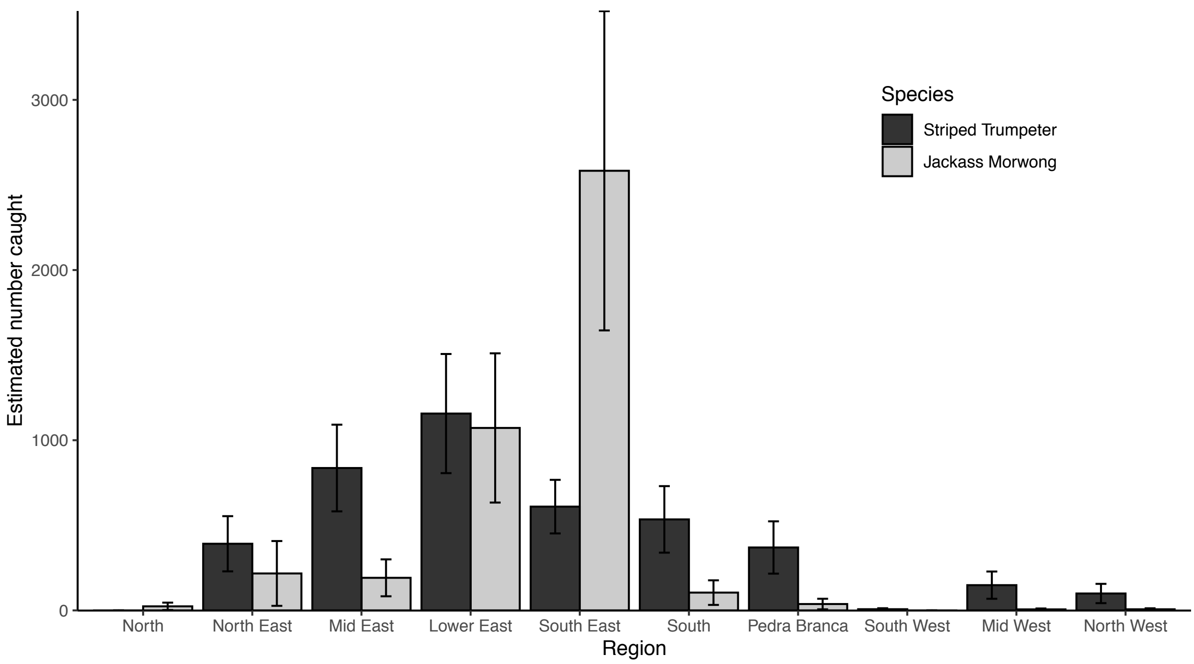

Figure 19. *Estimated total catch of key mid-depth reef associated species from private recreational vessels within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

3.3.8.1. Reasons for release of mid-depth reef associated species

An estimated 17% of Striped Trumpeter that were caught were released, the most common reason reported being that the fish were 'under size' (53%), followed by 'too small' (29%). A further 5% were released as it was reported that they had 'too many'. While no respondents indicated that they had caught the bag limit, it was revealed based on expanded data that 3% of all mid-depth reef fishing trips reached the daily catch limit (of a four fish bag limit to a maximum boat limit of 20 fish), and that for trips where at least one Striped Trumpeter was caught, 7% reached the catch limit. A further 9% reported 'other reasons', including 'surplus to requirements' and 'too big for their needs' (Figure 20).

An estimated 34% of Jackass Morwong were released, with the most common reason reported as the fish being 'under size' (56%), and a further 9% being 'too small'. An additional 15% were reported released as the respondents had 'too many'. Again, the catch limit was not mentioned as a reason for release, but an analysis of expanded catch data indicated that 1% of all mid-depth reef fishing trips reached the daily catch limit (bag limit of 10 fish). A further 20% were reported released due to 'other reasons', which was dominated by a 'don't eat them' response (Figure 20).

Ocean Perch/Gurnard had the highest release rate of the mid-depth reef associated species, reported at 66%. The most common reason for release was cited as 'other reason', which was again dominated by a 'don't eat them' response. The next most common reason was 'too small' (30%), followed by 15% for 'too many', and 1% indicating 'catch and release' fishing. A further 5% provided no reason for release (Figure 20).

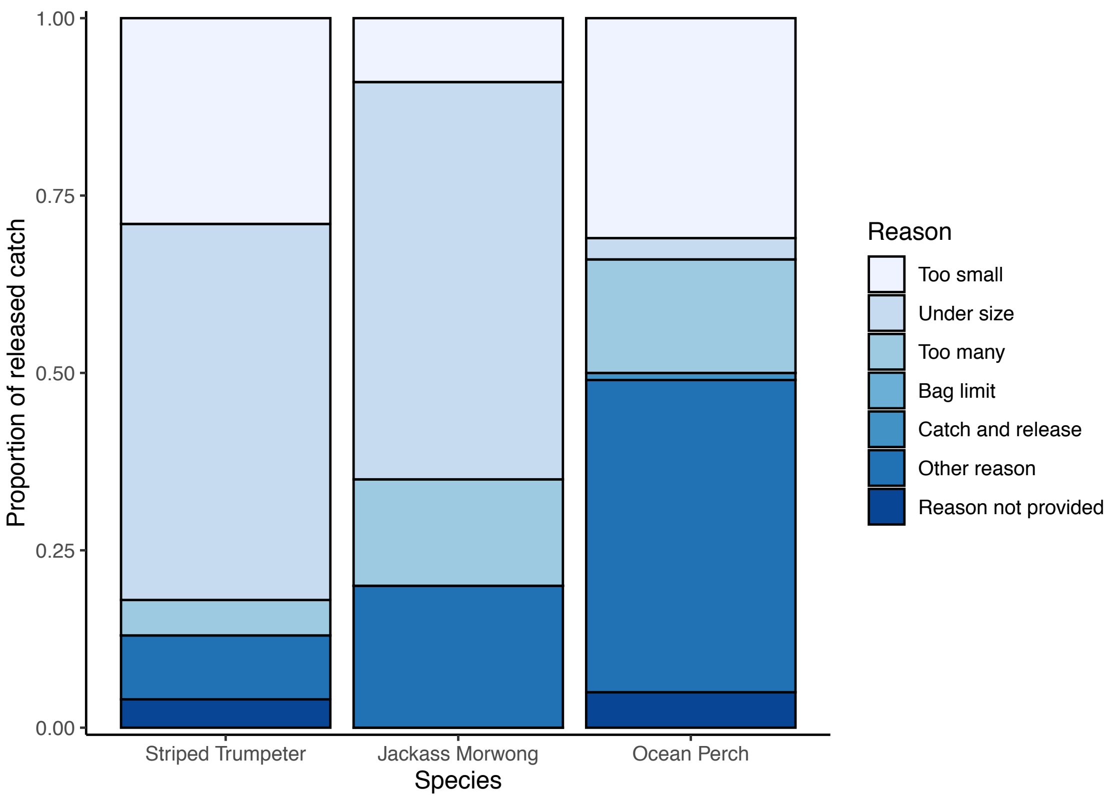

Figure 20. *Reason for release reported for three key mid-depth reef associated species caught in Tasmania.*

3.3.9. Deep offshore bottom fishing

3.3.9.1.Effort

Private vessels fished deep-water shelfedge associated trips on an estimated 1,092 (± 189 SE) boat days around Tasmania during the 12-month survey period. Deep water fishing trips were most common during summer and autumn months, with a marked peak in January (Figure 21). Fishing effort decreased markedly in winter, with no trips reported in August but a small increase in trips from September to the end of the survey in November (Figure 21). The vast majority of deep water fishing occurred on the east coast with no significant difference between the Mid-East, Lower East and South East regions A small amount of effort was also reported from the south coast region (Figure 22).

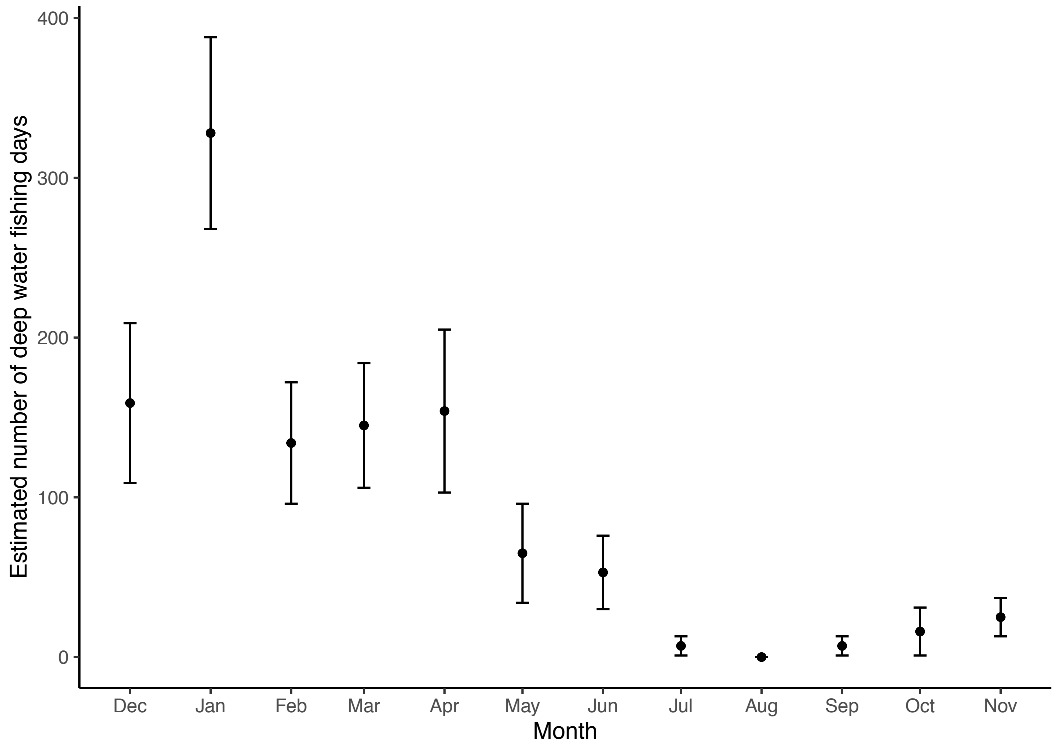

Figure 21. *Monthly estimates of the number of fishing boat days (± standard error) targeting deep-water shelf edge associated species from private recreational vessels in Tasmania.*

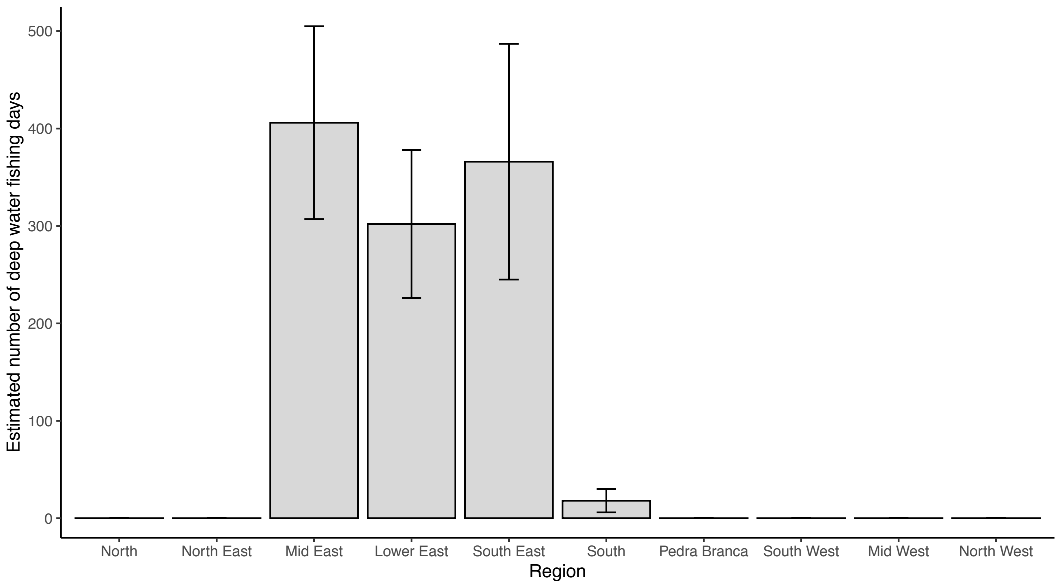

Figure 22. *Estimated total number of days (± SE) fishing targeting deep water shelf-edge associated species from private recreational vessels within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

3.3.9.1. Catch

The deep-water shelf-edge category is focused on collecting information on species such as Blue-eye Trevalla, Gemfish, Blue Grenadier and Pink Ling. As these fish are caught in deep water they do not generally survive after capture, so there are no estimates of released fish. Based on expanded data, a total of 4% of all deep-water fishing trips, and 7% of all deep-water fishing trips where at least one Blue-eye Trevalla was caught, reached the catch limit of five fish per person per day up to a boat limit of 25 fish per boat per day.

Blue-eye Trevalla was the most commonly caught species with an estimated 2,519 (±573 SE) landed, followed by Gemfish 1,534 (±493 SE), Blue Grenadier 955 (402 SE) and Pink Ling 338 (±150 SE) (Table 7). All four species were most commonly caught in summer months, with lower catches in autumn and low catches during winter and spring (Figure 23). The greatest catch of Blue-eye Trevalla was reported from the mid-east coast region, which also produced good catches of Gemfish but low catches of Blue Grenadier and Pink Ling (Figure 24). Conversely, the South East region had a higher proportion of Blue Grenadier and Gemfish reported in catches (Figure 24).

An estimated 72 (± 60 SE) Blue-eye Trevalla and 31 (± 28 SE) Gemfish were depredated, with the majority taken by orcas and a small fraction by seals (Table 7).

Table 7. *Estimates of catch (± standard error) of deep-water shelf-edge associated species from private recreational vessels in Tasmania, for the 12-month survey period. Numbers in bold indicate that the relative standard error for the estimate is greater than 0.30.*

Species	Total caught
Trevalla	2,519 ± 573
Gemfish	**1,534 ± 493**
Blue Grenadier	**955 ± 402**
Pink Ling	**338 ± 150**

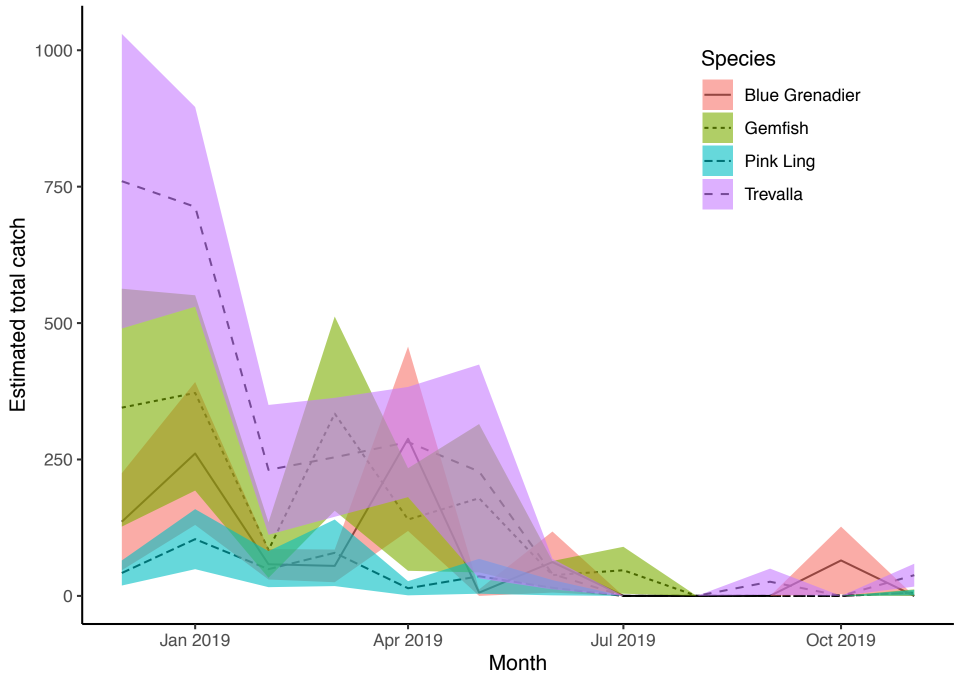

Figure 23. *Monthly total catch estimates (lines) for Blue-eye Trevalla, Gemfish, Blue Grenadier and Pink Ling caught from private recreational vessels between December 2018 through November 2019 in Tasmania. The coloured ribbons around the catch estimate lines indicated the standard error.*

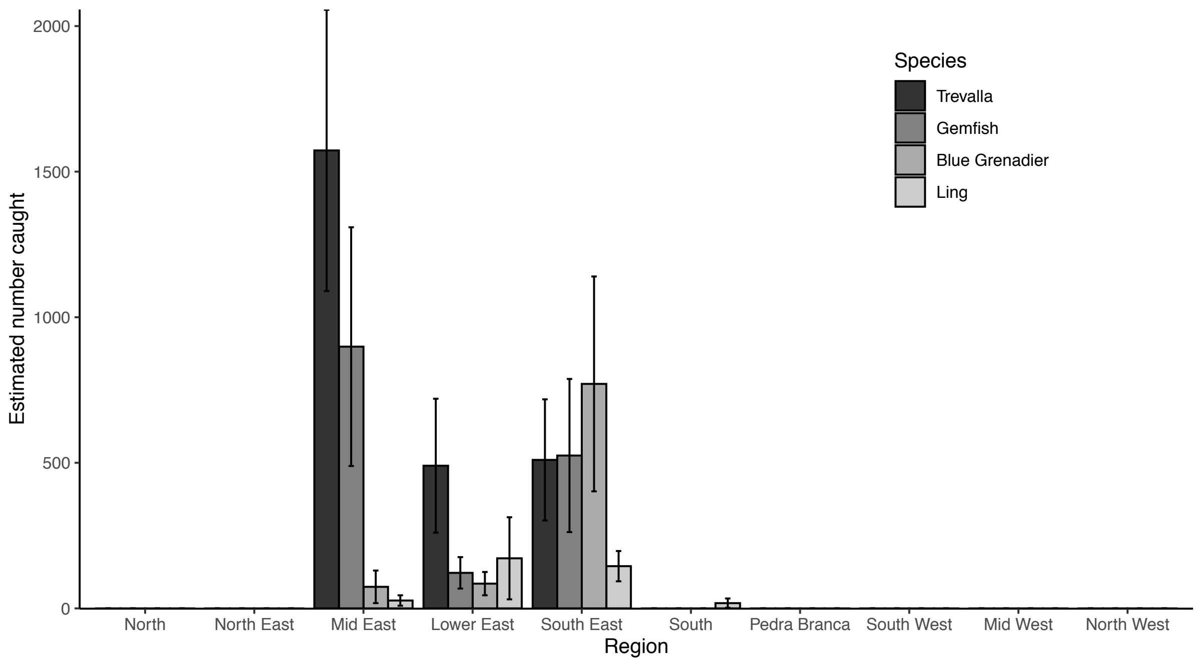

Figure 24. *Estimated total catch of key deep-water shelf-edge associated species from private recreational vessels within each coastal region of Tasmania for the 12-month survey period (see Figure 1 map for locations).*

4. Offshore Charter Boat Fishing

4.1. Introduction

Charter boats offer a fee-for-service operation for recreational fishers to access fisheries they may not be able to access otherwise. The service provides fit-for-purpose vessels and experienced operators, generally with a good knowledge of the species they are targeting. Vessel charter for game fishing trips is common in all States of Australia as larger vessels are required to venture offshore, and more expensive fishing equipment suitable to catch large fish and skipper and crew experience are important components of a successful and safe fishing trip. Charter vessels are an important component of both the Tasmanian game and offshore recreational fisheries.

4.2. Methods

4.2.1. Voluntary charter boat logbook

Tasmania does not have a mandatory charter logbook program across the sector. However, five operators are required to complete mandatory logbooks as a condition of a permit from the Department of Primary Industries, Parks, Water and Environment (DPIPWE), which allows them to take more SBT than the boat limit stipulated in the recreational fishing regulations. Other operators providing game or offshore fishing charters were initially identified through an internet search, and by asking identified operators if they knew of other operators in their region.

All operators identified were invited to complete a voluntary charter boat logbook reporting their game fishing and offshore fishing activities. Data to be recorded in the logbook included date and time of departure, time of return, location of departure, number of clients, primary fishing location, total number of fishing lines used, total fishing time, species targeted, total number of key species kept, fork length of key species kept, total number of key species released, and number of fish impacted by wildlife depredation interactions (seals, orcas or sharks predating on catch).

Since only a small proportion of SBT caught were measured by charter operators, the average length converted weight of school fish recorded by the creel clerk was used to estimate the weights of retained and depredated fish within this size class. It is assumed all large SBT captured were flagged by the charter operators, with all but one large fish weighed-in. This single exception was assigned the average weight of the other large fish reported.

Harvest weight conversion where reported for other species was conducted according to the methods for private vessels, reported in *Methods* (Section 3.2.3).

4.3. Results

4.3.1. Effort

Sixteen charter boat operators were identified as likely to provide game or offshore fishing trips in Tasmania. Of these, nine reported game and/or offshore fishing trips. Four of the remaining operators confirmed they did not do any charters where the target species were caught during the survey period, while one operator, who declined to participate in the logbook program, confirmed at the end of the season that he had done two trips targeting SBT during the survey period. As the catch on these trips was unknown, Tasmania's boat limit of four fish was assigned to each trip. Catch of other offshore species was not confirmed, but anecdotally believed to be minimal. A further two operators declined to participate in the logbook program and no information was obtained from them directly. However, anecdotally, it is highly unlikely they conducted many, if any, charters for SBT or other target species. Therefore, any uncertainty surrounding the overall charter boat catch estimate is considered minimal.

A total of 302 individual charter trips were reported from the nine operators who reported game or offshore fishing. Trolling for tuna was the most common form of fishing conducted on charters, and was reported to occur on 240 or almost 80% of charter trips (Table 8). This was a slight decrease on the 250 trolling trips reported in the 2011/12 survey (Tracey et al. 2013).

Trips targeting reef-associated species such as Striped Trumpeter and Jackass Morwong were the second most common activity. This was conducted on 85 or almost 30% of trips, noting that multiple fishing types can occur on a day of charter (Table 8). Game fishing for pelagic shark and deep-water shelf-edge associated species were less common, at 24 and 13 trips respectively (Table 8).

Table 8. *The number of charter fishing days that the target modes of fishing activity occurred during the 12-month survey period as reported in charter boat logbooks.*

Fishing category	Days fished
Game fishing – trolling	240
Game fishing – pelagic shark	24
Offshore mid-depth reef	85
Offshore deep	13

4.3.2. Catch

A total of 859 SBT were reported caught by the charter boat sector, which was approximately 21% fewer than in 2011/12 (Tracey et al. 2013). A total of 505 SBT were reported retained, resulting in a harvest weight of 7.97 t (± 0.3 SE). A further 354 were released, equating to a release rate of 41% (Table 9). The vast majority of retained SBT were school fish, with only four large fish reported.

Only four Skipjack Tuna were reported caught, all of which were retained. This low number coincides with the low catches of this species taken by private vessels in the survey period. Albacore was the most commonly caught species, with 867 reported retained and 32 reported released, resulting in a release rate of 4% (Table 9).

A total of 23 Mako Shark were reported retained and seven released, resulting in a release rate of 23%. No Blue Shark were reported caught during the survey period. One Swordfish was reported caught and released (Table 9).

A total of 153 Striped Trumpeter, equating to 0.8 t were reported caught and retained and 60 released, resulting in a release rate of 28%. Jackass Morwong and Ocean Perch/Gurnard were also reported, although their numbers are potentially under-reported, particularly for Ocean Perch/Gurnard. The reason for this under-reporting was that operators were asked to focus particularly on the key species for each fishing mode, in this case Striped Trumpeter. A total of 765 Jackass Morwong were reported retained with a further 233 released, resulting in a release rate of 23%. Only 220 Ocean Perch/Gurnard were reported caught in total, with 28% reportedly released (Table 9).

The most commonly caught species on the few offshore deep-water charters reported was Gemfish, followed by Blue-eye Trevalla, Blue Grenadier and Pink Ling (Table 9).

Table 9. *The total number of fish reported caught by species during the 12-month survey period as reported in charter boat logbooks.*

Fishing mode	Species	Total caught	Number retained	Number released	Release rate
Game fishing	Southern Bluefin Tuna	859	505	354	41
	Albacore	899	867	32	4
	Skipjack Tuna	4	4	0	0
	Mako shark	30	23	7	23
	Blue shark	0			0
	Swordfish	1			100
Offshore mid-reef	Striped Trumpeter	213	153	60	28
	Jackass Morwong	998	765	233	23
	Ocean Perch/Gurnard	220	172	48	28
Offshore deep	Blue-eye Trevalla	28	28	0	0
	Pink Ling	3	3	0	0
	Gemfish	45	45	0	0
	Blue Grenadier	23	23	0	0

4.4. Attitudinal survey

4.4.1. Introduction

The wash-up survey was intended to explore the experiences and perspectives of fishers in relation to the recreational SBT fishery in Tasmania, including trends in the availability of SBT, recreational fishing effort and overall fishery quality.

4.4.2. Method

The wash-up survey was conducted by telephone as a structured questionnaire, between January and February 2020. Respondents who had completed the phone-diary survey and had fished for SBT during the survey period were deemed eligible for inclusion in the wash-up survey. Since a probability-based sample design was applied to the initial selection of respondents, and assuming no major non-response bias effects, respondents eligible for inclusion in the wash-up survey are likely to be representative of the game fishing population in Tasmania.

4.4.3. Results

Of 141 potential respondents identified through the recruitment process, 131 (93%) were contacted. The remaining 7% could not be contacted, either due to a non-valid phone number or no answer despite multiple call attempts. Of those contacted, 126 (96%) fully responded to the questionnaire and a further 2 (2%) partially completed the survey. In the latter case, responses to answered questions have been included in the analyses. Overall survey non-response was low (2%).

4.4.3.1. Respondent profiling

The vast majority of respondents indicated that they had exclusively fished for SBT in Tasmania, with a very small fraction indicating that they had also fished for SBT in either New South Wales, Victoria or South Australia. Approximately 45% of respondents indicated that they had less than 10 years of experience in the fishery, but there was also a reasonably high proportion that indicated they had more than 20 years of experience in the Tasmanian fishery (29%) (Figure 25).

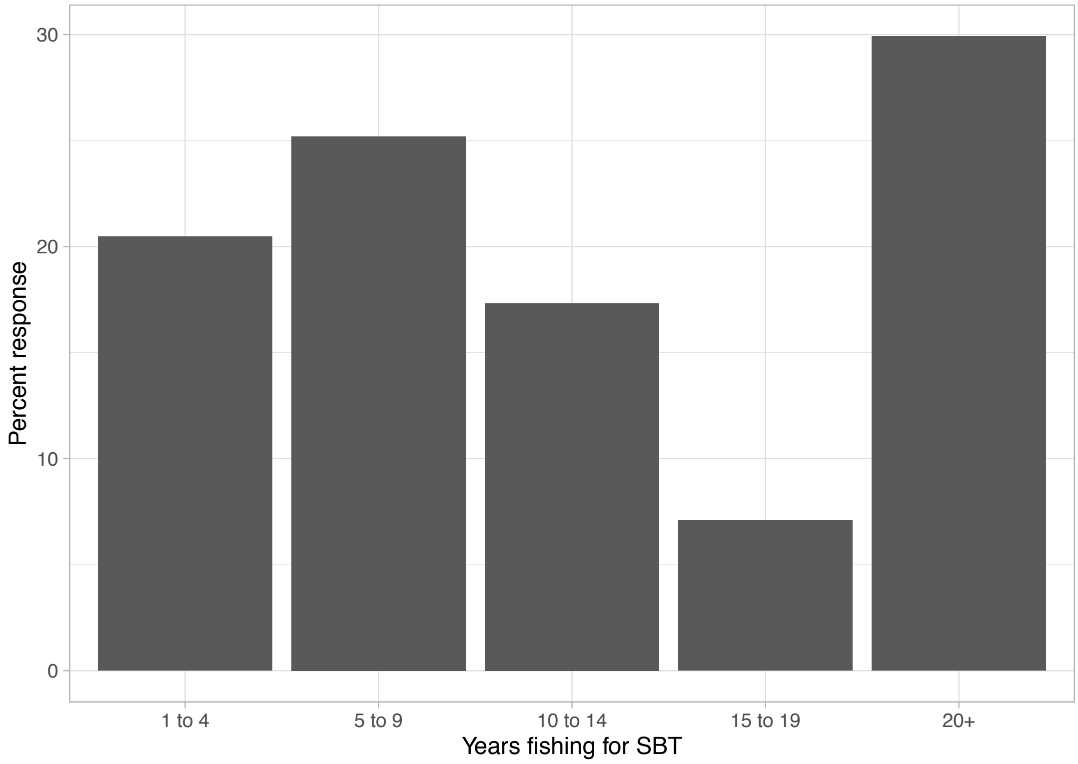

Figure 25. *Experience fishing (years) for SBT as reported by survey respondents (n = 127).*

Respondents who had fished for SBT in two or more years were asked to estimate the number of days they usually fished for SBT per year, the number of days fished during the survey period and whether they considered that they had fished more, less or about the same during 2018/19 compared with previous years. A comparison between 'usual' or average days fished for SBT and days fished during 2018/19 suggests that overall the fishing effort expended by respondents was lower than average during 2018/19 (Figure 26A). At an individual level, the vast majority of respondents reported fishing less or about the same number of days for SBT during 2018/19 compared to what they had usually done in the past. Comparatively few respondent (6%) reported fishing more than usual during the survey year (Figure 26B).

Work commitments, weather and time availability were the most commonly cited reasons for fishing less. The availability or lack of SBT did not emerge as an important factor (Figure 26).

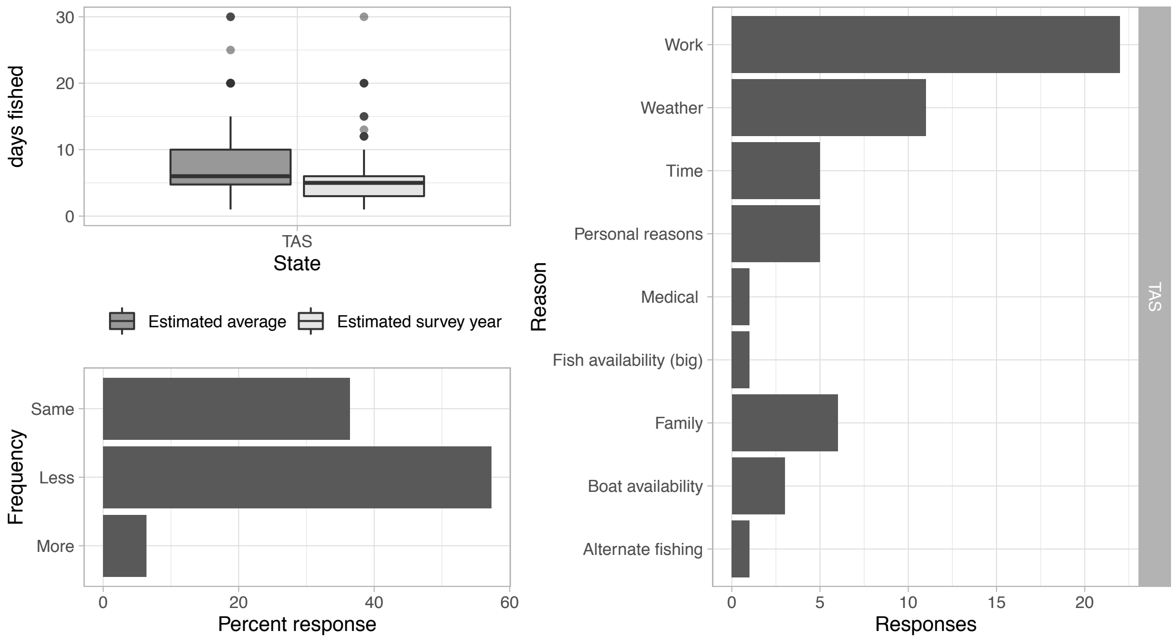

Figure 26. *(A – top left) Comparison of usual (average) days fished per year and days fished for SBT during the 2018/19 survey period (median indicated by bold horizontal line) – Y-axis truncated to a maximum of 30 days to aid visualisation; (B – bottom left) Responses to comparison of fishing effort in survey year relative to previous years; (C – right side) Main reasons given for fishing less in survey year.*

4.4.4. Trends in fishing effort, fish availability and fishery quality

The wash-up survey also canvassed perceptions relating to trends in recreational fishing effort and SBT availability relevant to the respondent's experience fishing for SBT. Overall, it was the perception of the majority of respondents that fishing effort for SBT had increased over time, with more than 70% of respondents reporting a general increase in effort (Figure 27A). Relatively few respondents (< 10%) indicated a belief that recreational effort had declined over time.

Changes in recreational fleet capability, attributed to an increase in the number of vessels suitable for offshore fishing, was suggested as a major contributor to the general increase in effort. Fish availability, social media and 'popularity' were also identified as factors influencing the growth in effort (Figure 27B).

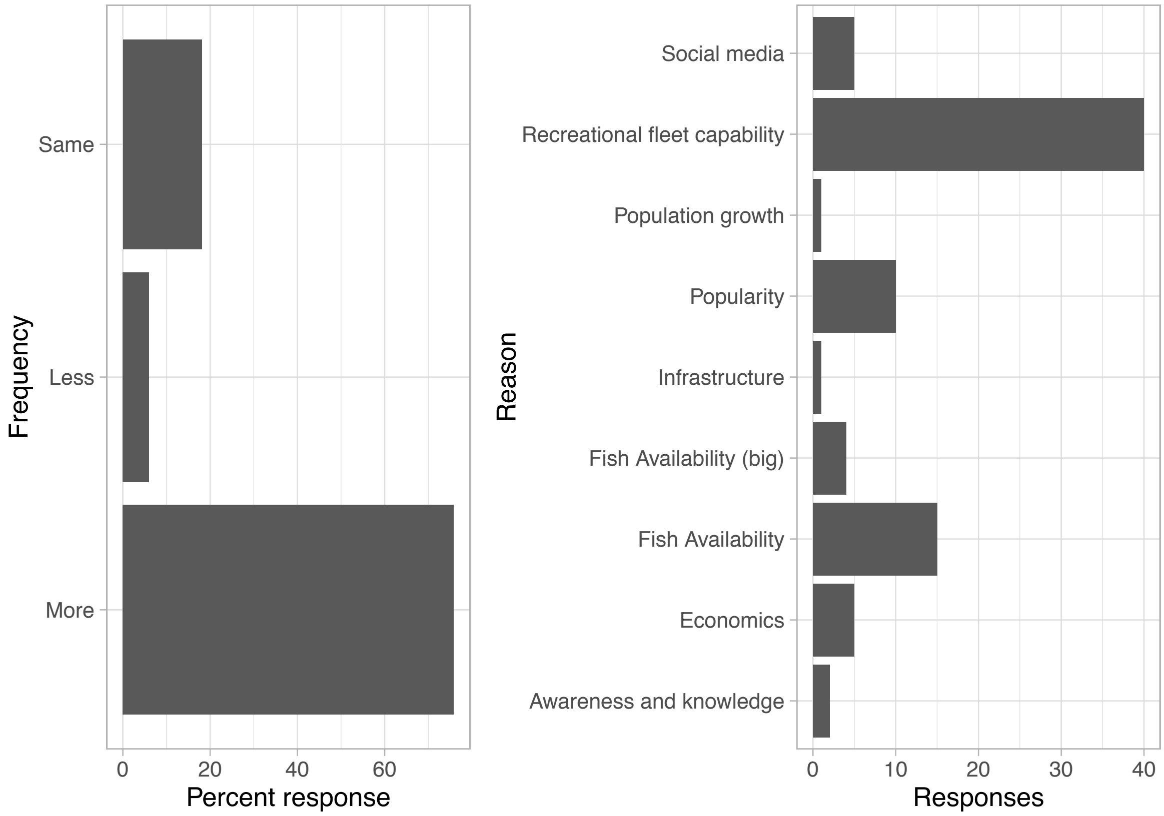

Figure 27. *(A – left) Fisher perception of trends in recreational fishing effort for Southern Bluefin Tuna. (B – right) Reasons suggested by respondents for effort increases.*

It is possible that the perceived increase in effort may actually be more closely related to an increased visibility of the fishery, through a rise in the reporting of successful fishing trips over the last decade on social media platforms. The increased visibility of the fishery on social media can lead to significant cognitive biases, including confirmation bias where people tend to be exposed more to subject matter they are interested in within their social networks. This reinforces perceptions of a general 'increase' in these subjects in their news feeds. This is further exacerbated by recall bias when considering trends over long periods.

The assumption that there may be significant biases in the perceptions of increased effort is supported by almost 60% of fishers reporting they had personally fished less in the survey year than on average, and less than 10% feeling they had fished more than on average (Figure 26B).

Most respondents considered that the availability of SBT to the recreational fisheries had either remained unchanged or increased over time, with fewer than 10% of respondents suggesting that availability had declined (Figure 28A).

Respondents identified fisheries management efforts as the most important factor contributing to increased availability (presumably linked to management efforts to rebuild SBT stocks), while environmental drivers were also identified as important contributing factors (Figure 28B).

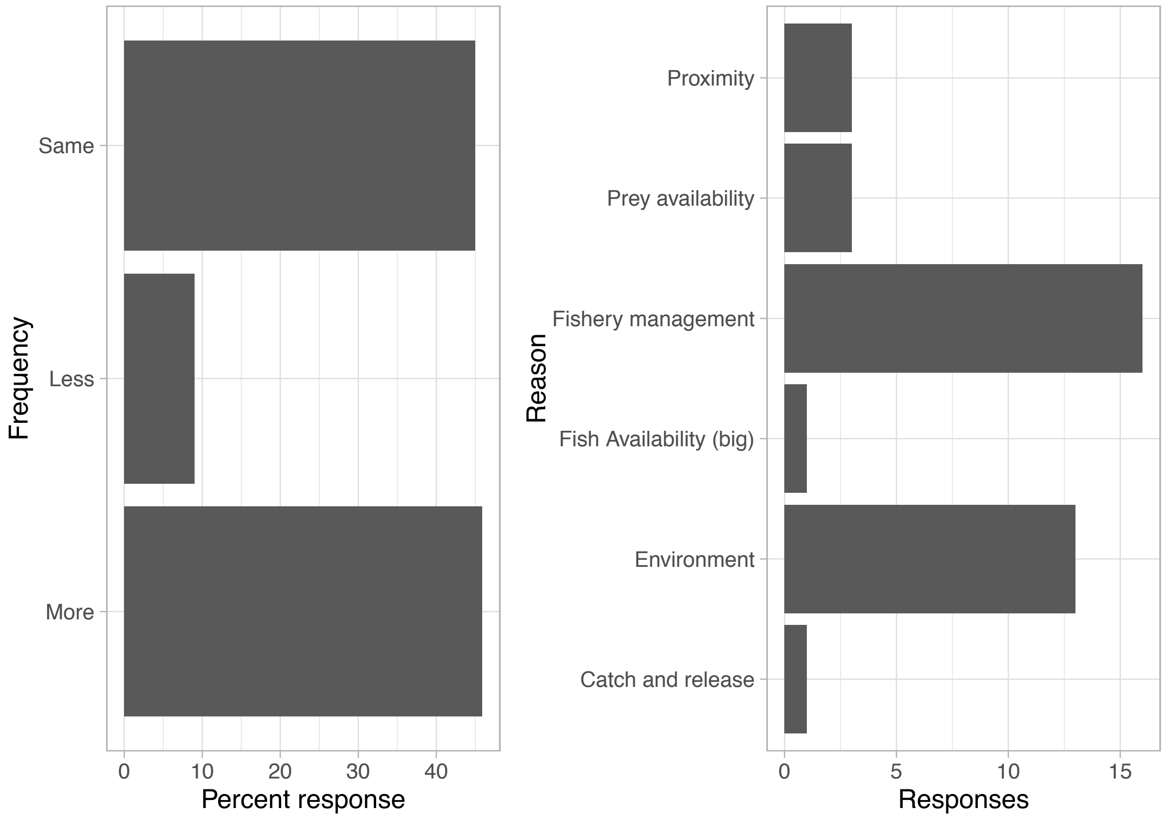

Figure 28. *(A – left) Fisher perception of trends in availability of Southern Bluefin Tuna. (B – right) Reasons suggested by respondents for SBT availability increase.*

Overall, there was a general consensus from respondents that the quality of the recreational fishery for SBT had either improved (better) or at least not changed (same) in recent years (Figure 29A). Relatively few respondents suggested that the quality of their fisheries had declined. Not surprisingly, these results align closely with fisher perceptions regarding trends in SBT availability, highlighting the link between fish availability and fisher satisfaction (expressed in this study as 'fishing quality').

Availability of SBT, including the availability of big fish, was commonly mentioned as a reason for the improved quality of the fishery (Figure 29B). Other experiential factors related to fishing were also mentioned, such as improved boat ramp facilities, improvements in fishing gear and fishing practices, and general knowledge and education on respect for the fish.

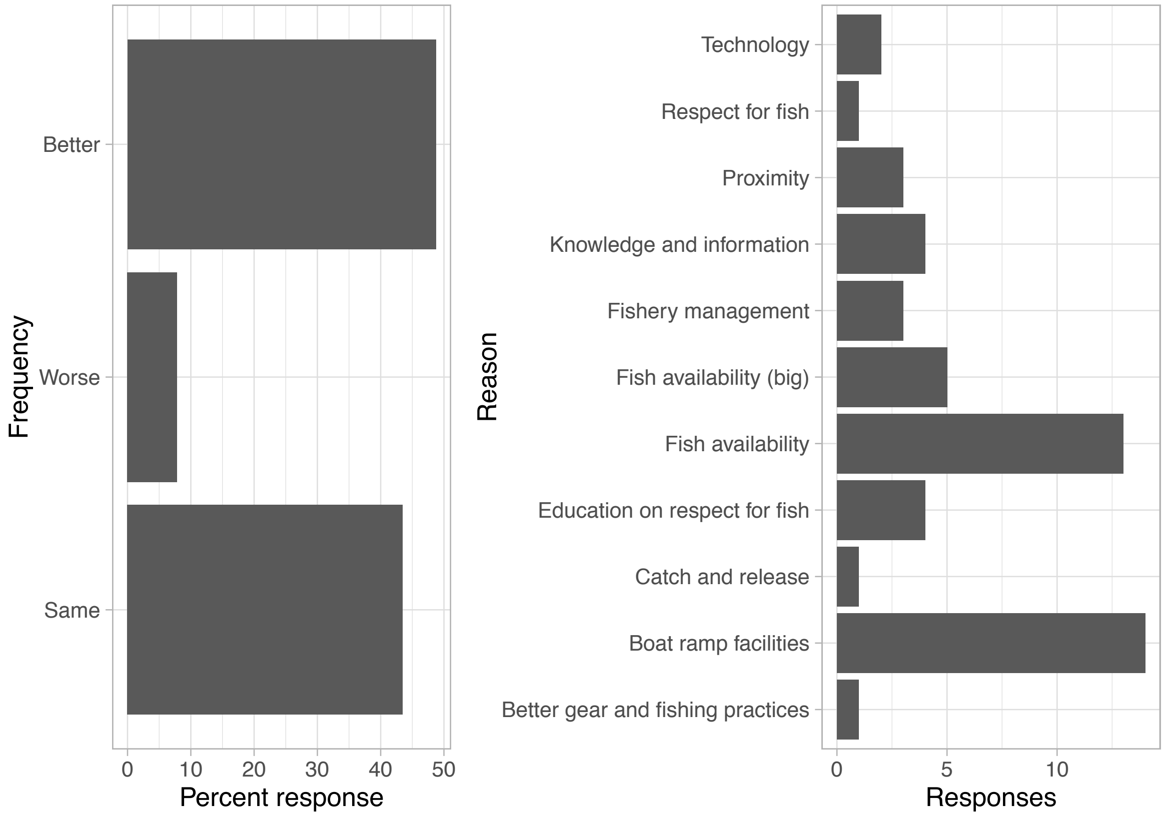

Figure 29. *(A – left) Fisher perception of trends in recreational fishing quality for Southern Bluefin Tuna. (B – right) Reasons suggested by respondents for improvement in fishing.*

5. Discussion

The current survey was conducted as a component of the 2018/19 National Survey of Recreational Fishing for Southern Bluefin Tuna in Australia (Tracey et al. 2020), with additional funds provided by DPIPWE to broaden the survey focus to include information on other key recreational game and offshore fish and shark species in Tasmania. The survey design replicates the methodology of a previous boat-based survey conducted in Tasmania in 2011/12 (Tracey et al. 2013), and allows for a robust comparison of results between years.

Overall, game fishing effort reportedly decreased between the 2018/19 and the 2011/12 survey, with trolling effort decreasing by 12% and pelagic shark effort by 25%. However, neither of these decreases were identified as statistically significant at the 95% confidence level (Table 10).

There was also a reported decrease in the amount of effort targeting mid-depth reef areas between the two surveys, which was down by 28%. Again, this was not statistically significant at the 95% confidence level (Table 10). In contrast, there was a statistically significant increase in the number of days targeting deep-water shelf-edge associated species, which was up by 69% (Table 10).

Table 10. *Comparison of estimated effort (days fished) between this current survey and the survey conducted in 2011/12 by Tracey et al. (2013). *indicates a statistically significant difference at the 95% confidence level.*

	2011/12	**2018/19**	
Fishing category	**Days fished**	**Days fished**	**% change**
Game fishing – trolling	5,231	4,581	12↓
Game fishing – pelagic shark	904	683	25↓
Offshore mid-depth reef associated	3,378	2,428	28↓
Offshore deep-water shelf-edge associated	329	1,092	69↑*

The catch of all tuna species declined between the 2018/19 and 2011/12 survey periods. The total estimated catch of SBT declined by 22%, but this was not statistically significant (Table 11). Furthermore, the release rate for SBT increased slightly (by 2%) between the two surveys.

Meanwhile, the decline in catch for both Albacore and Skipjack Tuna was statistically significant, with a reduction of 50% for Albacore and 98% for Skipjack Tuna (Table 11). Interestingly, despite lower catches, the release rate for both species increased by 16% for Albacore and 21% for Skipjack tuna. The highly migratory nature of tuna is likely to significantly affect the availability of each species to the recreational fishing sector. It is likely that this variability in availability, in areas accessible by the recreational fishing sector, has particularly had a significant impact on the catches of Albacore and Skipjack Tuna.

The estimated catch of Mako Shark declined by 12% between survey years, but the release rate increased by 8% (Table 11). The catch of Blue Shark declined by 72% but, given the high uncertainty associated with the Blue Shark estimates, this difference does not appear as statistically significant.

The catch for all key mid-depth reef associated species also declined, significantly so for Striped Trumpeter with catch numbers down about 50% and Jackass Morwong down 70% (Table 11). The number of Ocean Perch/Gurnard caught also declined by 14% which was not significantly different. The release rates for Striped Trumpeter and Ocean Perch/Gurnard were very similar between surveys, while the release rate for Jackass Morwong increased by 13% (Table 11).

Striped Trumpeter are caught commercially in Tasmanian and adjacent Commonwealth waters. Over the survey period (1 Dec 2018 – 31 Nov 2019) a reported 5.3 t of Striped Trumpeter were reported by the commercial sector (State and Commonwealth[1] reporting combined). This results in a total harvest of 23.4 t of which 77% was caught by the recreational sector (private and charter vessels).

In contrast to the declining catches of mid-depth reef associated species, catches of deep-water shelf-associated species increased. The estimated total catch of Blue-eye Trevalla increased by 24% and the catch of Blue Grenadier increased by just over 40%, noting that estimates for Blue Grenadier in both surveys are imprecise (Table 11). Both Gemfish and Pink Ling catches increased dramatically. Expanded catch estimates for these species were not produced for the 2011/12 survey as the number of fish reported at that time were minimal.

Table 11. *Comparison of total catch from private recreational vessels between this current survey and the survey conducted in 2011/12 by Tracey et al. (2013). *indicates a statistically significant difference at the 95% confidence level. Numbers in bold indicate that the relative standard error for the estimate is greater than 0.30.*

		2011/12		2018/19		
Fishing category	**Species**	**Total caught**	**Release rate**	**Total caught**	**Release rate**	**% change in catch**
Game fishing	Southern Bluefin Tuna	4,278	24	3,348	26	22↓
	Albacore	9,722	14	4,816	30	50↓*
	Skipjack Tuna	11,955	68	**185**	**89**	98↓*
	Mako shark	520	39	455	47	12↓
	Blue shark	**153**	**70**	**43**	**100**	72↓
Offshore mid-depth	Striped Trumpeter	8,522	15	4,153	17	51↓*
	Jackass Morwong	14,127	21	4,242	34	70↓*
	Ocean Perch/Gurnard	23,202	70	19,934	66	14↓
Offshore deep	Blue-eye Trevalla	**1,961**	0	2,573	0	24↑
	Pink Ling	ND		**344**	0	–
	Gemfish	ND		**1,546**	0	–
	Blue Grenadier	**548**	0	**930**	0	41↑

[1] Sourced from AFMA logbook data for all non-trawl species between latitude 39'00 - 44'00 and longitude 143'00 -149'00.

In summary, there has been a general declining trend in recreational offshore and game fishing effort and catch in Tasmania between the two snapshot surveys conducted in 2011/12 and 2018/19 (current survey). An anomaly to this trend is an increase in deep-water shelf-associated fishing, with a concurrent increase in catch of species such as Blue-eye Trevalla, Pink Ling, Gemfish and Blue Grenadier.

The wash-up survey relating to SBT may provide some insight into this trend. There was a perception that fishing for SBT had increased over time, but this is likely related to cognitive confirmation bias of an increased visibility of the fishery on social media forums such as Facebook, Instagram and YouTube. The vast majority of vessel owners who targeted SBT said they had, in fact, fished less or about the same in the survey year than they would on average, with a general lack of time reported as the main reason for less fishing. Given the strong overlap in game fishing and offshore demersal fishing, it is likely the same rationale may explain the overall decline in offshore fishing as well.

6. Acknowledgements

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7. Ethics Statement

This study was conducted with appropriate approvals from the Tasmanian Social Sciences Human Research Ethics Committee – H0017591, H0017641 and H0017781.

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