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Shore-based recreational fishing in the Perth Metropolitan area: 2022

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Executive Summary

Recreational fishing is a popular activity in Western Australia (WA), occurring throughout the state from boats, and from a variety of natural and man-made structures along the shore. Ongoing monitoring of the shore-based recreational fishery is essential to assist with resource allocation, management evaluation and stock assessments for nearshore species. Especially for species such as Australian Herring and Southern Garfish which had management changes including a reduction in bag limit from 30 to 12 in 2015 and closure of Perth Metropolitan waters in 2017, respectively. An on-site roving creel survey to collect effort and catch data from shore fishers has been conducted annually from February – June in the Perth Metropolitan area since 2014 and compared to a 2010 'pilot' survey.

Fishing effort for shore fishers in the Perth Metropolitan area in 2022 was 118,094 fisher hours (95%CI 73,391 – 162,796). This was steady when compared to 2021 (77,502 – 138,912) (as confidence intervals overlapped) and also 2010 (100,771 – 156,926).

The retained catch (in numbers) was 140,734 (95%CI 67,448 – 214,020) in 2022, of which an additional 169,730 (101,370 – 238,091) was released. This was steady when compared to 2021 for both retained (73,317 – 130,397) and released (65,764 – 138,105) catch. Released catch was steady across all years, while retained catch in 2022 was lower than in 2010, 2014, 2015 and 2017. The proportion of released catch increased from 17% (2010) to 54% (2022).

More than 50% of fishing parties had caught or released a fish of any species in all survey years, with a high of 75% in 2022. Collectively, and across all survey years, the five key species of Australian Herring, Whiting spp. (Family Sillaginidae), Tailor (*Pomatomus saltatrix*), Western Australian Salmon (*Arripis truttaceus*) and Pink Snapper (*Chrysophrys auratus)* were targeted by >40% of shore fishers and comprised >70% of the retained catch.

Australian Herring was the most commonly retained species by shore fishers in all years with an estimated retained catch of 9 t (95%CI 5 – 13 t) in 2022, which was lower than in 2010, 2014 and 2017. The release rate varied from 5 – 12% across years. The harvest rate (mean ± SE) was 0.7 ± 0.04 fish per fisher day, which was significantly lower in 2010, but remained steady from 2017 to 2021.

Whiting spp. was the second-most commonly retained species by shore fishers with an estimated retained catch of 0.6 t (95%CI 0 – 1 t) in 2022, which has been steady since 2014. The retained catch for Southern Garfish has been negligible since 2014. The retained catch of Tailor, WA Salmon and Pink Snapper have been negligible across all survey years, except for the WA Salmon retained catch between 2015 – 2017, which saw a 25% increase in targeting during this time. Although up to 15% of shore fishers targeted Pink Snapper, the majority of catches were released (95 – 99%).

1.0 Introduction

1.1 Background

In Western Australia (WA), recreational fishing is highly valued, with 25.4% of the population participating in this activity in 2020/21 (DPIRD, 2021). This level of participation is one of the highest of all Australian states and territories (Henry and Lyle, 2003). Recreational fishing occurs throughout the 13,000 km coastline of WA from boats and the shore, using a variety of fishing methods, with highly seasonal patterns of activity (Ryan et al., 2022). Although >3,000 fish species are found in WA waters (Hutchins, 2001), ~ 10% are harvested by recreational fishers, across a range of ecosystems.

Fisheries resources in WA are managed using an ecosystem-based approach with four marine bioregions (North Coast, Gascoyne Coast, West Coast and South Coast) divided into five ecological suites for finfish (estuarine, nearshore, inshore demersal, offshore demersal and pelagic) (Newman et al., 2018). Obtaining information on fishing effort and total catch from all sectors are essential for the management, assessment, and monitoring of these resources.

Due to the diverse and diffuse nature of recreational fishing, off-site surveys, where data are collected from fishers after they have been fishing, and on-site surveys, where data are recorded during a fishing event or straight after fishing has been completed, are used to capture data from this sector. Such surveys have been used widely in WA since the 1970s (Tate et al., 2020). The introduction of a Recreational Boat Fishing Licence (RBFL) in 2010 enabled the development of an integrated survey to collect data on boat-based recreational fishing (Wise and Fletcher, 2013). The key component is a phone-diary survey that utilises the RBFL as the sampling frame to collect data from boat-based recreational fishers throughout WA.

Collecting similar data for shore-based recreational fishing is more challenging as it is difficult to implement cost-effective surveys over broad scales due to the lack of a licence or sampling frame for this activity. This leads to a reliance on other survey methods, such as roving creel surveys, aerial surveys, or remotely operated cameras (Smallwood et al., 2012; Taylor et al., 2021).

Whiting spp. (*Sillago* spp.) and Australian Herring (*Arripis georgianus*) are the most commonly caught nearshore species by boat fishers with 21% and 12% of the total catch by numbers, respectively (Ryan et al., 2022). Catches of these same species from shore fishers are also known to be high, with data from the 2000/01 National Survey indicating that shore fishers can take a higher proportion than boat fishers (Henry and Lyle, 2003). While the majority of the catch from shore fishers were nearshore species, demersal species such as Pink Snapper were also targeted and caught by shore fishers. In addition, in some years the shore catch for some nearshore species, may be equal to or exceed, that for commercial fishers (Smith et al., 2013a, Henry and Lyle, 2003). However, until recently there was no regular monitoring of shore-based recreational fishing, with information collected via *ad hoc* roving creel

surveys to meet specific objectives (Ayvazian et al., 1997; Lenanton and Hall, 1976; Smallwood et al., 2012, 2006).

1.2 Need

Recreational fishing is a popular activity in WA, occurring widely from boats and the shore. Ongoing monitoring of the shore-based recreational fishery is essential to assist with management evaluation, resource and stock assessments for nearshore species. In addition, for some nearshore species, the recreational catch from shore fishers is estimated to exceed that for boat fishers. Therefore, to complement regular statewide surveys of boat-based recreational fishers, and to better understand the relationship between these two platforms (*i.e.,* the potential displacement of fishing activity), annual surveys of shore fishers have been undertaken in the Perth Metropolitan area since 2014.

1.3 Objectives

The objective is to report on the 2022 monitoring of shore-based recreational fishing in the Perth Metropolitan area using roving creel surveys. Data from the current year are compared to background periods (2010; 2014 – 2021).

Within this, specific aims were to calculate fishing effort and total catch (all species; key species). Key species of interest were identified as Australian Herring, Whiting spp., Southern Garfish, Tailor, Western Australian Salmon and Pink Snapper. For these key species, additional metrics were also explored, including standardised harvest rate, which can be used as an index to monitor inter-annual variations in abundance, as well as targeting, and the proportion of fishing parties who catch a fish, which provides a measure of the success of fishing trips. In conjunction with the roving creel surveys, concurrent phone-diary and boat ramp surveys were also used to explore differences between shore and boat fishers in terms of the total length of catches and catch-per-fisher, and the cumulative percentage of shore fishers attaining their daily (*i.e.,* midnight to midnight) bag limit. These analyses assist with evaluating the effect of changes to management regulations relevant to some nearshore indicator species (Appendix *1*).

2.0 Methods

Data from three survey methods were integrated to provide estimates of fishing effort, total catch, harvest weights, and summaries of total length, catch per fisher and targeting for key nearshore species. The design of these survey methods and associated analysis is described in detail in Tate and Smallwood (2021).

2.1 Roving creel surveys

This stratified, randomised survey collects data from 42 locations between Ocean Reef and Woodman Point from February – June each year (Figure 1) (Tate and Smallwood, 2021). In 2022, Ocean Reef was excluded from sampling due to the redevelopment of the marina which restricted access to the rock wall on 1 March 2022. Data from incomplete trip interviews were used to estimate fishing effort and total catch (retained plus released). The harvest weight of key species was calculated using weight data collected from boat ramp surveys to convert catch by numbers to catch by weight. In addition, standardised harvest rate was calculated, and summaries of total length, catch-per-fisher and targeting were completed. Where appropriate, comparison of shore and boat fishers was undertaken using boat ramp and phone-diary survey data.

Summary information including, number of survey days, fisher interviews, average party size, number of retained fish, and number of measured fish are presented in Appendix *2*. The variability of estimates was presented as Standard Errors (SE), 95% Confidence Intervals (95%CI) and Relative Standard Error (RSE) (*i.e.,* SE/estimate). If the RSE >40% then estimates are displayed in bold to indicate that it is not considered robust. Length weight relationships were used to convert length data to weight, from which an (arithmetic) mean weight was derived (Appendix 3). Statistical tests (*i.e.,* Kruskal Wallis) and minimum sample size (>10) requirements determined if the mean weight for the current survey year, or combined across years, was applied.

2.2 Boat ramp surveys

On-site biological surveys at a number of public boat ramps have been completed during five survey periods (Ryan et al., 2022, 2019, 2017, 2015, 2013). Although length and weight data were collected throughout the West Coast bioregion, only data from four public boat ramps (Ocean Reef, Hillarys, Leeuwin, and Woodman Point) was included as they were located in the study area (Figure 1). Length data were used to calculate average total length for key species caught by boat fishers, which could be compared with shore fishers. A Kruskal-Wallis test was used to make statistical comparisons between year and fishing platform (boat and shore). Data on the number of fishers and retained catch was used to calculate catch-per-fisher.

2.3 Phone-diary surveys

Phone-diary surveys have been completed throughout WA during five survey periods (Ryan et al., 2022, 2019, 2017, 2015, 2013). Information on boat-based fishing activity was collected via regular phone interviews with diarists throughout this time. Although data was collected statewide, only the number of fishers and retained catch from four public boat ramps (Ocean Reef, Hillarys, Leeuwin, and Woodman Point) was used to calculate catch-per-fisher as they were located within the study area (Figure 1).

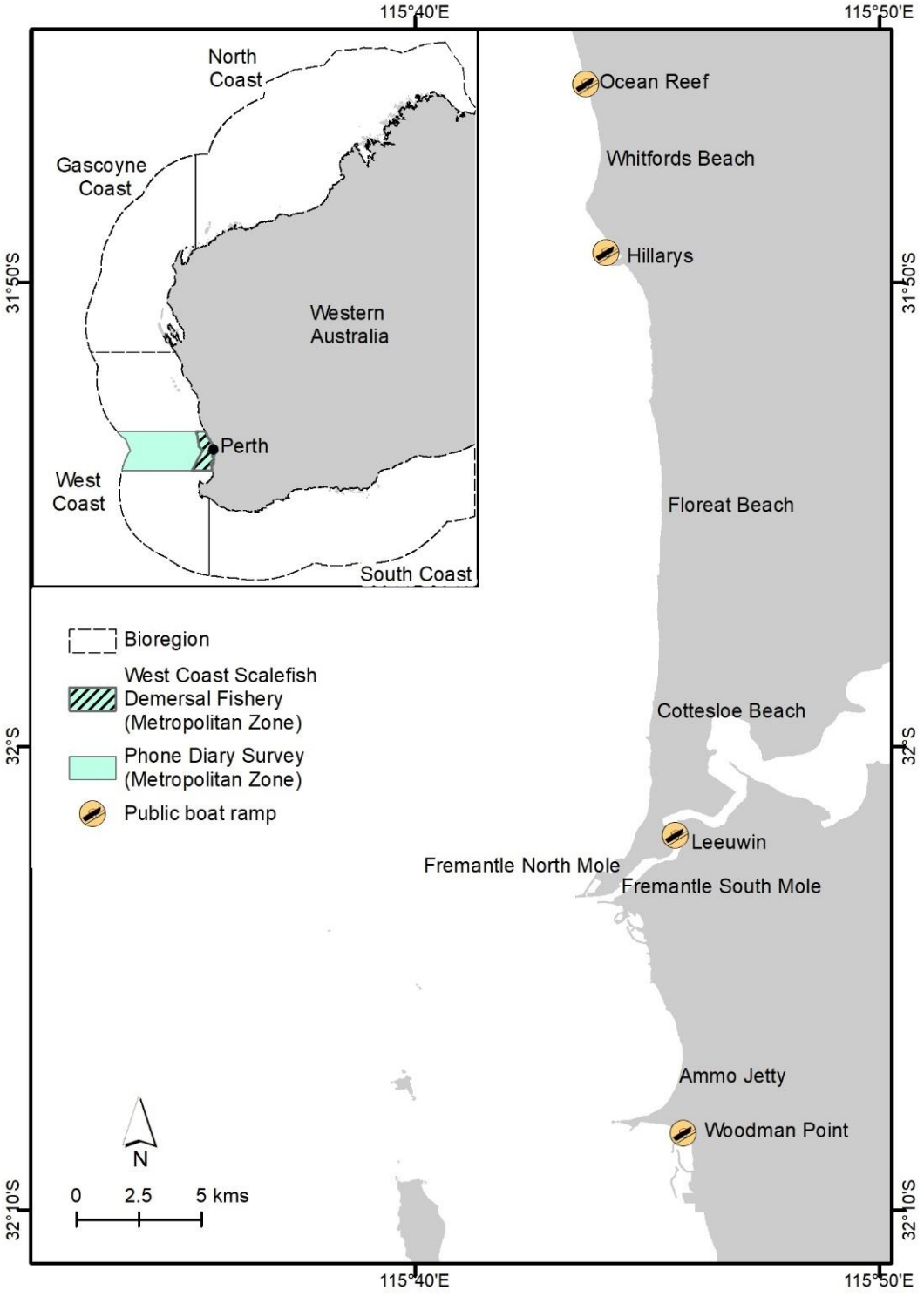

Figure 1 Key locations relevant to management of nearshore fish species as well as the roving creel survey, boat ramp survey and phone-diary survey.

3.0 Results

3.1 Fishing effort

Fishing effort for shore fishers in 2022 was 118,094 fisher hours (95%CI 73,391 – 162,796) (Figure 2). This was higher when compared to 2021 (75,502 – 138,912) (although not a significant difference as confidence intervals overlapped) but steady when compared to 2010 (100,771 – 156,926). Fishing effort in both these years was lower than the peak in 2016 (194,926 – 382,931). RSE for all survey years was ≤40% (*i.e.,* robust).

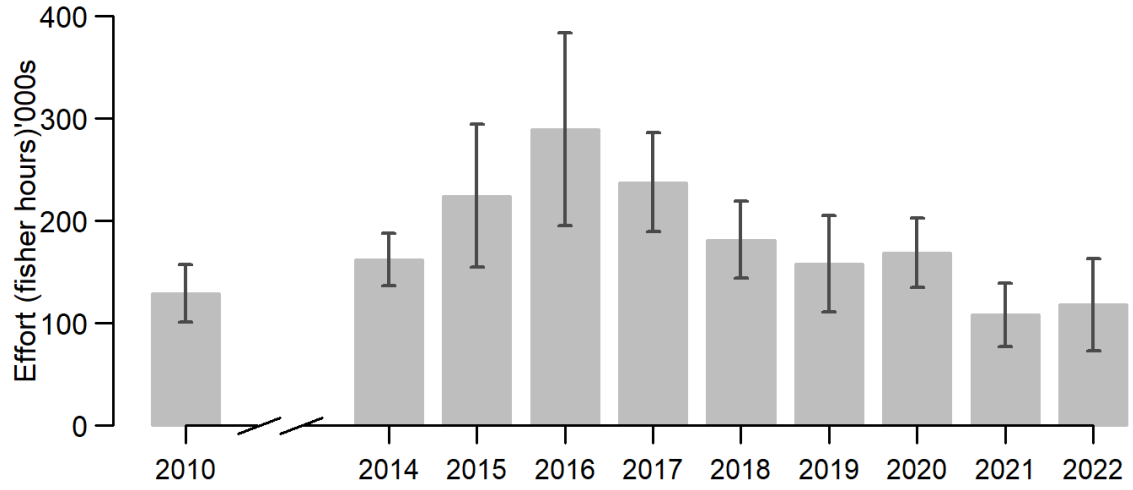

Figure 2 Estimated fishing effort (in fisher hours) from shore fishers in the Perth Metropolitan area (95%CI) as calculated using data from 5-month roving creel survey. Note: 3-month survey duration in 2010.

3.2 Catch estimates: all species combined

The retained catch (number of individuals) for shore fishers in 2022 was 140,734 (95%CI 67,448 – 214,020) (Figure 3). The retained catch was steady when compared to 2021 (73,318 – 130,397) (as indicated by overlapping confidence intervals) although was lower than in 2010 (3-months only) (206,849 – 346,836), 2014 (168,159 – 313,633) and 2017 (186,241 – 333,292). RSE was ≤40% for all survey years for retained catch.

An additional 169,731 (101,371 – 238,091) was released in 2022, which was steady across all survey years, including 2010 (28,068 – 87,185). However, the proportion of released catch increased from 2010 (17%) to 2016 (48%) and remained relatively consistent (30 – 45%) until 2022 when 54% of the total catch was released by shore fishers.

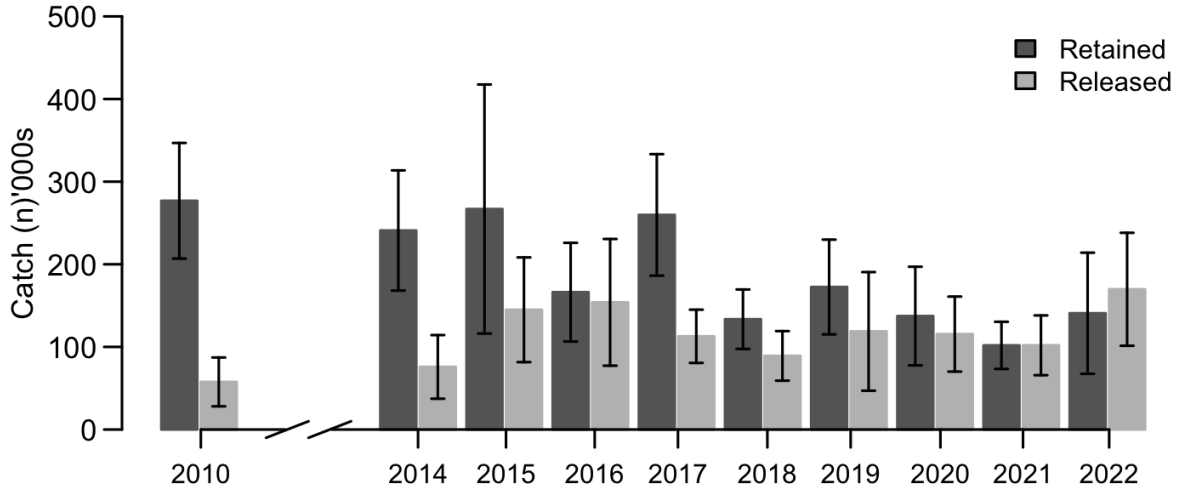

Figure 3 Estimated retained and released catch (in numbers of individuals) caught by shore fishers in the Perth Metropolitan area (95%CI), as calculated using data from roving creel survey 5-month roving creel survey. Note: 3-month survey duration in 2010.

3.3 Catch estimates: key species

Shore-based recreational fishers retained 163 species or species groupings across all survey years, of which 161 were teleosts (Appendix 4). An additional 174 species or species groupings were released by fishers. Australian Herring had the greatest proportion of retained catch in all survey years (41 – 64%), followed by Whiting spp. (7 – 24%) in all years except 2010 and 2022, in which Southern Garfish (17%) and Australian Sardine (*Sardinops sagax)* (9%) ranked second, respectively (Table 1). Various species from Family Tetraodontidae had the greatest proportion of released catch in all survey years. Species such as Australian Herring (5 – 37%), Silver Trevally (2 – 16%) and Pink Snapper (1 – 14%) had variable release rates across survey years (Table 2).

Table 1 **Percentage of estimated retained catch for each of the top 10 species (with rank in brackets) caught by shore fishers in the Perth Metropolitan area. Note: species were selected based on their combined catch across all survey years, the survey only includes species caught by line fishing (finfish and squid) Note: 3-month survey duration in 2010.**

Common name (Scientific name)	2010	2014	2015	2016	2017	2018	2019	2020	2021	2022
Australian Herring ***Arripis georgianus***	64% (1)	50% (1)	53% (1)	41% (1)	61% (1)	41% (1)	57% (1)	43% (1)	50% (1)	42% (1)
Whiting spp. ***Sillago* spp.**	5% (3)	19% (2)	19% (2)	21% (2)	11% (2)	24% (2)	16% (2)	20% (2)	12% (2)	7% (3)
Southern Garfish ***Hyporhamphus melanochir***	17% (2)	1% (8)	2% (7)	<1% (10)	2% (8)	2% * (6)	<1 * (15)	2% * (10)	- *	- *
Yellowtail Scad ***Trachurus novaezelandiae***	3% (4)	3% (5)	2% (6)	5% (4)	6% (3)	3% (5)	5% (4)	7% (3)	6% (3)	6% (4)
Squid **Teuthoidea**	1% (7)	2% (7)	5% (4)	5% (5)	3% (6)	8% (3)	4% (5)	4% (5)	4% (4)	3% (9)
Scaly Mackerel ***Sardinella lemuru***	<1% (11)	11% (3)	6% (3)	3% (6)	-	-	2% (7)	<1% (20)	2% (9)	5% (5)
Western Striped Grunter ***Pelates octolineatus***	-	3% (6)	1% (8)	<1% (16)	4% (4)	5% (4)	5% (3)	7% (4)	3% (6)	4% (7)
Silver Trevally ***Pseudocaranx georgianus* spp.**	2% (5)	<1% (14)	1% (10)	<1% (9)	3% (5)	2% (7)	3% (6)	2% (8)	2% (10)	1% (15)
Western Butterfish ***Pentapodus vitta***	-	<1% (11)	<1% (13)	2% (7)	1% (10)	2% (9)	<1% (14)	3% (6)	4% (5)	4% (6)
Western Australian Salmon ***Arripis truttaceus***	<1% (13)	<1% (23)	2% (5)	11% (3)	1% (11)	<1% (21)	<1% (23)	-	<1% (20)	-

*Perth Metropolitan waters closed to Southern Garfish.

Table 2 Percentage of estimated released catch for each of the top 10 species (with rank in brackets) caught by shore fishers in the Perth Metropolitan area. Note: species were selected based on their combined released catch across all survey years, the survey only includes species caught by line fishing (finfish and squid) Note: 3-month survey duration in 2010.

Common name (Scientific name)	2010	2014	2015	2016	2017	2018*	2019*	2020*	2021*	2022*
Weeping Toadfish ***Torquigener pleurogramma***	26% (2)	14% (2)	50% (1)	46% (1)	11% (4)	14% (1)	15% (2)	45% (1)	40% (1)	13% (2)
Toadfishes Family Tetraodontidae	-	-	-	-	21% (1)	11% (3)	49% (1)	25% (2)	19% (2)	30% (1)
Australian Herring ***Arripis georgianus***	37% (1)	14% (3)	12% (2)	5% (7)	12% (3)	5% (8)	6% (3)	5% (4)	6 % (3)	5% (6)
Tarwhine ***Rhabdosargus sarba***	1% (12)	13% (4)	5% (3)	7% (4)	15% (2)	10% (4)	1% (19)	1% (10)	2% (10)	8% (4)
Silver Trevally ***Pseudocaranx georgianus* spp.**	16% (3)	10% (5)	4% (5)	8% (2)	6% (6)	6% (6)	4% (6)	2% (8)	2% (14)	2% (12)
Pink Snapper ***Chrysophrys auratus***	1% (10)	7% (7)	1% (13)	6% (5)	9% (5)	14% (2)	5% (4)	2% (7)	4% (4)	10% (3)
Whiting spp. ***Sillago* spp.**	5% (5)	9% (6)	4% (6)	5% (6)	3% (8)	8% (5)	5% (5)	6% (3)	3% (7)	2% (13)
Silver Toadfish ***Lagocephalus sceleratus***	-	14% (1)	3% (8)	7% (3)	-	2% (13)	-	-	1% (19)	3% (9)
Western Striped Grunter ***Pelates octolineatus***	-	4 (9)	4 (7)	-	2% (11)	5% (7)	1% (17)	3% (6)	3% (6)	7% (5)
Breams ***Sparidae* spp.**	-	5% (8)	-	1% (11)	1% (17)	2% (12)	-	1% (11)	3% (8)	2% (11)

*Perth Metropolitan waters closed to Southern Garfish.

3.3.1 Australian Herring

The retained catch of Australian Herring in 2022 was 50,748 (95%CI 24,865 –76,631) and was steady compared to 2021 (30,338 – 76,631) (Figure 4). Retained catches in 2022 were lower compared with 2010 to 2015 (prior to bag limit reduction from 30 to 12 fish per fisher), and 2017 (post management change). Released catches were steady across all survey years. Overall RSE was ≤40% for retained catch across all years and ≤40% for released catch in 2022, 2018, 2017, 2014 and 2010. The release rate across all survey years ranged from 5% (2019) to 12% (2021) and was 10% in 2022.

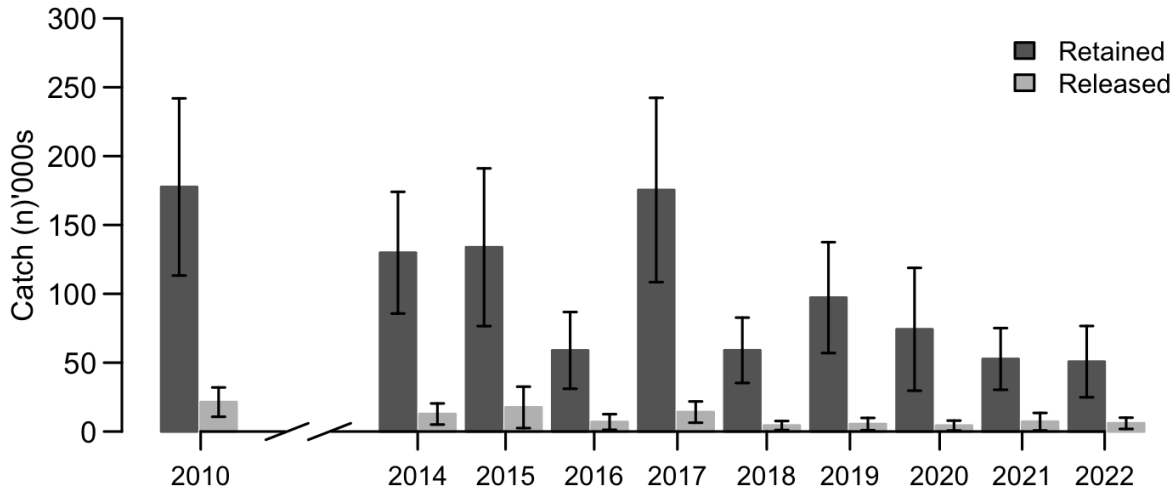

Figure 4 Estimated retained and released catch (in numbers of individuals) for Australian Herring caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month creel surveys. Note: (1) 3-month survey duration in 2010 (2) Bag limit reduced from 30 to 12 on 1 March 2015.

3.3.2 Whiting spp.

Whiting spp. (*Sillago* spp.) is a grouping of three Whiting species, of which Southern School Whiting was the dominant species in this group with 84% of the retained catch in 2022. This proportion ranged from 74 – 99% across survey years (Appendix 5). The retained catch of Whiting spp. in 2022 was 12,247 (95%CI 261 – 24,233) (Figure 5). Although the confidence intervals for retained catch overlapped, there was high variability in the catches across all years (as indicated by the large confidence intervals) and point estimates have generally declined since 2016. RSE was ≤40% for all survey years for retained catch except for 2015, 2020, 2021 and 2022. RSE was ≤40% for released catches in 2015 and 2018 only. The release rate was 16% in 2022 and ranged from 7% (2015) to 23% (2010) across all survey years.

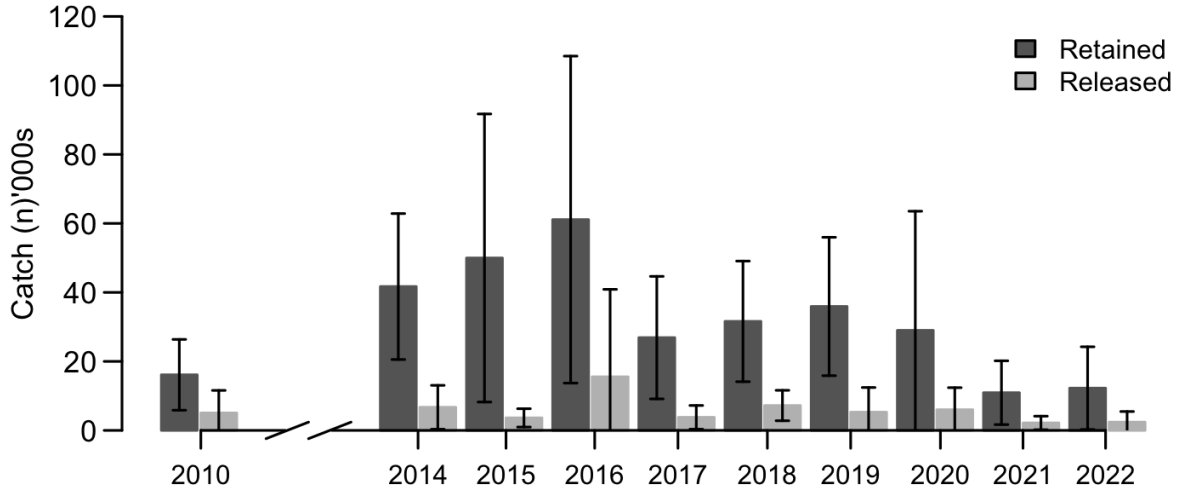

Figure 5 Estimated retained and released catch (in numbers of individuals) for Whiting spp. caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month roving creel surveys. Note: 3-month survey duration in 2010.

3.3.3 Southern Garfish

Fishing for Southern Garfish has been prohibited since June 2017. However, retained catch in 2022 was 155 (95%CI 0 – 1,544), higher compared to 2021 where no catch was retained for this species. Released catch of this species was 163 individuals (95%CI 0 – 525) (Figure 6). RSE was >40% (*i.e.,* non-robust) for all survey years for retained and released catch except for 2010 which had the highest retained catch of any survey year; 44,437 (95%CI 24,600 – 64,275). The release rate varied from 0% (2014, 2015) up to 64% in 2018, before decreasing to 51% in 2022.

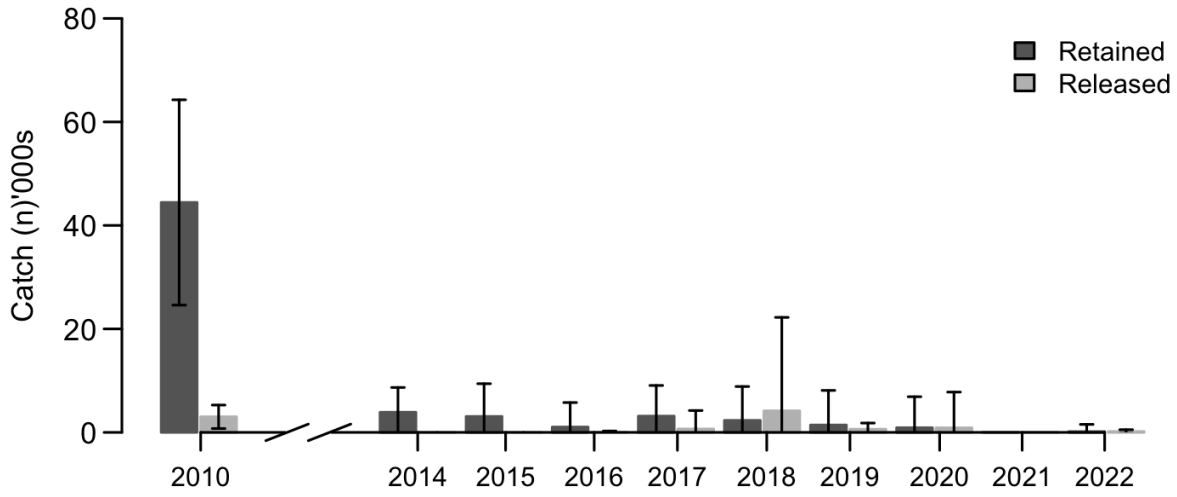

Figure 6 Estimated retained and released catch (in numbers of individuals) for Southern Garfish caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month roving creel surveys. Note: (1) 3-month survey duration in 2010, and (2) fishery closed since June 2017.

3.3.4 Tailor

The retained catch of Tailor in 2022 was 3,045 (95%CI 0 – 8,790) and released catch was 3,254 (95%CI 0 – 7,516) (Figure 7). Retained catch for this species was steady across all survey years, although there is high variability (as indicated by wide confidence intervals). RSE was >40% (*i.e.,* non-robust) for all survey years for retained and released catches. The release rate was 52% in 2022 and ranged from 13% (2018) – 89% (2019).

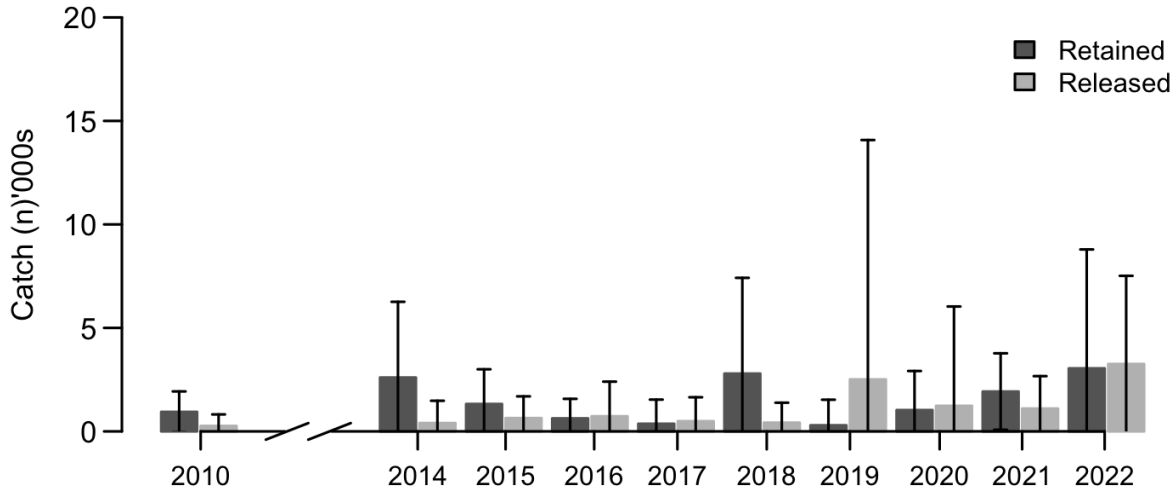

Figure 7 Estimated retained and released catch (in numbers of individuals) for Tailor caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month roving creel surveys. Note: 3-month survey duration in 2010.

3.3.5 Western Australian Salmon

The retained catch of WA Salmon in 2022 was 62 (95%CI 0 – 512) and there was no released catch for this species (Figure 8). Retained catch for this species was negligible across all survey years except for a peak in 2016, with 9,546 (0 – 19,620). SE was >40% (*i.e.,* non-robust) for all survey years for retained and released catches. The release rate for this species ranged from 0% in 2010, 2020 and 2022 to 66% in 2015.

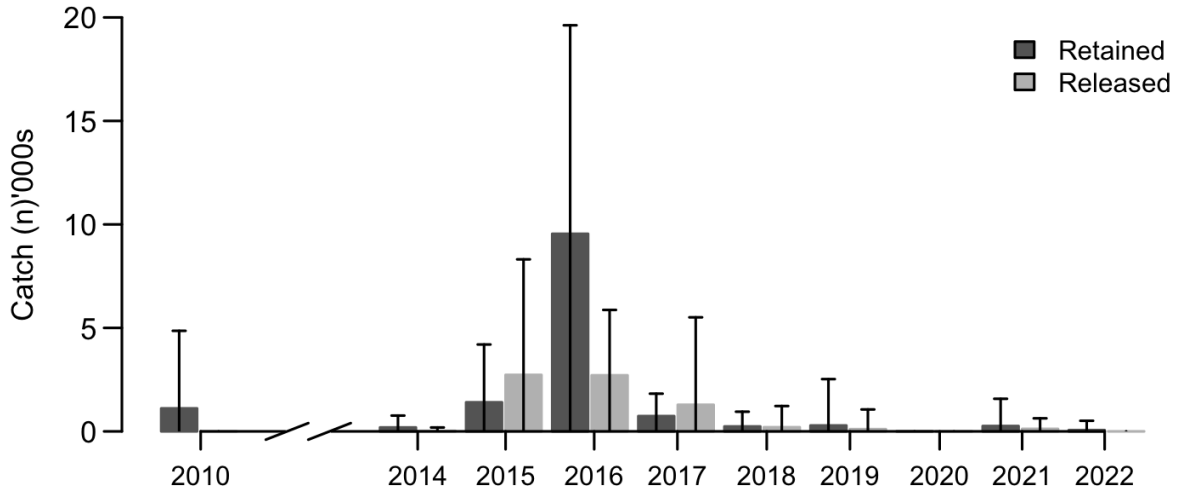

Figure 8 Estimated retained and released catch (in numbers of individuals) for Western Australian Salmon caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month roving creel surveys. Note: 3-month survey duration in 2010

3.3.6 Pink Snapper

The retained catch of Pink Snapper in 2022 was 407 (95%CI 0 – 1,276) and released catch was 18,717 (95%CI 0 – 39,094) (Figure 9). Retained catch for this species was negligible, and RSE was >40% (*i.e.,* non-robust), across all survey years. Although highly variable (indicated by large confidence intervals), the released catch was higher than retained in all survey years. RSE was ≤40% for released catch in 2014, 2017 and 2018. The release rate was 98% in 2022 and ranged from 81% (2010) – 99% (2019).

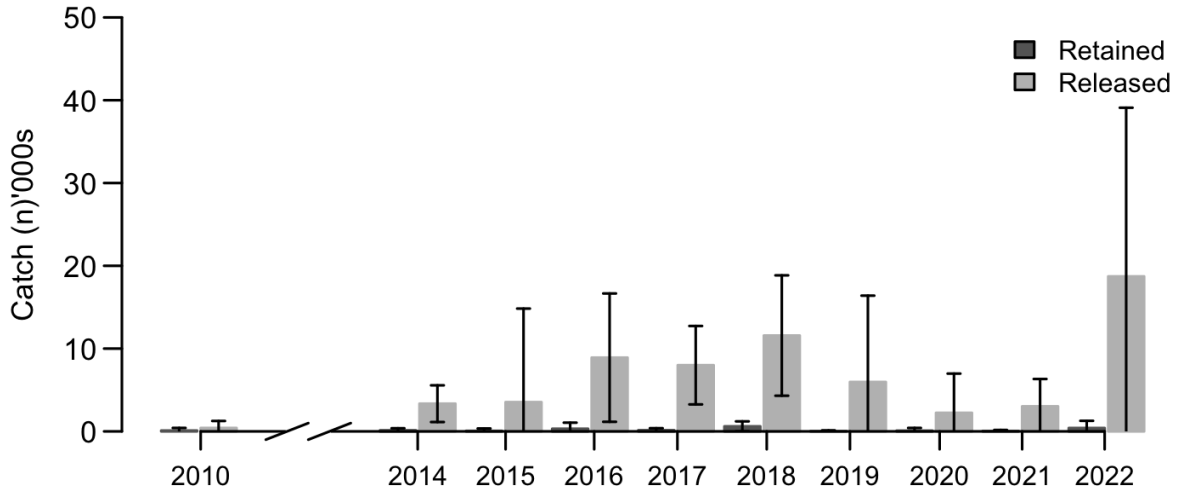

Figure 9 Estimated retained and released catch (in numbers of individuals) for Pink Snapper caught by shore fishers in the Perth Metropolitan area (95%CI), calculated from the 5-month roving creel surveys. Note: 3-month survey duration in 2010.

3.4 Harvest weights

3.4.1 Australian Herring

The harvest for Australian Herring in 2022 was 9 t (95%CI 5 – 13 t) and has been steady since 2018 (Figure 10). However, the harvest in 2022 was lower than achieved in 2010 (over a 3-month survey period), 2014, 2015 and 2017 with 31 t (95%CI 20 – 42 t), 22 t (14 – 29 t) and 32 t (20 – 44 t), respectively.

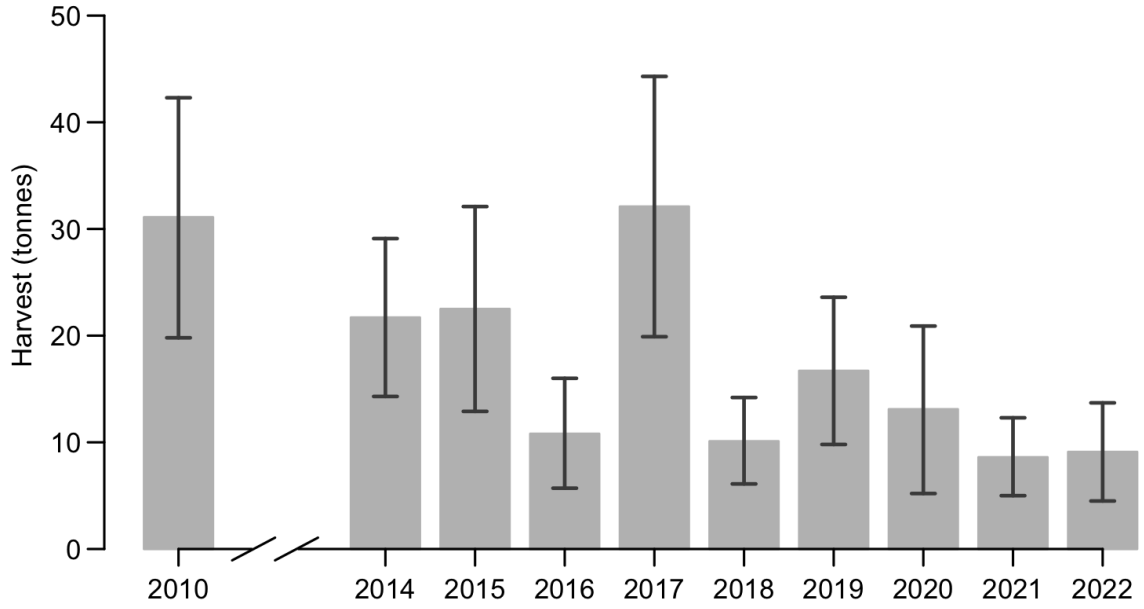

Figure 10 Estimated harvest (in tonnes) (95%CI) for Australian Herring caught by shore fishers in the Perth Metropolitan area, calculated from the 5-month roving creel surveys. Note: (1) 3-month survey duration in 2010 (2) Bag limit reduced from 30 to 12 on 1 March 2015.

3.4.2 Whiting spp.

The harvest for Whiting spp. in 2022 was 0.6 t (95%CI 0 – 1 t). Although the confidence intervals for harvest overlapped, there was high variability across all years (as indicated by the large confidence intervals) and point estimates have generally declined since 2016 (Figure 11).

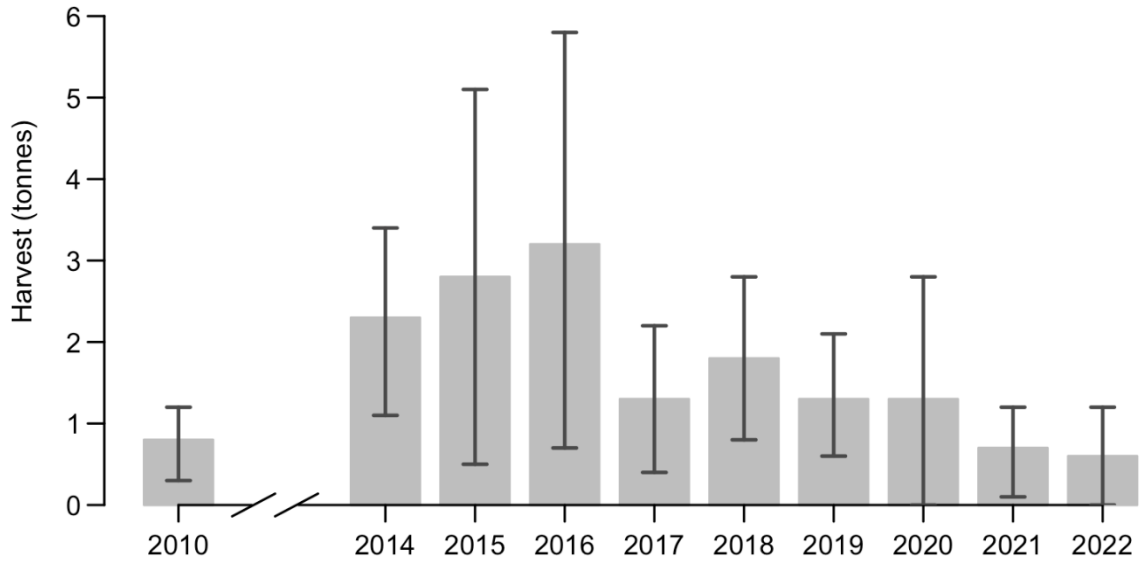

Figure 11 Estimated harvest (in tonnes) (95%CI) for Whiting spp. caught by shore fishers in the Perth Metropolitan area, calculated from the 5-month roving creel surveys. Note: 3-month survey duration in 2010.

3.4.3 Southern Garfish

The harvest of Southern Garfish in 2022 was negligible. Harvest between 2014 – 2021 was also negligible (0.1 – 1 t) while a harvest of 6 t (95%CI 3 – 9 t) was achieved in 2010 over a 3-month survey period.

3.4.4 Tailor

The harvest of Tailor in 2022 was 1 t (95%CI 0 – 4 t). Harvest has remained negligible for all survey years.

3.4.5 Western Australian Salmon

The harvest of WA Salmon in 2022 was 0.4 t (95%CI 0 – 3 t). Harvest was low except for 2015 – 2017, when a peak of 58 t (95%CI 0 – 119) occurred in 2016, although the large confidence intervals highlight the high uncertainty associated with this estimate.

3.4.6 Pink Snapper

The harvest of Pink Snapper in 2022 was 1 t (95%CI 0 – 3 t). Harvest has remained negligible in all survey years.

3.5 Harvest rate

3.5.1 Australian Herring

The standardised harvest rate (mean ± SE) (retained catches) for Australian Herring in 2022 was 0.7 ± 0.04 fish per fishing party day. Harvest rates for this species showed a significant difference between 2010 and 2022 with decline from 1.6 ± 0.10) to 0.7 ± 0.04 (Figure 12, Appendix *6*). There was no significant difference from 2019 (0.9 ± 0.07) to 2022.

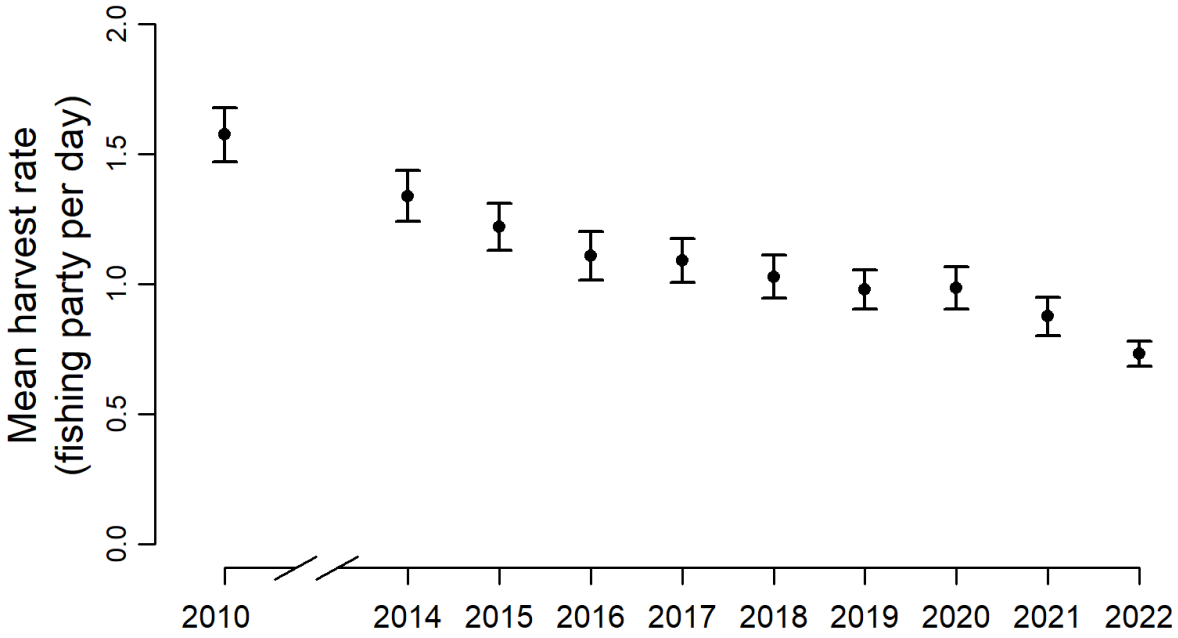

Figure 12 Standardised harvest rates (±SE) for Australian Herring based on data from the 5-month roving creel survey.

3.5.2 Whiting spp.

The standardised harvest rate (mean ± SE) for Whiting spp. in 2022 was 0.31 ± 0.04 fish per fishing party per day, which were lower than 2021 0.55 ± 0.07. Harvest rates for this species showed a significant difference between in 2014, 2015, 2016 and 2018 compared to 2022 (Figure 1313, Appendix *6*).

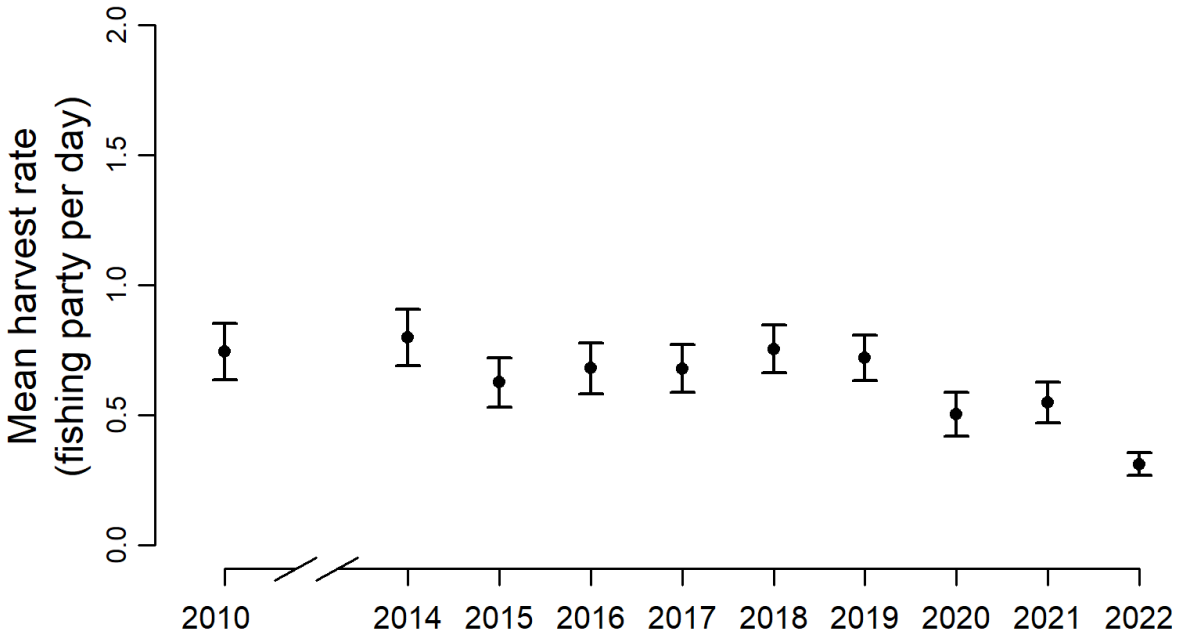

Figure 13 Standardised harvest rates (±SE) for Whiting spp. based on data from the 5-month roving creel survey.

3.5.3 Southern Garfish

There was insufficient data to calculate standardised harvest rates for Southern Garfish.

3.5.4 Tailor

There was insufficient data to calculate standardised harvest rates for Tailor.

3.5.5 Western Australian Salmon

There was insufficient data to calculate standardised harvest rates for WA Salmon.

3.5.6 Pink Snapper

There was insufficient data to calculate standardised harvest rates for Pink Snapper.

3.6 Total length

3.6.1 Australian Herring

Median total length of Australian Herring for the shore survey in 2022 was 235 mm (Figure 14). There was a significant difference in median total length across survey years for both the boat (225 – 238 mm, $X^2 = 104.28, p < 0.05$) and shore (225– 236 mm, $X^2 = 134.59, p < 0.05$) survey.

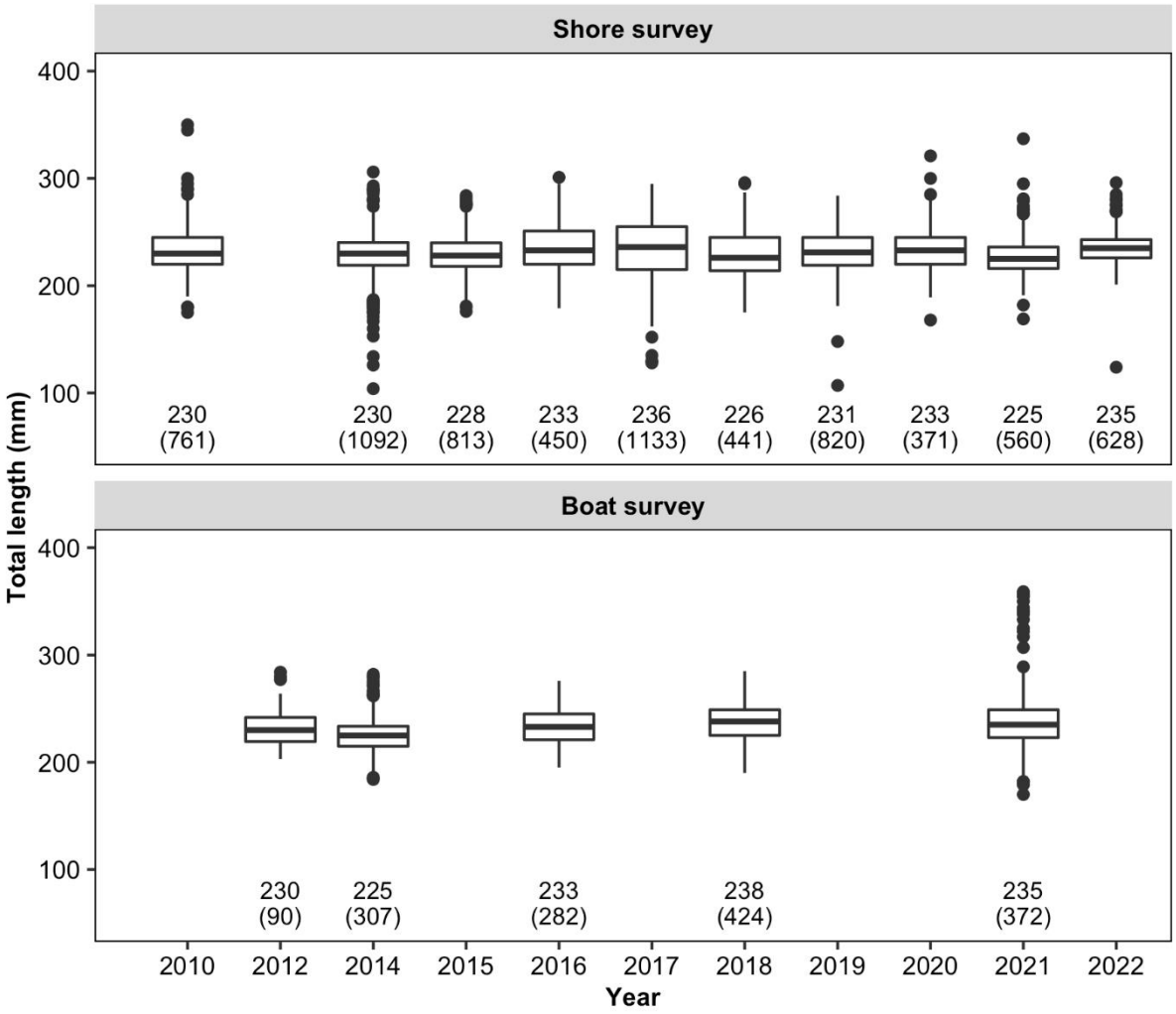

Figure 14 Boxplots summarising the distribution of length data for Australian Herring caught by shore and boat fishers from the roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). No minimum size limit for this species.

3.6.2 Whiting spp.

Median total length of Whiting spp. for the shore survey in 2022 was 149 mm (Figure 15). There was a significant difference in median total length across survey years for both the boat (220 – 233.5 mm, $X^2 = 36.16,\ p < 0.05$) and shore (145.5 – 175 mm, $X^2 = 98.88,\ p < 0.05$) survey.

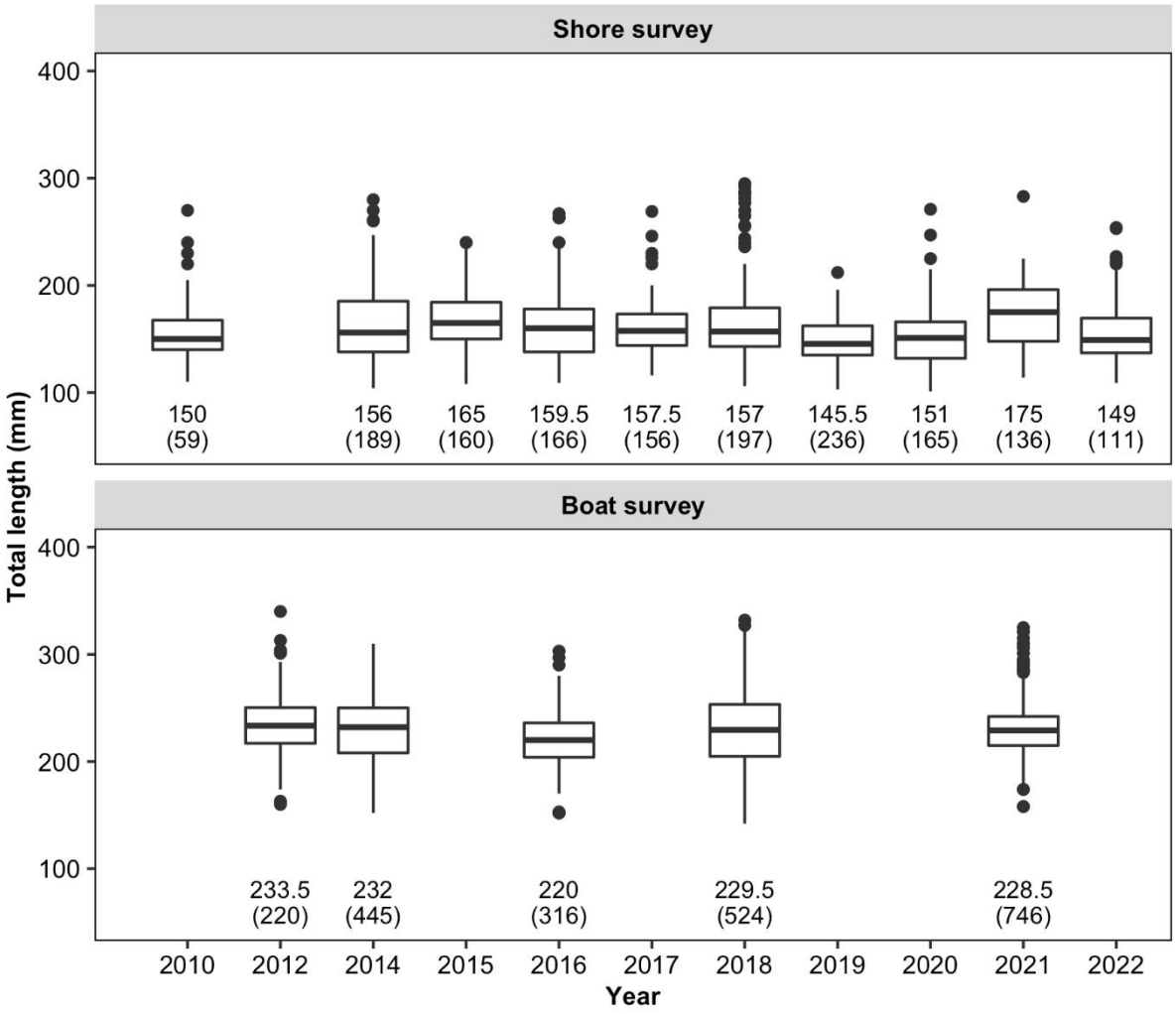

Figure 15 Boxplots summarising the distribution of length data for Whiting spp. caught by shore and boat fishers from roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). No minimum size limit for this species.

3.6.3 Southern Garfish

Median total length of Southern Garfish for the shore survey in 2022 was 286 mm (Figure 16). There was a significant difference in the median total length of Southern Garfish across survey years for both the boat (271.5 – 379 mm, $X^2 = 27.923, p < 0.05$) and shore (256 – 357.5 mm, $X^2 = 93.49, p < 0.05$) survey.

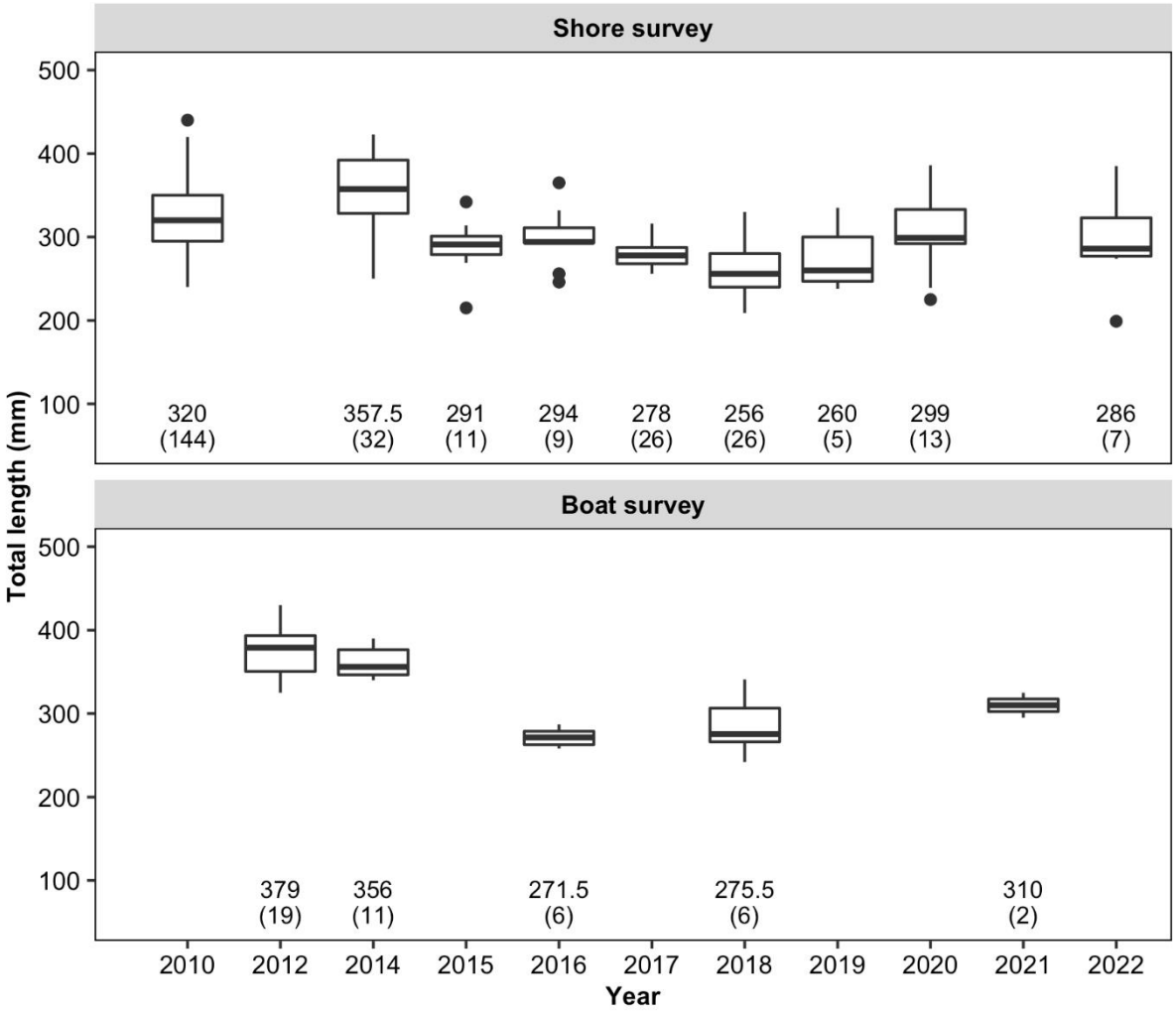

Figure 16 Boxplots summarising the distribution of length data for Southern Garfish caught by shore and boat fishers from roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). No minimum size limit for this species.

3.6.4 Tailor

Median total length of Tailor for the shore survey in 2022 was 344.5 mm (Figure 17). There was a significant difference in median total length of Tailor across survey years for both the boat (308.5 – 445 mm, $X^2 = 31.01, p < 0.05$) and shore (317.5 – 384 mm, $X^2 = 25.85, p < 0.05$) survey.

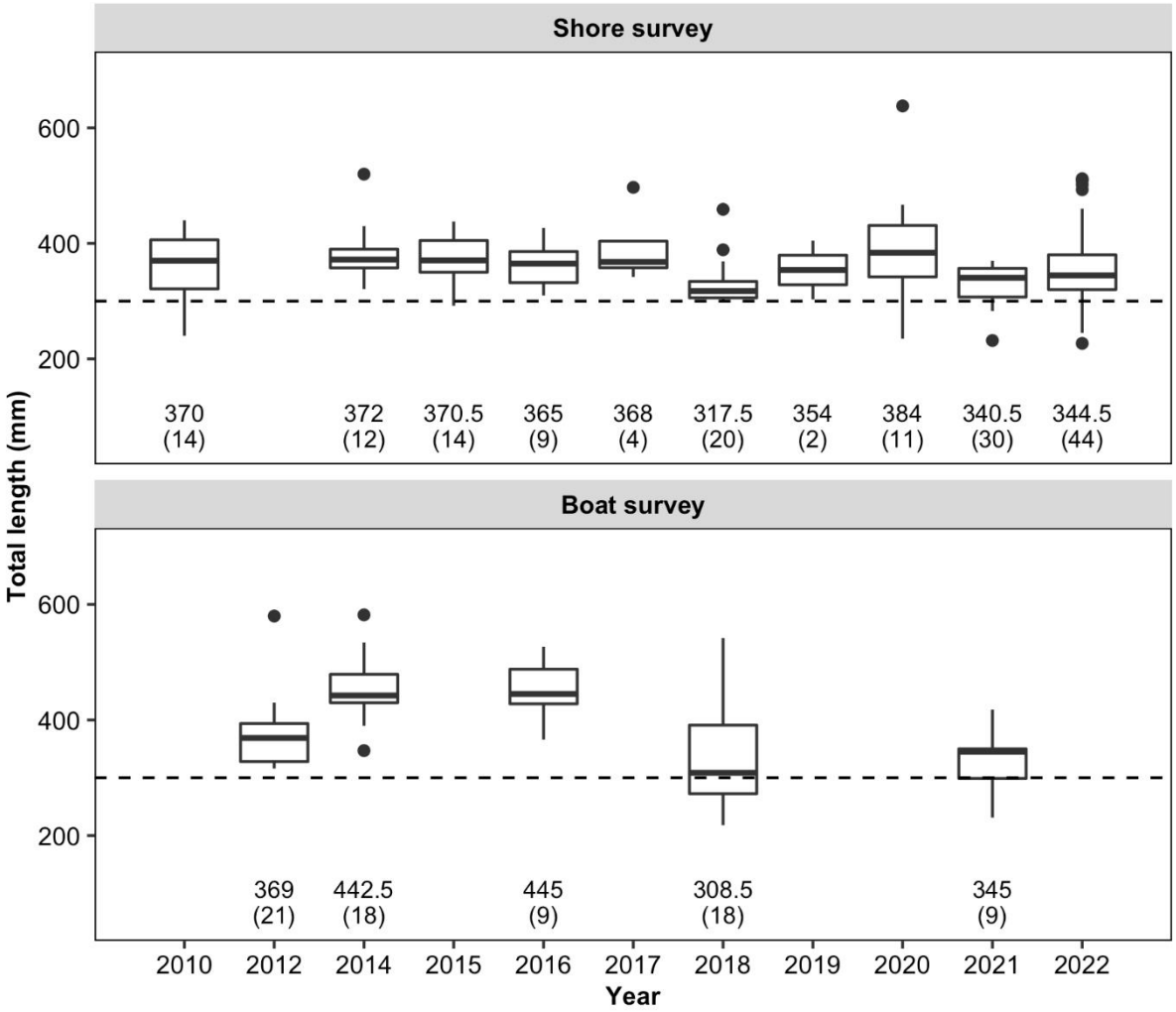

Figure 17 Boxplots summarising the distribution of length data for Tailor retained by shore and boat fishers from roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). Minimum size limit for this species (300 mm) indicated by dashed line.

3.6.5 Western Australian Salmon

Median total length of WA Salmon for the shore survey in 2022 was 537 mm (Figure 18). There were no length measurements obtained for WA Salmon in the boat survey in 2012 or 2021, when comparing the difference in median total length of this species across survey years (2016 and 2018) there was a significant difference (765.5 – 781.5 mm, $X^2 = 7.64, p < 0.05$). There was a significant difference in mean total length across survey years in the shore survey (415 – 777 mm, $X^2 = 35.05, p < 0.05$).

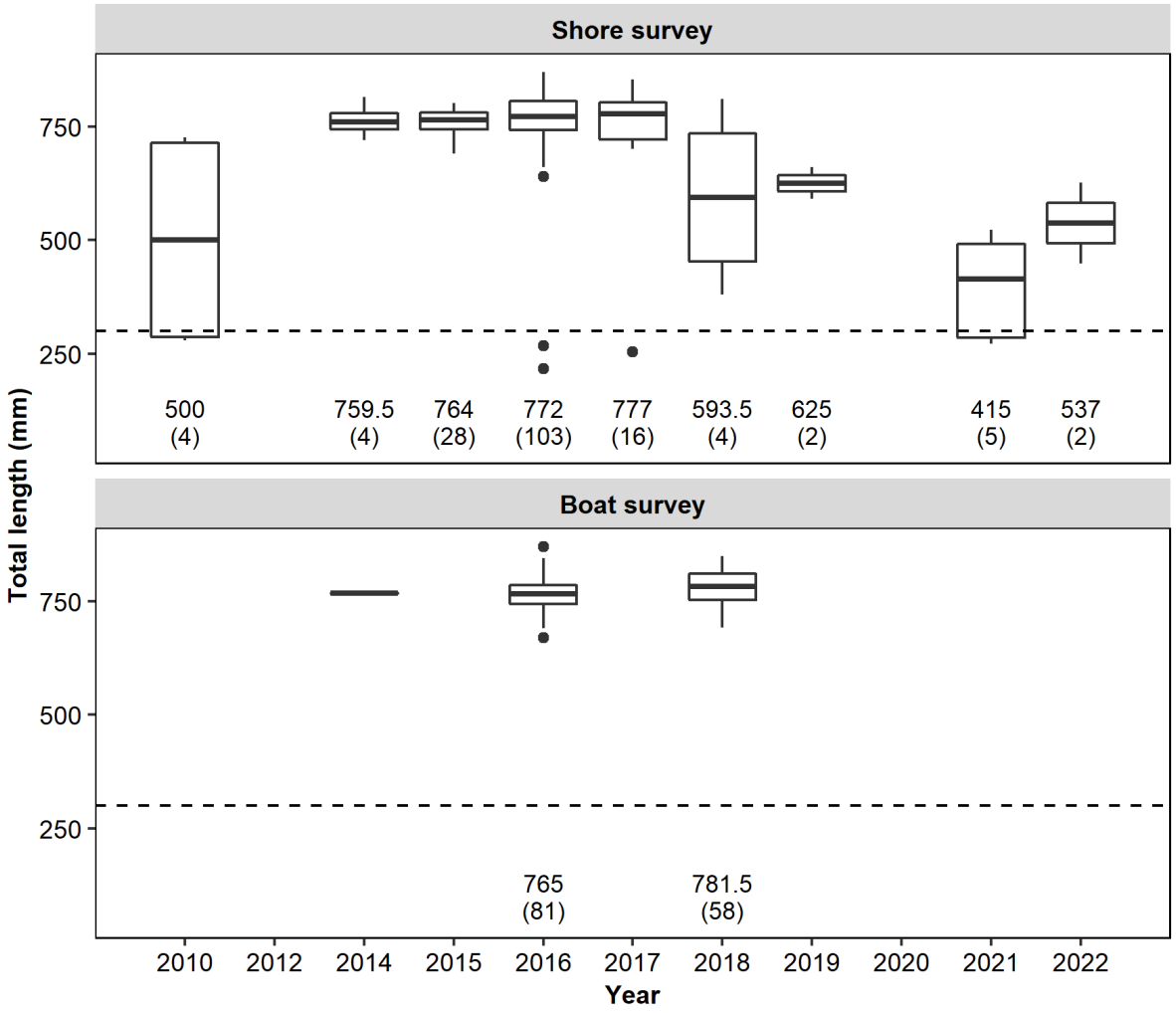

Figure 18 Boxplots summarising the distribution of length data for WA Salmon retained by shore and boat fishers from roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). Minimum size limit for this species (300 mm) indicated by dashed line.

3.6.6 Pink Snapper

Median total length of Pink Snapper for the shore survey in 2022 was 511 mm (Figure 19). There was no significant difference in median total length of Pink Snapper across survey years for the boat (555 – 602 mm, $X^2 = 3.11, p = 0.53$). However, there was a significant difference in median total length for the shore survey (180 – 740 mm, $X^2 = 19.02, p < 0.05$), noting that for some years the sample size was < 5.

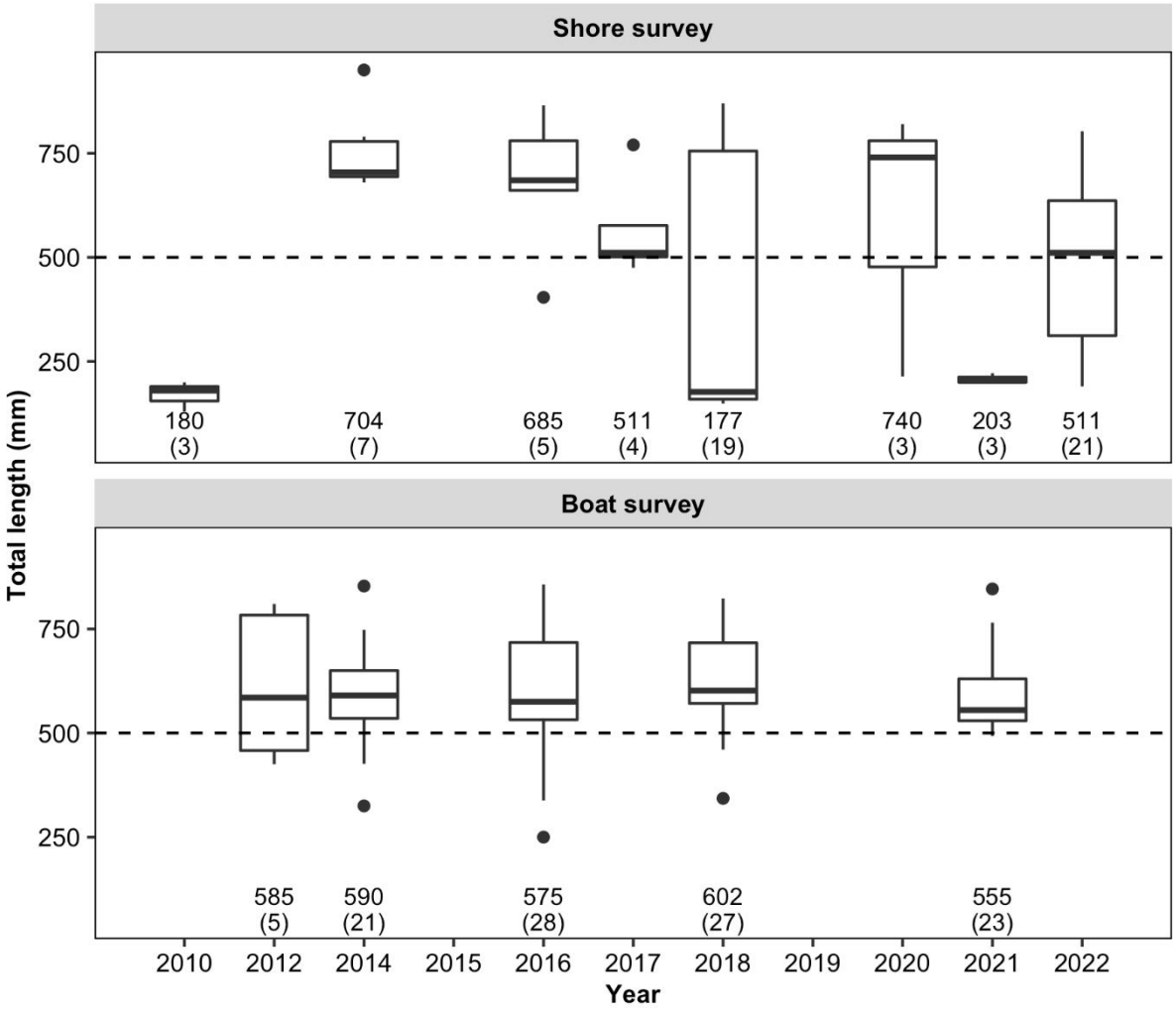

Figure 19 Boxplots summarising the distribution of length data for Pink Snapper retained by shore and fishers from roving creel and boat-ramp surveys including median total length (mm) and sample size (n) (in brackets). Minimum size limit for this species (500 mm) indicated by dashed line.

3.7 Catch per fisher

3.7.1 Australian Herring

The median catch for Australian Herring for the shore survey in 2022 was 2 fish retained per day per fisher, with a high of 3 achieved in 2010 and 2019 (Figure 20). When combined across all years, the median catch was higher for boat fishers (4 fish retained per day per licensed fisher) than shore fishers (2).

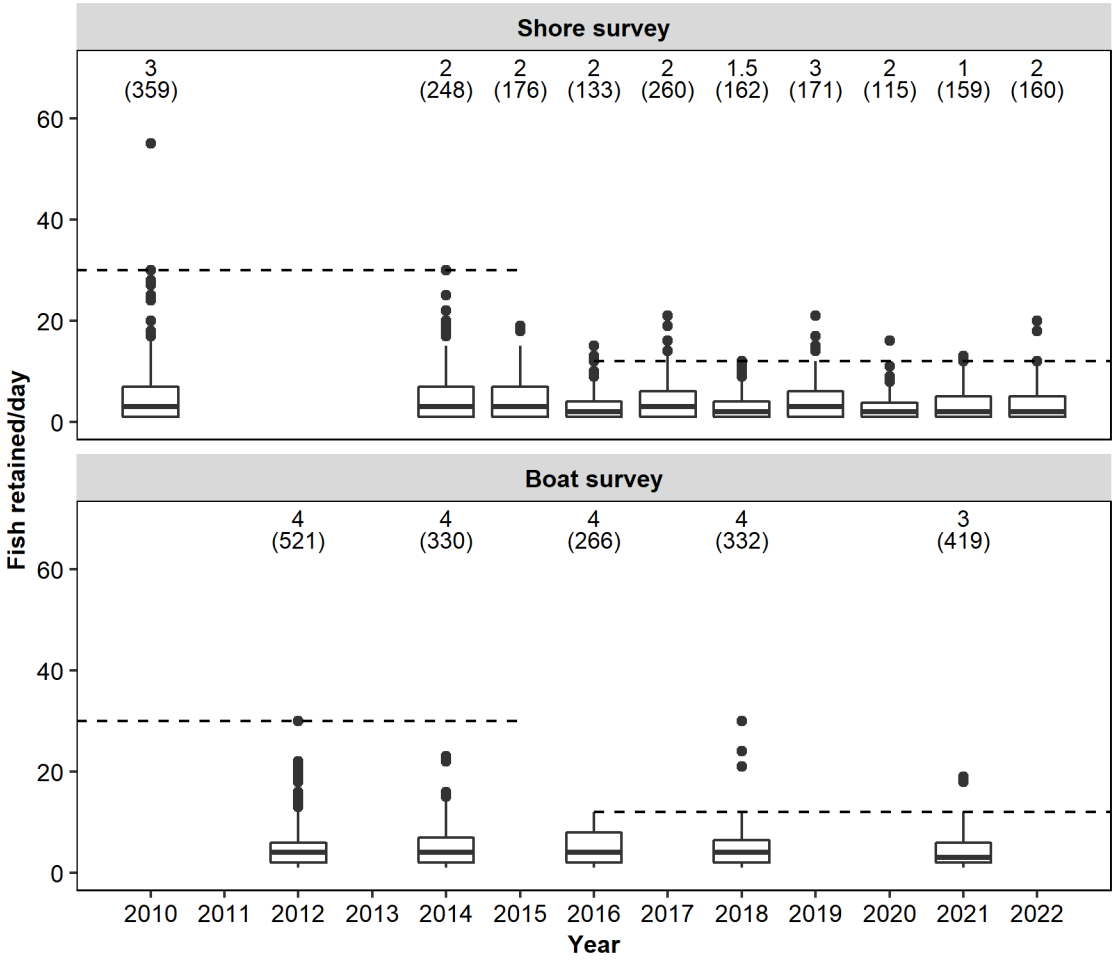

Figure 20 Boxplots summarising the catch frequency for Australian Herring retained by shore (fish retained per day per fisher) and boat fishers (fish retained per day per licensed fisher), calculated from raw data collected during roving creel and phone-diary surveys showing median catch per day and number of interviews (in brackets). Individual species daily bag limit (dashed line) reduced from 30 to 12 on 1 March 2015.

A Kruskal Wallis test showed no significant difference in catch distribution pre- (2010 – 2014; $X^2 = 0.55, p = 0.45$) and post (2015 – 2022; $X^2 = 8.53, p = 0.28$) species management changes when bag limit was reduced from 30 to 12 fish per fisher in 2015. Prior to the management changes <1% of shore and boat fishers were achieving the daily bag limit of 30 fish. The majority of shore (96.7%) and boat (97.2%) fishers retained <12 fish per day across all survey years (Figure 21). Non-compliance with bag limits was low, with <6% of shore and boat fishers exceeding the bag limit in any survey year. After the introduction of the reduced daily bag limit, the proportion of fishers retaining <12 fish per day was 98.4% and 90% for shore and boat fishers, respectively. Non-compliance with bag limits was still low after this change with 3% (n=44) of shore fishers and <1% (n=5) of boat fishers exceeding the daily bag limit of 12 fish (Figure 21).

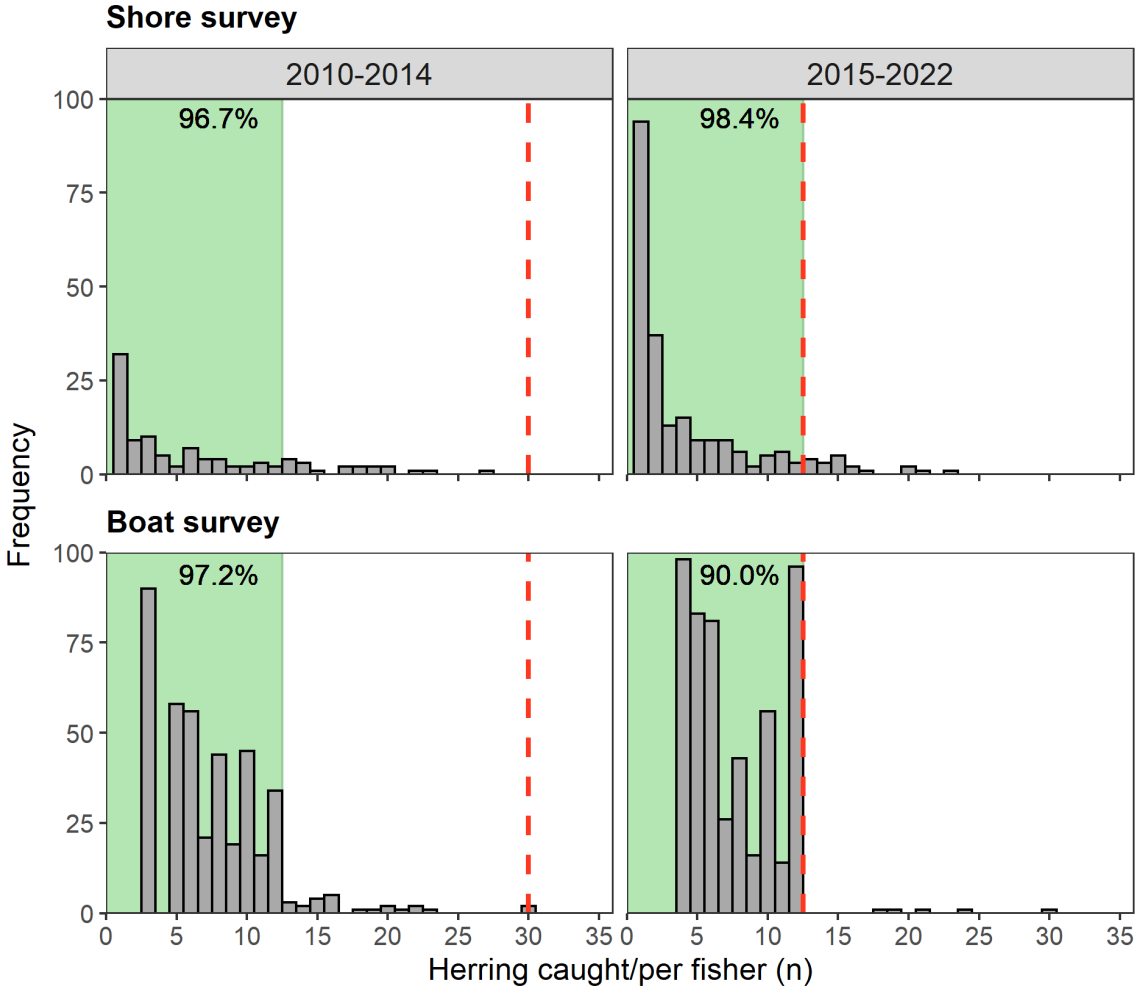

Figure 21 Catch frequency for Australian herring caught (retained + released per fisher) by shore and boat-based fishers in the Perth Metropolitan area between 2010 – 2014 (bag limit = 30) and 2015 – 2022 (bag limit = 12). Percentage of fishers attaining 12 fish (across all survey years) are highlighted by green shading, and dashed red line indicates individual daily bag limit for Australian Herring for each year grouping.

3.7.2 Whiting spp.

The median catch for Whiting spp. for the shore survey in 2022 was 1 fish retained per day per fisher, with a high of 2 achieved in 2015 (Figure 22). The number increased for the boat survey from 7 fish retained per day per licensed fisher in 2012 to 9 in 2018. The overall median catch frequency was higher for boat fishers (8) than shore fishers (2). Non-compliance with bag limits was low, with 2 shore fisher and 2 boat fishers exceeding the daily bag limit of 30 fish.

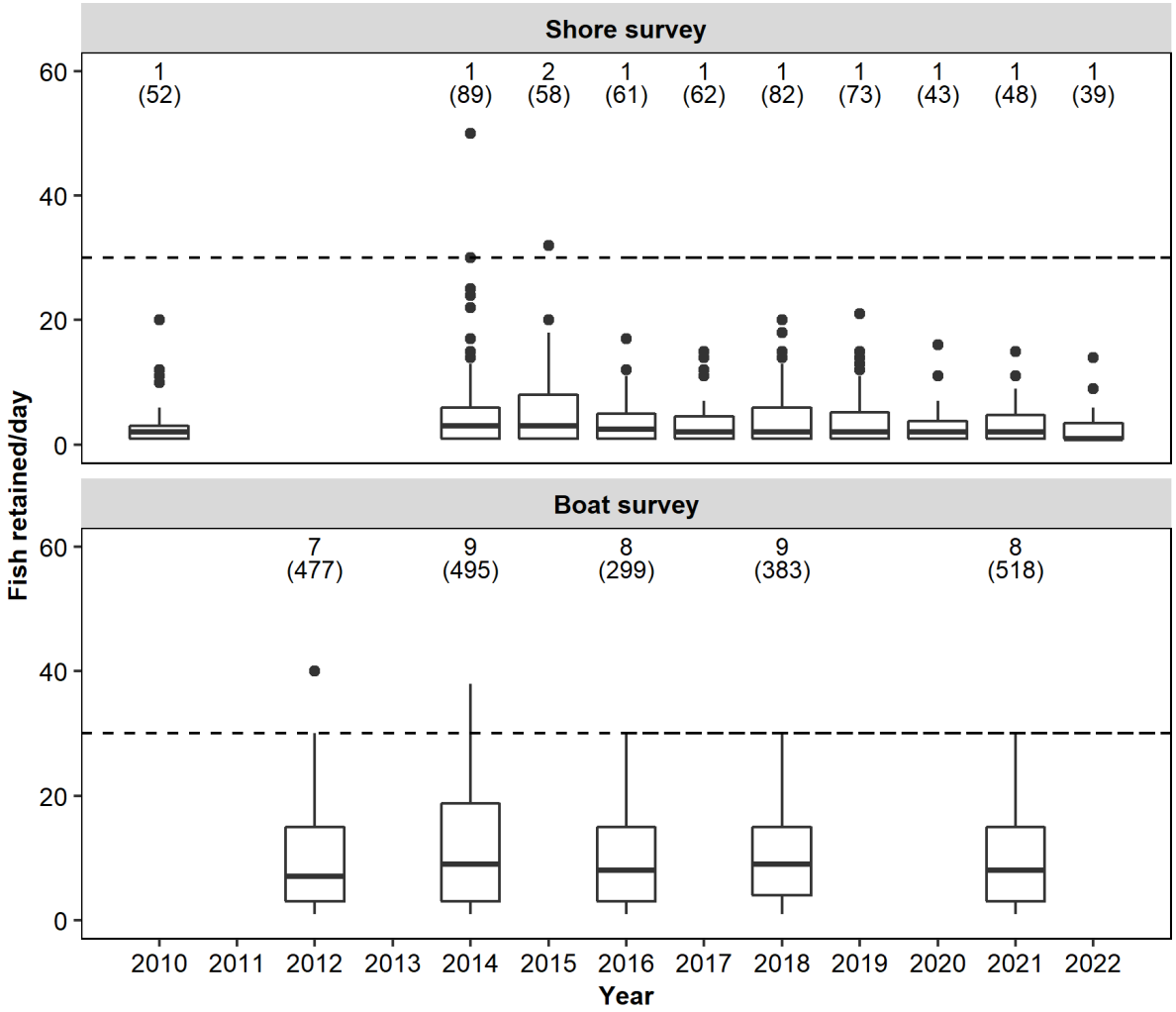

Figure 22 Boxplots summarising the catch frequency for Whiting spp. retained by shore (fish retained per day per fisher) and boat fishers (fish retained per day per licensed fisher), calculated from raw data collected during roving creel and phone-diary surveys showing median catch per day and number of interviews (in brackets). The individual species daily bag limit (dashed line) has been 30 since 2010.

3.7.3 Southern Garfish

The median catch for Southern Garfish for the shore survey in 2022 was <1 fish retained per day per fisher, with a high of 2 achieved in 2020 (Figure 23). The median catch for the shore survey declined from 2010 (2 fish retained per day per fisher) to 2019 (0). The number of fish retained per day per licensed fisher declined for the boat survey from 3 in 2011 to 1 in 2018. The overall median catch frequency was higher for boat fishers (2) than shore fishers (1.5). Non-compliance with bag limits was low, with <1% (n = 1) of shore fishers and no boat fishers exceeding the daily bag limit of 30 fish from 2010 until 2017 when fishing for this species in the survey area closed. However, 14 shore fishers and 14 boat fishers retained catch of this species after the closure commenced.

Figure 23 Boxplots summarising the catch frequency for Southern Garfish retained by shore (fish retained per day per fisher) and boat fishers (fish retained per day per licensed fisher), calculated from raw data collected during roving creel and phone-diary surveys showing median catch per fisher day and number of interviews (in brackets). Individual species daily bag limit (dashed line) was 30 until the fishery was closed in Perth Metropolitan waters in June 2017 (red line).

3.7.4 Tailor

Across all survey years, the median catch for Tailor caught by shore fishers was 1 fish retained per day per fisher and 2 for boat fishers. Non-compliance with bag limits was low, with 1 shore fisher and 1 boat fisher exceeding the daily bag limit of 8 fish.

3.7.5 Western Australian Salmon

Across all survey years, the median catch for WA Salmon was 1 for both shore and boat fishers. Non-compliance with bag limits was low, with 1 shore fisher and no boat fishers exceeding the daily bag limit of 4 fish.

3.7.6 Pink Snapper

Across all survey years the median catch for Pink Snapper for boat fishers and shore fishers was <1. Non-compliance with bag limits was low, with 3 shore fishers and no boat fishers exceeding the daily bag limit of 2 fish.

3.8 Targeting

The top target species (across all survey years) were unspecified demersal fish (27%), Australian Herring (25%), Pink Snapper (*Chrysophrys auratus,8%),* WA Salmon (8%), Tailor (6%)*,* unspecified pelagic fish (6%), Squid *(Family* Teuthoidea, 5%), Whiting spp. (5%), Mulloway (*Argyrosomus japonicas,* 1%) and Silver Trevally (*Pseudocaranx georgianus,* <1%) (Table 3).

Overall, 75% of fishing parties had caught (retained or released) a fish in 2022. This was higher than previous survey years where 51 – 74% of fishing parties had caught a fish. Target species were not specified by 32% of fishing parties. Of these, 44% and 44% of fishers targeting unspecified demersal and pelagic fish, respectively, did not catch a fish. Fishing parties that did catch a fish when targeting unspecified demersal fish species predominantly caught Toadfish (18%), Australian Herring (11%), Tarwhine (9%) and Pink Snapper (7%). Successful fishers targeting unspecified pelagic fish predominantly caught Australian Herring (25%), Toadfishes (Tetraodontidae, 19%), Southern Garfish (6%) and Silver Trevally (5%).

Table 3 Top species targeted by shore fishers in the Perth Metropolitan area and the percentage of fishing parties targeting each one (with rank in brackets). Note: species were selected based on their combined targeting across all survey years.

Common name (Scientific name)	2010	2014	2015	2016	2017	2018	2019	2020	2021	2022
Unspecified Demersal Fish	20% (2)	36% (1)	28% (1)	26% (1)	27% (2)	32% (1)	19% (2)	26% (1)	24% (2)	26% (1)
Australian Herring ***Arripis georgianus***	35% (1)	26% (2)	21% (2)	13% (3)	30% (1)	18% (2)	28% (1)	25% (2)	30% (1)	25% (2)
Western Australian Salmon ***Arripis truttaceus***	5% (6)	3% (8)	12% (3)	25% (2)	14% (3)	7% (4)	6% (7)	3% (9)	1% (10)	<1% (10)
Pink Snapper ***Chrysophrys auratus***	<1% (14)	3% (7)	8% (4)	9% (4)	6% (4)	12% (3)	15% (3)	15% (3)	8% (3)	12% (3)
Unspecified Pelagic Fish	14% (3)	5% (4)	5% (7)	7% (5)	4% (5)	4% (8)	3% (8)	3% (8)	5% (7)	5% (6)
Tailor ***Pomatomus saltatrix***	7% (4)	6% (3)	7% (5)	3% (8)	3% (7)	5% (7)	7% (6)	5% (6)	7% (5)	9% (4)
Whiting spp. **Sillago spp.**	3% (8)	4% (5)	5% (8)	5% (6)	4% (6)	6% (5)	7% (5)	5% (5)	6% (6)	5% (7)
Squid **Teuthoidea**	4% (7)	4% (6)	6% (6)	3% (9)	3% (8)	6% (6)	7% (4)	6% (4)	7% (4)	7% (5)
Mulloway ***Argyrosomus japonicas***	1% (10)	2% (11)	2% (9)	1% (11)	1% (10)	1% (11)	1% (10)	<1% (13)	1% (11)	<1% (13)
Silver Trevally ***Pseudocaranx georgianus***	2% (9)	<1% (24)	<1% (16)	<1% (14)	1% (9)	1% (10)	1% (9)	<1% (22)	2% (9)	<1% (25)
Garfish spp. ***Hyporhamphus melanochir &*** ***Hemiramphus robustus***	5% (5)	1% (12)	1% (10)	<1% (16)	<1% (15)	<1% * (18)	<1% * (20)	1% * (11)	<1% * (21)	- * (36)

* Perth Metropolitan waters closed to Southern Garfish fishing.

3.8.1 Australian Herring

Australian Herring was one of the most frequently targeted species in any survey year (Table 3). In 2022, this species was targeted by 25% (n = 345) of shore fishing parties and 31% (n = 93, 95% CI 26 – 36%) of these parties were successful in catching (retained or released) one or more of this species (Figure 24). This trend remained steady from 2010 to 2019 (as indicated by overlapping confidence intervals) however, post 2019 there has been a steady decline.

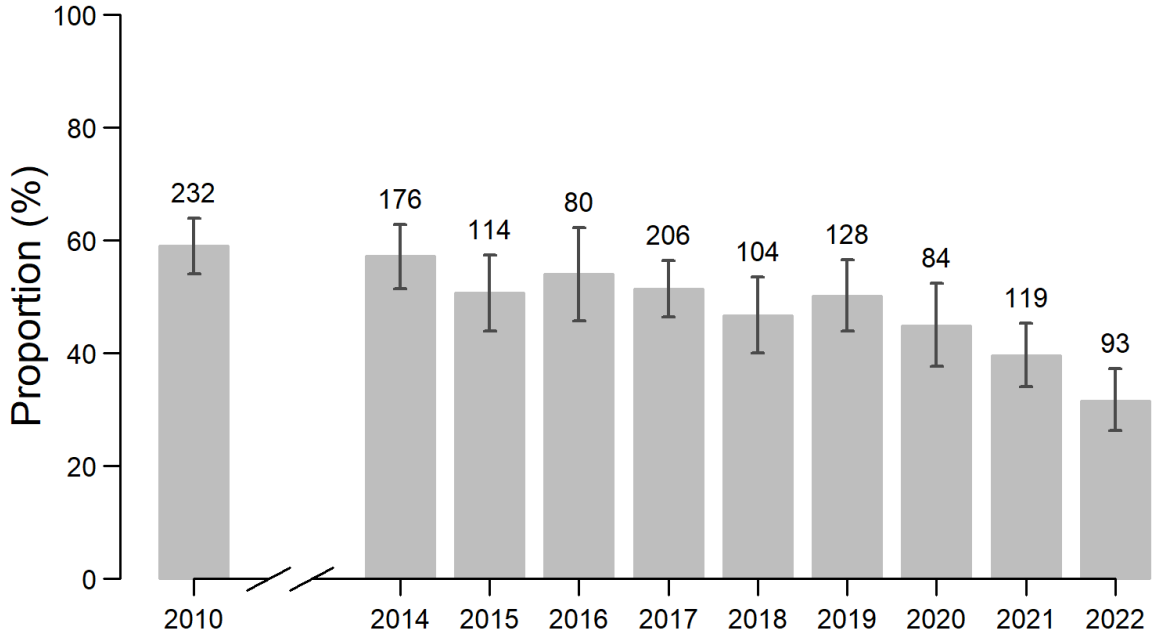

Figure 24 Proportion (95%CI), and number (indicated at top of each bar) of shore fishing parties successful in catching (retained or released) an Australian Herring when targeting this species.

3.8.2 Whiting spp.

Whiting spp. were targeted by 5% (n = 65) of shore fishing parties in 2022, which was within the range of all previous years (3 – 7%) (Table 3). In 2022, 29% (95% CI 17 – 44%) of shore fishing parties targeting Whiting spp. were successful in catching one or more of this species. This trend remained steady across all survey years (Figure 25).

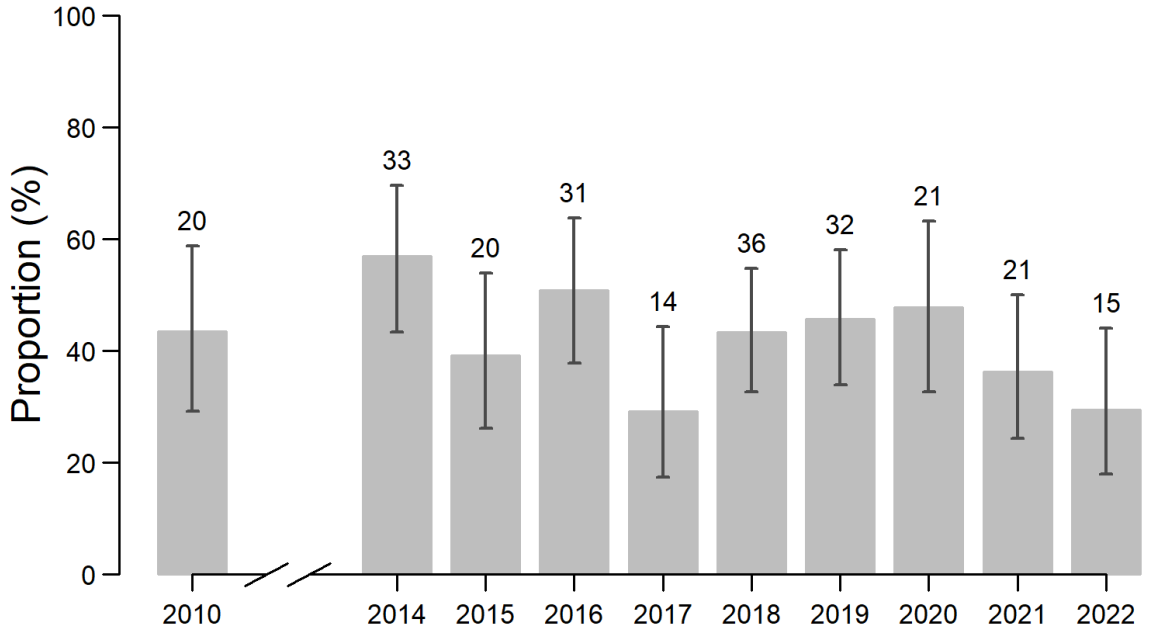

Figure 25 Proportion (95%CI) and number (indicated at top of each bar) of shore fishing parties successful in catching (retained or released) a Whiting spp. when targeting this species.

3.8.3 Garfish spp.

Fishing parties targeting Garfish spp. included all species from Family Hemiramphidae, namely Southern Garfish and Robust Garfish (*Hemiramphus robustus*), which are distributed in Perth Metropolitan waters. Garfish spp. were targeted by 5% of shore fishing parties in 2010 but this proportion declined to <1% in all subsequent survey years (Table 3). In 2022, no shore fishing parties targeted Garfish spp. (Figure 26).

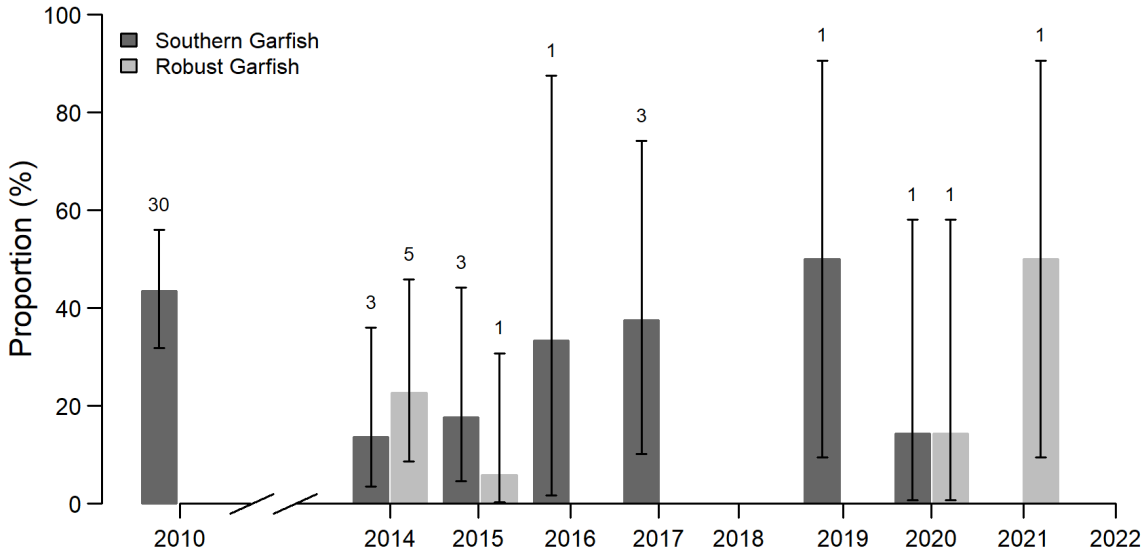

Figure 26 Proportion (95%CI) and number (indicated at top of each bar) of shore fishing parties successful in catching (retained or released) Southern or Robust Garfish when targeting Garfish spp. (*H. melanochir and H. robustus*).

3.8.4 Tailor

Tailor were targeted by 9% (n=130) of shore fishing parties in 2022, which was the highest of all survey years (3 – 9%) (Table 3). In 2022, 9% (n=6) of shore fishing parties targeting Tailor were successful in catching one or more of this species (Figure 27).

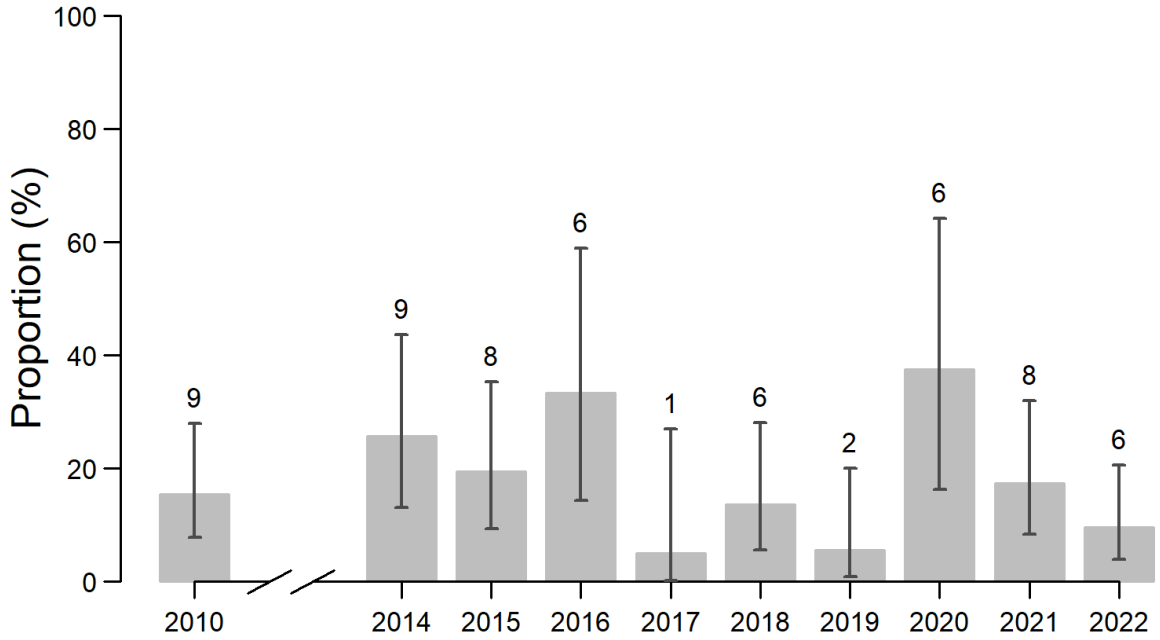

Figure 27 Proportion (95%CI) and number (indicated at top of each bar) of shore fishing parties successful in catching (retained or released) Tailor when targeting this species.

3.8.5 Western Australian Salmon

WA Salmon were targeted by <1% (n=17) of shore fishing parties in 2022 (Table 3). The proportion targeting this species varied between survey years, with a peak of 25% in 2016, with all others between 3 – 14%. In 2022, no shore fishing parties targeting WA Salmon was successful in catching a fish. The success of fishers catching this species was low from 2017 – 2020 (0 – 5% fishers targeting) compared with earlier surveys from 2010 – 2016 (8 – 20%) (Figure 28).

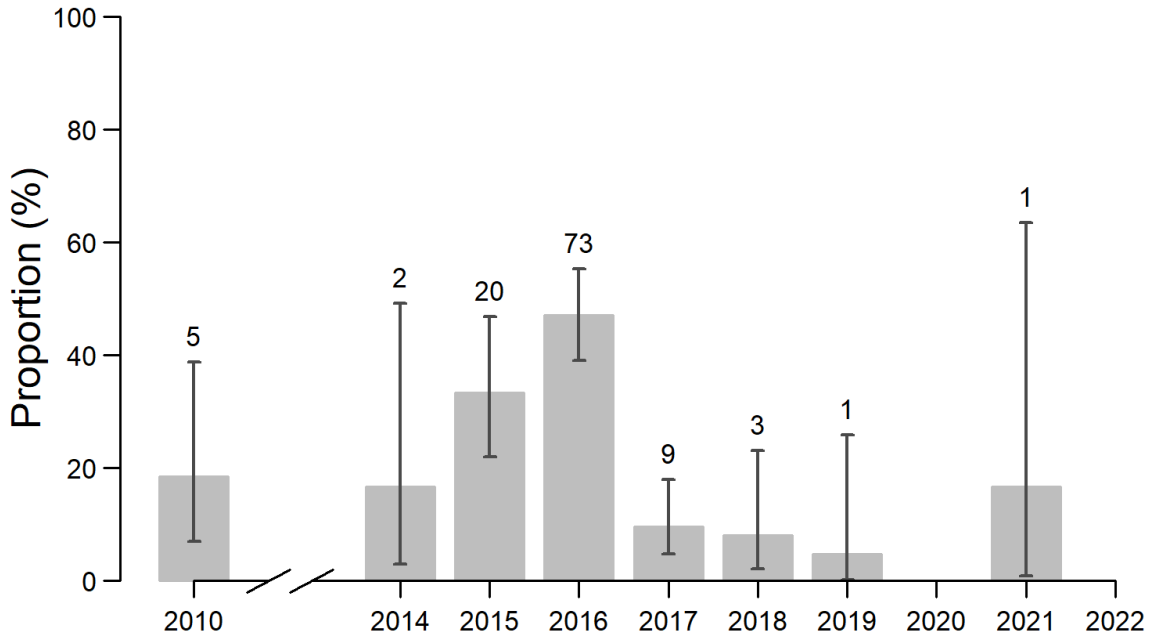

Figure 28 Proportion (95%CI) and number (indicated at top of each bar) of fishing parties successful in catching (retained or released) a Western Australian Salmon when targeting this species.

3.8.6 Pink Snapper

Pink Snapper were targeted by 12% (n=164) of shore fishing parties in 2022 and has been the third most frequently targeted species annually since 2018 (12 – 15%) (Table 3). This has increased from 2010 where <1% of fishing parties were targeting this species. In 2022, 36% (n=24) of fishing parties targeting Pink Snapper were successful in catching a fish. The success of fishers catching this species was low from 2019 – 2021 (0 – 10%) when compared with earlier surveys in 2014 (28%), 2017 (20%) and 2018 (24%), although the variability was high in all survey years (Figure 29).

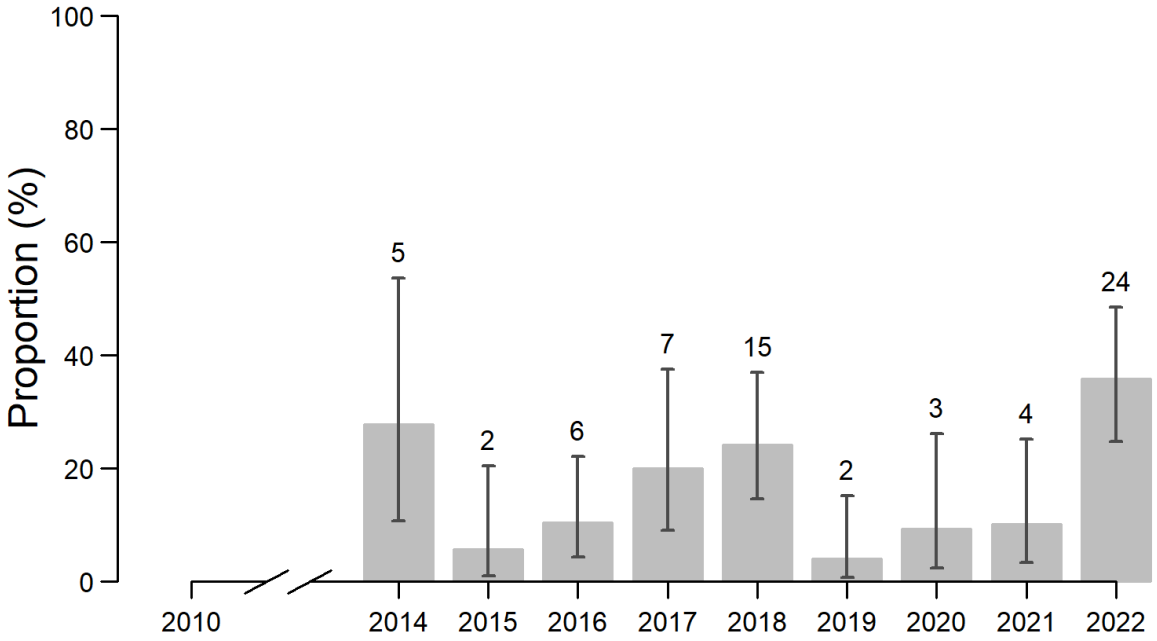

Figure 29 Proportion (95%CI) and number (indicated at top of each bar) of fishing parties successful in catching (retained or released) a Pink Snapper when targeting this species.

4.0 Discussion

Unlike boat-based recreational fishing, there are no statewide estimates of total catch and effort for shore-based recreational fishing in WA. Prior to 2014, *ad hoc* roving creel surveys had provided intermittent data on fishing effort and total catch to meet specific research objectives (Tate et al., 2020b). However, since 2014 a roving creel survey has used a consistent spatio-temporal sampling frame to provide annual estimates of fishing effort, total catch and standardised harvest rate for key nearshore species (Australian Herring, Whiting spp., Southern Garfish, Tailor, Western Australian Salmon and Pink Snapper) in the Perth Metropolitan area. The five-month survey period was selected as it covers a large proportion of the peak period of fishing activity in this area.

4.1 Trends in the nearshore shore-based recreational fishery

Fishing effort by shore fishers in the Perth Metropolitan area has been relatively consistent across all survey years, however, there has been some decline since a peak in 2016. A possible reason for this peak could be fishing activity related to the strong WA Salmon migration in that year, as indicated by increased targeting and harvest of this species.

Australian Herring has contributed the highest proportion of retained catch in all survey years (up to 64%). Whiting spp. was the second ranked species in all years except 2010 and 2022, where this position was held by Southern Garfish and Australian Sardine, respectively. This was similar to boat fishers, in which Australian Herring and Whiting spp. contributed the highest proportions to the total catch (by numbers) for the Metropolitan zone across the 12-month survey period (Ryan et al., 2022). Silver Trevally and Squid were other species frequently caught (retained or released) by both shore and boat fishers, while Yellowtail Scad (*Trachurus novaezelandiae*), Scaly Mackerel (*Sardinella lemuru*), and Western Striped Grunter and Western Butterfish ranked consistently in the top-ten species caught by shore fishers only.

The overall (all species combined) release rate by shore fishers increased over time from 17% in 2010 up to 54% in 2022. Release rates for Pink Snapper by shore fishers were the highest of the key species (95 – 99%) whereas boat fishers in the Perth Metropolitan Zone release rates ranged from 70 – 78% (Ryan et al., 2022, 2019, 2017, 2015, 2013). Release rates for Australian Herring by shore fishers was lower (5 – 12%) than boat fishers (15 – 24%) across all survey years. A similar pattern was also seen for Whiting spp. with 7 – 23% released by shore fishers and 20 – 24% released by boat fishers. Although the reason for releasing fish is unknown for shore fishers, the main reason identified by boat fishers for releasing Australian Herring and Whiting spp. was “too small”, which relates to the fish being too small in terms of personal preference (Ryan et al., 2022). However, the main reason for releasing Pink Snapper was “undersize”, which indicates catches below the Minimum Legal Limit (MLL).

Australian Herring was also the most frequently targeted (13 – 35%) species in all survey years. Fishing parties targeting this species were also successful in catching

one or more during their fishing trip (31 – 45%). Of the 5% of the shore fishing parties targeting Whiting spp., 21 – 47% were successful in catching a fish. The targeting preferences of shore fishing parties also changed depending on the availability of a species, such as occurred in 2016 which was a particularly strong year for the migration of WA Salmon. This resulted in both targeting and catches of this species increasing. The reasons for recreational fishing are varied, from catching a feed, to relaxing, and although fishers may be satisfied with their fishing trip without catching a fish, understanding the likelihood of catching a fish may be a useful measure of angler satisfaction (Frijlink and Lyle, 2010; Ogier et al., 2018).

A national recreational fishing survey used off-site survey methods to estimate catch and effort of boat- and shore-based fishing, finding catches of nearshore species were higher from shore fishers than boat fishers (Henry and Lyle, 2003). However, the differences in the spatial and temporal frame of the current roving creel and phone diary surveys do not allow for an ongoing comparison between the harvest of key species which may be caught by boats and the shore, such as Pink Snapper. Each survey method achieves its desired objectives by providing estimates of fishing effort and total catch at broad-scales (phone-diary survey) and small-scales (roving creel survey). Without additional sampling of shore fishers, direct comparison of the proportion of catch obtained from each fishing platform cannot be undertaken. Implementing on-site surveys across broad-scales are generally cost-prohibitive while without a licence, off-site methods are not able to be applied to this fishery.

Every effort is made to ensure that data collected from these roving creel surveys is both accurate and provided in a timely manner, However, there may be circumstances where additional QA/QC of data may identify data errors which may only be corrected for outside of the reporting period. These factors may lead to some estimates being revised and reported differently to previous years.

4.2 Management

The management arrangements for many nearshore species in the West Coast Bioregion are focused on bag and size limits, with few spatial and temporal closures (DPIRD, 2021). An exception to this is the closure of Perth Metropolitan waters to fishing for Southern Garfish in 2017 (Smith et al., 2017).

There are MLLs in place for three of the focus species for this report; Tailor, WA Salmon and Pink Snapper. Compliance with MLL was high, especially for Tailor and WA Salmon, with less than 10% of random length measurements in both the boat and shore survey being undersize. For Pink Snapper, 43% of those retained were undersized. Juvenile Pink Snapper have similar biological characteristics to Tarwhine (*Rhabdosargus sarba*) and Black bream (*Acanthopagrus butcheri*) which could explain the higher non-compliance for this species in the shore survey, where the likeness could confuse less avid fishers catching these species.

The daily bag limit for Australian Herring was reduced from 30 to 12 in 2015 (Smith et al., 2013a). Prior to the introduction of bag limit changes, very few shore or boat fishers were achieving the daily bag limit of 30 fish (less than <1%), and 10% were achieving the proposed daily bag limit of 12 fish. Reduction in the daily bag limit therefore affected very few recreational fishers. The proportion of fishers achieving the daily bag

limit since 2015 has remained relatively consistent for both boat 2 – 17% and shore fishing 0 – 3%. Additional bag limit changes are being implemented in October 2022 which will see the daily bag limit increased to 20 fish. Prior to 2015 the proportion of fishers retaining >20 fish was 7% for boat fishers and 2% for shore fishers. It should be noted that the roving creel survey collects incomplete trip information, intercepting fishers during their fishing activity, whereas boat surveys collect data on the total number of fish retained per trip (i.e., complete trip information).

Compliance with bag limits for other key species was very high with <1% of fishers exceeding the daily bag limit for Whiting, Tailor, WA Salmon and Pink Snapper. However, 6% of fishers were non-compliant with bag limits and spatial closures for Southern Garfish. There was no catch for this species in 2021, with negligible catches (<1 t) from 2014 – 2020. This could be for a number of reasons including, misidentification with the closely related Robust Garfish, lack of awareness of the closure, or deliberate ignorance of fishing rules.

There have been no recent changes to the management regulations to Whiting spp., Tailor and WA Salmon. The long-term monitoring of these and other nearshore species is important to provide an understanding of changes in catches over time, and to be incorporated into stock assessments to inform potential management changes. There is also a need to understand catches of demersal species, such as Pink Snapper, that are caught from boats and the shore.

The current roving creel survey is undertaken in a single location (Perth Metropolitan area) which is assumed to be representative of broader stocks and fishing activity. However, many nearshore species are distributed across the West Coast and South Coast bioregions, which have different management arrangements for some species. Additional survey locations could be selected in these bioregions to monitor and compare fishing effort, catch rate and total catch with the existing roving creel survey.

There are a broad range of environmental, biological variables and management changes that can affect recreational fishing. The significant annual variability in the catches of some species may be linked to environmental rather than management changes. Similar to data obtained from commercial fisheries, fishery-dependent data from shore-based recreational fisheries are subject to influential factors that can affect variability in harvest rate. These indices can be used for assessing the status of individual species or a fishery, and in some cases, as indicators of stock abundance. The harvest rates for Australian Herring and Whiting spp. are lower in 2022 when compared to 2010. These results are consistent with fishery-independent and dependent sampling around the same time (Smith *et al*., 2017; Smith *et al*., 2013a).

4.3 Future research

Roving creel surveys of shore fishers are required to continue to help inform management of nearshore species until more cost-effective catch and effort data for shore-based recreational fishing are available. Several areas have been identified which could further assist with improving the knowledge of shore-based recreational fishing including; recent statewide surveys of RBFL holders which have collected data on their shore fishing activity, catch reconstruction (utilising a variety of data and information sources to construct a time series of catch estimates) and further

development of an index of standardised harvest rate for key species. Current monitoring in the Perth Metropolitan area is limited to a small section of the coastline, however, there is significant development occurring along the coast (i.e. Westport, Ocean Reef Marina Development) (Government of Western Australia, 2020; Westport Port and Environs Strategy, 2020) and in the waters of the metropolitan zone, and thus it is important that the scale of this survey be reconsidered to include shore fishing in these areas.

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7.0 Appendices

Appendix 1 Summary of changes to management arrangements of recreational catches of key nearshore finfish species in the West Coast bioregion.

Year	Bag Limit	MLL	Spatial closure
Australian Herring *Arripis georgianus*			
1913		152mm	
1937		178mm	
1986		180mm	
1991	40		
2009	30		
2015	12		
2022	20		
Tailor *Pomatomus saltatrix*			
1913		230mm	
1973		229mm	
1975		250mm	
1991	20	250mm	
1995	8	250mm	
2003	8	300mm	
2009	8	300mm (2 fish over 500mm)	
Whiting spp. *Sillago* spp.			
1913		230mm	
1960		216mm	
1975		220mm	
1991	40		
2009	30		
2013	30		
Southern Garfish *Hyporhamphus melanochir*			
1959		230mm	
1991	40	230mm	
2009	30		
2013	30		
2017			Perth Metropolitan waters
Western Australian Salmon *Arripis truttaceus*			
1913		241mm	
1975		230mm	
1977		300mm	
1979	5	300mm	
1991	4	300mm	
Pink Snapper *Chrysophrys auratus*			
1913		279mm	
1974		380mm	
1975	10	380mm	
1992	8	410mm	
1996	8	410mm (2 fish over 700mm)	
2003	4	410mm	Cockburn Sound (15 Sep to 31 Oct)
2005	4	410mm (1 fish over 700mm)	Cockburn and Warnbro Sound (1 Oct to 31 Jan)
2008	2	450mm (1 fish over 700mm)	
2009	2	500mm (1 fish over 700mm)	West Coast Bioregion (15 Oct to 15 Dec)

Appendix 2 Summary table for each survey year, survey days, number of interviews, average (Av) party size, number of retained fish, and number of measured fish in the roving creel surveys.

Year	Survey days	Interviews (n) (Av/day)	Party size (Av)	Retained (n)	Measurements (n)
2010	38	1,640 (31)	2	3,744	1,083
2014	60	1,729 (24)	2	2,649	1,581
2015	60	1,532 (21)	2	1,707	1,219
2016	60	1,738 (25)	2	1,200	901
2017	60	2,012 (26)	2	2,022	1,567
2018	60	1,845 (25)	2	1,394	926
2019	60	1,302 (18)	2	1,574	1,329
2020	60	1,169 (18)	2	878	791
2021	60	1,408 (23)	2	1,253	1,041
2022	60	1,163 (19)	2	1,505	1,452

Appendix 3 Mean weight (grams) for key nearshore species by year for roving creel (shore) survey and boat ramp (boat) surveys between 2010 – 2022.

Note: length-weight equations used to convert random length samples obtained during the roving creel survey to weight are indicated in the table.

Year	Shore survey				Boat survey			
	n	median	mean	±95%CI	n	median	mean	±95%CI
Australian Herring [$W=1.44*10^{-5}TL^{2.94}$ (Gaughan et al., 2006)]								
2010	761	166	175	3.3				
2011/12					109	128	132	4.8
2014	1,092	166	167	2.5	304	116	120	3.4
2015	813	162	168	2.7				
2016	450	172	184	4.8	279	128	131	3.1
2017	1,133	179	183	3.2				
2018	441	157	172	5.7	421	140	139	2.8
2019	820	168	172	2.7				
2020	370	171	176	4.6				
2021	560	155	164	3.2	358	126	126	5.1
2022	628	177	179	2.6				
Combined	7,069	168	174	1.1	1,471	127	130	1.8
Whiting spp. [$W=1.3*10^{-5}TL^{2.964}$ (Smallwood et al., 2018)]								
2010	59	37	47	8.5				
2011/12					237	111	118	5.6
2014	189	41	54	5.4	472	101	103	3.6
2015	160	49	56	4.3				
2016	168	44	53	5.8	343	88	93	3.6
2017	160	44	49	4.0				
2018	197	42	58	6.7	566	94	102	3.7
2019	236	34	37	1.9				
2020	166	37	44	4.7				
2021	137	58	61	5.8	893	98	100	2.7
2022	113	37	49	6.2				
Combined	1,585	40	50	1.7	2,511	97	102	1.6
Southern Garfish [$W=5.2724*10^{-7}TL^{3.3520}$ (Smith et al., 2017)]								
2010	144	132	147	10.3				
2011/12					27	124	127	13.5
2014	32	190	196	25.7	17	111	108	10.6
2015	11	96	97	18.9				
2016	9	99	110	29.6	15	92	101	12.9
2017	26	82	85	6.9				
2018	26	62	71	11.8	6	88	99	29.0
2019	5	66	86	38.3				
2020	13	105	118	30.2				
2021					2	114	114	22.5
2022	7	90	115	54.5				
Combined	273	118	133	8.0	67	112	112	7.4
Tailor [$W=0.7*10^{-5}TL^{3.0415}$ (Smith et al., 2013b)]								
2010	14	454	445	101.6				

Year	Shore survey				Boat survey			
	n	median	mean	±95%CI	n	median	mean	±95%CI
2011/12					21	434	527	125.9
2014	12	461	532	149.0	18	842	853	134.4
2015	14	455	488	84.9				
2016	9	435	447	97.0	9	703	825	173.4
2017	4	446	590	343.6				
2018	20	285	336	64.7	18	256	402	148.8
2019	2	422	422	343.0				
2020	11	507	669	362.9				
2021	30	352	334	31.8	20	372	370	42.4
2022	44	364	460	86.7				
Combined	160	381	444	42.0	86	438	565	69.2
Western Australian Salmon [$W=1.3*10^{-6}TL^{3.36}$ (Gaughan et al., 2006)**]**								
2010	4	2,594	2,678	2,773.1				
2011/12								
2014	4	6,204	6,355	1,084.5	1	4,619	4,619	
2015	28	6,327	6,230	283.4				
2016	103	6,551	6,549	296.9	81	4,499	4,506	123.4
2017	16	6,695	6,171	990.0				
2018	4	3,122	3,637	3,243.9	58	4,646	4,681	152.4
2019	2	3,262	3,262	1,189.7				
2020								
2021	5	814	887	614.6				
2022	2	2,146	2,146	2,142.3				
Combined	168	6,354	6,034	300.4	140	4,574	4,579	96.0

Appendix 4 Estimated annual catch (total, retained and released numbers) and proportion released in roving creel surveys conducted in the Perth Metropolitan area in 2022. Note: values in bold indicate RSE>40% (i.e., non-robust).

Reporting group	Common Name	Scientific Name	Retained	SE	Released	SE	% Rel
Boxfish	Western Smooth Boxfish	*Anoplocapros amygdaloides*	27		0		0
	Boxfishes	Ostraciidae - undifferentiated	0		22		100
Bream	Pink Snapper	*Chrysophrys auratus*	**407**	**444**	**18,717**	**10,396**	98
	Tarwhine	*Rhabdosargus sarba*	**2,072**	**1,511**	**11,881**	**5,326**	85
	Breams	Sparidae - undifferentiated	0		**5,572**	**5,308**	100
Bullseye	Bronze Bullseye	*Pempheris analis*	33		0		0
Butterfishes & Pomfrets	Butterfishes & Pomfrets	Stromateidae - undifferentiated	**1,750**	**9,766**	**151**	**845**	8
Cardinalfish	Gobbleguts	*Apogon rueppellii*	0		62		100
	Western Striped Cardinalfish	*Ostorhinchus victoriae*	**271**	**828**	**103**	**469**	28
Catfish	Estuary Cobbler	*Cnidoglanis macrocephalus*	**41**	**229**	**437**	**2,441**	91
Cephalopods	Gould's Squid	*Nototodarus gouldi*	**2,210**	**1,014**	0		0
	Southern Calamari	*Sepioteuthis australis*	**5,785**	**5,844**	0		0
	Squid	Order Teuthoidea - undifferentiated	**2,168**	**3,599**	**137**	**195**	6
	Cuttlefish	*Sepia spp.*	**699**	**923**	0		0
	Octopuses	Octopodidae - undifferentiated	**239**	**563**	**48**	**136**	17
Damselfishes	Mcculloch's Scalyfin	*Parma mccullochi*	66		0		0

Reporting group	Common Name	Scientific Name	Retained	SE	Released	SE	% Rel
	Scalyfin	*Parma victoriae*	663		0		0
Drummer	Silver Drummer	*Kyphosus sydneyanus*	0		**481**	**1,820**	100
Eels	Eel	Colocongridae - undifferentiated	0		43		100
Flatfish	Smalltooth flounder	*Pseudorhombus jenynsii*	**42**	**17**	0		0
Flathead	Southern Bluespotted Flathead	*Platycephalus speculator*	21		0		0
	Flatheads	Platycephalidae - undifferentiated	**262**	**1,196**	**267**	**814**	50
Garfish	Southern Garfish	*Hyporhamphus melanochir*	**155**	**708**	**163**	**185**	51
	Three-By-Two Garfish	*Hemiramphus robustus*	**168**	**734**	0		0
	Garfishes	Hemiramphidae - undifferentiated	0		**6,197**	**11,201**	100
Giant Perch	Sand Bass	*Psammoperca waigiensis*	0		50		100
Goatfish	Goatfishes	Mullidae - undifferentiated	0		36		100
Grunter	Western Striped Grunter	*Pelates octolineatus*	**6,329**	**5,882**	**12,320**	**9,301**	66
	Striped Grunters	Terapontidae - undifferentiated	0		**4,339**	**17,284**	100
Herring	Scaly Mackerel	*Sardinella lemuru*	**1,558**	**5,820**	**414**	**1,427**	21
Jewfish	Mulloway	*Argyrosomus japonicus*	**41**	**229**	**29**	**159**	41
Leatherjacket	Leatherjackets	Monacanthidae - undifferentiated	0		**558**	**661**	100
Lizardfish	Sergeant Baker	*Latropiscis purpurissatus*	0		16		100

Reporting group	Common Name	Scientific Name	Retained	SE	Released	SE	% Rel
Mackerel	Blue Mackerel	*Scomber australasicus*	**1,466**	**1,711**	0		0
Mullet	Sea Mullet	*Mugil cephalus*	994		0		0
	Yelloweye Mullet	*Aldrichetta forsteri*	**897**	**4,148**	0		0
Pike	Snook	*Sphyraena novaehollandiae*	**1,564**	**4,091**	**184**	**546**	10
	Yellowtail Barracuda	*Sphyraena obtusata*	**273**	**694**	**243**	**697**	47
Rabbitfish	Rabbitfish	*Siganus spp.*	0		197		100
Rays	Ray	Dasyatidae, Gymnuridae, Myliobatidae & Urolophidae spp.	**23**	**131**	**83**	**324**	78
	Southern Fiddler Ray	*Trygonorrhina dumerilii*	0		36		100
	Stingrays	Dasyatidae - undifferentiated	0		**582**	**1,557**	100
Salmon Herring	Australian Herring	*Arripis georgianus*	50,748	13,205	5,970	2,091	10
	Western Australian Salmon	*Arripis truttaceus*	**62**	**230**	0		0
Small Baitfish	Australian Sardine	*Sardinops sagax*	**11,089**	**25,738**	**547**	**2,492**	5
Sharks	Cobbler Wobbegong	*Sutorectus tentaculatus*	0		197		100
	Port Jackson Shark	*Heterodontus portusjacksoni*	**31**	**172**	**62**	**343**	66
	Sharks	Sharks - undifferentiated	0		**257**	**396**	100
Tailor	Tailor	*Pomatomus saltatrix*	**3,045**	**2,931**	**3,254**	**2,174**	51
Threadfin Bream	Western Butterfish	*Pentapodus vitta*	**16,422**	**13,272**	**6,043**	**3,744**	27

Reporting group	Common Name	Scientific Name	Retained	SE	Released	SE	% Rel
Toadfish	Silver Toadfish	*Lagocephalus sceleratus*	0		**4,748**	**3,057**	100
	Weeping Toadfish	*Torquigener pleurogramma*	0		19,851	7,916	100
	Toadfishes	Tetraodontidae - undifferentiated	**1,026**	**1,145**	55,518	19,909	98
Trevally	Samsonfish	*Seriola hippos*	34		0		0
	Silver Trevally	*Pseudocaranx georgianus* spp. complex	**1,399**	**1,417**	**3,365**	**1,400**	71
	Yellowtail Scad	*Trachurus novaezelandiae*	**11,129**	**8,019**	**655**	**765**	6
	Trevallies	Carangidae - undifferentiated	0		**211**	**494**	100
Tuskfish Wrasse	Brownspotted Wrasse	*Notolabrus parilus*	**461**	**544**	**692**	**547**	60
	Foxfish	*Bodianus frenchii*	0		38		100
	Western King Wrasse	*Coris auricularis*	**628**	**1,420**	**66**	**259**	9
	Wrasses	Labridae - undifferentiated	0		**186**	**699**	100
Whiting	King George Whiting	*Sillaginodes punctatus*	**176**	**403**	**1,428**	**4,201**	89
	Western Trumpeter Whiting	*Sillago burrus*	**2,013**	**3,363**	0		0
	Whiting spp.	*Sillago spp. (S. bassensis, S. vittata, S. schomburgkii)*	**12,247**	**6,115**	**2,391**	**1,571**	16

Appendix 5 Percentage of retained catch for each Sillago species (*S. bassensis, S. vittata, S. schomburgkii*) within the aggregated Whiting spp. group across all survey years.

	Southern School Whiting ***Sillago bassensis***	**Western School Whiting** ***Sillago vittata***	**Yellowfin Whiting** ***Sillago schomburgkii***
2010	99%	1%	-
2014	95%	5%	-
2015	99%	1%	-
2016	98%	2%	-
2017	98%	-	2%
2018	85%	15%	-
2019	95%	5%	-
2020	74%	26%	-
2021	94%	5%	1%
2022	84%	14%	2%

Appendix 6 Final Generalised Linear Models with preferred variables and error distribution to describe the harvest rate of nearshore species (Australian herring and Whiting spp.), where bold values indicate significance p < 0.05).

Australian herring Tweedie model (power variance 1.1)				
Parameter	**Category**	**Estimate**	**Std Error**	**p-value**
Intercept		2.970	0.165	**<0.001**
Survey year	2022			
	2021	-0.137	0.172	0.425
	2020	-0.230	0.178	0.198
	2019	0.129	0.152	0.396
	2018	-0.405	0.179	**0.023**
	2017	-0.063	0.160	0.694
	2016	-0.640	-3.214	**0.001**
	2015	0.338	0.143	**0.018**
	2014	0.205	0.148	0.165
	2010	0.399	0.135	**0.003**
Targeted	Targeted			
	Non-target	-2.381	0.1030	**<0.001**
Time of Day	Afternoon			
	Morning	0.4754	0.0764	**<0.001**
Whiting spp. Tweedie model (power variance 1.9)				
Parameter	**Category**	**Estimate**	**Std Error**	**p-value**
Intercept		3.815	0.492	**<0.001**
Survey year	2022			
	2021	0.308	0.424	0.467
	2020	0.725	0.442	0.101
	2019	0.465	0.406	0.251
	2018	0.907	0.403	**0.024**
	2017	0.333	0.413	0.420
	2016	1.228	0.412	**0.002**
	2015	0.847	0.412	**0.040**
	2014	1.078	0.406	**0.008**
	2010	0.313	0.399	0.432
Targeted	Targeted			
	Non-target	-3.433	0.226	**<0.001**