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Recreational fishing for Abalone in Western Australia in 2021/22: estimates of participation, effort and catch

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Executive Summary

The Western Australian Recreational Abalone Fishery (RAF) operates in shallow coastal waters along the metropolitan, south-west and south coasts. This hand collection fishery targets three species of abalone. Roe's Abalone (*Haliotis roei*) inhabit nearshore reef complexes and are therefore generally collected while wading from the shore in accessible areas. This species is taken from the metropolitan, south-west and south coast regions. Greenlip Abalone (*H. laevigata*) and Brownlip Abalone (*H. conicopora*) are collected while wading (including snorkelling) and diving (using compressed air) and occur predominantly in the south coast region.

Recreational fishing for all abalone species is licensed and highly regulated, especially in the Western Zone (includes the Perth Metropolitan Roe's Abalone Fishery) where fishing is only permitted for a 1-hour period on four days per year.

Recreational abalone fishers are required to hold a licence, and this was used as a sampling frame to select fishers for a phone-recall survey to generate estimates of participation, fishing effort and retained catch (by numbers and weight) for 2021/22. These are the first statewide estimates since intermittent phone-diary surveys in the mid-2000's.

Participation in the RAF (all three species) by licensed fishers (abalone licence holders aged five years and older) in 2021/22 (1 April 2021 – 31 March 2022) was 12,700 fishers (95% CI 12,391 – 13,008; 74.8% of licence holders). The total fishing effort (all three methods) for abalone fishing (all species) in 2021/22 was 48,860 days fished (95% CI 46,186 – 51,534); of which 94.4% or 46,111 (43,554 – 48,667) was by wading and 5.6% or 2,749 (1,846 – 3,652) by diving.

The statewide harvest of Roe's Abalone in 2021/22 was 48.0 t whole weight (ww) (95% CI 45.6 – 50.4); of which 99.6% or 47.8 t ww (45.4 – 50.2) was caught by wading and 0.4% or 0.2 t ww (0.1 – 0.4) by diving. The majority of this catch occurred in the Metro (46.9%) and South-West (34.6%) regions. The statewide harvest of Greenlip Abalone was 4.0 t meat weight (mw) (95% CI 3.3 – 4.7); while Brownlip Abalone was 1.5 t mw (95% CI 0.9 – 2.1), with the majority of these catches obtained by wading.

A range of social and attitudinal information was also collected to inform future strategies for safety, communication and engagement with fishers. In terms of safety, 92.8% of fishers considered the weather and ocean conditions before going fishing and 68% of abalone licence holders could swim more than 200 metres (m) in a standard 25m swimming pool. Although 77.2% of abalone fishers spoke English at home, Mandarin (6.2%) and languages from other parts of Asia (9.2%) were also common. The majority of abalone fishers who fished were very satisfied (55.7%) or quite satisfied (29.6%) with this activity.

This statewide phone-recall survey of the RAF will complement annual on-site monitoring within the Perth Metropolitan Roe's Abalone Fishery, as well as provide robust estimates for use in stock assessments.

1.0 Introduction

1.1 Background

The Western Australian Statewide Abalone Resource (herein referred to as Resource) targets three species of abalone, Greenlip Abalone (*Haliotis laevigata*), Brownlip Abalone (*H. conicopora*) and Roe's Abalone (*H. roei*). These abalone inhabit intertidal reef platforms and adjoining subtidal reef complexes in shallow coastal waters off the western and southern coasts of WA. The Resource is accessed by commercial, recreational, aquaculture and customary fishing sectors. However, the Western Australian Recreational Abalone Fishery (RAF) and commercial Abalone Managed Fishery (AMF) sectors are the dominant sectors and managed in accordance with the *Abalone Resource of Western Australia Harvest Strategy* (DPIRD, in press).

The AMF achieved Marine Stewardship Council (MSC) certification in 2017 (Hart et al., 2017) and is managed primarily through Total Allowable Commercial Catches (TACCs) which are set annually for each species and management area, and allocated as Individually Transferable Quotas (Strain et al., 2023). Data on commercial catches are obtained via mandatory logbook reporting and hand collection whilst diving is the only allowable method of commercial capture (Hart et al., 2017; Ryan et al., 2016).

Sectoral allocation between commercial and recreational fishers for the Resource only exists for the Perth Metropolitan Roe's Abalone Fishery (herein referred to as Perth Metro Fishery), which comprises of Area 7 (Commercial) and the Western Zone (Recreational) (DoF, 2005; DPIRD, in press) (Figure 1).

The RAF is managed primarily via output controls such as size, bag and possession limits, along with temporal and spatial closures (DPIRD in press). An abalone licence (first introduced in 1992) is required to target any abalone species in Western Australia (WA), with 17,255 issued in the 2021/22 financial year (Strain et al., 2023). The RAF is divided into three zones: the Northern Zone, the Western Zone, and the Southern Zone (Figure 1). The Western Zone is the centre of the recreational fishery and includes the Perth Metro Fishery which is adjacent to a population of 2.1 million people (ABS, 2022).

There is also a high value placed on abalone by a diversity of cultural groups who have a long tradition of harvesting abalone species (Bentz and Braje, 2017; Chen and Ryan, 2018; McCarthy et al., 2014; Schnierer and Egan, 2016). The unique characteristics of this fishery make it vulnerable to overfishing and hence fishing in the Western Zone is highly regulated and only permitted for four, 1-hour sessions per year, although this may be reduced or extended if in-season monitoring shows it is necessary to protect stocks (Strain et al., 2023). The Northern Zone and the Western Zone north of Moore River have been closed since 2011 due to a catastrophic mortality (99.9%) associated with a marine heatwave (Strain et al., 2019). The Southern Zone is dominated by catches of Greenlip and Brownlip Abalone.

In the Western Zone, annual estimates of recreational catch taken by wading are available for the Perth Metro Fishery, with field surveys undertaken during every 1-hour fishing session. Estimates are calculated from information collected through fisher interviews, shoreline vantage points, aerial surveys and weight and numbers of abalone kept by recreational fishers (Hancock and Caputi, 2006). However, expanding this annual, on-site survey to capture data across the entire RAF would be resource intensive.

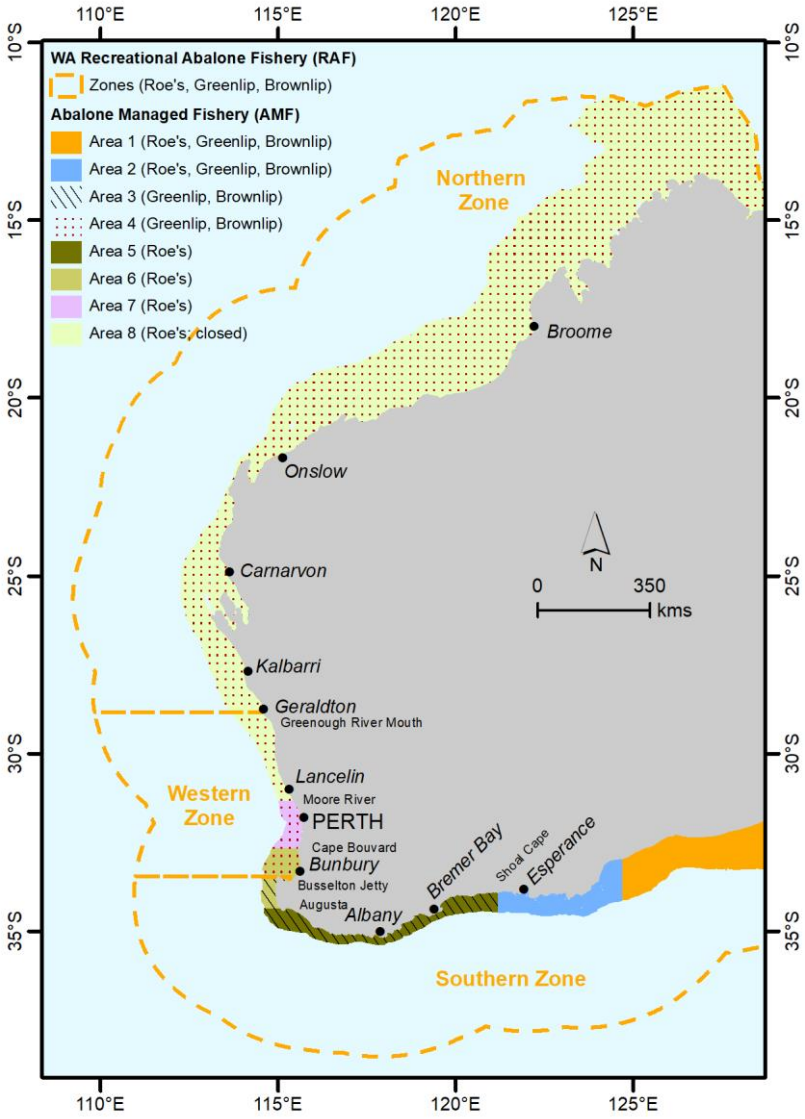

Figure 1 Fishing zones for the Recreational Abalone Fishery (RAF) and management areas for the commercial Abalone Managed Fishery (AMF) in Western Australia.

Historically, estimates of effort and catch for the recreational sector were collected using phone-diary surveys (2004, 2006 and 2007) (DoF, 2006), which captured data at a statewide level for Roe's, Greenlip and Brownlip Abalone using the abalone licence as a sampling frame. More recently, statewide phone-diary surveys of boat-

based recreational fishing in WA provide statewide, bioregional and zone estimates of recreational catches for key species, using the Recreational Boat Fishing (RBF) licence as a sampling frame (Ryan et al., 2022). Due to these differences in sample frame, the phone-diary surveys underestimate abalone catch due to fishers only being included in this study if they hold both a RBF licence and an abalone licence (52.7% of the abalone licence population). Furthermore, the phone-diary only provides coverage of boat-based recreational fishing, and the majority of recreational abalone catch occurs by wading from the shore.

1.2 Need

There has been a paucity of data for recreationally caught abalone species at a statewide level in recent years. Expanding annual on-site monitoring, which is used to provide catch estimates for Roe's Abalone in the Perth Metro Fishery, to capture data statewide is not feasible (i.e., cost and resource intensive). Therefore, an alternative survey method is needed to address the lack of statewide catch data for all three abalone species at spatial and temporal scales relevant to management.

1.3 Objectives

This report provides estimates of participation, fishing effort and retained catch (by numbers) of three abalone species from the recreational sector over a twelve-month period (April 2021 – March 2022) using a phone-recall survey of abalone licensed fishers. The retained catches (by weight) are also calculated for Roe's Abalone, Greenlip Abalone and Brownlip Abalone at a statewide and region level, and for specific management zones.

Information relating to human dimensions of recreational abalone fishers participating in the RAF were also collected (i.e., age, gender, area fished), as were data on safety (i.e., swimming ability, consideration of weather conditions prior to fishing), cultural diversity (i.e., country of birth, main language spoken at home) and satisfaction.

2.0 Method

2.1 Phone-recall survey

2.1.1 *Survey design and scope*

The phone-recall survey is a single-phase design, with all sampling completed in a single wave over a period of four to six weeks. Interviews were conducted by Computer-Assisted Telephone Interview (CATI), which provides a cost-effective and flexible means of recording questionnaire data. Interviewers were provided with a detailed briefing prior to the commencement of the survey to ensure high quality and consistent data collection was achieved. The use of interviewer prompts and defined fishing regions and months with CATI were used to assist fishers with recalling information and minimise recall bias.

The phone-recall survey is a stratified random sampling design, with samples divided into homogeneous units to reduce sampling variance. These residential strata were related to Regional Development Commission (RDC) boundaries, similar to other statewide recreational fishing surveys (Ryan et al., 2022; Smallwood et al., 2022). However, some RDC boundaries have been combined to better represent the population of abalone licensed fishers. The five residential strata are defined as Metro, South-West (including Peel and South-West RDCs), Goldfields-Esperance, Great Southern and Country (including the Kimberley, Pilbara, Gascoyne, Mid-West, Wheatbelt RDCs and Interstate) (Appendix 2).

Table 1 Data elements for the phone-recall survey of abalone licence holders in 2021/22.

Specification	Item	Phone-recall survey
Persons in scope	Residency status	All, including Western Australian residents and interstate visitors* (n=5)
	Age	<5 years excluded
	Sampling frame	Abalone licence holders valid for 12-months prior to survey
Activities	Sectors	Recreational fishing only (traditional/Indigenous fishing excluded)
	Platform	Shore- and boat-based
	Boat type	Private-boat and for-hire fishing (charter-boat excluded)
	Methods	All methods including diving and wading
Species	Species	All abalone species (n=3)
	Catch	Retained
	Biological	N/A
Geographic scope	Fishing activity	Regions (n=4)
	Fishing access	All shore access and boat launching locations
Temporal scope	Coverage	April 2021 – March 2022
	Day hours	All

* International visitors out-of-scope

The sampling frame for this phone-recall survey was a list of abalone licence holders. This licence is required to undertake fishing in WA for any of the three abalone species. A minimum age criterion of five years was applied to the phone-recall surveys, and parents were required to be a proxy for children aged 5 – 13 years. Parent permission was required for children aged 14 – 17 years to participate. A random sample of 4,000 abalone licence holders were selected for each survey. Subject to their consent to participate in the survey, abalone fishers were asked to recall their effort and catch within this fishery over the previous 12-months (Table 1). Due to the highly constrained fishing season and small bag limits, especially for Roe's Abalone in the Perth Metro Fishery, recall-bias was minimised in this phone-recall survey.

Activity from fishers collecting abalone by wading (including snorkelling) and diving (using compressed air) are included in the phone-recall survey. Abalone fishing by licensed fishers from charter-boats were excluded as these catches are reported through mandatory Tour Operator Returns (Charter Logbooks).

Management boundaries for the commercial and recreational abalone fishery are different to the bioregions and zones used for reporting recreational fishing activity in the statewide surveys (DPIRD, in press; Ryan et al., 2022). Modification of the geographical boundaries used for the statewide survey allowed for broad alignment of reporting between sectors.

Based on the distribution of abalone in WA waters and alignment with broader management boundaries, four marine 'regions' were specified for the purposes of collecting data in the phone-recall survey: Metro and South-West in the West Coast Bioregion, Albany and Esperance in the South Coast Bioregion (Appendix 3).

There are three zones in the RAF (Figure 1). The survey regions used in the phone-recall survey encapsulate most of Western Zone and Southern Zone (Table 2). Noting that a portion of Western Zone (north of Moore River) and the entire Northern Zone is currently closed to recreational abalone fishing.

There are eight management areas within the AMF, with the fishery for Greenlip and Brownlip Abalone operating in Areas 1 to 4 and the Roe's Abalone Fishery operating in Areas 1, 2, 5, 6, 7 and 8 (Figure 1). The survey regions approximate Areas 1 – 7 of the AMF whilst Area 8 is currently closed to commercial fishing (Table 2).

Table 2 Alignment of reporting boundaries for the phone-recall survey, WA Recreational Abalone Fishery (RAF) and commercial Abalone Managed Fishery (AMF).

Bioregion	**Survey Region**	**RAF Zone**	**AMF Area**	
	All species	**All species**	**Roe's**	**Greenlip/Brownlip**
West Coast	Metro	Western Zone	Area 7	Area 4
	South-West	Southern Zone	Area 6	Area 3
South Coast	Albany		Area 5	
	Esperance		Area 1 and 2	Area 1 and 2

2.1.2 *Analysis*

Raw data on participation, fishing effort and retained catch was expanded to the population of abalone licence holders within the recall period using the *survey* package in R, following established protocols for analysis of recreational fishing surveys (Lumley, 2010; Lyle et al., 2010; Ryan et al., 2022). Each estimate has an associated measure of variability, including Standard Error, Confidence Intervals and Relative Standard Error (RSE). For example, the range around estimated catch is represented as 95% confidence intervals (95% CI).

As part of the validation process, the distribution of raw data on effort and retained catch for each abalone species were explored, and compared by fishing method and region, prior to the expansion to the abalone licence holder population.

The median number of days fished per year (all species) for wading in the Metro region (Western Zone) was 3 (n = 712 licence holders, range = 1 – 4 days) (Appendix 4). There is no diving permitted in the Metro region for abalone, and fishing activity is constrained by the limited fishing season. The median number of days fished per year for all other regions outside of the Metro region (Southern Zone) was 3 for wading (n = 784 licence holders, range = 1 – 105 days) and 4 for diving (n = 66 licence holders, range = 1 – 40 days).

For Roe's Abalone in the Metro region (Western Zone) the median retained catch per year from wading was 30 (n = 697 licence holders; range = 1 – 80 animals) (Appendix 5). There is no diving permitted in the Metro region for this species, and fishing activity is constrained by the limited fishing season. For Roe's Abalone outside of the Metro region (Southern Zone), the median retained catch per year from wading was 36 (n = 686 licence holders, range = 2 – 400 animals). The median for diving was 16.5 (n = 14 licence holders, range = 5 – 80 animals).

Retained catch for Greenlip Abalone in the Metro region (Western Zone) could not be summarised due to the small number of licence holders reporting catch of this species (n = 4). There is no diving permitted in the Metro region, and fishing activity is constrained by the limited fishing season. For Greenlip Abalone outside of the Metro region (Southern Zone) the median retained catch per year from wading was 6 (n = 200 licence holders, range = 1 – 100 animals) while diving was 12 (n = 52 licence holders, range = 1 – 80 animals) (Appendix 6).

Retained catch for Brownlip Abalone in the Metro region (Western Zone) could not be summarised due to the small number of licence holders reporting catch of this species (n = 1). There is no diving permitted in the Metro region, and fishing activity is constrained by the limited fishing season. For Brownlip Abalone outside of the Metro region (Southern Zone) the median retained catch per year from wading was 3 (n = 84 licence holders, range = 1 – 160 animals) while diving was 10 (n = 21 licence holders, range = 1 – 40 animals) (Appendix 7).

The sample weight (or expansion factor) for each RDC was calculated as

$$\alpha_{hi} = \frac{N_h}{n_h}$$

where α_{hi} is the weight for the licence holder i in stratum h, N_h= total number of abalone licence holders in stratum h and n_h= number of abalone licence holders sampled in stratum h.

In 2021/22, the population total for abalone licence holders used to draw the survey sample was taken nine days earlier (22 March 2021 – 21 March 2022) than the recall period (1 April 2021 – 31 March 2022). This resulted in a difference of 23 abalone licences but enabled the survey to commence as swiftly as possible after the recall period had ended. The number of abalone licence holders from the recall period was used to expand raw survey data to population estimates.

The timing of the phone-recall surveys was selected to capture information as soon as possible after the last permitted fishing day in the Perth Metropolitan area (19 February 2022). This also coincided with the reporting period for the commercial fishing season (1 April 2021 – 31 March 2022).

Estimates of participation (by number of abalone licence holders) are summarised statewide and survey region for all abalone fishing (all three species) as well as by fishing method for each season (1 April 2021 – 31 March 2022).

A number of questions relating to safety (i.e., swimming ability, weather conditions prior to fishing), cultural diversity (i.e., country of birth, main language spoken at home) and satisfaction were also asked to survey participants who had fished in the previous 12-months. Categories for swimming competency were based on an established approach for asking respondents to estimate how many lengths of a 25-m swimming pool they could swim without touching the bottom or stopping, using four response categories ranging from cannot swim to can swim more than 200 m (Moran and Moran, 2008). Categories for country of birth and language were assigned using standard Australian Bureau of Statistics protocols (ABS, 2016a, 2016b).

Estimates of effort are calculated as number of days fished for abalone (all species) and are summarised statewide and by survey region, RAF zone and method.

Retained recreational catch estimates were converted from numbers to weight (tonnes) to calculate harvest statewide and by survey region, RAF zone and method (Table 2).

The unit of measurement for each species (whole weight for Roe's Abalone, meat weight for Greenlip and Brownlip Abalone) were consistent with other reporting for the statewide abalone resource (DPIRD, in press) The whole weight for Roe's Abalone was based on data from on-site, annual surveys conducted in the Perth Metro Fishery (DPIRD unpublished data) (Table 3). In the absence of other data for Roe's Abalone caught outside of the Metro region, the same value was applied statewide, although there is known variability in the weight of this species across its distribution.

Table 3 Weight (grams; g) applied to each abalone species.

Common name (Scientific name)	Spatial area	Whole weight (ww, grams)	Meat Weight (mw, grams)
Roe's Abalone (*Haliotis roei*)	Statewide	90	-
Greenlip Abalone (*Haliotis laevigata)*	Statewide	-	177
Brownlip Abalone (*Haliotis conicopora*)	Statewide	-	190

There is no weight data for recreationally caught Greenlip and Brownlip Abalone. The meat weight for these species were therefore determined using length-weight relationships for lengths 10mm above the minimum legal limit (Hart et al., 2017).

Consistent with other studies, estimates were deemed to be robust when a sample size of ≥30 fishers was achieved and the Relative Standard Error (RSE) was ≤0.40 (calculated as the standard error of the sample divided by the estimate) (Henry and Lyle, 2003; Ryan et al., 2022). Non-robust estimates are indicated when they occur.

2.1.3 *Response rate*

A random sample of 4,000 abalone licence holders were selected from those who held a licence in the previous 12-months (1 April 2021 – 31 March 2022) (Table 4). This represents ~24% of the total number of licences in the 2021/22 fishing season (n = 16,978). This high proportion of licence holders was sampled to achieve target levels of precision for the various abalone species and management areas.

The overall response rate was 51.7%. One abalone licence holder was out of scope (*i.e.,* international visitor).

Table 4 Sample size and response profile by stratum for the phone-recall survey conducted in March 2022. Note: Abalone licence holder total population valid for period 1 April 2021 – 31 March 2022.

	Total licence holders	Initial sample	Sample loss	Net sample	Non-response		Full response	Response rate^
					Non Contacts	Refusals		
Metro	10,291	2,000	110	1,890	715	183	992	52.5%
South-West*	3,915	1,100	24	1,076	428	105	543	50.5%
Great Southern	1,036	300	5	295	96	35	164	55.6%
Goldfields-Esperance	825	300	3	297	124	27	146	49.2%
Country *	910	300	2	298	111	38	149	50.0%
Out of scope	1							
TOTAL	16,978	4,000	144	3,856	1,474	388	1,994	51.7%

* Country combines Kimberley, Gascoyne, Pilbara, Mid-West and Wheatbelt RDC and Interstate
# South-West combines South-West and Peel
^ Full response / (Full response + Refusals + Non-Contacts)

2.2 Tour Operator Returns

Daily trip sheets are a mandatory reporting requirement for all tour (charter) operators as part of their licence requirement and therefore provide an assumed census of fishing activity. Interrogation of tour operator data revealed no catches of abalone in 2021/22.

3.0 Results

3.1 Participation

Overall participation in the RAF (all three species) by licensed fishers (all abalone licence holders aged five years and older) was 12,700 fishers (95% CI 12,391 – 13,008; 74.8% of licence holders) (Figure 2a). For those abalone licence holders that fished in the previous 12-months, this was most commonly for food (27.1%), followed by spending time with family (17.4%), enjoyment (17.0%), spending time with friends (15.2%), getting outdoors (11.8%), to relax (8.8%) and to be on their own (2.7%). For those abalone licence holders who did not fish in the previous 12-months, this was most commonly for personal reasons (i.e., family, health, preference, work; 60.4%), followed by access (i.e., relocation, sold equipment, location closed; 16.4%), unsure (11.5%), environmental (i.e., weather, water quality; 7.4%), social (i.e., friends fished less often) (3.6%) and fishing quality (i.e., catch rate; 0.6%).

Higher participation occurred in wading (96.2%) compared with diving (2.0%), with the remaining 1.8% participating in both abalone fishing methods (Figure 2b). Fishing for abalone from the shore had the highest participation (81.3%) compared with boats (11.4%), with the remaining 7.3% fishing from both platforms (Figure 2c).

Males accounted for the majority of abalone licence holders who fished (86.3%) compared with females (13.7%; Figure 2d). The highest number of abalone licence holders that fished were in the 30 – 44 and 45 – 59-year age groups, with 35.7% and 29.8%, respectively (Figure 2g).

The number of days fished (by recall) in the previous 12-months is a measure of fishing avidity. Abalone licence holders were most likely to fish less than five days (79.6%), followed by 5 – 14 days (18.1%) and 15 days or more (2.3%; Figure 2f).

Most abalone licence holders fished in the Metro region (54.4%), followed by the South-West region (26.2%) (Figure 2e). Lower proportions of abalone licence holders fished in the Albany region (11.1%) and Esperance region (5.4%), with the remaining 2.9% fishing across multiple regions.

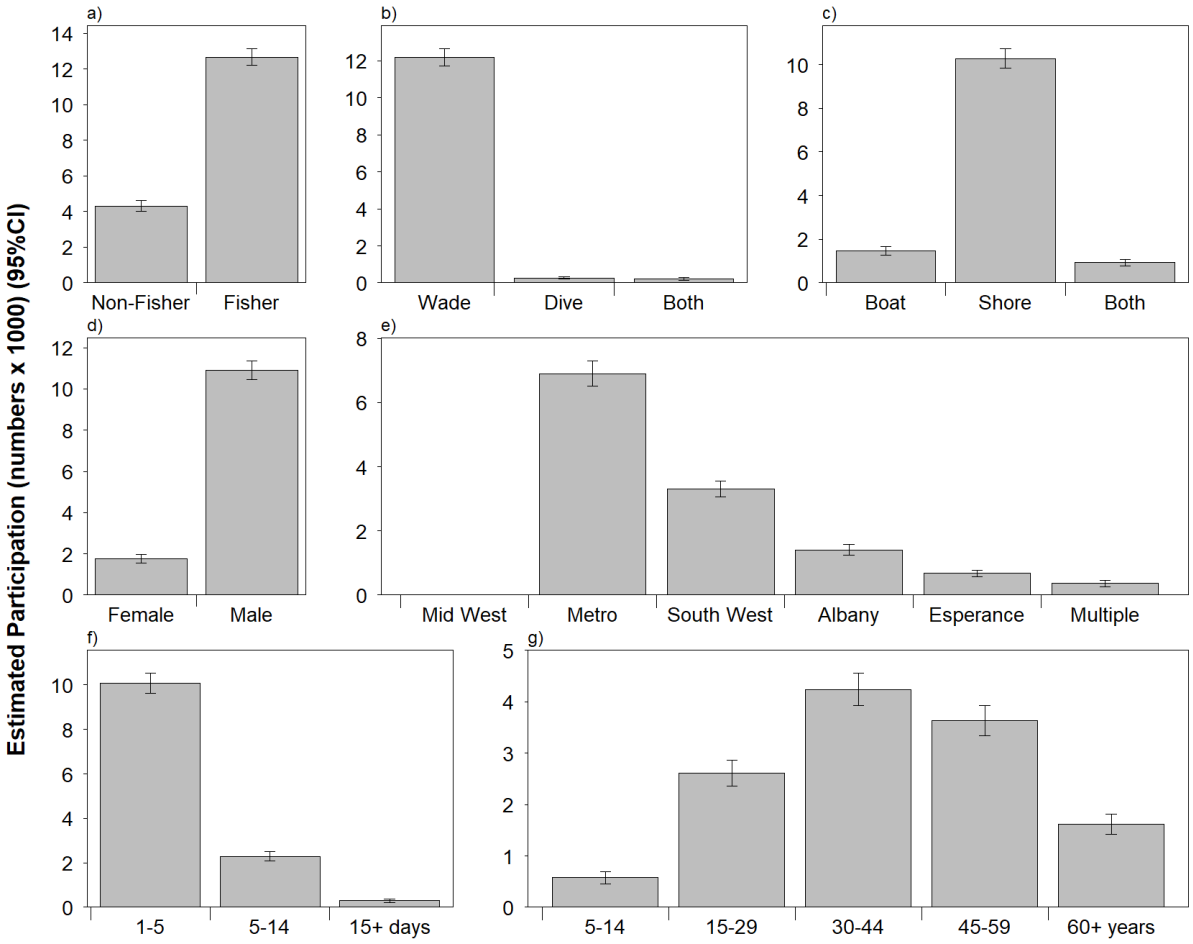

Figure 2 Number of abalone licence holders (±95% CI) aged five years and older in 2021/22 summarised by (a) non-fishers (i.e., have not fished for abalone in previous 12-months) and fishers; (b) fishing method; (c) platform; (d) gender; (e) bioregion fished; (f) avidity (days fished for abalone per year); (g) age (years).

3.2 Effort

3.2.1 *Statewide*

Total fishing effort for abalone fishing (all species) in 2021/22 was 48,860 days fished (95% CI 46,186 – 51,534); of which 94.4% or 46,111 (43,554 – 48,667) was by wading and 5.6% or 2,749 (1,846 – 3,652) by diving.

3.2.2 *Survey region*

The proportion of statewide fishing effort occurring in each survey region was similar in the Metro region (37.9%) and South-West region (38.1%), followed by Albany region (15.3%) and Esperance region (8.7%) (Table 5). In the Metro region, wading was the only fishing method used, with 18,533 days fished (95% CI 17,680 – 19,385). The South-West region had 18,816 days fished (16,268 – 20,958); of which 92.7% or 17,261 days (14,955 – 19,567) was by wading and 7.3% or 1,352 (797 – 1,908) was by diving.

Table 5 Fishing effort (days fished) for all abalone species obtained using phone-recall surveys in 2021/22 for each survey region by wading, diving and total with lower (LCI) and upper (UCI) 95% confidence intervals.

Note: (1) values in bold indicate RSE>0.4; values in italics indicate n<30; (2) due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level.

Survey Region	Fishing effort (days)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Metro	18,533	17,680	19,385				18,533	17,680	19,385
South-West	17,261	14,955	19,567	1,352	797	1,908	18,613	16,268	20,958
Albany	6,641	5,588	7,694	*815*	*339*	*1,292*	7,456	6,249	8,663
Esperance	3,676	2,977	4,375	***582***	***84***	***1,079***	4,258	3,418	5,098

3.2.3 *Recreational fishing zone*

The proportion of statewide fishing effort occurring in each recreational fishing zone was greater in the Southern Zone (62.1%) than the Western Zone (37.9%) (Table 6). In the Western Zone, wading was the only fishing method used, with 18,533 days fished (95% CI 17,680 – 19,385). The Southern Zone had 30,327 days fished (27,602 – 33,052); of which 90.9% or 27,578 days (24,980 – 30,175) was by wading and 9.1% or 2,749 days (1,846 – 3,652) was by diving.

Table 6 Fishing effort (days fished) for all abalone species obtained using phone-recall surveys in 2021/22 for each recreational fishing zone by wading, diving and total with lower (LCI) and upper (UCI) 95% confidence intervals.

Note: (1) values in bold indicate RSE>0.4; values in italics indicate n<30; (2) due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level.

Recreational Fishing Zone	Fishing effort (days)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Western	18,533	17,680	19,385				18,533	17,680	19,385
Southern	27,578	24,980	30,175	2,749	1,846	3,652	30,327	27,602	33,052

3.3 Harvest

The weight per individual animal applied for each abalone species (Section 2.1.2) were used to convert statewide (Appendix 8), survey region (Appendix 9) and recreational fishing zone (Appendix 10) estimates of the retained catch (harvest) of abalone by number to weight.

3.3.1 *Statewide*

Roe's Abalone had the highest harvest of all abalone species in 2021/22 with 48.0 t ww (95% CI 45.6 – 50.4); of which 99.6% or 47.8 t ww (45.4 – 50.2) was caught by wading and 0.4% or 0.2 t ww (0.1 – 0.4) by diving (Table 7).

The harvest of Greenlip Abalone was 4.0 t mw (95% CI 3.3 – 4.7); of which 70.7% or 2.8 t mw (2.2 – 3.3) was caught by wading and 29.3% or 1.2 t mw (0.8 – 1.7) by diving (Table 7). Brownlip Abalone had the lowest harvest of all species with 1.5 t mw (95% CI 0.9 – 2.1); of which 73.8% or 1.1 t mw (0.6 – 1.6) was caught by wading and 26.2% or 0.4 t mw (0.2 – 0.6) by diving.

The combined statewide harvest of Greenlip and Brownlip Abalone was 5.5 t mw (95% CI 4.4 – 6.6) which equates to 14.4 t ww (95% CI 11.6 – 17.2).

Table 7 Statewide recreational harvest (in tonnes) of abalone species obtained using a phone-recall survey in 2021/22 by wading, diving and total, with harvest ranges (lower and upper 95% confidence intervals).

Note: (1) values in bold indicate RSE>0.4; values in italics indicate n<30; (2) ww = whole weight (g) and mw = meat weight (g).

Common Name	Harvest (tonnes)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone - ww	47.8	45.4	50.2	*0.2*	*0.1*	*0.4*	48.0	45.6	50.4
Greenlip Abalone - mw	2.8	2.2	3.3	1.2	0.8	1.7	4.0	3.3	4.7
Brownlip Abalone - mw	1.1	0.6	1.6	*0.4*	*0.2*	*0.6*	1.5	0.9	2.1

3.3.2 *Survey region*

The majority of Roe's Abalone was caught in the Metro region, with 22.4 t ww (95% CI 21.3 – 23.6) harvested, comprising 46.9% of the statewide harvest of this species. The harvest from the South-West region was 16.6 t ww (14.7 – 18.5), which comprised 34.6% of the statewide harvest of this species (Table 8).

Greenlip Abalone were harvested in similar amounts in the South-West region and Albany region with 1.5 t mw (1.1 – 1.9) and 1.4 t mw (1.0 – 1.9), respectively. Harvest in the South-West region comprised 37.8% of the statewide harvest of this species, while the Albany region comprised 35.4%.

Brownlip Abalone was harvested predominately in the South-West region, with 0.9 t mw (0.6 – 1.3), comprising 61.4% of the statewide harvest of this species.

Table 8 Recreational harvest (tonnes) of abalone species obtained using a phone-recall survey in 2021/22 for each survey region by wading, diving and total, with harvest ranges (lower and upper 95% confidence intervals).

Note: (1) values in bold indicate RSE>0.4; values in italics indicate n<30; (2) due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level; (3) ww = whole weight (g) and mw = meat weight (g).

Survey Region	Harvest (tonnes)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone (*Haliotis roei*) - ww									
Metro	22.4	21.3	23.6				22.4	21.3	23.6
South-West	16.5	14.6	18.5	***0.1***	***0.0***	***0.1***	16.6	14.7	18.5
Albany	5.8	4.6	6.9	***0.1***	***0.0***	***0.2***	5.9	4.8	7.0
Esperance	3.1	2.5	3.7	***0.0***	***0.0***	***0.1***	3.1	2.5	3.7
Greenlip Abalone (*Haliotis laevigata)* - mw									
Metro	***0.1***	***0.0***	***0.1***				***0.1***	***0.0***	***0.1***
South-West	1.0	0.7	1.3	0.5	0.3	0.7	1.5	1.1	1.9
Albany	0.9	0.6	1.2	*0.5*	*0.2*	*0.8*	1.4	0.9	1.9
Esperance	0.8	0.5	1.1	***0.2***	***0.0***	***0.4***	1.0	0.6	1.4
Brownlip Abalone (*Haliotis conicopora*) - mw									
Metro	***0.0***	***0.0***	***0.1***				***0.0***	***0.0***	***0.1***
South-West	0.7	0.4	1.0	*0.2*	*0.1*	*0.4*	0.9	0.6	1.3
Albany	*0.1*	*0.1*	*0.2*	***0.1***	***0.0***	***0.2***	*0.3*	*0.1*	*0.4*
Esperance	***0.2***	***0.0***	***0.6***	***0.0***	***0.0***	***0.1***	***0.3***	***0.0***	***0.7***

3.3.3 *Recreational fishing zone*

A similar amount of Roe's Abalone was harvested in the Western and Southern Zones, with 22.4 t ww (95% CI 21.3 – 23.6) and 25.6 t ww (23.3 – 27.9), respectively (Table 8). Harvest in the Western Zone comprised 46.7% of the statewide harvest of this species, while the Southern Zone region comprised 53.3%. All the harvest from Western Zone was caught by wading, as was the majority of harvest from the Southern Zone (99.2%).

The majority of Greenlip Abalone were harvested in the Southern Zone; 98.4% or 3.9 t mw (3.2 – 4.6). This was similar to Brownlip Abalone, of which 97.2% or 1.5 t mw (0.9 – 2.0) was harvested in the Southern Zone. The majority of the harvest of these species in the Southern Zone was by wading (>69.1%).

Table 9 Recreational harvest (in tonnes) of abalone species obtained using a phone-recall survey in 2021/22 for each recreational fishing zone by wading, diving and total, with harvest ranges (lower and upper 95% confidence intervals).

Note: (1) values in bold indicate RSE>0.4; values in italics indicate n<30; (2) due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level; (3) ww = whole weight (g) and mw = meat weight (g).

Recreational Fishing Zone	Harvest (tonnes)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone (*Haliotis roei*) - ww									
Western	22.4	21.3	23.6				22.4	21.3	23.6
Southern	25.4	23.0	27.7	*0.2*	*0.1*	*0.4*	25.6	23.3	27.9
Greenlip Abalone (*Haliotis laevigata)* - mw									
Western	***0.1***	***0.0***	***0.1***				***0.1***	***0.0***	***0.1***
Southern	2.7	2.2	3.3	1.2	0.8	1.7	3.9	3.2	4.6
Brownlip Abalone (*Haliotis conicopora*) - mw									
Western	***0.0***	***0.0***	***0.1***				***0.0***	***0.0***	***0.1***
Southern	1.1	0.6	1.5	*0.4*	*0.2*	*0.6*	1.5	0.9	2.0

3.4 Human dimensions

3.4.1 *Safety*

The majority (92.8%) of abalone licence holders who fished took weather and ocean conditions into consideration before going abalone fishing, followed by 7.0% of abalone fishers who did not and 0.2% who were unsure.

In the Metro region, the majority of abalone licence holders who fished were more likely to fish at a location that was patrolled by Surf Lifesaving WA (51.0%), compared to locations that were not patrolled (39.2%). The remaining 9.8% were unsure. The majority (89.7%) of abalone licence holders who fished had received text communication from Fisheries WA (DPIRD) with safety alerts prior to any abalone fishing day in the Metro region, with 8.1% not receiving alerts and 2.2% who were unsure.

The majority (68.2%) of abalone licence holders who fished indicated they were able to swim more than 200 m in a standard 25 m swimming pool without having to stop or touch the bottom, followed by 21.3% who could swim 25 – 200 m and 8.4% who could swim <25 m. There were 1.7% of abalone licence holders who were unable to swim, with the remaining 0.4% unsure.

3.4.2 *Cultural diversity*

There were 80 countries listed as a place of birth by abalone licence holders who had fished in 2021/22. Australia was the dominant place of birth (65.4%). The top five other countries were New Zealand (7.4%), China (including Hong Kong) (7.2%), United Kingdom and Ireland (4.2%), Vietnam (3.5%) and South Korea (2.3%).

There were 48 languages listed as the main language spoken at home most often by abalone licence holders who fished. English was the dominant language (77.2%). The top five other languages were Mandarin (6.2%), Vietnamese (4.5%), Korean (2.3%), Cantonese (1.4%) and Japanese (1.0%).

The majority of abalone licence holders who fished were not of Aboriginal or Torres Strait Islander origin (98.4%) with less than 1% responded that they were of Aboriginal or Torres Strait Islander origin.

3.4.3 *Satisfaction*

The majority of abalone licence holders who had fished were very satisfied (55.7%) or quite satisfied (29.6%) with their fishing. Of the remaining abalone fishers, 10.3% were neutral, 3.3% not very satisfied and 1.1% not at all satisfied.

4.0 Discussion

Recreational fishing for abalone has been a licensed activity since the early 1990s. This licence sampling frame has been used for intermittent monitoring of statewide catches, primarily phone-diary surveys completed in the mid-2000's (DoF, 2006). The phone-recall survey described in this report provides the first statewide estimates of participation, effort and catch since this time.

4.1 Participation

Participation in the RAF (all three species) by licensed fishers (abalone licence holders aged five years and older) was 12,700 fishers (95% CI 12,391 – 13,008; 74.8% of licence holders). Participation has also been reported for a number of fishery (i.e., bioregion fished) and demographic (i.e., gender, age, avidity) variables for licensed fishers in 2021/22. These results showed some consistency in participation across licence types. For example, males are the dominant gender type participating in recreational fishing for both Rock Lobster (RL) (88.8%) and RBF (84.0%) licence holders (Ryan et al., 2022; Smallwood et al., 2022). However, unlike RL, the majority of fishing activity for abalone is undertaken from the shore (81.1%) (Smallwood et al., 2022). This is the first time that these variables have been reported for abalone licence holders. Ongoing reporting and further investigation of these variables will enable monitoring of changes in this population over time and help develop a greater understanding of the behaviours and characteristics of abalone fishers.

4.2 Fishing effort and harvest

Total fishing effort for abalone fishing (all three species) in 2021/22 was 48,860 days fished (95% CI 46,186 – 51,534), with wading the most common method (94.4%). Roe's Abalone had the greatest harvest (tonnes) of all abalone species by licensed fishers in 2021/22 (48.0 t ww, 95% CI 45.6 – 50.4), followed by Greenlip Abalone (4.0 t mw, 95% CI 3.3 – 4.7) and then Brownlip Abalone (1.5 t mw, 95% CI 0.9 – 2.1).

The harvest of Roe's Abalone from the phone-recall survey for the Metro region (Western Zone) 22.4 t ww (95% CI 21.3 – 23.6), comprising 46.9% of the statewide harvest of this species. Annual on-site surveys of Roe's Abalone in the Perth Metro Fishery in 2021 estimated a harvest of 20.7 t ww from the Perth Metro Fishery (Strain et al., 2023). This is similar to the value obtained from the phone-recall survey.

Data on recreational fishing for abalone have been collected historically using off-site (phone-diary) and on-site (fisher counts and interviews) methods, including fishing effort and catch (Hancock and Caputi, 2006; Hart et al., 2017; Henry and Lyle, 2003; Ryan et al., 2022). Like the concurrent off-site and on-site surveys from the early 2000's there is good alignment between harvest estimates for these contemporary surveys (phone-recall, on-site) (Hart et al., 2005; Strain et al., 2023). However, differences in sampling frames only allow for some of these limited comparisons between methods. For example, periodic phone-diary surveys of RBFL holders will under-report catches of abalone species as 47.3% of abalone fishers do not hold a RBFL licence (Ryan et al., 2022). As a result, the sample sizes associated with the

catches of specific abalone species from the phone-diary survey (which uses the RBFL licence) are small and results are combined across all abalone species.

Exploration of the distribution of raw data on effort and retained abalone catch in 2021/22 provided additional insights into the behaviour of licensed abalone fishers. The distribution of fishing effort and catch in the Metro region is constrained by the four fishing sessions (hours) per year within the Western Zone (as occurred in 2021/22), with median values of 3 days fished and 30 abalone retained. This distribution for all other regions (which have longer periods where fishing for abalone is permitted) is positively skewed, with the majority of fishers undertaking abalone fishing <10 days per year, and with annual catches <20 for Greenlip and Brownlip Abalone, and <50 for Roe's Abalone.

Although every effort is made to ensure that data collected from abalone licensed fishers via phone-recall surveys are accurate and provided in a timely manner, there may be circumstances where additional quality assurance/quality control 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 in future reporting.

4.3 Human dimensions

Sustainable management of recreational fisheries depends on understanding behavioural and human dimensions of participants (Birdsong et al., 2021). In the phone-recall survey, specific questions were asked regarding a number of elements which were of relevance to the RAF (i.e., safety, cultural diversity and satisfaction). The diversity of participants in various recreational fisheries is well documented (Arlinghaus, 2006; Hamelin et al., 2022; Sutton, 2006). However, this is the first time this information has been collected specifically for abalone licensed fishers in WA.

There is a high value placed on abalone by a diversity of cultural groups, who have a long tradition of harvesting abalone species (Bentz and Braje, 2017; Chen and Ryan, 2018; McCarthy et al., 2014; Schnierer and Egan, 2016). This diversity is evident in the high number of birth countries (80) and languages (48) used by abalone fishers, especially those from China and other parts of Asia (Vietnam, Korea and Japan). This information will assist in developing better communication channels with abalone fishers (i.e., information on safe fishing practices and regulations in alternative languages), particularly given that the proportion of WA population from non-main English speaking birthplaces (such as China) is gradually growing (ABS, 2021).

The majority of abalone fishers (68.2%) indicated they were able to swim more than 200 m. This is not surprising as abalone fishing occurs in the water, either wading or diving, with the later requiring demonstrated swimming competency. One in 10 abalone fishers indicated they were able to swim less than 25 m (8.4%) or were unable to swim (1.7%). While migrants are not over-represented in drowning statistics within the broader community, migrants are more likely to drown when swimming or rock fishing, while people born in Australian are more likely to drown when boating or diving (Willcox-Pidgeon et al., 2021). In 2019/20, funding from the Recreational Fishing Initiatives Fund was made available to Surf Life Saving WA (SLSWA) for initiatives to

improve abalone fisher safety (SLSWA, 2021). including signage and website information on abalone fishing tips and gear (SLSWA, 2023).

Safety, weather and ocean conditions were taken into consideration by 92.8% of abalone fishers before going fishing, and 89.4% of those who fished in the Metro region recalled received a safety alert from Fisheries WA (DPIRD) prior to abalone fishing days. However, just over half of fishers were more likely to fish at a location that was patrolled by Surf Life Saving WA (51.0%). These findings suggest that the current safety practice implemented by Fisheries WA (DPIRD) of sending alerts via text message prior to fishing days is reaching its intended audience.

4.4 Management Implications

The unique characteristics of the RAF, in particular the Perth Metro Fishery, make it vulnerable to overfishing. Coupled with the impact of external environmental factors (i.e., marine heatwave in 2011) (Hart et al., 2018; Strain et al., 2019) this has resulted in a number of management changes over the years (Hart et al., 2017, 2013). For example, the limited fishing season in the Western Zone (i.e., four 1-hour sessions per year in 2021/22) and the closure of all abalone fishing north of Moore River (northern part of the Western Zone and all of the Northern Zone).

For the first time since the early 2000's, retained catch of all abalone species has been provided for the recreational sector in the Southern Zone and this can be used for improved reporting and inclusion in stock assessments to determine stock status of the Resource. This is of particular importance in the Southern Zone where there are sustainability concerns regarding both Greenlip and Brownlip Abalone in various commercial Management Areas (Strain et al., 2023).

Sectoral allocation between the commercial and recreational sectors only exists for the Perth Metro Fishery, which occurs in Area 7 (Commercial) and the Western Zone (Recreational) (Figure 1). This report provides contemporary values for catch of the recreational sector that can be utilised in allocation processes for the Southern Zone.

4.5 Future research

Annual on-site monitoring of the Perth Metro Fishery was established in the late 1990s and is fit-for-purpose as this fishery operates over restricted spatial and temporal scales, which makes aerial-access surveys cost-effective (Hancock and Caputi, 2006; Ryan et al., 2016). The phone-recall survey complements this annual monitoring by capturing data on the RAF statewide. The survey design, and the frequency of implementation, for any future statewide surveys will depend on the information needs of the fishery and resourcing. Off-site surveys are most appropriate for recreational fisheries that operate over large spatial and temporal scales (i.e., statewide survey of boat-based fishing) (Ryan et al., 2022). However, surveys of low participation recreational fisheries present challenges for selecting respondents. This is usually mitigated by sampling from specialised fisheries and species licence databases (i.e., lobster) (Smallwood et al., 2022). Survey methods are also evolving, and novel approaches need to be explored to identify the most cost-effective survey design to provide accurate and precise estimates of recreational catch for each Abalone species at the scale required for management.

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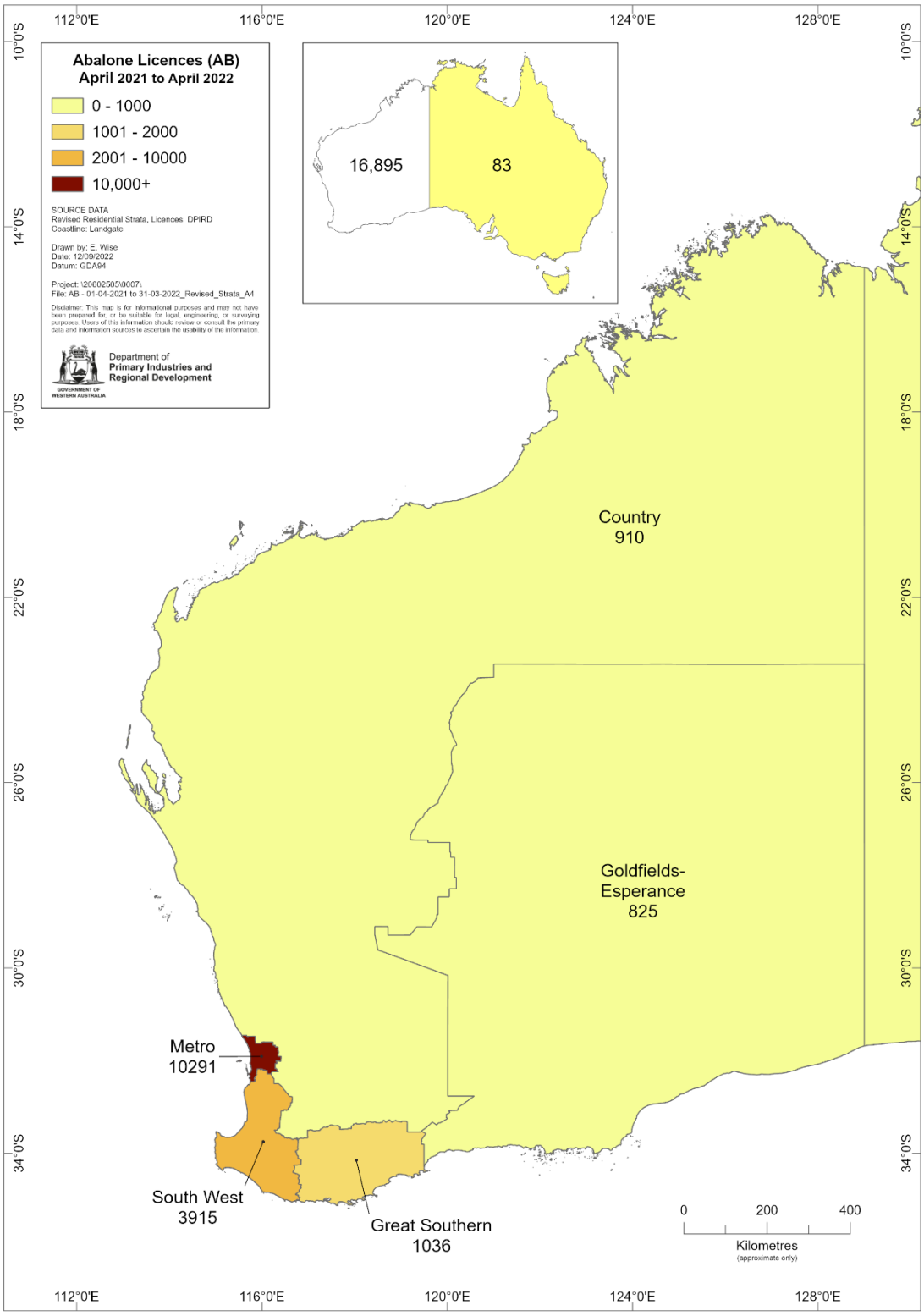
7.0 Appendices

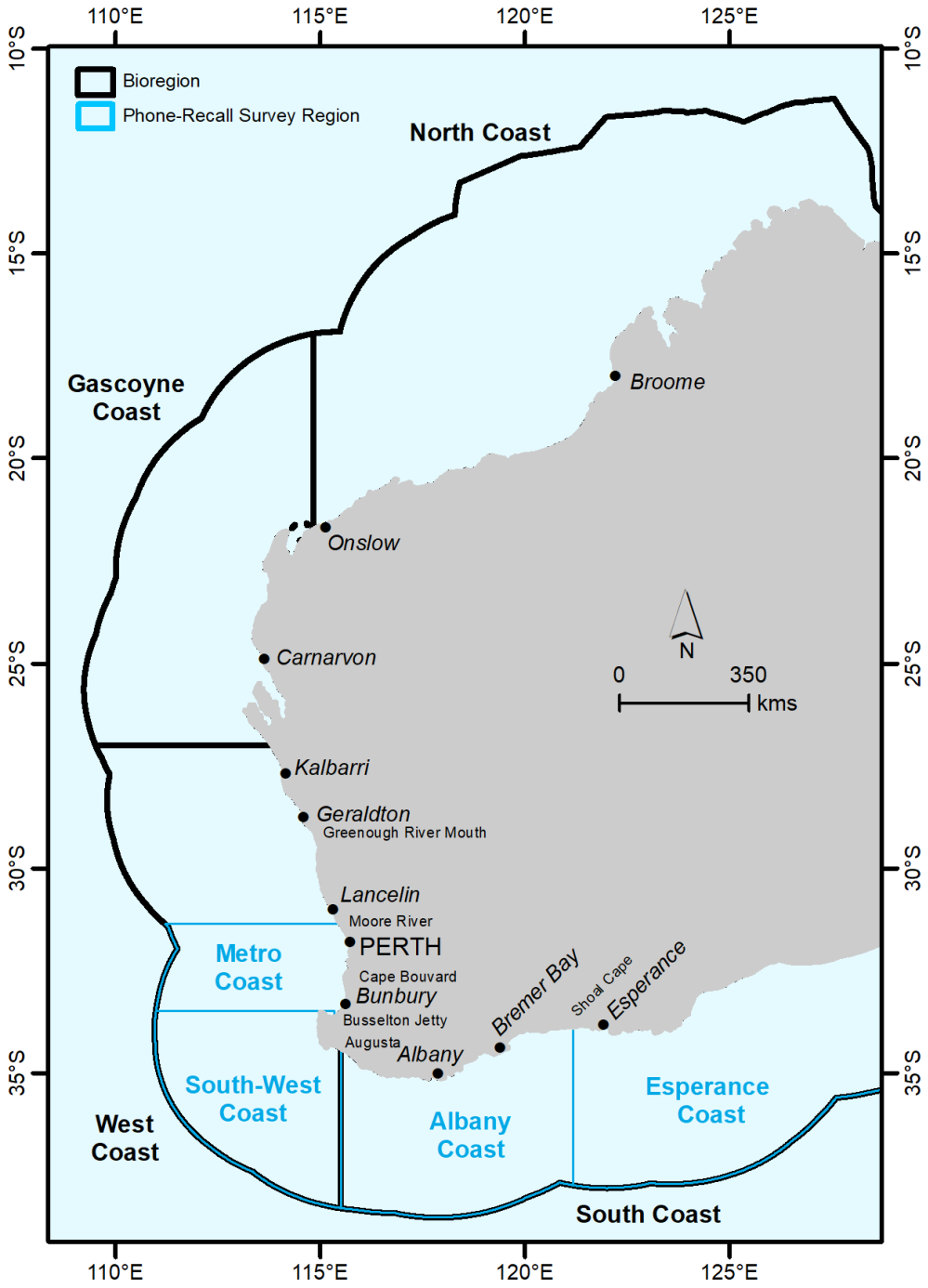
Appendix 1 Management history of the Abalone recreational fishery [adapted from Ryan et al. (Hart et al., 2017, 2013; Ryan et al., 2016).

Year	Management
1975	Three management zones created (Zone 1 – West Coast Zone, Zone 2 – Northern Zone, and Zone 3 – Southern Zone) Daily bag limit of 36 per fisher (combined species)
1979	Zone 1 – limited to a seasonal opening from mid-October to mid-December for Roe's Abalone Minimum size limit for Roe's Abalone of 60 mm introduced statewide; with a daily bag limit of 36 per fisher. Daily bag limit of 10 Greenlip Abalone and 10 Brownlip Abalone per fisher
1984	Daily bag limit of 20 Roe's Abalone per fisher
1986	Minimum size limit of 140 mm set for Greenlip and Brownlip Abalone Daily bag limit for Greenlip and Brownlip Abalone (combined) reduced to 10 per fisher
1988	Zone 1 – open on weekends and public holidays between 6:00 – 10:00 am
1992	Recreational licence introduced, with an annual fee. No limit on the number of licences issued per year Zone 1 – open on Sundays from 17 October – 20 December between 07:00 – 09:00 am)
1994	Possession and daily bag limit of 20 Roe's Abalone and 10 Greenlip and Brownlip Abalone (combined). Boat possession limit of 30 for Greenlip and Brownlip Abalone (combined)
1995	Zone 1 – limited to 6 fishing days on consecutive Sundays during November – December between 7:00 – 8:30 am
2003	A daily bag limit of 5 per fisher per day for Greenlip and Brownlip Abalone (combined) Possession limit of 80 Roe's Abalone and, 20 Greenlip and Brownlip Abalone (combined) per household Boat limit of 20 Greenlip and Brownlip Abalone (combined)
2004	Zone 2 and 3 – closed season introduced between 16 May – 30 September
2005	Zone 1 – total allowable recreational catch (TARC) for Roe's Abalone introduced Boat possession limit of 5 Greenlip and Brownlip Abalone (combined) per fisher (or 10 where there are 2 or more licensed fishers)
2006	Zone 1 – fishing hours limited to 7:00 – 8:00 am
2010	Zone 1 – limited to 5 fishing days on consecutive Sundays during November – December
2011	Zone 1 – fishing permitted on the first Sunday of each month between November – March; waters to the North of Moore River closed to fishing for Roe's Abalone Zone 3 – all waters closed to fishing for Roe's Abalone
2015	Zone 1 – reduction in recreational bag limits for Roe's Abalone to 15
2017	Zone 1 – limited to 4 fishing days on Saturdays during December – February between 7:00 – 08:00 am

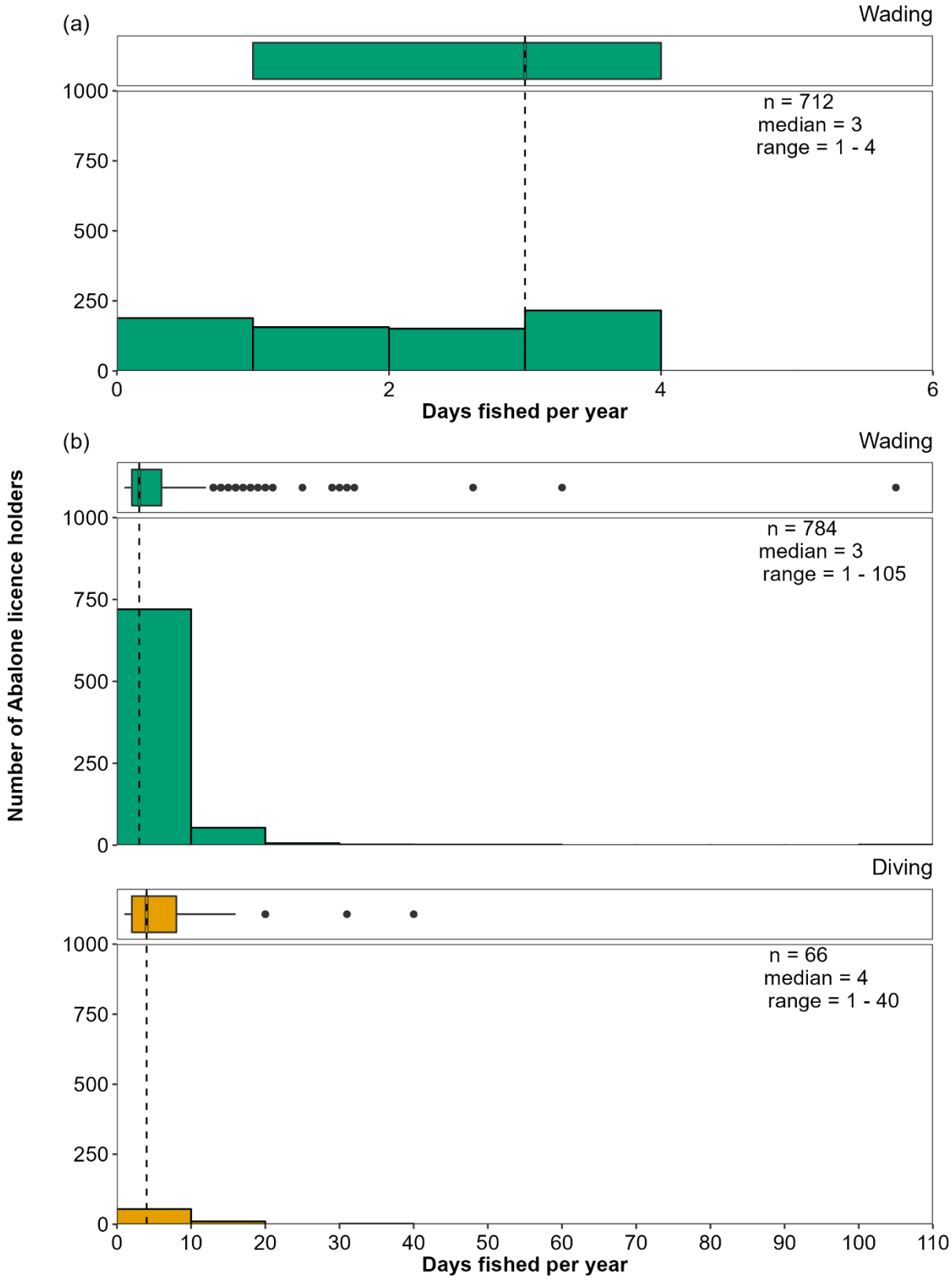
Appendix 2 Number of Abalone licence holders within the modified Regional Development Commission Boundaries from 1 April 2021 to 31 March 2022. Note: country total includes interstate abalone licence holders.



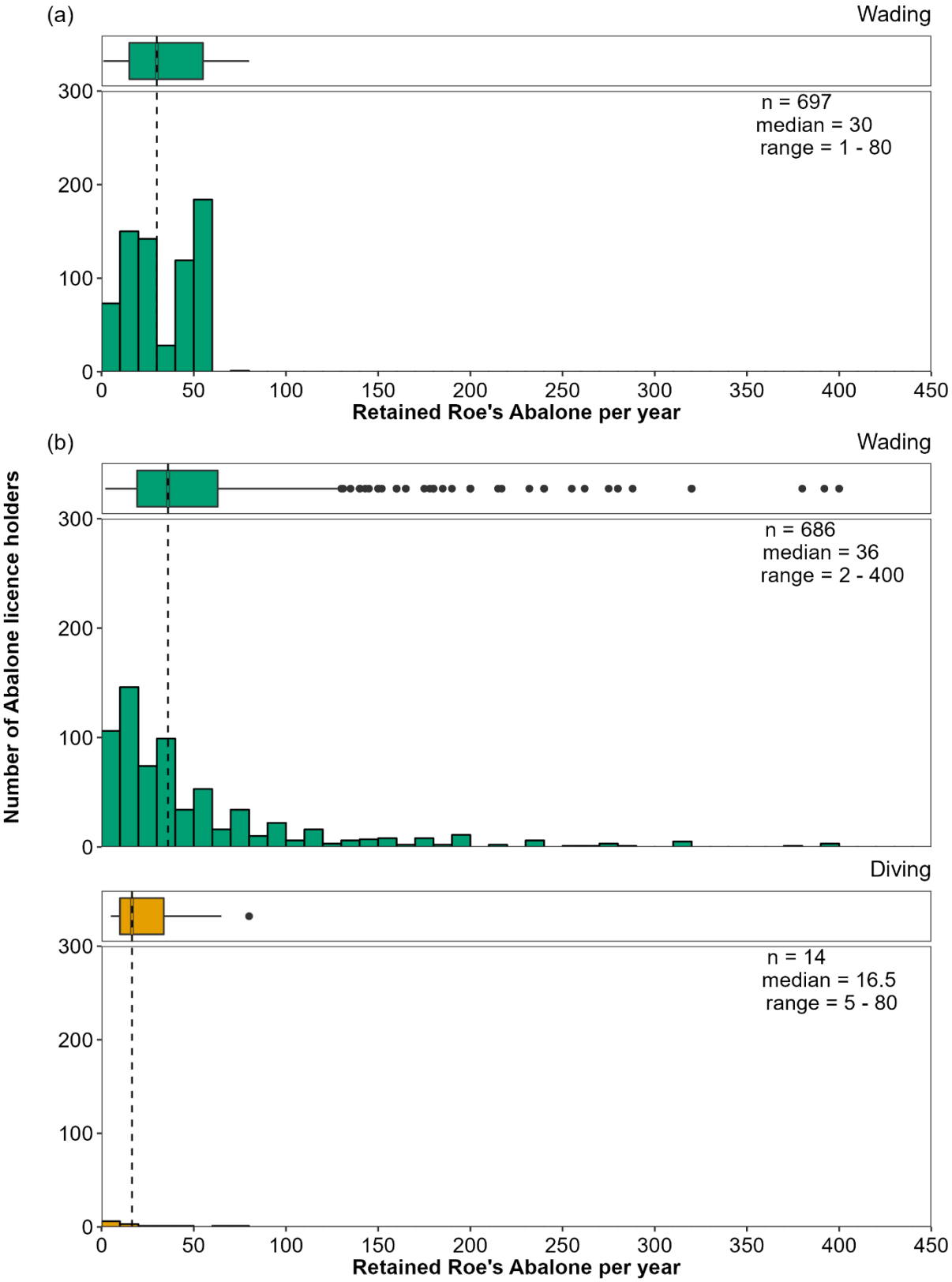
Appendix 3 Bioregion boundaries and reporting regions for the phone-recall survey.



Appendix 4 Distribution of raw data for fishing effort (number of days fished per year) for each abalone licence holder surveyed, and who fished, in 2021/22 by (a) Metro region (wading only) and (b) all other regions by wading and diving. Note: n = number of licence holders.



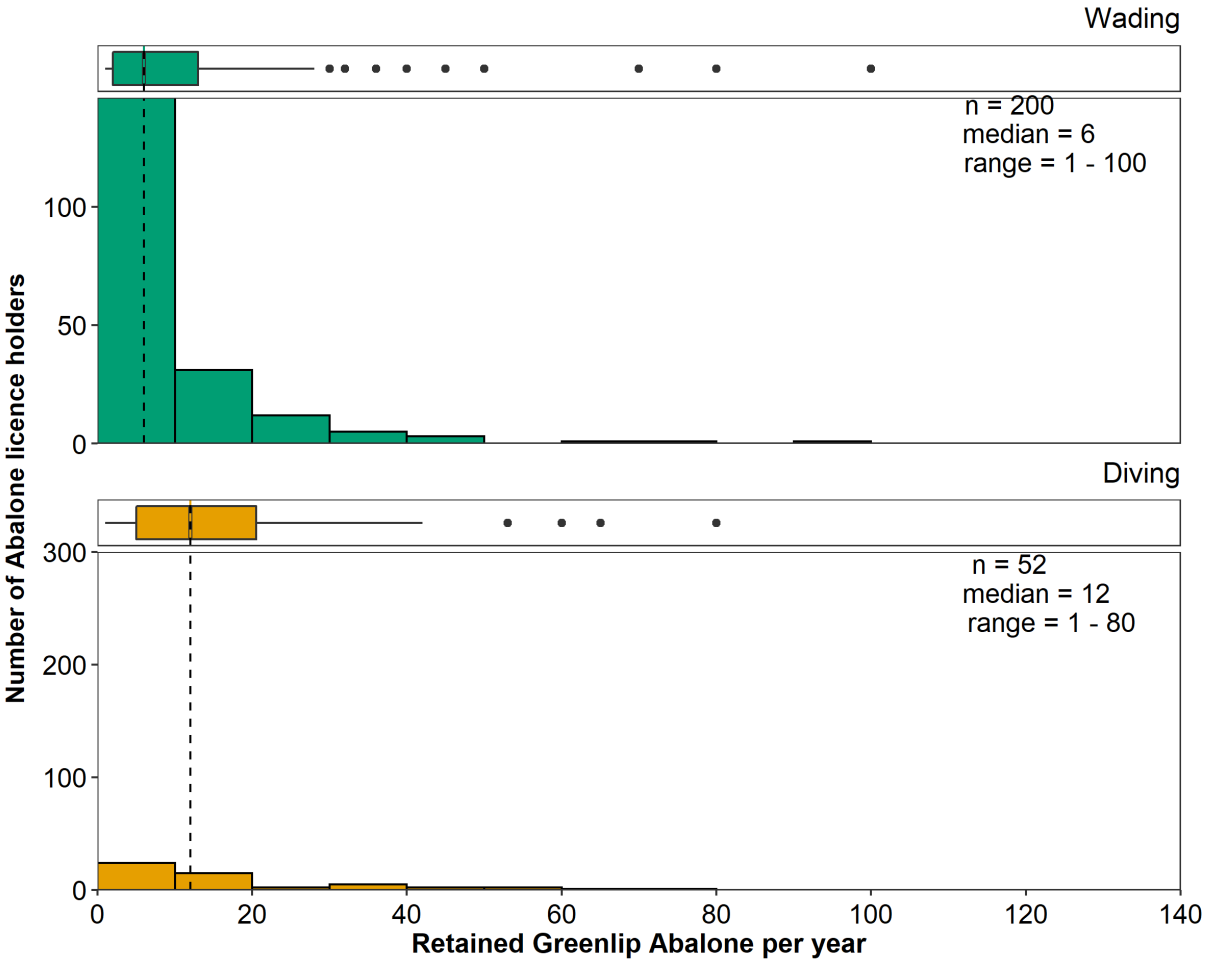
Appendix 5 Distribution of raw data for retained catch (number retained per year) for Roe's Abalone (*H. roei*) for each abalone licence holder surveyed, and who fished, in 2021/22 by (a) Metro region (wading only) and (b) all other regions by wading and diving. Note: n = number of licence holders.



Appendix 6 Distribution of raw data for retained catch (number retained per year) for Greenlip Abalone (*H. laevigata*) for each abalone licence holder surveyed, and who fishedoutside the Metro region in 2021/22 by wading and diving.

Note:

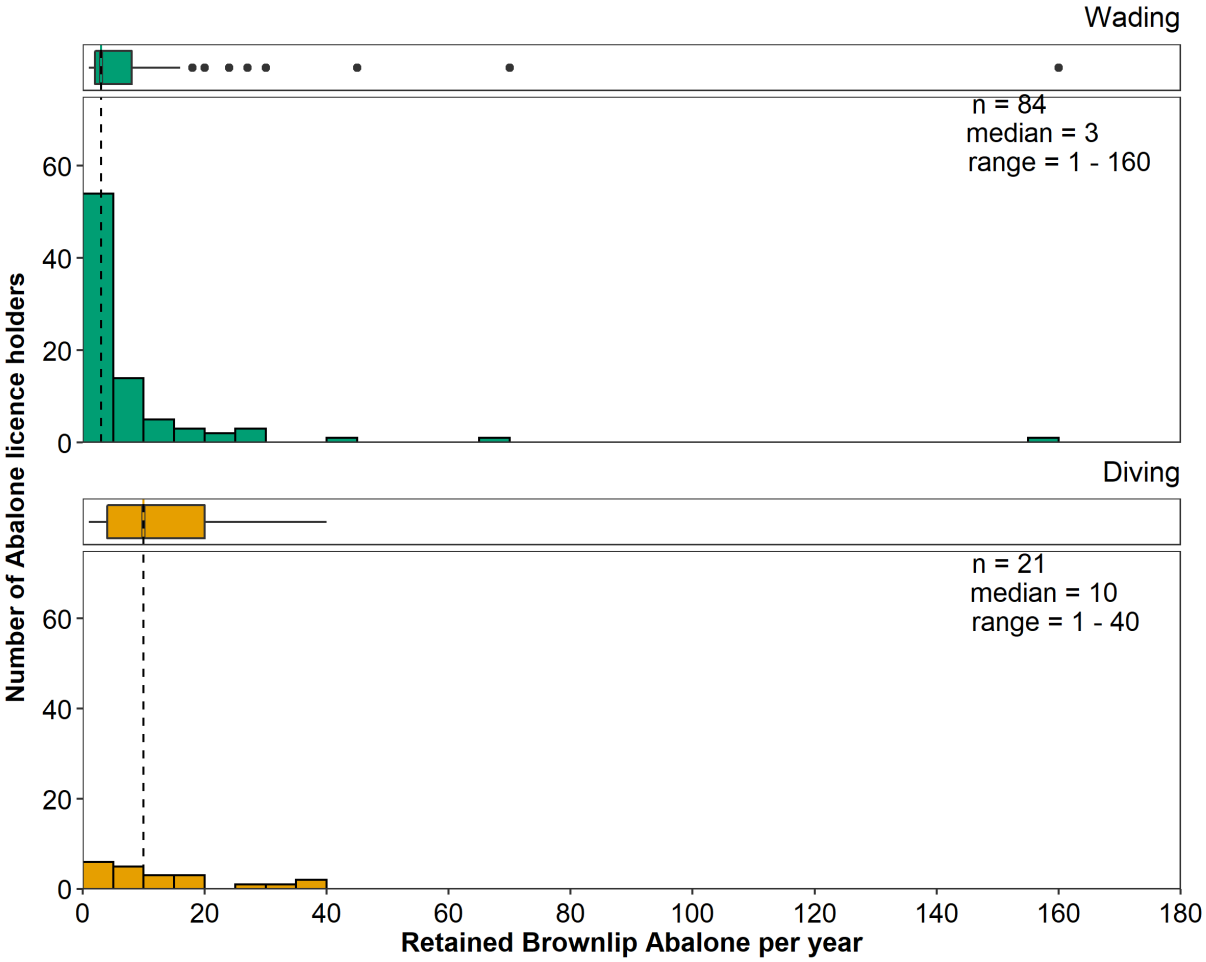
1. n = number of licence holders.
2. A summary of retained raw catch data in the Metro region was not possible due to the small number of fishers (n = 4) retaining Greenlip Abalone.



Appendix 7 Distribution of raw data for retained catch (number retained per year) for Brownlip Abalone (*H. conicopora*) for each Abalone licence holder surveyed, and who fished outside of the Metro region in 2021/22 by wading and diving.

Note:

1. n = number of licence holders.
2. A summary of retained raw catch data in the Metro region was not possible due to the small number of fishers (n = 1) retaining Brownlip Abalone.



Appendix 8 Statewide retained recreational catch (in numbers) for each abalone species obtained using the phone-recall survey in 2021/22 for wading, diving and total (combined methods).

Note: values in bold indicate RSE>0.4; values in italics indicate n<30.

Common Name (Scientific Name)	Retained catch (numbers)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone (*Haliotis roei*)	531,152	504,560	557,745	*2,370*	*787*	*3,952*	533,522	506,994	560,050
Greenlip Abalone (*Haliotis laevigata)*	15,682	12,473	18,892	6,865	4,366	9,363	22,547	18,505	26,588
Brownlip Abalone (*Haliotis conicopora*)	5,842	3,332	8,352	*2,082*	*957*	*3,207*	7,924	4,877	10,971

Appendix 9 Retained recreational catch (in numbers) for each abalone species obtained using the phone-recall survey in 2021/22 for each survey region by wading, diving and total (combined methods).

Note:

1. values in bold indicate RSE>0.4; values in italics indicate n<30.
2. due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level.

Survey Region	Retained catch (numbers)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone (*Haliotis roei*)									
Metro	249,343	236,751	261,935				249,343	236,751	261,935
South-West	183,591	162,097	205,085	***755***	***6***	***1,505***	184,346	162,879	205,813
Albany	63,904	51,551	76,257	***1,313***	***0***	***2,643***	65,217	52,835	77,599
Esperance	34,314	27,420	41,207	***301***	***0***	***732***	34,615	27,745	41,484
Greenlip Abalone (*Haliotis laevigata)*									
Metro	***366***	***0***	***760***				***366***	***0***	***760***
South-West	5,663	3,779	7,547	2,860	1,651	4,069	8,523	6,274	10,772
Albany	5,169	3,387	6,952	*2,802*	*913*	*4,692*	7,972	5,366	10,578
Esperance	4,484	2,603	6,365	***1,202***	***147***	***2,257***	5,686	3,548	7,823
Brownlip Abalone (*Haliotis conicopora*)									
Metro	***225***	***0***	***648***				***225***	***0***	***648***
South-West	3,678	2,093	5,264	*1,190*	*397*	*1,982*	4,868	3,085	6,650
Albany	*736*	*298*	*1,174*	***643***	***0***	***1,300***	*1,379*	*590*	*2,168*
Esperance	***1,202***	***0***	***3,056***	***250***	***0***	***712***	***1,452***	***0***	***3,766***

Appendix 10 Retained recreational catch (in numbers) for each abalone species obtained using the phone-recall survey in 2021/22 for each recreational fishing zone by wading, diving and total (combined methods).

Note:

1. values in bold indicate RSE>0.4; values in italics indicate n<30.
2. due to the number of decimal places in the input parameters and rounding, the values across regions with a year may not sum to the totals at a statewide level.

Recreational Fishing Zone	Retained catch (numbers)								
	Wading			Diving			Total		
	Estimate	LCI	UCI	Estimate	LCI	UCI	Estimate	LCI	UCI
Roe's Abalone (*Haliotis roei*)									
Western	249,343	236,751	261,935				249,343	236,751	261,935
Southern	281,809	255,982	307,635	*2,369*	*787*	*3,952*	284,178	258,409	309,947
Greenlip Abalone (*Haliotis laevigata)*									
Western	***366***	***0***	***760***				***366***	***0***	***760***
Southern	15,316	12,156	18,476	6,864	4,366	9,363	22,180	18,178	26,183
Brownlip Abalone (*Haliotis conicopora*)									
Western	***225***	***0***	***648***				***225***	***0***	***648***
Southern	5,617	3,142	8,091	*2,082*	*957*	*3,207*	7,699	4,681	10,717