



TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES: 2015-16 FISHING SEASON

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Executive Summary

This report provides an assessment of the 2015-16 recreational Rock Lobster and Abalone fishing season and continues the time series monitoring trends in these fisheries conducted since the mid-1990s.

During 2015-16 16,800 persons held at least one recreational Rock lobster licence and almost 10,500 persons held a recreational Abalone licence. Compared with 2014-15 this represented a 13% decline in numbers and was >20% below the peak in licence sales that occurred in the late 2000s.

A random sample of licence-holders was contacted by telephone prior to the start of the 2015-16 fishing season and invited to participate in a telephone/diary panel survey to monitor their Rock Lobster and Abalone fishing activity between November 2015 and April 2016. A total of 457 respondents (374 valid licence-holders) completed the survey (84% effective response rate), providing detailed catch and effort information for each fishing trip undertaken. These data were scaled up to represent the activity of all licence-holders.

The 2015-16 Rock Lobster season (Eastern region: 21 Nov 2015 – 30 Apr 2016; Western region: 7 Nov 2015 – 31 Aug 2016) was monitored to the end of April 2016. Licensed recreational fishers were estimated to have harvested 58,805 (95% CI: 48,186 – 71,091) lobster, based on 69,920 fisher days of effort. Potting was the dominant method, representing 79% of the effort (days fished) and 61% of the estimated harvest. Dive collection accounted for 19% of the effort and 36% of the harvest, while ring usage contributed 2% of the effort and 3% of the harvest. The overall average harvest rate was 0.84 lobster per day fished, with daily harvest rates of 0.65 for pots, 1.61 for dive collection, and 1.17 for rings.

The Rock Lobster fishery was concentrated off the east coast, in particular the southeast, with this area accounting for 64% of the harvest (by number). The remaining harvest was split more or less evenly between the north and west coasts. Conversion of numbers to weights produced a recreational harvest estimate of 63 tonnes for the 2015-16 season, with catches from the east coast accounting for 57%, the north coast 27%, and the west coast 16% by weight. By weight the recreational catch represented about 37% of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to about 5% of the 2015-16 total allowable catch (TAC) of 1221 tonnes (which includes the total allowable commercial catch of 1051 tonnes).

In terms of actual landings, the recreational fishery accounted for about 6% of the total catch from the recreational and commercial fisheries combined. However, winter fishing in the Western region was not covered in the current survey and thus the relative significance of the recreational fishery will have been underestimated in this comparison. Notwithstanding this issue, the impact is likely to have been very small since effort and catches during the winter months tend to be low (typically <5% of seasonal totals). There was marked regional variability in the relative contributions represented by the recreational fishery. For instance, off the east coast recreational catches represented between 15 and 20% of the combined catch, whereas in the southwest the recreational catch represented just 1% of the total. By restricting catch comparisons to shallow inshore waters, the area of greatest overlap between sectors, the recreational component of the state-wide total was more significant at 15% overall, accounting for 25-32% of the catches from the east coast.

A key component of the East Coast Stock Rebuilding Strategy has been the implementation of a notional east coast recreational catch share of 42 tonnes. Unlike in 2014-15 this catch share was not exceeded; the estimated recreational catch during 2015-16 was 35.7 tonnes for the management area. The lower catch was influenced by a combination of factors, including reduced licence sales, east coast biotoxin closures (between November and mid-January in some zones), reduction in the east coast daily bag limit (from 3 to 2 lobsters) and a winter fishery closure (May to August, inclusive).

There is strong evidence, however, to suggest that the 2015-16 catch share would have been exceeded had the biotoxin events not occurred. The biotoxin events had a direct impact on licence sales and, for those who did go fishing, there was a general perception they had fished less often than expected because of the closures. Notwithstanding this, there was some displacement of effort within the east coast (e.g. into the Storm Bay Bruny and Central East zones, both of which were open from late November) as well as to the Western Region. Overall, however, the levels of displaced effort appeared to be relatively minor, with most fishers choosing not to fish for lobster at least until their usual fishing areas were opened.

In relation to communicating information about the biotoxin events, DPIPWE Fishing News email updates and the DPIPWE website along with traditional media (TV and newspaper) proved quite effective according to respondents. By contrast, the Tas Fish Guide phone app and the Fisheries Tas facebook page were relatively minor sources and the Health Department's website was rarely cited as a source of information. Overall, almost three-quarters of respondents were satisfied with the level of communication by the government about the issue.

Recognising the health risks associated with the consumption of Rock Lobsters that may have accumulated harmful levels of the paralytic shellfish toxin (PST) in the hepatopancreas, this study established that prior to the first major biotoxin event in Tasmania during 2012 almost 20% of fishers at least occasionally consumed the hepatopancreas (known colloquially as the mustard). There was some evidence of slightly higher consumption rates in regional areas and amongst interstate licence-holders, though the sample of interstate fishers surveyed was small. Interestingly, since the initial health warnings just 15% of fishers who previously ate the mustard indicated that they now avoided it, regardless of whether or not closures were in place. With less than half of all respondents agreeing that the health risks associated with the biotoxin events were well communicated and understood, there would appear to be a need for further community education on the issue.

The recreational Abalone harvest up until the end of April 2016 was estimated at 47,113 (95% CI: 34,262 – 59,025) animals, based on 9,548 diver days of effort. Blacklip Abalone accounted for 90% and Greenlip Abalone 10% of the total numbers. Over 60% of the catch was taken from the east coast, with a further 25% from the north and 10% from the west coasts. About one in five dives resulted in the daily bag limit of 10 abalone being taken; the overall average daily harvest rate was 4.9 abalone. By converting numbers to weights, the 2015-16 recreational harvest of Abalone was estimated at 23 tonnes, equivalent to just over 1% of the 2015 commercial and 2015-16 recreational catches combined. There are currently no performance indicators or a TARC for the Tasmanian recreational Abalone fishery.

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1 INTRODUCTION

Rock Lobster and Abalone are highly prized by recreational fishers in Tasmania. Southern Rock Lobster (*Jasus edwardsii*) and occasionally the Eastern Rock Lobster (*J. verreauxi*) are taken by a variety of methods, including pots, ring nets and dive collection. Two species of Abalone, Blacklip (*Haliotis rubra*) and Greenlip (*H. laevis*), are targeted by recreational divers, the former harvested around the state and dominating the total catch, the latter generally restricted to the north coast of Tasmania and Bass Strait Islands. In addition to recreational importance, Rock Lobster and Abalone support major commercial fisheries in Tasmania, both of which are subject to catch quotas.

Recreational licences (first introduced in the late 1970s) are required to harvest Rock Lobster and Abalone in Tasmania. The licences are method-based and prior to the mid-1990s consisted of a pot and a general dive licence; the latter permitted the capture of Rock Lobster, Abalone, and Scallops by diving. The licensing system was revised in 1995 and the general dive licence was split into lobster dive, scallop dive and abalone licences. In 1998, a Rock lobster ring licence was introduced to close a loophole in the legal capture of Rock Lobster by recreational fishers. Pot fishers are permitted to use one pot, ring fishers up to four rings, and divers can use artificial breathing apparatus (scuba and surface air supply, the latter commonly known as hookah).

Licences are issued annually, with the licensing year extending from November to the following October. Recreational fishers may hold up to three categories of lobster licence (pot, ring and/or dive) and/or an abalone licence in a given fishing year¹. In addition to licensing, minimum size limits, closed seasons, and a ban on the taking of females holding eggs, referred to as in 'berry', apply to Rock Lobster. Minimum size limits apply for Abalone. Recreational fishers are also subject to daily bag and possession limits for both Rock Lobster and Abalone.

Following the introduction of the current licensing system, the number of persons holding recreational Rock Lobster licences more than doubled from about 8500 in 1995-96 to 21,000 by 2007-08 (Fig. 1). Increases occurred in each of the licence categories, with over 18,000 pot, 9000 dive and 5600 ring net licences issued in 2007-08. Rock Lobster licence numbers remained relatively stable up until 2009-10, then declined over the following three seasons before increasing slightly to levels comparable to the mid-2000s. A sharp fall in licence numbers was experienced in 2015-16, no doubt influenced by a series of east coast biotoxin closures early in the season. About 16,800 persons held at least one category of recreational Rock Lobster licence during 2015-16, 13% fewer than the previous fishing season, with a total of 14,200 pot, 7500 dive and 4200 ring licences issued. Abalone licence numbers followed a similar trend, almost tripling between 1995-96 and 2007-08 to peak at 13,500 (Fig. 1). Numbers remained relatively stable at a lower level between 2010-11 and 2014-15, but then declined by about 13% to 10,500 for the current season.

¹ Note, the licensing system also includes gillnet, beach seine, setline and scallop licence categories.

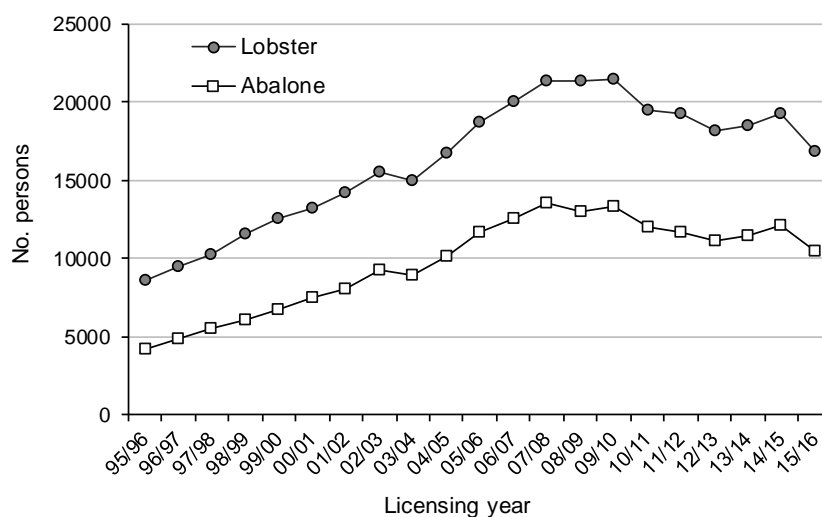


Fig. 1. Number of persons holding recreational Rock Lobster and Abalone licences by licensing year.

In 1998, concurrent with the initial increase in recreational licence numbers was the introduction of quota management for the commercial Rock Lobster fishery. This was to address the objectives of reducing catches to sustainable levels and allowing for the rebuilding of legal-sized biomass (Ford 2001). The total allowable commercial catch (TACC) was initially set at 1502 tonnes and represented a reduction in catches which had previously averaged over 1700 tonnes per annum for the decade prior to 1998. The TACC was increased to 1523 tonnes in 2002 and was maintained at this level until 2008-09. In response to concerns about declining stock levels, a situation exacerbated by a protracted period of poor recruitment (Linnane *et al.* 2010), the TACC was then progressively reduced to 1103 tonnes by 2011-12, remaining at this level until 2013-14 and then further reduced to 1050.7 for the 2014-15 and subsequent seasons.

As part of the 2005 management review of the Tasmanian Rock Lobster fishery, provision was made for an explicit catch allocation to the recreational sector. Under these arrangements, a notional total allowable recreational catch (TARC) was set at 170 tonnes or 10% of the total allowable catch (TAC), whichever is the larger quantity. Based on these criteria, the TARC defaulted to 170 tonnes for 2015-16 which, when added to the TACC, resulted in a notional TAC of 1220.7 tonnes. Recreational catch information is thus required to evaluate performance against the TARC and also as an input into the Rock Lobster assessment developed to model stock status and undertake risk assessments under different management scenarios (Hartmann *et al.* 2013).

Concerns over the status of the Rock Lobster stock, in particular off the east coast of Tasmania, provided impetus for management to implement an east coast stock rebuilding strategy (DPIPWE, 2015). The rebuilding strategy seeks to limit the total Rock Lobster catch from the east coast (Areas 1-3, refer to Fig. 3) to 200 tonnes, and is based on a notional resource sharing arrangement of 21% for the recreational sector (42 tonnes) and 79% for the commercial sector (158 tonnes). Key elements of the strategy relevant to recreational fishers involved dividing Tasmania into Eastern and Western Rock Lobster Fishing Regions (Fig. 2), reducing Eastern Region bag and possession limits and delaying the opening of the Eastern region fishery by two weeks. The daily bag and possession limits in the Eastern region were reduced from 5 to 3 and from 10 to 6, respectively in November 2011. Bag and possession limits for the Western region remained unchanged at 5 and 10 lobsters, respectively. Boat limits were also introduced for the first time and were set at 15 lobsters for the Eastern region and 25 for the Western region. In November 2015, daily bag, the Eastern region possession and boat limits were further reduced to 2, 4 and 10 lobsters, respectively. In addition, the Eastern region

fishing season closed on 30 April, some four months earlier than in previous years. These more recent changes were implemented to help constrain the recreational catches to within the east coast catch share, noting that the 2014-15 recreational catch estimate for the east coast (55.6 tonnes) exceeded the notional catch limit by 13.6 tonnes or 32% (Lyle and Tracey, 2016).

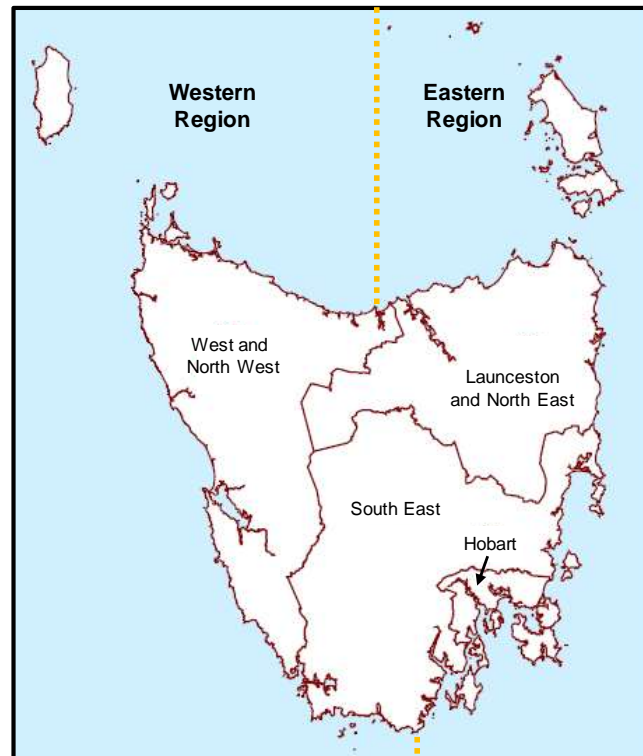


Fig. 2 Map showing Tasmanian ASGS Statistical Areas (adapted from Pink, 2011) and Rock Lobster Fishing Regions.

The TACC for Abalone has been reduced progressively since 2010, from 2660 to 1932 tonnes in 2014 (1792 tonnes for Blacklip and 140 tonnes for Greenlip Abalone). While there are no specific management performance indicators relating to the recreational fishery for Abalone, recreational catch data are taken into account in the annual assessment process (Tarbath & Mundy 2015).

This survey represents the eleventh in a series for Rock Lobster and the tenth for Abalone undertaken since 1996. Key objectives include characterisation of the 2015-16 Rock Lobster and Abalone fisheries in terms of participation, fishing effort and catch, with particular focus on the fishery off the east coast. Unlike previous

2 METHODS

2.1 Survey design

The methodology applied is based on that used successfully in previous surveys and independently reviewed by Pollock (2010). The design involves a two-stage process; an initial telephone interview to profile licence-holders and establish eligibility for the next survey phase; and a follow-up telephone-diary survey in which fishing activity was monitored in detail during the 2015-16 licensing year up until the closure of the Eastern region rock lobster fishery (i.e between 1 November 2015 and 30 April 2016).

2.1.1 Survey sample

The survey sample was selected from the 2014-15 recreational licensing database administered by the Department of Primary Industries, Parks, Water and Environment. While the majority of licence-holders are Tasmanian residents, a small number of interstate and overseas residents also take out licences. Commercial fishers are eligible to hold recreational licences, although restrictions controlling recreational gear and its use on commercial fishing trips apply. Persons under 10 years of age are not eligible to hold a licence.

The database of all persons holding 2014-15 recreational rock lobster licences was divided into five regional (i.e. residential) strata. For Tasmanian residents, regions corresponded to the Australian Bureau of Statistics (ABS) ASGS Statistical Areas (Level 4), namely Hobart, South East, Launceston and North East, and West and North West (Fig. 2). Interstate residents were grouped into a fifth 'Interstate' stratum. A random sample based on a constant sampling fraction was applied to both the South East and Launceston and North East strata whereas a lower sampling fraction (two thirds of that for the South East, Launceston and North East) was applied for residents of the Hobart, West and North West, and Interstate strata. The higher sampling rates outside of Hobart and the West and North West were intended to improve the precision of estimates of fishing activity for the east coast (Areas 1-3). For analytical purposes, licence-holders were treated as if they were derived from four strata, namely (i) Hobart, (ii) South East and Launceston and North East combined strata, (iii) West and North West, and (iv) Interstate.

2.1.2 Screening survey

Respondents were contacted by telephone during October 2015 and asked about their fishing for Rock Lobster and Abalone during the 2014-15 season (numbers of days fished and estimated retained catch for either species) and the likelihood of their renewing the fishing licences for the 2015-16 fishing season. Sampling was conducted without replacement, i.e. persons without a telephone listing or those who did not respond were not substituted in the sample.

2.1.3 Telephone-diary survey

Respondents who indicated an intention to renew their licences were deemed eligible and were invited to participate in the diary survey. Those who accepted were mailed a diary and letter of introduction. Diarists were contacted by telephone shortly afterwards to confirm receipt of their diary kit and have reporting requirements explained. Diarists were then contacted regularly by telephone throughout the survey period by experienced interviewers who recorded details of any Rock Lobster and/or Abalone fishing activity since last contact. The frequency of the contact was tailored to the needs and behaviour

(level of fishing activity) of individual respondents and thus detailed information was routinely collected soon after each fishing event, minimising recall bias for non-diarised data. By maintaining regular contact, mostly at least once a month, interviewers were also able to clarify any misunderstandings or inconsistencies at the time of the interview, thereby maximising overall data quality and completeness.

Information collected for each fishing activity or 'event' included the date, location, method used, target species for divers, start and finish times (including any significant breaks from fishing), and the numbers of lobster and/or abalone kept (harvested). In addition, the numbers of lobster released and reason(s) for release were recorded. Fishing locations were allocated into the eight areas used for lobster fishery assessment reporting (Fig. 3), though further disaggregation was feasible since more specific location information was routinely collected.

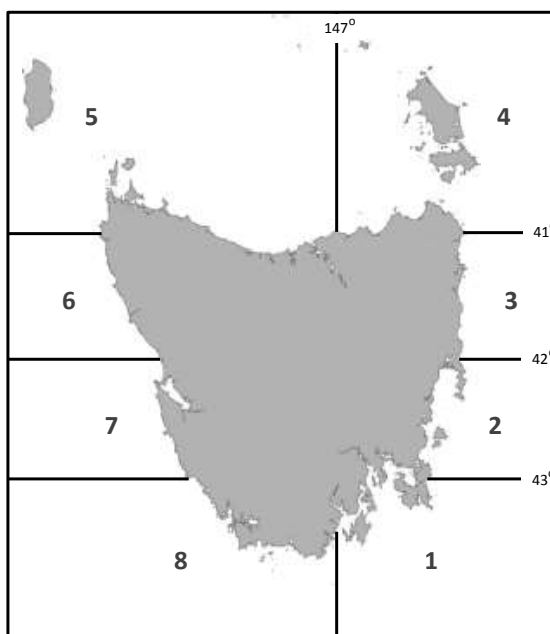


Fig. 3. Map of Tasmania showing fishery assessment areas referred to in the text.

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

Pots were generally fished overnight, although in a small number of instances they were not checked for several days, generally because unfavourable sea conditions prevented retrieval. The start of a fishing day was taken as the time the pot was set and the finish as the last time on a given day that it was checked or hauled. In cases where the pot was checked more than once in a day, the reported catch related to the total number of lobster taken for that day. For the purposes of calculating effort, overnight sets were considered to represent a single pot-day of effort.

The enumeration period for lobster was from the opening of the season (7 Nov 2015 Western region; 21 Nov 2015 Eastern region) until closure of the Eastern region fishery (30 April 2016). For abalone the survey period was from 1 Nov 2015 to 30 Apr 2016.

2.1.4 Wash-up survey

At the completion of the diary survey all fully responding diarists aged 18 years and older were asked a series of questions relating to their fishing activity, perceptions relating to the quality of the fishery, opinions regarding recent management changes, and understanding of biotoxin events that occurred during 2015-16.

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2014-15 licence database, licence details for 2015-16 were used for data expansion. That is, the licence status (licences held and dates of issue) was established for all diarists by reference to the 2015-16 licence database and expansion factors calculated as the size of the licensed population divided by the number of licensed diarists.

Since the number of licensed fishers increased progressively during the season, the sample size (i.e. number of *licensed* diarists) and total number of licensed fishers changed within the diary enumeration period. For instance, 64% of Rock Lobster and 62% of Abalone licences were issued by the end of November 2015, these proportions increased to 85 and 83% by the end of December and 92 and 91% by the end of January 2015. In order to account for this dynamic, the number of licence holders registered on the licence database and the number of licensed diarists at the end of each month (sensitive to the stratification) provided the basis for calculating expansion factors that were applied to fishing activity for the given month.

The survey scope was confined to licensed recreational fishing activities; namely, the use of pots and rings and dive methods to harvest Rock Lobster and the harvesting of Abalone. Any fishing activity reported by diarists whilst unlicensed (either prior to renewing a licence or by diarists who did not renew licences) was considered out of scope and thus excluded from all analyses.

The 'bootstrap' method was used to estimate 95% confidence limits, determined using the percentile method (Haddon 2001). In each instance 1000 simulations were conducted.

2.3 Size composition

Size composition information for recreationally caught Rock Lobster was provided by volunteer diarists. At screening, potential diarists who had reported substantial fishing activity during the 2014-15 fishing season were asked whether they would be prepared to measure their catch as part of the survey. Respondents who expressed an interest in measuring their catch were provided with a set of callipers and an instruction sheet showing how to measure and sex Rock Lobster. Sex and carapace length (mm) information reported by respondents was linked to capture events, enabling size composition information to be made sensitive to fishing method and region.

Lengths were converted into weights using the following relationships:

$$W = 0.000285L^{3.114} \quad \text{males}$$

$$W = 0.000271L^{3.135} \quad \text{females}$$

where W is body weight (g), L is carapace length (mm) (Punt & Kennedy 1997). Average weights by method and region were then applied to convert harvest numbers to weight for the purpose of comparison with the TARC.

2.4 Commercial catch data

Commercial catch data was obtained from compulsory catch returns provided by Rock Lobster and Abalone fishers. Rock Lobster data are reported on a daily basis by depth and by $\frac{1}{2}$ degree fishing blocks and for this analysis relate to logbook catch and effort data for the 2015 quota year (March 2015 and February 2016, inclusive). Catches are reported in terms of numbers and weights.

Abalone divers report daily catch weights taken by fishing block or sub-block. In situations where commercial fishing blocks were bisected by recreational area boundaries (defined in Fig. 3), commercial catches within such blocks were apportioned equally between the two adjacent recreational areas, thereby facilitating regional comparisons between commercial and recreational Abalone catches. Commercial Abalone catch data relate to the period January to December 2015.

3 RESULTS

3.1 Response rates

3.1.1 Screening survey

From a random sample of 808 licence-holders selected from the 2014-15 licence database, 67 (8.3%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 741. Contact was made with 717 licence-holders, of whom 669 fully responded, representing a screening survey response rate of 90.3%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 6.5% of the net sample and refusals or other non-response a further 3.2% (Table 1).

Amongst the respondents, 81 indicated that they were not likely to renew their licence(s) in 2015-16 and hence were not eligible for inclusion in the diary survey. The balance (588) indicated they were likely to renew their licence(s) (Table 1). Of the respondents who indicated they were likely to renew their licences 75.7% did so, compared with 37.0% of those respondents who did not expect to renew their licences.

Table 1 Sample details and response rates for the screening and diary survey components

	Sample	% sample/ eligible	Licence renewed 2015-16	Licence not renewed 2015-16	% renewed
Screening survey					
Gross sample	808		568	240	70.3
Sample loss	67	8.3	41	26	61.2
Net sample	741		527	214	71.1
Full response	669	90.3	475	194	71.0
Non-response	24	3.2	17	7	70.8
Non-contact	48	6.5	35	13	72.9
Eligible for diary					
Y- Likely to renew	588		445	143	75.7
N - Not likely to renew	81		30	51	37.0
Diary Survey					
Full response	457	77.7	374	83	81.8
Partial response	40	6.8	18	22	45.0
Refuse diary	91	15.5	53	38	58.2

3.1.2 Telephone-diary survey

In total 497 respondents eligible to participate in the diary survey accepted the diary, 457 (91.9%) of whom completed the survey. Of the responding diarists, 83 (18.2%) did not take up a licence during 2015-16 despite rating themselves as 'quite likely' or 'very likely' to do so. Among the remaining 374 respondents, 372 held at least one category of lobster licence while 235 had an abalone licence. Considering the number of eligible

respondents who both renewed their licences (445) and completed the survey the effective survey response rate was 84.0% (Table 1). Data for the diarists who partially responded (i.e. declined to participate for the full period or with whom contact was lost) have been excluded from all analyses.

The numbers of individual lobster and abalone licences (population) and the sample of responding diarists are presented in Table 2. Overall, about one in 45 licence holders participated in the survey.

Table 2 Total number of 2015-16 lobster and abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.

Licence type	Licence holders	Diarists	% sampled
Rock Lobster pot	14,166	321	2.27
Rock Lobster dive	7,483	173	2.31
Rock Lobster ring	4,180	89	2.13
Abalone	10,509	235	2.24
Total licences	36,338	818	2.25
Total persons	17,514	374	2.14

Fully responding diarists reported a total of 1732 fishing events during the survey period, 1663 (96%) of which were valid events². In total, 65% of all valid fishing events were reported as being diarised, the balance was based on recalled fishing activity (typically collected by survey interviewers within a few weeks of the activity taking place).

3.2 Rock Lobster

3.2.1 2014-15 seasonal participation

Information provided in the screening survey indicated that 77.2% (SE 1.6%) of 2014-15 Rock Lobster licence holders fished for Rock Lobster during that season, with 63.9% (SE 1.9%) harvesting at least one lobster. That is, out of the 19,306 persons licensed in 2014-15, 14,898 fished for Rock Lobster but only 12,327 harvested one or more lobster for the season. However, this information is subject to recall bias as it was collected retrospectively at the end of the season and as such is considered indicative only.

3.2.2 2015-16 catch and effort

Information reported in this and following sections relates to diary survey data provided by fully responding licence holders and is presented as expanded estimates representative of the activities of all recreational Rock Lobster licence holders between November 2015 and April 2016, inclusive.

An estimated 68.4% (SE 2.4%) of licence holders fished for Rock Lobster at least once during the fishing season and just 53.8% (SE 2.6%) of licence holders harvested at least one lobster. That is, out of 16,810 licence-holders, 11,500 fished for Rock Lobster and 9,039 caught and kept at least one Rock Lobster.

² Events reported by diarists whilst unlicensed were considered out of scope and not valid.

Overall, total fishing effort was estimated to be 69,920 fisher days³ for the period November to April, yielding a harvest of 58,805 Rock Lobster⁴ (Table 3). This represented an average seasonal harvest rate of 0.84 Rock Lobster per day fished. Pots were the most popular fishing method (accounting for 61% of the total harvest) followed by dive collection (36%) and rings (3%) (Table 3). Although four times as many fisher days of effort were spent using pots compared with diving, the catch taken by pots was only 1.7 times greater than that taken by diving. Average daily harvest rates for diving (1.61 lobster) was about 2.5 times higher than that for fishing with pots (0.64 lobster). The average daily harvest using rings was 1.17 lobster.

Table 3. Rock Lobster effort, harvest and harvest rates for the 2015-16 season
Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day ⁻¹)
Pot	35,833 (27,462 – 44,708)	55,325 (44,370 – 66,250)	0.65
Dive	21,452 (14,451 – 30,270)	13,293 (9,359 – 18,086)	1.61
Ring	1,520 (428 – 3,091)	1,303 (666 – 2,052)	1.17
Total	58,805 (48,186 – 71,091)	69,920 (58,341 – 80,425)	0.84

3.2.3 Regional catch and effort

Catch, effort and catch rates by fishing areas (refer Fig. 3) are summarised in Table 4 and indicate that the fishery was primarily concentrated on the east coast (Areas 1-3). This combined region accounted for 64% of the total estimated harvest (37,676 Rock Lobster) and attracted almost three-quarters of the total effort (51,103 fisher days) during the survey period. Area 1 alone accounted for 36% of the total harvest and 45% the total state-wide effort. The north coast (Areas 4 & 5) accounted for 17% of the harvest (10,086 Rock Lobster) and 11% of effort (7,947 fisher days) while the west coast (Areas 6 - 8) contributed 19% of the total harvest (11,043 Rock Lobster) and 14% of total effort (10,002 fisher days).

Marked regional differences were evident in the proportion of the Rock Lobster harvest taken by different fishing methods (Fig. 4). Pots accounted for the bulk of the harvest in Areas 1 and 3 (67-86%), while dive collection was the primary capture method in Area 2 (57%). Dive methods also dominated in Areas 4 and 5 (59-70%) whereas in Area 6 pot and dive produced similar catches. In Area 7 pot and ring methods dominated with pots accounted for the vast majority of the catch in Area 8.

Mean daily harvest rates were highly variable around the state, ranging from almost two Rock Lobster per day in Area 5 to 0.7 in Area 1 (Table 4). Stock abundance and fishing pressure (including commercial activity), along with differing regional bag limits and the relative mix of fishing methods used (Fig. 4), noting significantly higher harvest rates for

³ A fisher day is defined as a day in which lobster was a nominated target species and/or lobsters were caught.

⁴ While the vast majority of the lobster were Southern Rock Lobster, diarists did report two instances involving catches involving Eastern Rock Lobster, one off St Helens and the second in Recherche Bay (southern Tasmania).

dive collection and rings compared with pots (Table 3), represent key factors contributing to this regional variability.

Table 4. Recreational Rock Lobster effort, harvest and harvest rates by fishing area for 2015-16

Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	21,375 (14,334 – 29,313)	31,279 (23,004 – 39,857)	0.68
2	7,429 (4,463 – 10,645)	8,541 (5,663– 11,458)	0.87
3	8,873 (5,132 – 13,888)	11,370 (6,670– 17,094)	0.78
4	3,287 (1,567– 5,419)	4,462 (2,137– 7,294)	0.74
5	6,799 (3,217 – 11,001)	3,485 (1,620– 5,651)	1.95
6	4,354 (2,182 – 6,730)	3,979 (1,898– 6,413)	1.09
7	3,396 (1,456 – 5,777)	2,703 (1,152– 4,146)	1.26
8	3,293 (1,484 – 5,170)	3,809 (1,859– 5,364)	0.84

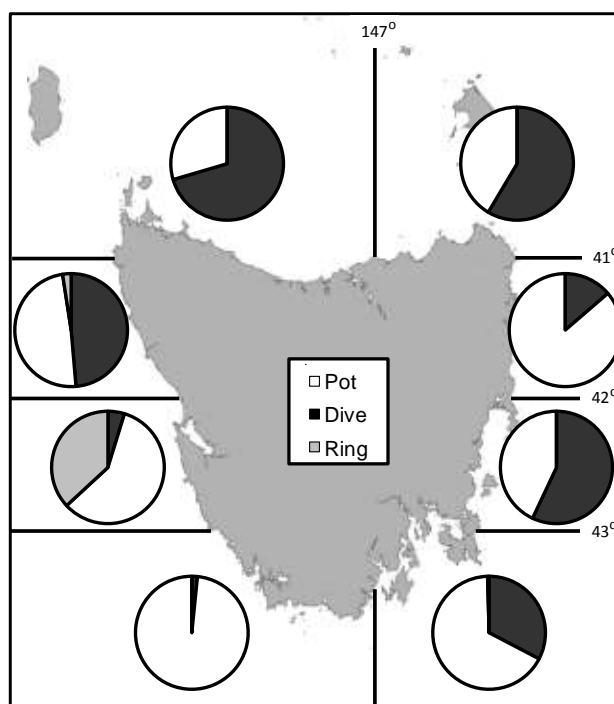


Fig. 4. Proportion of regional harvest by fishing method (pie charts).

3.2.4 Southeast coast

Catch data for Area 1 have been disaggregated into five sub-areas to better describe the spatial characteristics of the fishery in the southeast (Fig. 5). Waters surrounding the Tasman Peninsula and the western area of Storm Bay (including Bruny Island)

collectively accounted for two-thirds of the catch, with the D'Entrecasteaux Channel⁵ and Norfolk-Frederick Henry Bay regions contributing the bulk of the remainder. Comparatively low catches were taken from the Derwent Estuary.

Pots accounted for the majority of the catch taken from the Tasman Peninsula and Norfolk- Frederick Henry Bay areas and were more or less comparable to those taken by diving in the western Storm Bay region (Fig. 5). Dive collection was the dominant capture method in the D'Entrecasteaux Channel and Derwent Estuary. Rings accounted for a very minor proportion of the catch.

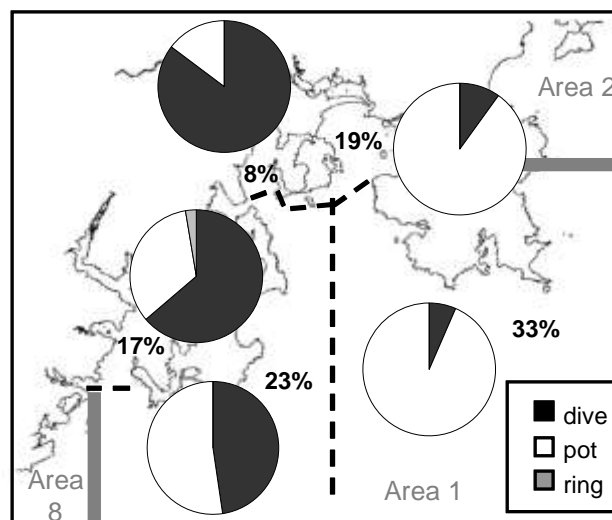


Fig. 5. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

3.2.5 Seasonal catch and effort

The scheduled opening of the Eastern region (21 November) was delayed by biotoxin closures, which in most areas of the east coast extended to mid-December or beyond. This resulted in the typically intense period of fishing activity immediately following the opening of the season in November not occurring in 2015/16 (Fig. 6). Even though the Western Region was open from the 7th of November, the level of fishing activity in that region was relatively low in comparison to what typically occurs off the east coast. Effort and harvest peaked sharply during December and January before slowing dramatically in February followed by a minor increase in March associated with the Easter holiday period.

The underlying seasonal pattern of catch and effort in the fishery was influenced most strongly by variation in pot fishing activity, with 70% of the pot catch taken between December and January (Fig. 6). Dive catch and effort followed a similar pattern although the magnitude of the variability in catches during the December-April period was less pronounced, with 49% of the catch taken between December and January.

⁵ It should be noted that the region defined as the D'Entrecasteaux Channel for the purposes of this report does not correspond with that defined in the fisheries regulations, rather it includes waters south of the Scott Point to Partridge Island (including Southport) boundary which are open to the use of pots.

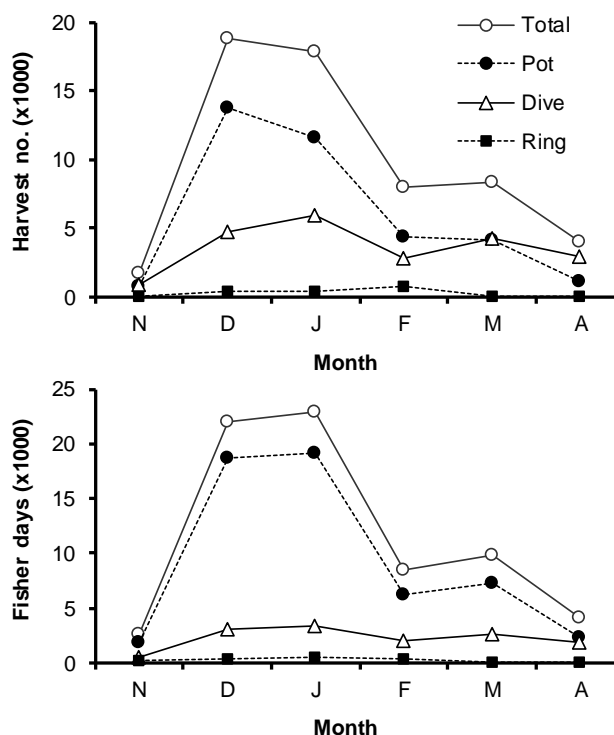


Fig. 6. Recreational Rock Lobster harvest (numbers) and effort (days fished) by month and method for the 2015-16 fishing season.

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method and between management regions (Fig. 7). Overall about 59% pot-days of effort yielded no retained catch in the Eastern region (Areas 1-4) and the daily bag limit of two Rock Lobster was achieved on about 15% of occasions (Fig. 7). This compared with the Western region (Areas 5-8) where 48% of pot effort resulted in no retained catch but 30% of the effort resulted in catches of at least two Rock Lobster (2% resulting in the bag limit of five lobster being taken). Divers had higher success rates, with 60% of dives in the Eastern region attaining the bag limit of two lobster compared with 64% in the Western region (14% the dive effort in the Western region resulted in daily catches of five lobsters). Although nil catches were reported for over 50% of the ring effort in both regions, rings proved relatively effective, with catches of two or more lobster per day achieved for 22% and 33% of the total ring effort in the Eastern and Western regions, respectively.

A strong effect of dive method on catch rates was evident. Overall, average daily harvest rates were highest for hookah (1.7 and 3.5 Rock Lobster for Eastern and Western regions, respectively), followed by scuba (1.5 and 2.3 Rock Lobster) and snorkel (0.4 and 1.7 Rock Lobster). Catches taken on hookah accounted for 45% of the total dive harvest, followed by scuba at 42% and snorkel catches at 13%.

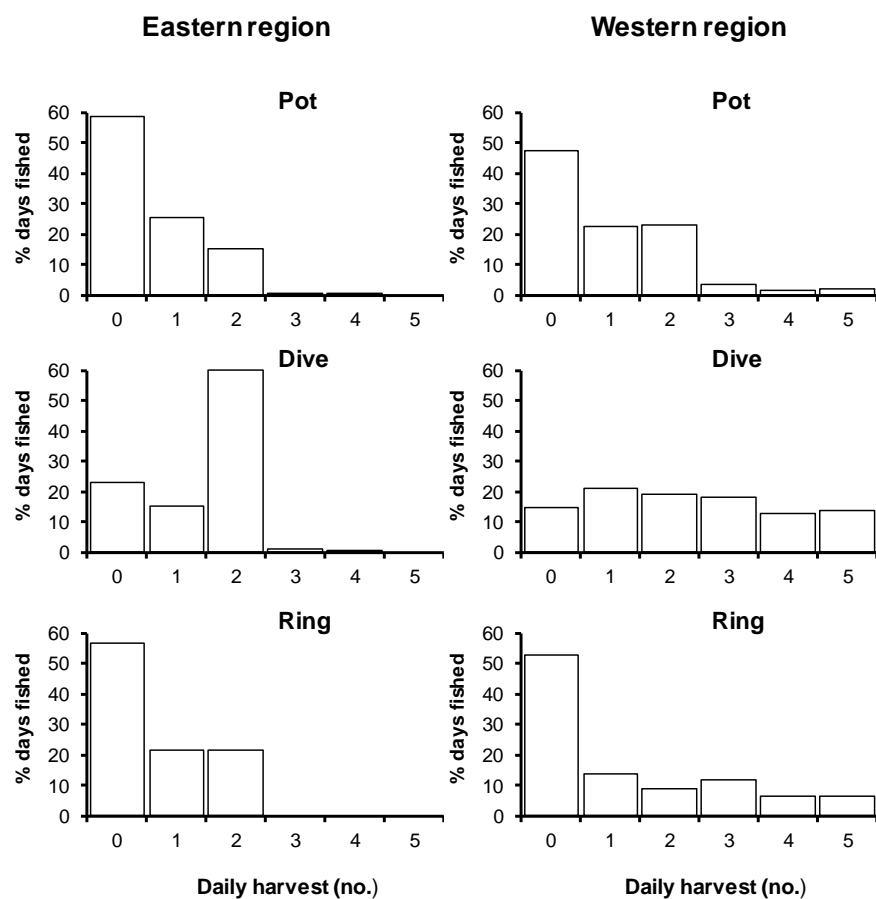


Fig. 7. Distribution of daily Rock Lobster harvest by fishing method and management region.

3.2.7 Individual season harvest estimates

Individual season limits for recreational fishers have been flagged as a potential management option to constrain the overall recreational harvest and share the catches more equitably between fishers. It was, therefore, worthwhile to report on the numbers of Rock Lobster retained by individual fishers during the 2015-16 fishing season up to the end of April (Fig. 8). Overall almost one in five active fishers harvested no lobsters while a further 49% harvested between one and five lobsters for the survey period, with proportionally fewer active fishers who harvested six or more lobsters from the east coast compared with the west coast (23% compared with 33%). About 4% of active fishers reported catches of more than 20 lobsters, accounting for 22% of the total catch. This clearly demonstrates the impact that a relatively small number of active fishers has on the recreational catch of Rock Lobster in Tasmania.

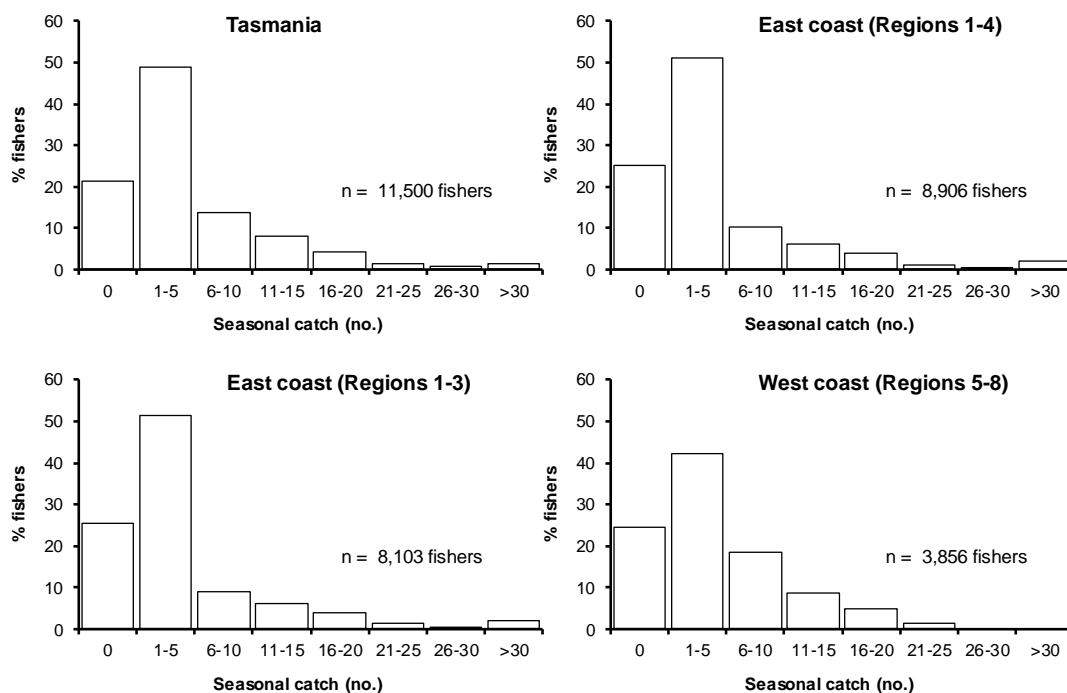


Fig. 8. Seasonal harvest of Rock Lobster for fishers who were active within specific fishing areas and for the whole fishery. n is estimated number of active licence-holders.

3.2.8 Released catch

A total of 41,989 Rock Lobster (95%CL 26,937 – 59,502) were estimated to have been released or discarded from pot catches, equivalent to 1.17 for every retained Rock Lobster. About 89.9% of pot releases were due to the capture of undersized Rock Lobster, 6.8% of releases were due to over bag limit catches, 1.2% were berried females, and 1.4% were dead or damaged.

Although divers may release Rock Lobster some of this 'sorting' probably occurs underwater and therefore a similar analysis of reasons for release by divers was not attempted.

3.2.9 Size composition

Diarists reported lengths for 369 pot caught, 232 dive caught and 5 ring caught Rock Lobster from around Tasmania. Overall, retained pot caught Rock Lobster ranged between 105-226mm carapace length (CL), with an average estimated weight of 997 g. Dive caught Rock Lobster had a similar size range, 105–230 mm CL, but were larger on average, with an estimated average weight of 1249 g. Ring caught Rock Lobster also ranged between 112–123 mm CL, with an average weight of 782 g. However, as relatively few ring caught Rock Lobster were measured⁶, data for pots and rings have been combined in subsequent analyses. Male to female sex ratios for pot catches (1.0:0.99) did not differ significantly from 1:1, whereas dive catches were comprised of significantly more males than females (1:0.0.70).

Length frequency distributions by region are presented in Fig. 9. Moving south to north along the east coast there was a general trend for the average size of Rock Lobster to increase, with the largest lobsters taken off the north coast (refer Table 5). There was

⁶ Measurements of ring caught lobster were mainly derived from Areas 6 & 7.

insufficient data available from the west coast (Areas 6-8) catches to determine whether the latitudinal trend in average size observed off eastern Tasmania persisted in that region and areas have been combined for analysis.

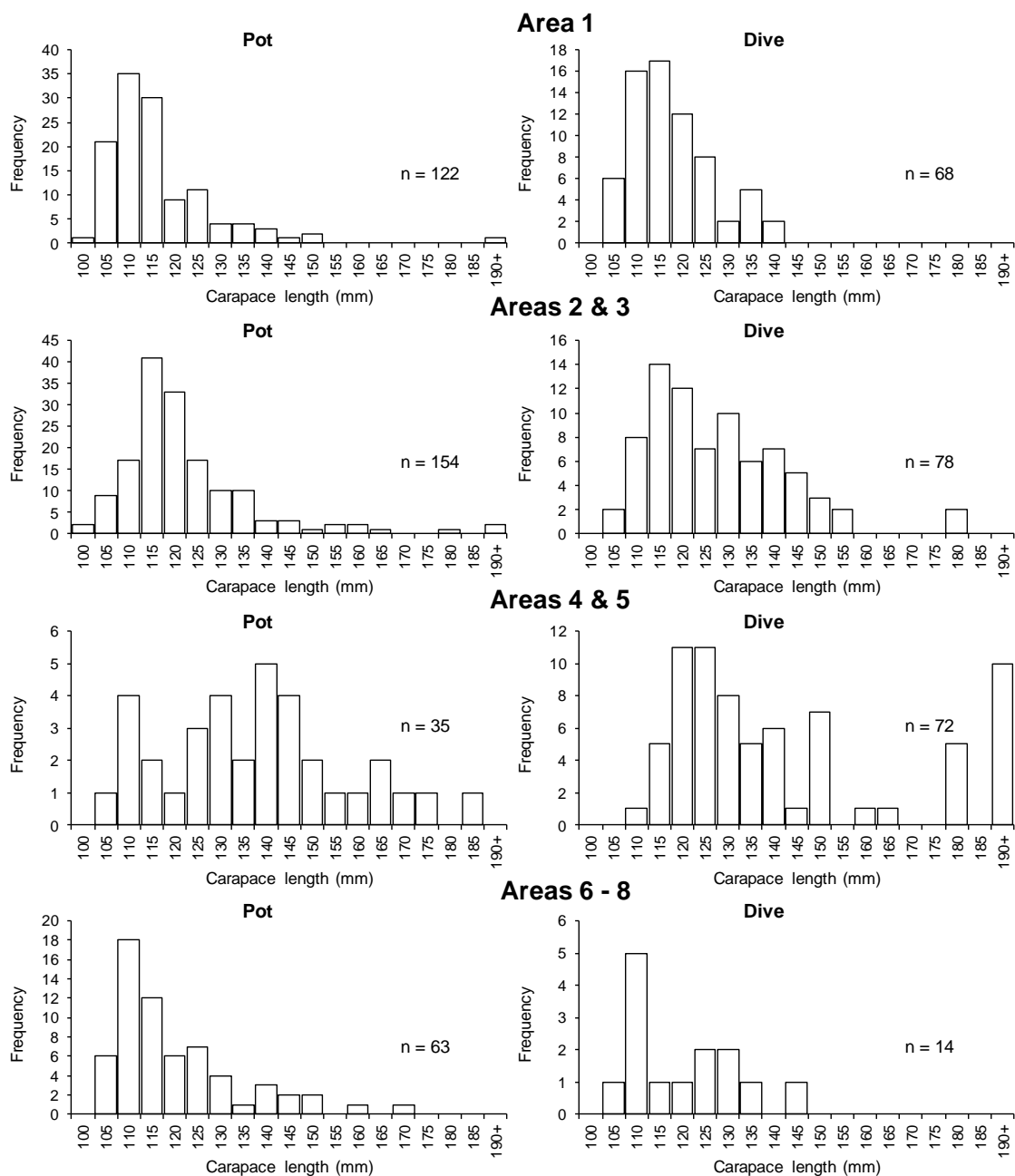


Fig. 9. Length frequency distributions by 5 mm size class for recreationally caught Rock Lobster taken by dive, pot and ring fishing methods by assessment area(s). n is sample size.

3.2.10 Harvest weights

The weight of the 2015-16 recreational harvest was estimated by multiplying the average Rock Lobster weights by the numbers harvested by method and area. Average weights by area and method used to determine harvest weights are presented in Table 5.

The state-wide harvest was estimated to be 63 tonnes⁷, equivalent to 37% of the TARC. Regional harvest estimates ranged between 18.4 tonnes (Area 1) and 3.1 tonnes (Area 8) (Table 5). As a proportion of the recreational harvest, the east coast (Areas 1-3) accounted for 57%, north coast (Areas 4&5) 27%, and west coast (Areas 6-8) 16% of the total weight. In the case of the north coast, the combined effects of larger Rock Lobster on average and the dominance of dive collection meant that the region contributed disproportionately more to the overall catch weight compared with numbers (17% of the retained numbers, refer Table 4).

Table 5. Average Rock Lobster weight (g) by method and estimated harvest (kg) by area

Area	Av. weight (g)		Harvest (kg)	%
	Pot/Ring	Dive		
1	858	861	18,368	29.1
2	1027	1135	8,086	12.8
3	1027	1135	9,243	14.7
4	1464	1798	5,457	8.7
5	1464	1798	11,536	18.3
6	933	945	4,088	6.5
7	933	945	3,171	5.0
8	933	945	3,074	4.9
Total			63,022	

3.2.11 Comparison with commercial catches

The recreational harvest represented 5.2% of the notional 2015-16 TAC and 5.9% of the combined recreational and commercial catch⁸. Regionally, there was marked variability in the recreational share of the combined harvest, ranging from 15-20% in the east (Areas 1-3) to 1% in the southwest (Area 8) (Fig. 10A).

Since the majority (here assumed to be all) of the recreational catch is taken from shallow coastal waters (≤ 20 m), it is also appropriate to compare catches at the spatial scale (depths) at which the two sectors overlap and therefore interact. On this basis, the recreational harvest represented 14.9% of the combined shallow water catch of 429 tonnes⁹ (Fig. 10B). The recreational fishery accounted for over 25% of the total catch from east coast inshore waters (Areas 1-3) and over 14% of the catch in Areas 5 and 6, though the latter was more a reflection of the relatively low inshore commercial catch rather than a large recreational catch. The recreational fishery represented a relatively minor component of the inshore catch from the central and south west coastal fishing areas (Areas 6 & 7).

⁷ Any illegal harvest taken by recreational fishers, whether due to fishing whilst unlicensed or catches in excess of legal limits, is not included in the harvest estimates.

⁸ The commercial catch taken between March 2015 and February 2016 was 1014 tonnes.

⁹ The commercial catch reported from ≤ 20 m was 365 tonnes, equivalent to 36% of the total commercial catch for the period March 2015 – February 2016.

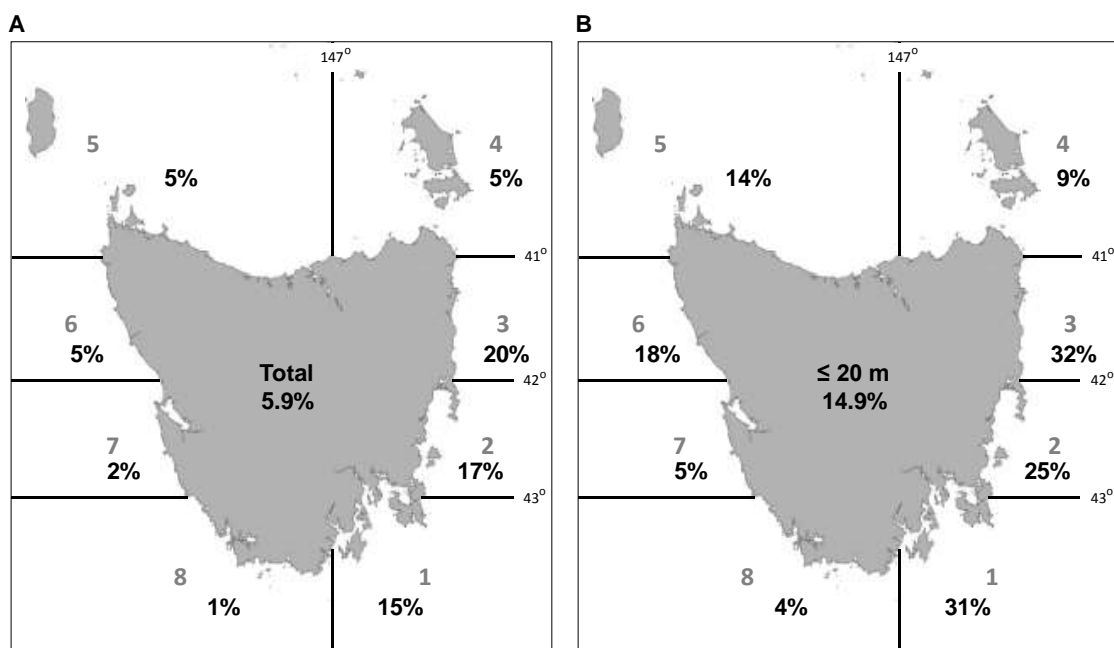


Fig. 10. Recreational Rock Lobster harvest (weight) expressed as a percentage of the total Rock Lobster catch (2015-16 recreational catch and 2015 quota year commercial catch combined) by area: (A) based on total catch (all depths); and (B) commercial catches from shallow water ($\leq 20\text{m}$) (refer text).

3.3 Abalone

3.3.1 2014-15 participation

Information provided in the screening survey suggested that 63.1% (SE 2.4%) of 2014-15 licence holders fished for Abalone during that season and that 59.3% (SE 2.4%) kept at least one Abalone. That is, out of 12,083 persons licensed in 2014-15, an estimated 7629 fished for Abalone with 7165 harvesting at least one Abalone. However, as this information was collected retrospectively at the end of the 2014-15 season it is subject to recall bias and as such is considered indicative only.

3.3.2 2015-16 State-wide catch and effort

Information reported in this and following sections relates to diary survey data provided by fully responding licence holders and is presented as expanded estimates representative of the activities of recreational abalone licence holders between November 2015 and April 2016, inclusive.

During 2015-16 an estimated 37.9% (SE 3.2%) of Abalone licence holders (i.e. 3986 out of the 10,509 licence-holders) fished for Abalone with 31.9% (SE 3.1%) (3350 persons) harvesting at least one Abalone.

The total estimated harvest was estimated to be 47,113 Abalone (95% CI: 34,262 – 59,025), the result of 9,548 fisher days¹⁰ of effort. This represented an average harvest rate of 4.9 Abalone for each day fished. Blacklip Abalone dominated the catch,

¹⁰ A fishing day was defined as one in which Abalone was a nominated target species and/or Abalone were caught.

accounting for 90% of the total catch numbers (42,500) while Greenlip Abalone represented 10% of the state-wide total (4,613) (Table 6).

Table 6. Abalone harvest, effort and harvest rates by fishing area for 2015-16

Values in parentheses represent the 95% confidence intervals, * average weight based on commercial catch sampling data; ** weighted in accordance to the proportion of Blacklip and Greenlip Abalone in the catch and average species weight.

Area	Harvest (no.)		Effort (fisher days)	Harvest rate (no. per fisher day)	Av. weight (g)*	Harvest (kg)
	Blacklip Abalone	Greenlip Abalone				
1	19,776 (10,822 – 27,828)	-	4,099 (2,372– 5,753)	4.82	522	10,248
2	5,943 (2,391 – 10,340)	-	1,123 (591 – 1,513)	5.29	517	3,091
3	5,762 (2,136– 10.830)	-	905 (358 – 1,513)	6.37	528	3,087
4	2,810 (549 – 4,978)	3,283 (1997 – 5,623)	1,304 (633 – 1,991)	4.67	404**	2,590
5	3,354 (512 – 7,310)	1,395 (25 – 3,025)	1,203 (548 – 2,149)	3.89	361**	1,695
6	4,344 (794 – 8,638)	-	783 (250 – 1,337)	5.55	501	2,115
7	-	-	-	-	-	-
8	510 (14 – 1,370)	-	130 (14 - 295)	3.92	531	254
Total	42,500 (29,074 – 54,032)	4,613 (1,901 – 7,269)	9,516 (7,079 – 11,618)	4.93		23,081

3.3.3 Regional catch and effort

Regional catch, effort and harvest rates for Abalone are presented in Table 6. The recreational fishery was concentrated on the east coast of Tasmania (Areas 1 - 3) (> 64% of the catch and effort), with Area 1 alone accounting for 42% of the state-wide totals. The north coast (Areas 4 & 5) accounted for about 25% and the west coast (Areas 6 - 8) 10% of the total catch and effort. Blacklip Abalone were taken from all areas whereas Greenlip Abalone were restricted to the north coast. Regional harvest rates varied between 3.9 and 6.4 Abalone per day.

3.3.4 Southeast coast

Data for Area 1 were disaggregated into five sub-areas to better define the spatial characteristics of the fishery in the southeast (Fig. 11). The Tasman Peninsula and outside of Bruny Island were the most important sub-areas, collectively accounting for half of the total harvest. The D'Entrecasteaux Channel, Norfolk-Frederick Henry Bay and Derwent Estuary were of secondary importance, with roughly similar catches taken from each of these sub-areas.

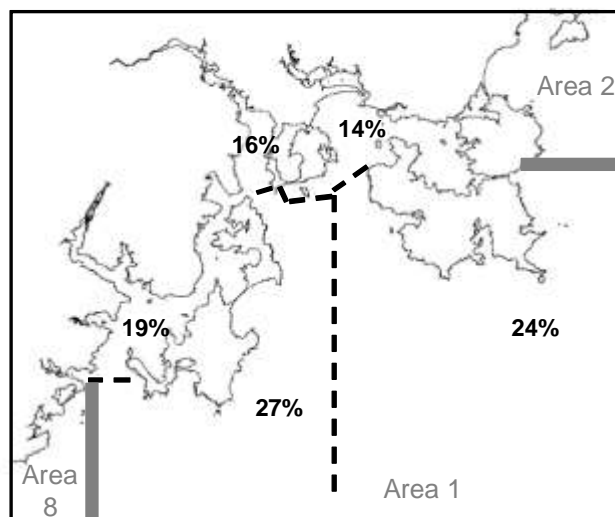


Fig. 11. Regional distribution of Area 1 Abalone harvest.

3.3.5 Seasonal catch and effort

The fishery for Abalone exhibited a strong seasonal pattern, with a marked increase in catch and effort between December and January and a secondary peak in March associated with the Easter holiday period (Fig. 12). The typical peak in catch and effort in November was not evident in 2015, highlighting the link between issues impacting the opening of the Rock Lobster season and fishing for Abalone (the majority of Abalone licence-holders also hold a Rock Lobster dive licence).

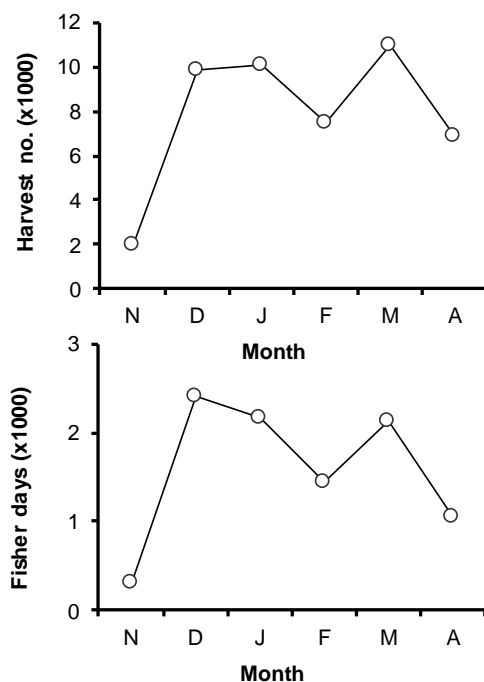


Fig. 12. Recreational Abalone harvest (numbers) and effort (days fished) by month during the 2015-16 fishing season.

3.3.6 Daily harvest

One in five targeted dives resulted in the daily bag limit of ten Abalone being achieved, while a similar proportion resulted in no catch (Fig. 13). Hookah divers reported the highest catch rates (5.5 Abalone per day), with 30% of diver-days of effort achieving the bag limit. Average daily catch rates for snorkel (4.8) and scuba (4.4) were considerably lower, as was the proportion of effort that resulted in ten Abalone being taken (15% for snorkel and 19% for scuba). However, of the three dive methods snorkel dominated, accounting for 44% of the harvest and 46% of effort (diver days). Hookah dive effort was next in importance, representing 39% of the harvest and 35% of the effort, while scuba divers contributed 17% of retained catch and 19% of the effort.

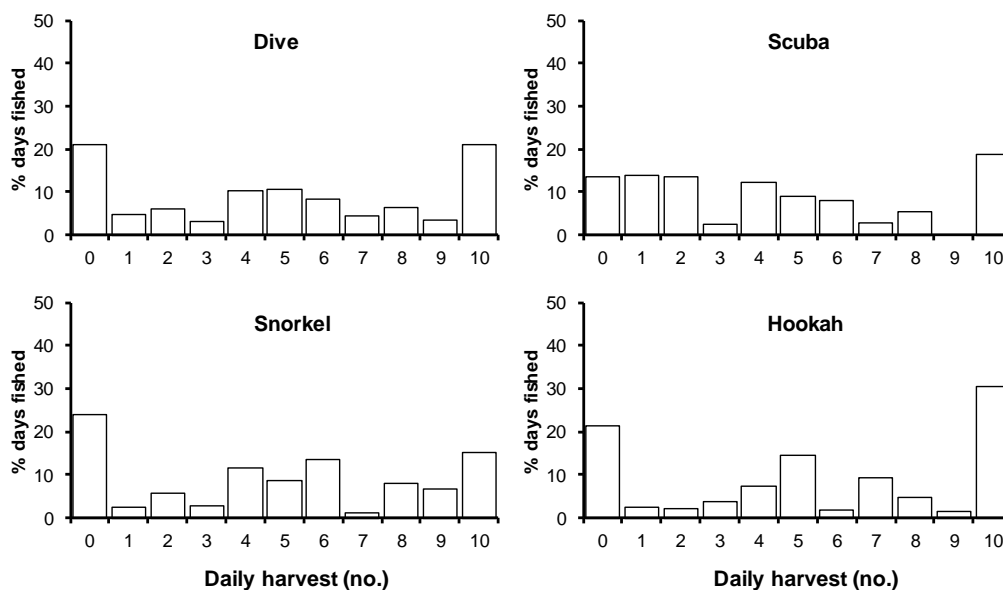


Fig. 13. Distribution of daily Abalone harvest by dive methods for 2015-16 licence holders

3.3.7 Harvest weights

Size composition information was not available for recreationally caught Abalone. However, based on commercial catch sampling, the average legal-sized Abalone by the major fishing regions was estimated to vary between 531 g off the southwest coast (Area 8) and 361 g off the northwest coast (Area 5) (Table 6). Using these values, the recreational harvest between November and April was estimated to be about 23.0 tonnes. Regionally, harvest estimates ranged from 10.2 tonnes in Area 1 to just less than one tonne in Area 8¹¹ (Table 6). The catch for the combined east coast (Areas 1-3) was 16.4 tonnes, the north coast (Areas 4&5) 4.3 tonnes, and the west coast (Areas 6-8) 2.4 tonnes.

¹¹ Respondents reported no fishing for Abalone in Area 7; this does not, however, mean that there was no recreational catch taken from this area.

3.3.8 Comparison with commercial catches

The 2015 commercial Abalone catch was 1850 tonnes (1706 tonnes of Blacklip Abalone and 144 tonnes of Greenlip Abalone) suggesting that the 2015-16 recreational harvest accounted for 1.2% of the combined state-wide catch. Regionally, the recreational component of the fishery accounted for 5-7% of the combined commercial and recreational harvest in Areas 2 and 3, and over 2% in Area 1. In all other regions the recreational contribution was relatively low (< 1.4%) (Fig. 14).

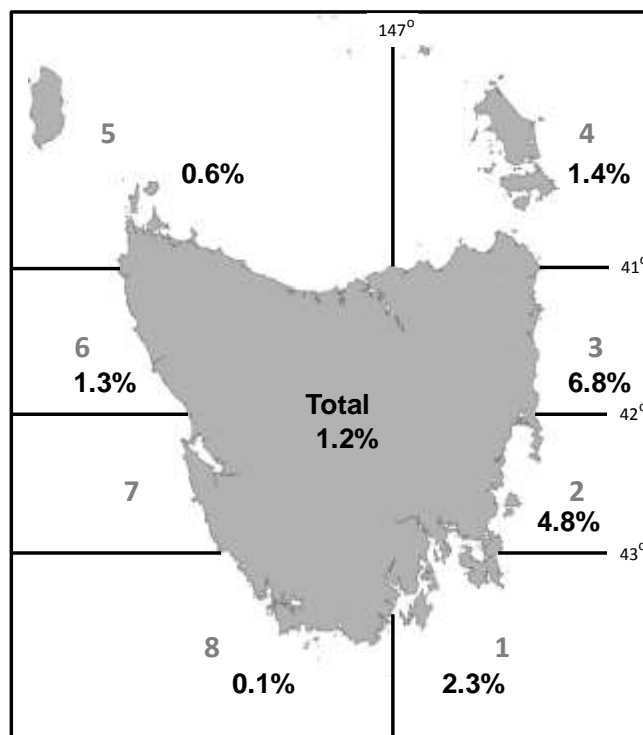


Fig. 14. Recreational harvest (weight) of Abalone expressed as a percentage of the total catch (2015-16 recreational catch and 2015 commercial catch combined) by area.

3.4 Wash-up survey

3.4.1 General

The overall response rate to the wash-up survey was 98.1% (432 out of a net eligible sample of 440)¹².

3.4.2 Constraints to fishing

Diarists who did not fish for Rock Lobster during 2015-16 were asked, as an open ended question, about their main reasons for not fishing for Rock Lobster. Responses from licensed respondents indicated that lack of time due to work and/or family commitments was the most commonly cited reason followed by the biotoxin closures as the next most important reasons for not fishing (Table 7). Lack of time followed by the harmful algae bloom were also the main reasons diarists did not renew licences.

¹² Eligible respondents were those who completed the diary survey but were also over 18 years of age.

Table 7. Main reasons for not fishing for Rock Lobster during 2015-16

Reasons	Not licensed	%	Licensed	%	Combined	%
Lack of time/work and/or family commitments	26	40.0	43	37.4	69	38.3
Biotoxin closures	14	21.5	14	12.2	28	15.6
Health	5	7.7	11	9.6	16	8.9
Lack of opportunity/ fishing partner	3	4.6	11	9.6	14	7.8
Lack of interest/ alternative interests			13	11.3	13	7.2
Weather	5	7.7	8	7.0	13	7.2
Lack of boat or equipment	2	3.1	9	7.8	11	6.1
Moved interstate/travelling/did not visit Tasmania	2	3.1	4	3.5	6	3.3
Chose not to buy a licence	5	7.7			5	2.8
Other	3	4.6	1	0.9	4	2.2
Poor catch rates			1	0.9	1	0.6
No. responses	65		115		180	

3.4.3 Fishery quality

Amongst those respondents who had fished for Rock Lobster, more than twice as many suggested that the quality of the fishery in 2015-16 was worse (27%) rather than better (17%) compared with the previous season (Table 8). More than half of the active fishers, however, suggested that the overall quality was about the same as in the previous year. Respondents were then asked whether, based on their own experience, they had noticed that legal-size Rock Lobster were less abundant or more difficult to catch in 2015-16. On this question, respondents were more or less evenly split, with 46.2% agreeing and 44.4% disagreeing with the proposition and 9.4% unsure.

Table 8. Response to the question relating to the perceived quality of the 2015-16 Rock Lobster season relative to 2014-15

Total respondents = 235		
Response	No.	%
Better	26	11.1
Worse	64	27.2
(About the) Same	127	54.0
Unsure	18	7.7

3.4.4 Impacts of Eastern Region management changes

Respondents were reminded of management changes implemented at the start of the 2015-16 season and applying to the Eastern region. Specifically, these changes involved reductions in the daily bag limit from 3 to 2 and maximum boat limit from 15 to 10 lobsters. Respondents were then asked whether they had exceeded these reduced limits and had to release legal sized lobsters or cease fishing. Of those respondents (n = 199) who fished in the Eastern region, 23% indicated that they had exceeded one or both of these limits at least once during the season. The bag limit was the more commonly achieved limit by the east coast fishers (20%); relatively few fishers reached the new boat limit (5%). For those individuals who reported reaching the boat limit, the

average number of trips on which their fishing party reached the boat limit was 2.4 times (range 1-6).

Respondents were also asked whether the Eastern region management changes had had a direct influence on how often or where they went fishing for lobsters, focusing on whether they fished more or less because of the lower limits or fished more than usual in the Western region where the limits were higher. The vast majority (79%) of respondents (n = 232) indicated that the management changes had not really influenced their fishing activities, 2% indicated they fished more, 18% fished less and only 1% fished more in the Western region.

3.4.5 Policing and enforcement

Out of 224 active fishers who responded to questions about policing, 45 (20.1%) indicated that they had been checked by Marine Police whereas 178 (79.5%) were not checked whilst fishing for lobster during 2015-16 (0.4% unsure). Inspections occurred mostly on water (33 responses or 75%) and to a lesser extent off water (14 responses or 32%), noting that some respondents reported being checked on as well as off water. Of those individuals checked whilst in possession of Rock Lobster, 86% indicated that their catch had been inspected by the Marine Police.

3.4.6 Impacts of biotoxin closures

All respondents, regardless of whether they had fished or not, were asked whether the biotoxin closures that impacted areas of the east coast between November and January had had any influence on where, when or how often they went fishing/diving for Rock Lobster or whether they took out a licence. A map of the biotoxin management zones and dates on which they were opened is provided in Fig. 15.

Out of 424 respondents, 178 (42%) indicated the closures did have an impact, with 108 (61%) having fished for Rock Lobster, 65 (37%) not fishing for Rock Lobster and 5 (3%) not renewing their licence. For those who fished, 19 (18%) fished in areas that they probably would not have had the closures not occurred. Based on the biotoxin management zones, 11 (58%) redirected effort into the Storm Bay Bruny Zone, 3 (16%) into the Central East Zone and 5 (26%) in the Western Region (including the south-west coast). Respondents were also asked whether the closures had impacted on the times they would normally have expected to have fished for Rock Lobsters. All 17 respondents who indicated an impact, noted that they would have expected to have fished in November, typically on the opening weekend. Finally, all respondents who fished were asked whether they fished fewer, about the same or more days for Rock Lobsters than they might have expected had the closures not occurred. The overwhelming majority (91%) indicated that they had fished fewer days than expected, 8% about the same and only 1% (1 respondent) fished more days.

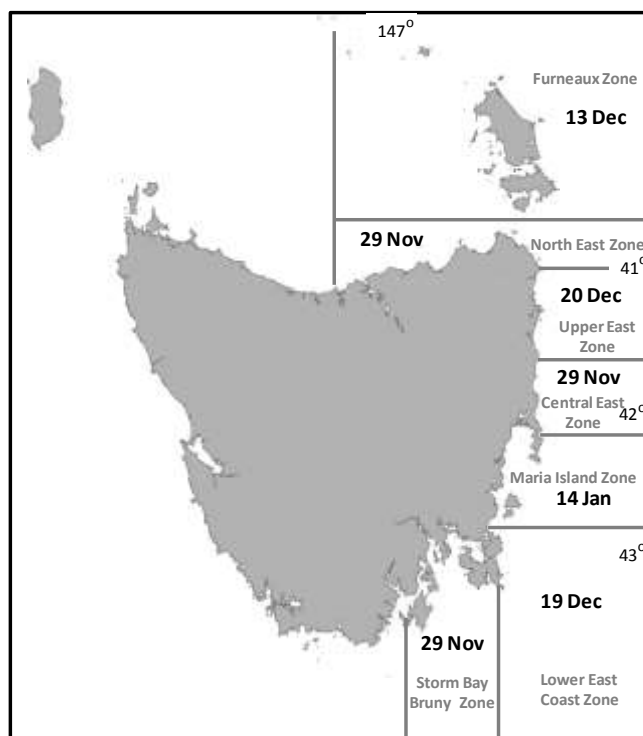


Fig. 15. Map showing the biotoxin management zones and dates on which the zones were opened for fishing during 2016-17.

3.4.7 Communication of biotoxin closures

Respondents were asked to recall how they first heard about the biotoxin closures and then obtained subsequent reports about the biotoxin situation. The Fishing News email alert, followed by friends/family and TV reports represented the most commonly cited initial information sources (Table 9). In terms of obtaining information as the season progressed these sources continued to be important as did updates reported in the newspaper and updates on the DPIPWE website.

Table 9. Information sources by which respondents first heard about the biotoxin closures and then subsequent sources used to monitor the situation.

Source	Initial		Subsequent	
	No.	%	No.	%
Fishing News email (DPIPWE)	109	26.1	145	35.3
Friends/family	90	21.5	186	45.3
TV	64	15.3	104	25.3
Newspaper	54	12.9	121	29.4
Fisheries Tas Facebook (DPIPWE)	26	6.2	39	9.5
DPIPWE website	25	6.0	83	20.2
Radio	22	5.3	31	7.5
Other	12	2.9	39	9.5
Other social media	11	2.6	15	3.6
Tas Fish Guide Phone App	4	1.0	14	3.4
Online fishing forum	1	0.2	2	0.5
Health Dept website		-	2	0.5
No. respondents	418		411	

Overall, almost three-quarters of respondents (73%) indicated that they thought the government had done enough to communicate information about the closures, 14% indicated that they did not consider the government had done enough and 13% were unsure.

3.4.8 Biotoxins and human health risks

In order to better understand the potential risks to human health from eating Rock Lobsters that could have accumulated the biotoxin (paralytic shellfish toxin, PST), respondents were asked whether, prior to the first major biotoxin outbreak in 2012, they consumed the hepatopancreas (commonly known as “mustard”) (Table 10). Overall 17% of respondents indicated that they at least occasionally consumed the hepatopancreas, with highest proportions (>20%) amongst respondents resident in the South East and Launceston and North East regions and lowest incidence amongst Hobart residents (<12%). Interestingly, of those respondent who indicated that prior to 2012 they ate the hepatopancreas (even occasionally/sometimes) just 14.9% indicated that as a consequence of the biotoxin event they had changed the parts of the lobster they now ate. In all cases these respondents no longer ate the mustard, regardless of whether there was a closure.

Table 10: Responses to the question of whether the respondent consumed the hepatopancreas prior to the first major biotoxin outbreak in 2012, based on region of residence

Response	Residential Region				Total
	Hobart	South East / Launceston and North East	West and North West	Interstate	
Yes	10.9	14.2	15.2	22.2	13.5
Occasionally/sometimes	1.5	5.9	2.5	0.0	3.7
No	86.9	78.9	81.0	77.8	81.8
Unsure	0.7	1.0	1.3	0.0	0.9
No. respondents	137	204	79	9	429

Respondents were then asked whether they considered the health risks associated with the biotoxin were generally well communicated and understood, poorly communicated and understood or overstated and even alarmist. Almost half of the respondents considered the information to be well communicated and understood, less than a third considered the information was poorly communicated and understood, while about one in ten suggested that the risks were overstated (Table 11).

Table 11 Communication and general understanding of the health risks associated with the biotoxin events

Total respondents = 426		
Response	No.	%
Well communicated/ understood	195	45.8
Poorly communicated/ understood	116	27.2
Overstated/alarmist	41	9.6
Unsure	74	17.4

3.4.9 Likelihood to renew licences

Respondents were asked about their likelihood to take out a Rock Lobster licence for the 2016-17 season. Overall the vast majority of respondents (~ 90%) indicated that they were likely to re-licence (Table 12). Not unexpectedly, proportionally fewer (83%) of those respondents who did not renew their licence in 2015-16 considered they would take a licence in 2016-17. The main reasons given for being unlikely to take out a licence included age/health, lack of access (boat), poor status of the stocks, lack of value of the licences, lack of time, potential for future biotoxin closures, and not expecting to be resident or visit Tasmania in 2016.

Table 12 Likelihood to renew Rock Lobster licences in 2016-17 based on licence status in 2015-16.

	All respondents		Licensed 2015-16		Not licensed 2015-16	
	No.	%	No.	%	No.	%
Likely	381	89.9	317	91.4	64	83.1
Not likely	28	6.6	18	5.2	10	13.0
Unsure	15	3.5	12	3.5	3	3.9
Total	424		347		77	

4 DISCUSSION

4.1 Catch and effort

4.1.1 General trends

To date, eleven estimates of recreational Rock Lobster harvest are available based on the methodology applied in this survey. Rock Lobster catches generally increased between the mid-1990s up until 2002-03, reflecting growth in licence sales. Subsequent catches have, however, tended to decline despite continued growth in licence numbers up until 2009-10 (Fig. 16). The catch estimate for 2015-16 was 40% lower by number and 47% by weight than that for 2014-15, reflecting the impact of a 32% reduction in effort due to the combined effects of the reduced survey period (November-April) and biotoxin closures early in the fishing season (Table 13).

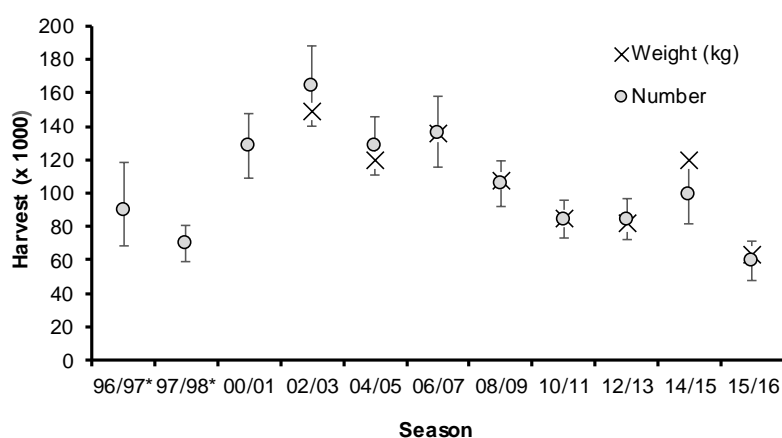


Fig. 16. Estimated Rock Lobster harvest (number and weight) plotted against fishing season. Error bars represent 95% confidence limits for numbers. * indicates partial season surveys.

Although general declines in recreational Rock Lobster catches have been experienced in most areas since the early 2000s, the sharp fall in catches from Area 1 in 2008-09 had a major impact on the state-wide Rock Lobster catches (Fig.17). Catches were lower in all areas in 2015-16, for Areas 1-4, the biotoxin closures are likely to have been a significant factor whereas the reduced survey period may have contributed to the lower catches in the Western region (Areas 5-8).

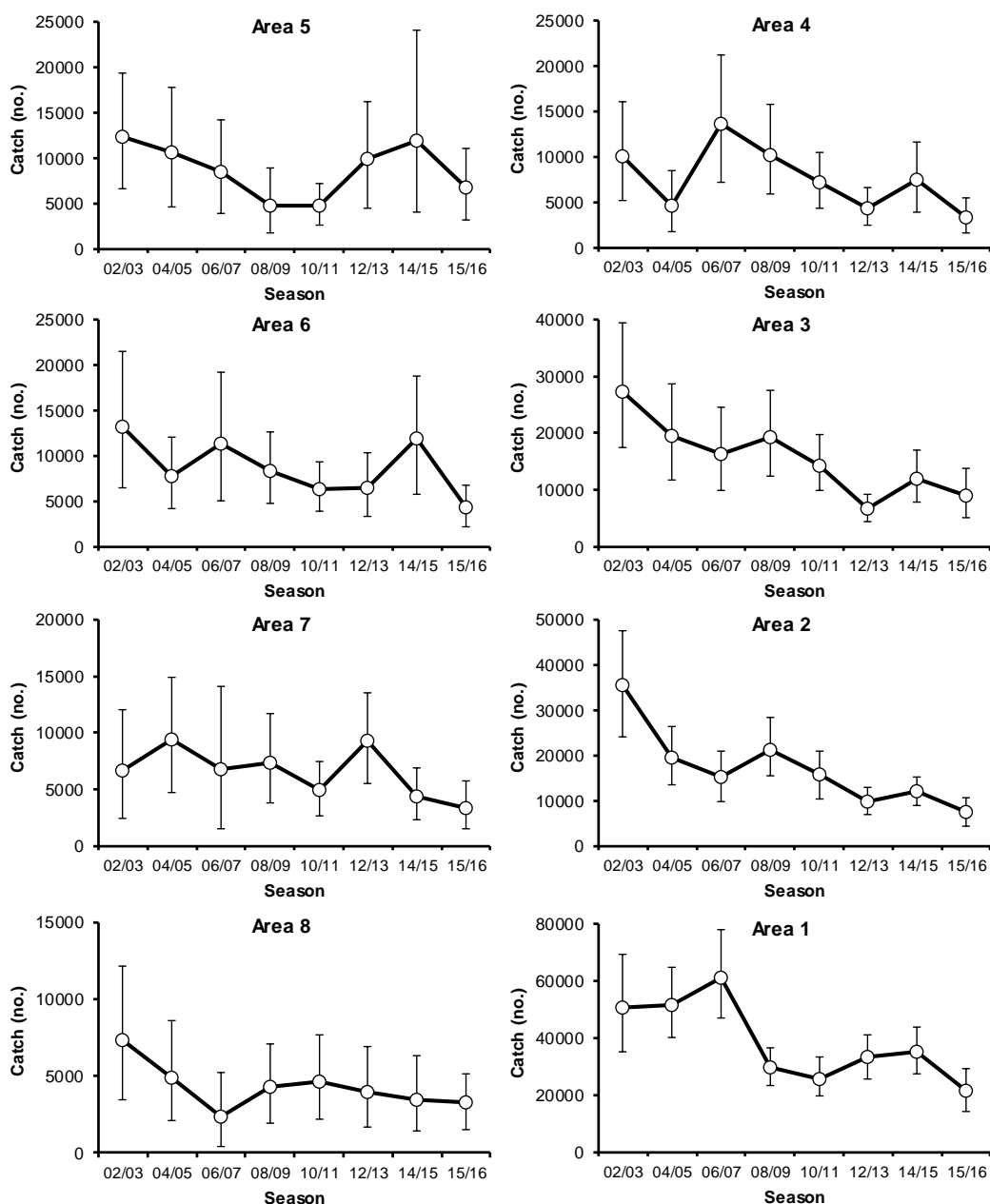


Fig. 17. Regional Rock Lobster harvest estimates (numbers) by recreational fishing season. Error bars represent 95% confidence limits.

Abalone harvest levels have also declined since the early 2000s even though licence numbers continued to grow up until 2008-09 (Fig. 18). The catch estimate for the current season was 37% lower (by weight and numbers) than that for 2014-15, reflecting a 37% reduction in effort (Table 13).

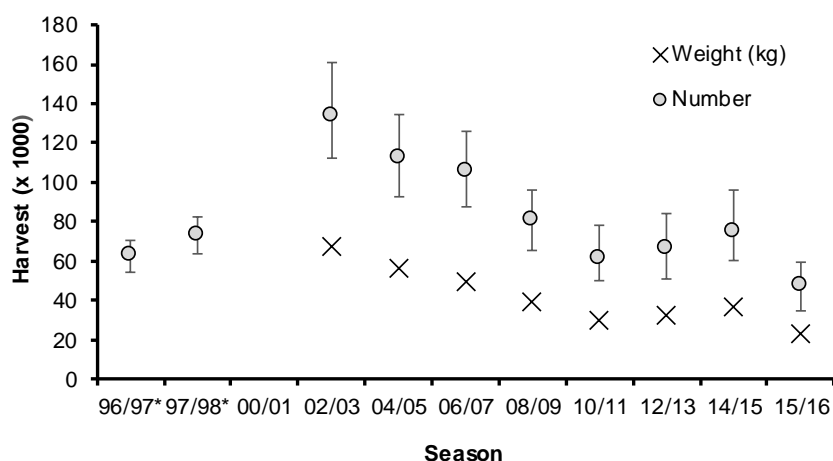


Fig. 18. Estimated Abalone harvest (number and weight) plotted against fishing season. Error bars represent 95% confidence limits for numbers. * indicates partial season surveys.

Social (e.g. motivations, availability of time, access), biological (e.g. stock size, catch rates) and environmental (weather) factors all play a role in influencing fisher behaviour and highlight the need to better understand the dynamics and drivers of recreational fishers. Information about the behaviour of fishers is particularly useful in explaining some of the observed changes in catches through time. For instance, since the early 2000s the proportion of licence-holders who actually utilised their licences (i.e. fished) has declined from over 86 to 68% for lobster, and from 63 to 38% for abalone (Table 13). This has had the effect of slowing growth or even resulting in a decline in the number of active fishers despite increased licence sales. Lack of time (due work and/or family commitments) along with the impacts of the east coast biotoxin closures were the most commonly cited reasons for not fishing for lobster during 2015-16.

Coupled with this has been a general decline in the average number of days fished per season by active fishers for both lobster (8.8 down to 6.0 days) and abalone (4.3 down to 2.4 days), contributing to declines in average seasonal harvest per fisher (from greater than 11 to about 5 for lobster, and from 23 to 12 for abalone) (Table 13). Furthermore, daily harvest rates for lobster have declined since the early 2000s (1.3 down to 0.85 per day); this decline being most influenced by pot catch rates which fell from 1.0 in 2002-03 to 0.65 lobster per day in 2015-16 (Table 13). This pattern for pot catch rates is consistent with the trend in Rock Lobster population biomass over the past decade (Hartmann *et al.* 2013). Dive catch rates, by contrast, tended to fluctuate without obvious trend, although the step down to below 2 lobsters per day since 2012-13 is almost certainly a response to reductions in the Eastern region bag limit. The difference in trends for the two methods arises because divers actively search for lobster and are able, to some extent, to maintain catch rates (many taking the bag limits) whereas pots represent a passive method that is dependent upon lobster availability and catchability (behaviour). Abalone catch rates have also fluctuated without obvious trend through time, reflecting the fact that many divers regularly attain the bag limit.

Given the above, the general growth in licence numbers up until 2008-09 did not translate into comparable increases of effort or harvest. On the contrary, declines in participation rates, a general reduction in avidity (days fished) and falling (or stable) catch rates have tended to dampen any influence that increased licence sales has had on catches.

Table 13 Number of Rock Lobster and Abalone licence holders, estimated number and proportion who fished, total and average harvest and effort per fisher by licence year and average daily harvest rates.

* part year only.

	Licence year								
	2000-01	2002-03	2004-05	2006-07	2008-09	2010-11	2012-13	2014-15	2015-16*
Rock lobster									
No. licence holders	13,265	15,580	16,710	20,008	21,351	19,519	18,185	19,306	16,810
% fished	86.5	88.4	81.9	78.4	75.2	71.7	76.0	75.4	68.4
No. active fishers	11,408	14,308	13,679	15,687	16,050	13,997	13,814	14,552	11,500
Harvest (nos.)	128,219	163,454	127,987	135,592	105,538	83,472	83,772	98,442	58,805
Harvest (kg)		148,526	119,354	135,067	107,027	84,261	81,849	118,996	63,022
Av. catch per active fisher	11.2	11.4	9.4	8.6	6.6	6.0	6.1	6.8	5.1
Fisher days	100,866	125,898	109,788	124,305	103,985	87,617	85,849	101,699	69,051
Av. days per active fisher	8.8	8.8	8.0	7.9	6.5	6.3	6.2	7.0	6.0
Av. daily harvest (nos)	1.27	1.30	1.17	1.09	1.01	0.95	0.98	0.97	0.85
Av. daily pot-harvest	0.87	1.00	0.90	0.94	0.75	0.68	0.78	0.71	0.65
Av. daily dive-harvest	2.61	2.30	2.31	2.15	2.27	2.36	1.83	1.92	1.61
Abalone									
No. licence holders		9,272	10,133	12,514	12,976	11,972	11,157	12,084	10,509
% fished		63.5	55.8	52.3	38.8	36.3	42.0	42.4	37.9
No. active fishers		5,853	5,653	6,542	5,033	4,349	4,682	5,126	3,896
Harvest (nos.)		133,711	112,571	105,515	81,021	60,943	66,438	74,769	47,264
Harvest (kg)		66,857	56,283	49,022	39,024	29,438	32,138	36,047	23,081
Av. catch per active fisher		22.8	19.9	16.1	16.1	14.0	14.2	14.6	12.1
Fisher days		25,342	18,185	23,201	14,445	12,117	11,428	15,110	9,517
Av. days per active fisher		4.3	3.2	3.5	2.9	2.8	2.4	2.9	2.4
Av. daily harvest (nos)		5.28	6.19	4.55	5.61	5.03	5.81	4.95	4.97

4.1.2 Fishing methods

Pots represent the main method for catching Rock Lobster by the recreational sector and apart from 2000-01, have accounted for 58-66% of the total harvest numbers in each of the years surveyed (Fig. 19). Dive methods have typically accounted for about a third of the harvest in all seasons apart from 2000-01, when divers took 44% of the total. The reason for the apparent increase in the dive harvest proportion in 2000-01 was unclear and has not been evident in subsequent seasons. Rings continue to represent a minor component of the fishery.

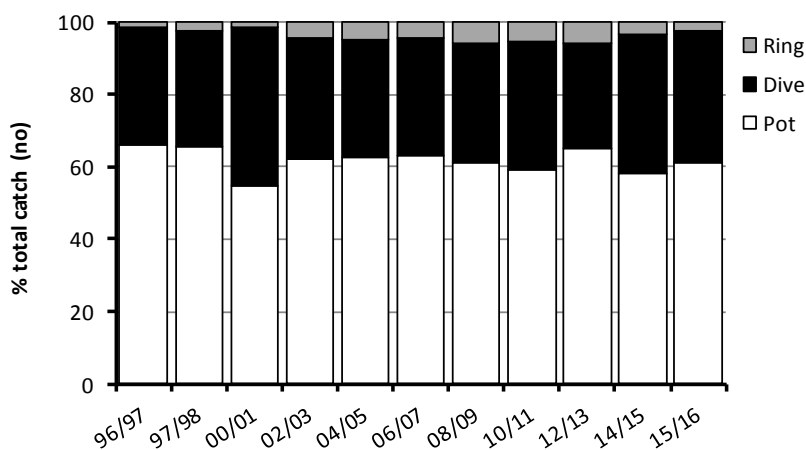


Fig. 19. Proportion of the Rock Lobster harvest by method and fishing season

The average daily harvest rate for pots (0.65 lobster) during 2015-16 represented a slight fall compared with the previous season and was substantially lower than catch rates prior to 2008-09 (Table 13). The dive harvest rate (1.61 per day) was the lowest on record and was particularly influenced by the reduction in the Eastern region bag limit from 3 to 2 lobsters. For instance, the average dive catch rate for the Eastern region was 1.4 and compared with 2.3 lobster per day for the Western region. The average daily harvest rate for Abalone (4.97) was within the range of that reported in previous years (4.5-6.2 per day).

Bag limits represent the primary management strategy to constrain recreational Rock Lobster and Abalone catches in Tasmania. Bag limits had a less obvious impact on pot catches, with 15% of the pot effort in the Eastern region and almost 2% of the pot effort in the Western region resulting in the respective bag limits being achieved. By contrast, bag limits had a more obvious impact on dive catches, with 60% of the dive effort in the Eastern region and almost 14% of the dive effort in the Western region resulting in the bag limits being achieved. For divers, artificial breathing apparatus (hookah and scuba) conferred a clear advantage when targeting Rock Lobster, as reflected in catch rates and incidence of the bag limit being attained, but were less of an advantage when diving for Abalone.

4.1.3 Regional patterns

The recreational Rock Lobster and Abalone fisheries are concentrated off the southeast and east coasts of Tasmania, with Areas 1 - 3 accounting for >60% of the harvest (by number) in both fisheries. The remainder of the Rock Lobster harvest was split more or less evenly between the north (Areas 4 & 5) and west coasts (Areas 6 - 8). For Abalone

the north coast was more important than the west coast, the former accounting for about 25% and the latter about 10% of the state-wide recreational harvest.

The intensity of the fishing activity off the southeast and east coasts reflects a combination of factors, including sheltered and accessible waters and proximity to major population and holiday centres. Factors such as limited availability of suitable reef habitat off the north coast (apart from the Bass Strait islands), and exposure to unfavourable sea conditions and limited access points off the west coast, contribute to the lower levels of recreational fishing pressure observed in those regions. Despite this, catch rates for Rock Lobster and Abalone tend to be higher off the west coast than elsewhere, this region representing a very significant area for both commercial Rock Lobster and Abalone fisheries (Hartmann *et al.* 2013, Tarbath & Gardner 2013).

There is considerable regional variability in the relative importance of the various Rock Lobster fishing methods. Pot catches clearly dominate the harvest off the southeast and east coasts, whereas dive collection is the dominant method off the north coast. Pots, dive collection, and rings are each locally important in the west coast areas. Such method-based regional differences are consistent with patterns observed in previous seasons (Lyle 2000, 2008, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010, 2012, 2014, 2016).

4.1.4 Seasonality

Fishing for Rock Lobster and Abalone are highly seasonal activities, being most intense immediately following the opening of the season (or licensing year) and over the summer holiday period. The pattern in 2015-16 was, however, different in that the traditional peak in catch and effort during November was not evident, clearly impacted by the early season biotoxin closures of the Eastern Region. Although the Western Region was open throughout November, activity in that region was comparatively low.

4.2 Comparison with commercial fisheries

The estimated recreational Rock Lobster harvest of 63 tonnes represented just 37% the TARC (170 tonnes) and was equivalent to 5.2% of the notional 2015-16 TAC or 5.9% of the actual catch for the two sectors combined. In this respect, recreational catches did not breach these management reference points. Although this survey did not cover fishing activity that may have occurred between May and August (noting that the Eastern Region was closed during that period), previous surveys have consistently indicated that recreational effort during the winter months is low and catches generally account for less than 5% of the seasonal totals.

Comparisons based on state-wide catches can, however, underestimate regional impacts and interactions between sectors. This was particularly evident for eastern Tasmania where, depending on assessment area, the recreational fishery accounted for 15-20% of the total Rock Lobster catch. Furthermore, recognising depth limitations on diving and the practicalities of hauling pots and ring nets imply that the recreational Rock Lobster fishery operates primarily in shallow inshore waters, presumably at depths of less than about 20 m. By contrast, commercial fishers operate over wider areas including deeper offshore reefs. For instance, 36% of the commercial harvest was taken from depths of less than or equal to 20 m. Thus, if only shallow water catches are considered, then the recreational component of the catch is more significant, representing about 15% of the total Rock Lobster take and over 25% of the catch taken off the east coast.

The estimated recreational harvest of Abalone between November 2015 and April 2016 was 23 tonnes, equivalent to 1.2% of the combined recreational and 2015 commercial catch of Abalone. Regionally, as a proportion of the total harvest, the recreational catch was most significant (~ 5%) in the east (Areas 2 & 3), followed by the southeast (2%) (Area 1) and northeast (1%) (Area 4) coasts. The relatively high contributions made by the recreational sector in the east are, however, more a reflection of comparatively low commercial catches in these areas rather than indicative of areas of especially high recreational harvest. While there are no management performance indicators relating to the recreational fishery in the Abalone Management Plan there is a need to explicitly include recreational catches into on-going stock assessment and future management of the fishery. This is particularly important since recreational fishers may continue to fish areas even when Abalone densities are reduced to below levels that are typically classed as commercially viable.

4.3 East coast stock rebuilding strategy

The 2015-16 recreational harvest from the east coast (Areas 1-3) represented 47% of the total for the sector and was estimated at 35.7 tonnes. This was 6.3 tonnes (15%) below the notional recreational east coast catch share allocation of 42 tonnes and compares with an “over-catch” of 13.6 tonnes in 2014-15. Biotxin closures of much of the east coast during some or all of the traditional peak fishing period (November-December) undoubtedly had a major effect on reducing catches. This would imply that had the closures not occurred catches are likely to have reached or exceeded the notional catch share despite the reduced bag limit and winter closure of the Eastern Region. This situation will be further exacerbated since recreational fishers are highly responsive to changing abundances in terms of the numbers of active participants and their individual fishing activity levels (refer Table 13). As stocks start to rebuild and catch rates to improve it will become increasingly difficult to constrain catches.

4.4 Biotxin closures

The biotoxin events during 2015-16 had a significant impact on the Rock Lobster fishery, with licence sales well down and, for those who did go fishing, a general perception they had fished less often than expected because of the closures. Notwithstanding this, there was some displacement of effort within the east coast (e.g. into the Storm Bay Bruny and Central East zones, both of which were open from late November) as well as to the Western Region. Overall, however, the levels of displaced effort appeared to be relatively minor, with most fishers choosing not to fish for lobster at least until their usual fishing areas were opened.

In relation to communicating information about the biotoxin situation, DPIPWE Fishing News email updates and the DPIPWE website along with traditional media (TV and newspaper) proved quite effective. By contrast, the Tas Fish Guide phone app and the Fisheries Tas facebook page were relatively minor sources and the Health Department’s website was rarely cited as a source of information. Overall, almost three-quarters of respondents were satisfied with the level of communication by the government about the issue.

Recognising the health risks associated with the consumption of Rock Lobsters that may have accumulated harmful levels of the PST in the hepatopancreas, this study established that prior to the first major biotoxin event in Tasmania during 2012 almost 20% of fishers at least occasionally consumed the hepatopancreas or mustard. There was some evidence of slightly higher consumption rates in regional areas and amongst interstate licence-holders, though the sample of interstate fishers was small.

Interestingly, since the initial health warnings just 15% of fishers who previously ate the mustard indicated that they now avoided it, regardless of whether or not closures were in place. With less than half of all respondents agreeing that the health risks associated with the biotoxin events were well communicated and understood there would appear to be potential for further community education on the issue.

Having identified the biotoxin closures as a major issue for many respondents, either in terms of limiting the fishing they did during 2015-16 or in their decision not to renew licences, it is perhaps significant to note that the vast majority indicated an intention to take out a licence in 2016-17 regardless of whether they fished during 2015-16.

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