



FINAL REPORT

TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES:
2012-13 FISHING SEASON

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Tasmanian recreational Rock Lobster and Abalone fisheries: 2012-13 fishing season

Executive Summary

Southern Rock Lobster and Abalone (Blacklip and Greenlip) are highly prized by recreational fishers in Tasmania as well as supporting major commercial fisheries. The present study represents the ninth survey of the recreational Rock Lobster fishery and the eighth for the recreational Abalone fishery undertaken since the mid-1990s.

Following a period of growth in licence numbers up until 2009-10, 2012-13 saw a continued decline in sales with around 18,200 persons licensed for Rock Lobster and 11,150 licensed for Abalone, down by about 5% compared with 2011-12 and more than 15% since the peak.

A random sample of licence-holders was contacted by telephone prior to the start of the 2012-13 licensing year and invited to participate in the survey in which fishing activity was monitored throughout the 2012-13 season. A total of 582 respondents completed the survey, representing about one in 38 licence holders and an effective response rate of 82%.

During the 2012-13 Rock Lobster season (3 November 2012 – 31 August 2013), licensed recreational fishers harvested an estimated 83,772 (95% CI: 71,849 – 96,708) Rock Lobster, based on 85,849 fisher days of effort. Potting was the dominant method, representing 82% of the effort (days fished) and 65% of the estimated harvest. Dive collection accounted for about 15% of the effort and 29% of the harvest, while ring usage contributed 3% of the effort and 6% of the harvest. The overall average harvest rate for the season was 0.98 Rock Lobster per day fished, with daily harvest rates of 0.78 for pots, 1.83 for dive collection, and 2.18 for rings. Daily bag limits of three Rock Lobster in the Eastern region and five in the Western region were rarely attained for pots (<3% of pot days) but were achieved for about 40% of the dive effort in the Eastern region and 19% in the Western region.

Seasonally the Rock Lobster fishery exhibited three distinct phases: intense activity early in the season (November to January) that accounted for about 65% of the total harvest; a period of intermediate fishing activity (February to April) that contributed a further 33%; and a phase of low activity (May to August) that accounted for around 5% of the season's total.

Conversion of numbers to weights produced a recreational harvest estimate of 81.8 tonnes, with catches from the east coast accounting for 54%, the north coast 25%, and west coast 21% of the total weight. The catch estimate was almost half of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to about 6% of the notional total allowable catch (TAC) of 1273 tonnes (which is inclusive of the total

allowable commercial catch or TACC of 1103 tonnes). 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.

An estimated 66,438 (95% CI: 50,940 – 84,357) Abalone, based on 11,428 diver days of effort, were harvested by recreational fishers between 1 November 2012 and 31 October 2013. Blacklip Abalone accounted for 83% and Greenlip Abalone 17% of the total numbers. In total, over half of the catch was taken from the east coast, with the balance more or less equally distributed between the north and west coasts. About 58% of the catch was taken between November and January, 35% between February and April, and 8% in the final six months of the season.

Almost one in three dives targeted at Abalone resulted in the daily bag limit of 10 Abalone being taken; the overall average daily harvest rate was 5.8 Abalone.

By converting numbers to weights, the 2012-13 recreational harvest of Abalone was estimated at 32.1 tonnes, equivalent to 1.5% of the combined recreational and commercial catch of 2137 tonnes. There are currently no explicit performance indicators relating to the recreational fishery for Abalone.

Rock Lobster and Abalone catches in 2012-13 were similar to those estimated for 2010-11 but were substantially lower than those taken during the early 2000s. The lower catches in recent years appear to be influenced by a number of factors, including fewer licence-holders, lower participation rates (i.e. proportion of active fishers), lower avidity (average days fished) and, in the case of Rock Lobster, lower catch rates especially off the east coast.

The 2012-13 fishery was also impacted by two unexpected events: (i) the closure of a large part of the East coast between late November and early February to fishing for Rock Lobster (and Abalone) due to a toxic algal bloom; and (ii) destructive bush fires between November-January that impacted several east coast communities. The impact of these events on fisher behaviour was explored in a structured questionnaire, with 40% of licence-holders interviewed indicating that these events had impacted on their fishing activities in some way; the vast majority reported that they fished less than they would have done had the closure not occurred. There is strong evidence to suggest that catches of Rock Lobster from the east coast of Tasmania would have been higher during 2012-13 had neither of these events occurred.

Table of Contents

EXECUTIVE SUMMARY	I
1 INTRODUCTION	1
2 METHODS	5
2.1 SURVEY DESIGN	5
2.1.1 Survey sample	5
2.1.2 Screening survey.....	6
2.1.3 Telephone-diary survey.....	6
2.1.4 Wash-up survey	7
2.2 DATA ANALYSIS	8
2.2.1 Catch and effort.....	8
2.3 SIZE COMPOSITION.....	9
2.4 COMMERCIAL CATCH DATA.....	9
3 RESULTS	10
3.1 RESPONSE RATES	10
3.1.1 Screening survey.....	10
3.1.2 Telephone-diary survey.....	11
3.2 ROCK LOBSTER.....	12
3.2.1 2011-12 participation	12
3.2.2 2012-13 catch and effort	12
3.2.3 Regional catch and effort.....	13
3.2.4 Southeast coast fishery.....	14
3.2.5 Seasonal catch and effort	15
3.2.6 Daily harvest	16
3.2.7 Individual season harvest estimates	17
3.2.8 Released catch.....	18
3.2.9 Size composition	18
3.2.10 Estimated harvest weight.....	20
3.2.11 Comparison with commercial catches	20
3.3 ABALONE	21
3.3.1 2011-12 participation	21
3.3.2 2012-13 State-wide catch and effort	22
3.3.3 Regional catch and effort.....	22
3.3.4 Southeast coast fishery.....	23
3.3.5 Seasonal catch and effort	24
3.3.6 Daily harvest	24
3.3.7 Estimated harvest weight.....	25
3.3.8 Comparison with commercial catches	25
3.4 WASH-UP SURVEY.....	26
3.4.1 General	26
3.4.2 East coast algal event emergency closure and bush fires	28
3.4.3 Management of Rock Lobster	31
4 DISCUSSION	34
4.1 CATCH AND EFFORT	34
4.1.1 General trends.....	34
4.1.2 Fishing methods.....	37
4.1.3 Regional patterns	38
4.1.4 Seasonality.....	39
4.1.5 Comparison with commercial fisheries	39

4.2	IMPACTS OF THE EAST COAST FISHERY CLOSURE	40
ACKNOWLEDGMENTS.....		41
REFERENCES.....		42

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 or hoop nets and dive collection. Two species of Abalone, Blacklip (*Haliotis rubra*) and Greenlip (*H. laevis*), are targeted by recreational divers, the former dominating the catch and 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. 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 Rock 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, 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 Rock 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 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 present licensing system, the number of persons holding at least one recreational Rock Lobster licence 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 but have declined since that time, such that by 2012-13 there were 18,200 persons licensed for Rock Lobster, with 15,500 pot, 7800 dive and 4650 ring licences issued. Abalone licences have followed a similar trend, with numbers almost tripling to about 13,500 between 1995-96 and 2007-08, before stabilising in the following two seasons (Fig. 1). Between 2009-10 and 2012-13 Abalone licence numbers fell by over 15%, to just over 11,150.

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

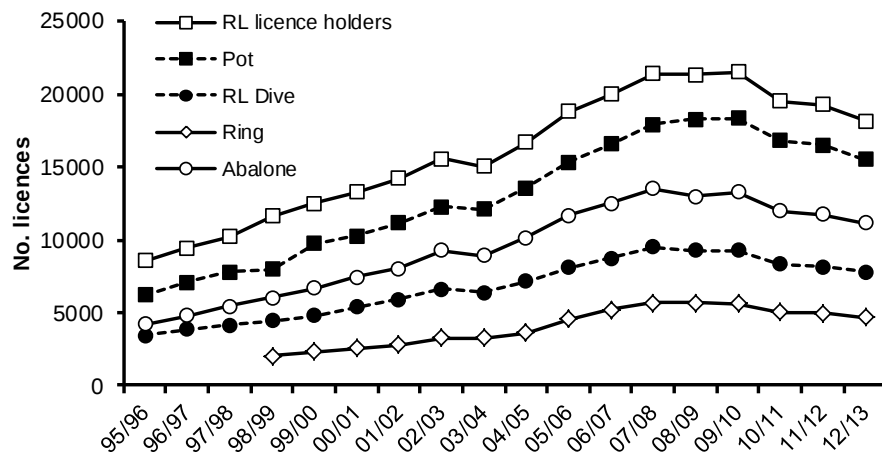


Fig. 1. Numbers of recreational Rock Lobster (RL) and Abalone licences issued annually since 1995-96. RL licence holders refers to the number of persons holding at least one recreational Rock Lobster licence.

Giving consideration to where licence-holders reside, and defined using the Australian Statistical Geography Standard (ASGS) (Pink 2011), Rock Lobster licence-holders are concentrated in the south east of the state; 40% of 2012-13 licence-holders resided in the Hobart statistical area with a further 15% in the surrounding South East statistical area (Fig. 2). Launceston and North East, and West and North West statistical areas each accounted for a further 21% of licence holders. Interstate based licence holders accounted for 4% of the total. A similar pattern applies for Abalone licence-holders (not shown), which is not unexpected since the vast majority (95%) of Abalone licence-holders also hold at least one Rock Lobster licence.

Set against the general trend of increasing recreational licence numbers was the introduction of quota management for the commercial Rock Lobster fishery in 1998, with 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 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 2013-14².

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) is 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 2012-13 which, when added to the TACC, resulted in a notional TAC of 1273 tonnes. Recreational catch information is thus required to evaluate performance against the TARC and also as an

² The TACC was reduced for the 2014-15 season to 1050.7 tonnes

input into the Rock Lobster assessment developed to assess stock status and undertake risk assessments under different management scenarios (Hartmann *et al.* 2013).

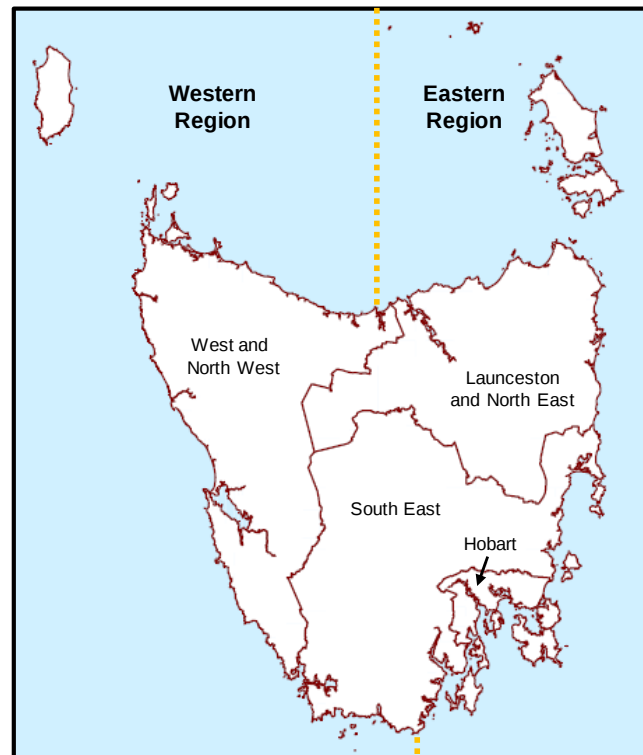


Fig. 2 Map showing Tasmanian ASGS Statistical Areas (Level 4) (adapted from Pink, 2011) and Rock Lobster Fishing Regions.

Concerns over the status of the Rock Lobster stocks, in particular stocks off the east coast of Tasmania, provided impetus for management to divide the state into Eastern and Western Rock Lobster Fishing Regions (Fig. 2) and reduce recreational bag and possession limits in the Eastern Region. These new measures took effect in November 2011 and saw the daily bag and possession limits in the Eastern region reduced from 5 to 3 and from 10 to 6, respectively. Bag and possession limits for the Western region remained unchanged at 5 and 10 Rock Lobster, respectively. Boat limits were also introduced for the first time and were set at 15 for the Eastern region and 25 Rock Lobster for the Western region.

Since 1995, the TACC for Abalone has varied between 2100 – 2800 tonnes and was set at 2366 tonnes (2226 tonnes for Blacklip and 140 tonnes for Greenlip Abalone) in 2012. 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 & Gardner 2013).

During 2012-13, the Rock Lobster and Abalone fisheries were impacted by two unexpected events: (i) the closure of a large part of the Eastern Region between late November and early February to fishing for Rock Lobster (and Abalone for part of this time) due to a toxic algal bloom; and (ii) destructive bush fires between November-

January that impacted several east coast communities. The current survey represents the ninth in a series for Rock Lobster and the eighth for Abalone undertaken since 1996. Key objectives include characterisation of the 2012-13 Rock Lobster and Abalone fisheries in terms of participation, fishing effort and catch including an assessment of the impacts of the biotoxin closure and bush fires on the fisheries.

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 establish eligibility and collect profiling information from licence-holders; and a follow-up telephone-diary survey in which fishing activity was monitored in detail during the 2012-13 licensing year.

2.1.1 Survey sample

The survey sample was selected from the 2011-12 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 Rock Lobster licence.

All persons with Rock Lobster and/or Abalone licences in 2011-12 were included in the 'population' of licence-holders and the database was divided into five regional (i.e. residential) strata. For Tasmanian residents, regions corresponded to 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 each of the strata with the exception of Hobart, where a lower sampling fraction (69% of that for all other strata) was applied. The higher sampling rate for strata outside of the Hobart statistical area was intended to improve the precision of estimates of fishing activities in areas away from the southeast coast. For analytical purposes, Rock Lobster data were treated as if they were derived from two strata, namely 'Hobart' and 'Elsewhere'³. By undertaking the initial regional stratification within the Elsewhere stratum, it was possible to achieve a sample that properly reflected the relative numbers of licence-holders based on their area of residence. A similar approach was taken for the analysis of the Abalone data, with only the holders of Abalone licences included in the analyses.

³ It should be noted that regional stratification was recommended by Pollock (2010) in a review of the survey method and differed to the approach undertaken in surveys prior to 2010-11 in which stratification was based on licence type rather than residence. Previous surveys involved 'oversampling' divers in order to improve precision in catch estimates based on method, noting that divers are a comparatively minor component of the licence-holder population but do tend to exert a disproportionately high influence on harvest estimates.

2.1.2 Screening survey

Respondents were contacted by telephone during October 2012 and asked about their intention to renew their Rock Lobster and/or Abalone licences for the 2012-13 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 in 2012-13 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 the diary and to have reporting requirements explained. Diarists were then contacted regularly by telephone throughout the diary period by survey interviewers who recorded details of any 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, interviewers were also able to immediately clarify any misunderstandings or inconsistencies at the time of the interview, thereby ensuring overall data quality and completeness.

In practice, most diarists were contacted at least once a month between November 2012 and April 2013, even if no fishing activity was planned. In May, all diarists were contacted as usual and asked whether they anticipated any more fishing trips during the remainder of the season. Regular contact was maintained with those who expected to fish, whereas those not planning to fish again were not contacted again until September (after the closure of the Rock Lobster season), when details of any unexpected fishing activity was collected. Diarists who held Abalone licences were contacted again in November to ensure that any late season Abalone fishing activity was also recorded.

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

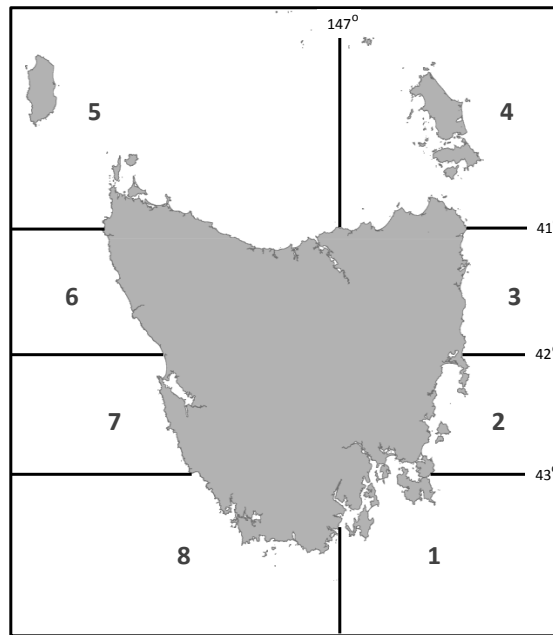


Fig. 3. Map of Tasmania showing fishery assessment areas

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 Rock Lobster on the same day, with catch and effort information linked separately to each method.

Pots were generally fished overnight. In a small number of instances pots were not checked for several days, generally because unfavourable sea conditions prevented retrieval. The start of the 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 Rock Lobster taken for the day. For the purposes of calculating effort, overnight sets were considered to represent a single pot-day of effort.

For Rock Lobster, the enumeration period encompassed the 2012-13 fishing season (3 November 2012 to 31 August 2013) while the enumeration period for Abalone was the licensing year (1 November 2013 to 31 October 2013).

2.1.4 Wash-up survey

At the completion of the Rock Lobster fishing season all fully responding diarists aged 18 years and older were asked a series of questions relating to their fishing activity during 2012-13, perceptions relating to the quality of the fishery and status of Rock Lobster stocks and general satisfaction with the management of the fishery. A particular focus of the questionnaire centred on the impacts of two major events that occurred during the 2012-13 season: (i) the closure of a large part of the Eastern Region between late November 2012 and early February 2013 to fishing for Rock Lobster (and

Abalone⁴) due to a toxic algal bloom that resulted in unacceptably high levels of paralytic shellfish toxin (PST) in shellfish; and (ii) destructive bush fires between November-January that impacted coastal communities especially those on the Tasman and Forestier Peninsulas as well as around Bicheno.

In addition to diarists, a random sample of 2012-13 Rock Lobster licence-holders who were not included in the initial screening survey sample was selected and a modified wash-up survey was administered by telephone to these respondents. Data from the diarists and this supplementary sample have been combined in the wash-up survey analysis.

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2011-12 licence database, licence details for 2012-13 were used for data expansion. That is, the licensing status (licences held and dates of issue) was established for all diarists by reference to the 2012-13 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, about 71% of Rock Lobster and Abalone licences were issued by the end of November 2012, this proportion increased to 85% by the end of December and 90% by the end of January 2013. Very few additional licences were issued after April 2013. 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 harvest 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 base unit for catch and effort analysis was the total monthly effort and catch for each licensed respondent and this was expanded by the relevant monthly expansion factor.

The ‘bootstrap’ method was used to estimate harvest and effort confidence limits, determined using the percentile method (Haddon 2001). In each instance 1000 simulations were conducted.

⁴ The closure also initially applied to Abalone but that fishery was re-opened in mid-December 2012.

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 2011-12 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 period November 2012 to September 2013. 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 corresponding to the 2012-13 recreational licensing year (i.e. November 2012 to October 2013).

3 RESULTS

3.1 Response rates

3.1.1 Screening survey

From a random sample of 1092 licence-holders selected from the 2011-12 licence database, 172 (15.8%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 920. Contact was made with 841 licence-holders, of whom 800 fully responded, representing a screening survey response rate of 87.0%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 8.6% of the net sample and refusals or other non-response a further 4.4% (Fig. 4).

Amongst the respondents, 88 indicated that they were not likely to renew their licence(s) in 2012-13 and hence were not eligible for inclusion in the diary survey⁵. The balance (712)⁶ indicated they were likely to renew their licence(s) and 616 (86.5%) agreed to participate in the diary survey (Fig. 4).

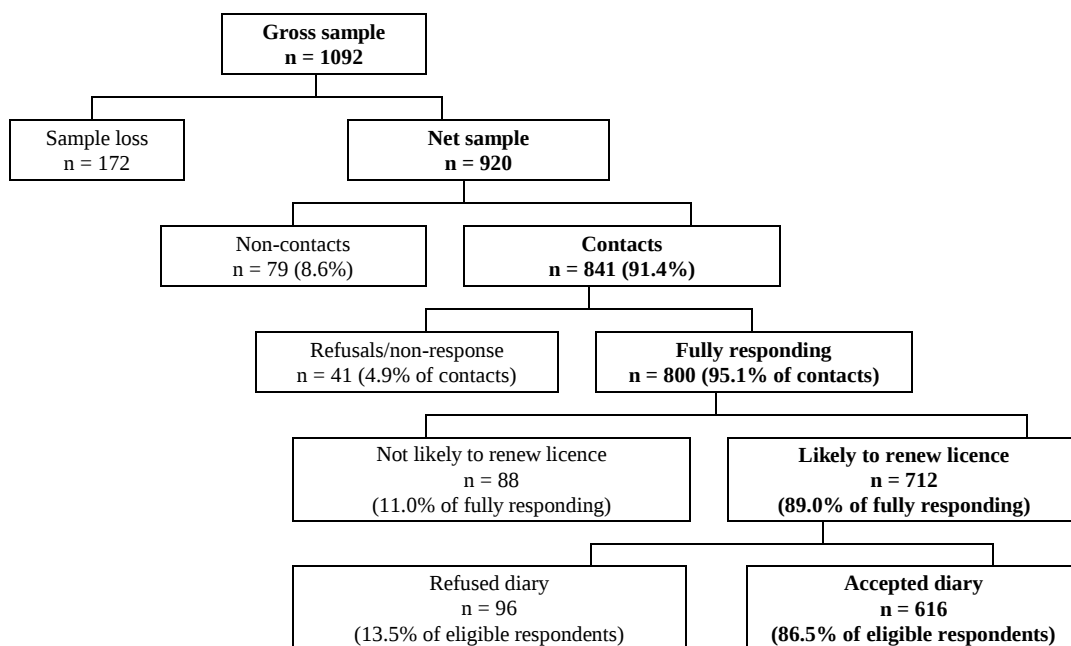


Fig. 4. Diagrammatic representation of the screening survey response profile (n is sample size).

⁵ The licence status of these respondents was checked at the end of the 2012-13 season and 20 renewals (22.7%) were identified.

⁶ In practice only 598 (84.2%) of those who expected to renew their licence in 2012-13 did so.

3.1.2 Telephone-diary survey

Diary response was high, with 582 diarists or 94.5% of respondents who accepted the diary participating for the entire survey period (Fig. 5). Based on the total number of eligible respondents identified in the screening survey (712), the effective response rate for the diary survey was 82.4%. Given the high response rates, possible biases arising from non-response were not considered to be a significant problem in this study and thus analyses do not incorporate non-response adjustments.

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

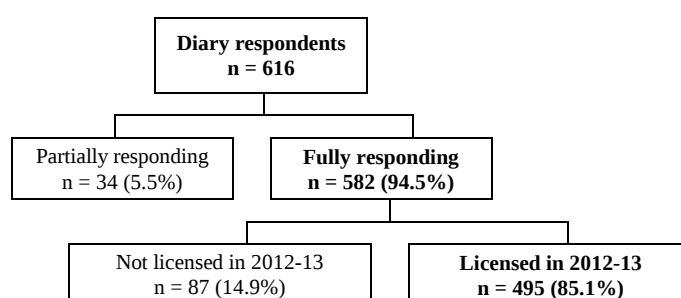


Fig. 5. Diagrammatic representation of the diary survey response profile (n is sample size).

Of the responding diarists, 87 (14.9%) did not take up a licence during 2012-13 despite rating themselves as ‘quite likely’ or ‘very likely’ to do so. Among the remaining 495 respondents, 483 held at least one category of Rock Lobster licence while 295 had an Abalone licence. The numbers of individual Rock Lobster and Abalone licences (population) and the sample of responding diarists are presented in Table 1. Overall, about one in 38 licence holders participated in the survey.

Table 1 Total number of 2012-13 Rock Lobster and Abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.

Licence type	Licence holders	Diarists	% sampled
Rock Lobster pot	15,495	426	2.75
Rock Lobster dive	7,774	217	2.79
Rock Lobster ring	4,652	131	2.82
Abalone	11,157	295	2.64
Total licences	39,078	1,294	2.74
Total persons	18,882	495	2.62

Fully responding diarists reported a total of 2580 fishing events during the survey period, 2472 (96%) of which were valid events⁷. In total, 84% of all valid fishing events were reported as being recorded in the diaries, the balance was based on recalled fishing activity (typically collected by survey interviewers within a few weeks of the activity taking place).

⁷ Events reported by diarists whilst unlicensed were considered out of scope and not valid.

3.2 Rock Lobster

3.2.1 2011-12 participation

Information provided in the screening survey indicated that 83.1% (SE 1.3%) of 2011-12 Rock Lobster licence holders fished for Rock Lobster during that season, with 69.2% (SE 1.7%) harvesting at least one lobster. That is, out of the 19,264 persons licensed in 2011-12, 16,001 fished for Rock Lobster but only 13,335 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 2012-13 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 population of recreational Rock Lobster licence holders during 2012-13.

An estimated 76.0% (SE 1.9%) of licence holders fished for Rock Lobster at least once during the fishing season and just 58.1% (SE 2.3%) of all licence holders harvested at least one lobster. That is, out of 18,185 licence-holders, 13,814 fished for Rock Lobster and 10,571 reported some harvest.

Overall, total fishing effort was estimated to be 85,849 fisher days⁸ for the season, yielding a harvest of 83,722 Rock Lobster (Table 2). This represented an average seasonal harvest rate of 0.98 Rock Lobster per day fished. Pots were the most popular fishing method (accounting for 65% of the total harvest) followed by dive collection (29%) and rings (6%) (Table 2). Although over five times as many fisher days of effort were spent using pots compared with diving, the catch taken by rock lobster pots was only 2.3 times greater than that taken by diving. Ring harvest and effort was low by comparison with the other methods. Mean daily harvest rates were over two times higher for dive (1.83 Rock Lobster) and ring (2.18 Rock Lobster) methods compared with pots (0.78 Rock Lobster).

Table 2. Rock Lobster effort, harvest and harvest rates for the 2012-13 season

Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day ⁻¹)
Pot	54,585 (45,522 – 64,473)	70,404 (57,270 – 83,784)	0.78
Dive	24,068 (16,656 – 32,488)	13,121 (9,427 – 15,502)	1.83
Ring	5,070 (2,725 – 8,129)	2,323 (924 – 2,551)	2.18
Total	83,722 (71,849 – 96,708)	85,849 (73,126 – 99,248)	0.98

⁸ A fisher day is defined as a day in which lobster was a nominated target species and/or lobsters were caught.

3.2.3 Regional catch and effort

Effort, catch and catch rates by fishing areas (refer Fig. 3) are summarised in Table 3 and indicate that the fishery was primarily concentrated on the east coast (Areas 1-3). This combined region accounted for almost 60% of the total estimated harvest (49,675 Rock Lobster) and attracted three-quarters of the total effort (61,953 fisher days) during 2012-13. Area 1 alone accounted for 40% of the total harvest and just over half of the total statewide effort. The north coast (Areas 4 & 5) accounted for 17% of the harvest (14,169 Rock Lobster) and 11% of effort (9570 fisher days) while the west coast (Areas 6 - 8) contributed 24% of the total harvest (19,879 Rock Lobster) and 15% of total effort (12,649 fisher days).

Table 3. Recreational Rock Lobster effort, harvest and harvest rates by fishing area for 2012-13

Values in parentheses represent the 95% confidence intervals			
Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	33,167 (25,763 – 41,276)	43,189 (32,081 – 55,803)	0.77
2	9,798 (6,894 – 12,902)	10,576 (7,794 – 13,549)	0.93
3	6,709 (4,333 – 9,308)	8,188 (5,796 – 10,612)	0.82
4	4,291 (2,427 – 6,613)	3,666 (2,371 – 5,269)	1.17
5	9,877 (4,490 – 16,174)	5,904 (3,330 – 9,044)	1.67
6	6,543 (3,360 – 10,370)	3,794 (2,184 – 5,825)	1.72
7	9,367 (5,476 – 13,506)	3,805 (2,374 – 5,273)	2.46
8	3,969 (1,657 – 6,899)	5,050 (1,688 – 9,813)	0.79

Marked regional differences were evident in the proportion of the Rock Lobster harvest taken by different fishing methods (Fig. 6). Pots accounted for the bulk (61-97%) of the harvest from the east coast (Areas 1 - 3) and in the north east (Area 4; 56% of the harvest), whereas off the northwest (Areas 5) dive collection was the primary capture method (84%). All three methods were of significance in Area 6, whereas in Area 7 pot and ring methods dominated. In Area 8, pots accounted for vast majority of the catch.

Mean daily harvest rates were highly variable around the state, ranging from about 2.5 Rock Lobster per day in Area 7 to 0.8 in Area 1 (Table 3). Stock abundance and total fishing pressure (including commercial activity), along with the relative mix of fishing methods used (Fig. 6), noting significantly higher harvest rates for dive collection and rings compared with pots (Table 2), represent key factors contributing to this regional variability.

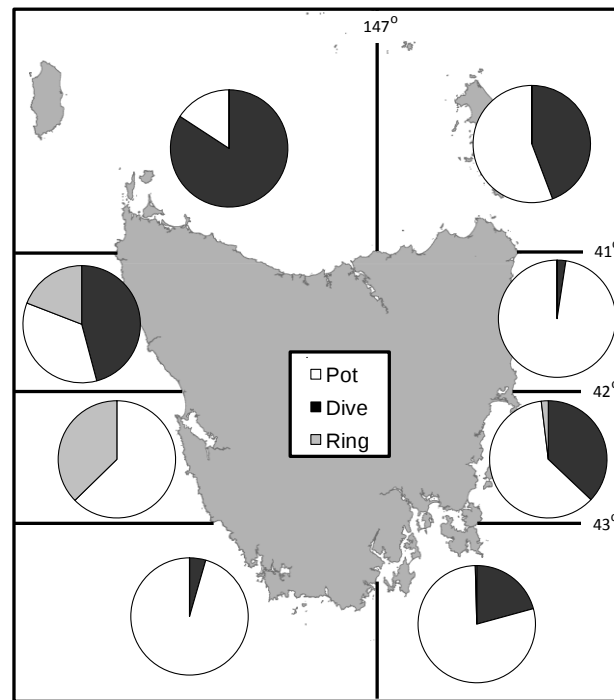


Fig. 6. Proportion of regional harvest by fishing method (pie charts).

3.2.4 Southeast coast fishery

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. 7). Waters surrounding the Tasman Peninsula and the western area of Storm Bay (including Bruny Island) accounted for just under two-thirds of the catch, with the D'Entrecasteaux Channel⁹ 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 vast majority of the catch taken in the Tasman Peninsula, western Storm Bay and Norfolk- Frederick Henry Bay regions whereas dive catches were more or less comparable to those taken by pots in the D'Entrecasteaux Channel region (Fig. 7). Dive collection was the dominant capture method in the Derwent Estuary.

⁹ 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) which are open to the use of pots.

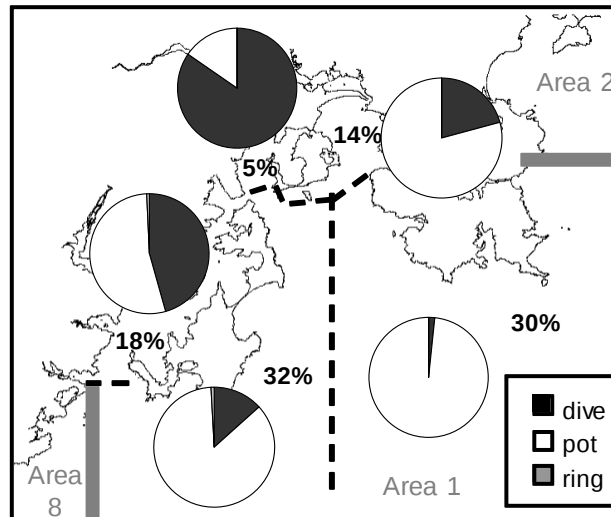


Fig. 7. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

3.2.5 Seasonal catch and effort

Intense fishing activity corresponded with the opening of the season, with greatest levels of effort and harvest during November (Fig. 8). Fishing activity slowed dramatically between December and January, coinciding with the emergency closure of the east coast to the taking of Rock Lobster, and stabilised between February and March, with the Easter holiday period occurring at the end of March. There was relatively limited fishing during the final five months of the season, with the closure of the fishery for female Rock Lobster occurring at the start of May and the onset of cooler and unsettled weather.

The underlying seasonal pattern of catch and effort in the fishery was influenced strongly by monthly variation in pot fishing activity, with 73% of the pot catch taken between November and January and 25% between February and April (Fig. 8). Dive catch and effort followed a similar pattern although the magnitude of the variability in catches during the November-April period was less pronounced, with 51% of the catch taken in the first three months and a further 43% in the following three months.

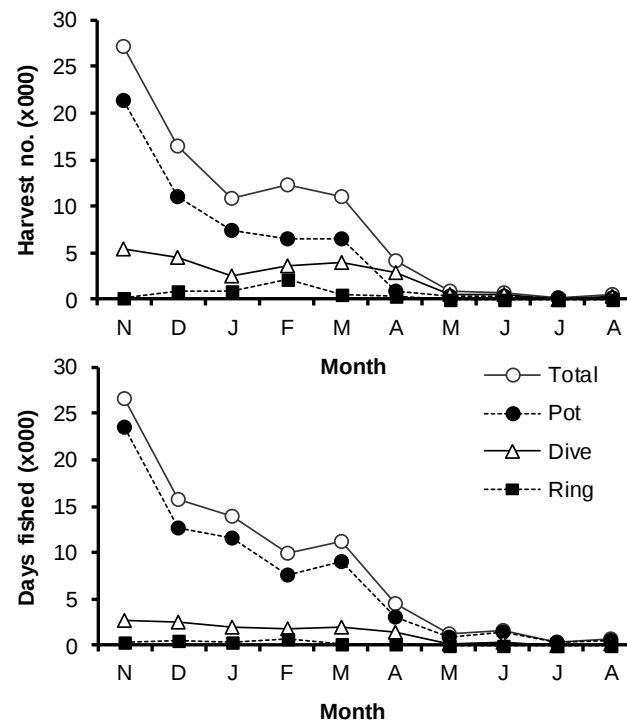


Fig. 8. Recreational Rock Lobster harvest (numbers) and effort (days fished) by month and method for the 2012-13 fishing season.

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method and management regions (Fig. 9). Overall about 55% of Eastern region pot-days yielded no retained catch, with the daily bag limit of three Rock Lobster achieved 3% of the time (Fig.9). This compared with the Western region where 45% of effort resulted in no retained catch and over 15% of the effort resulted in a retained catch of at least three Rock Lobster (3% of the effort resulted in the bag limit of five lobster being taken). In both regions, about one-third of the dive effort resulted in no catch, whereas 40% of dives resulted in at least three Rock Lobster being taken (with 19% of Western region effort achieving the bag limit of five lobsters). Rings also proved relatively effective, with Western regional bag limits achieved on 23% of days fished with rings, and nil catches were reported for around 25% of the effort in each region¹⁰.

A strong effect of dive method on catch rates was evident. Overall, average daily harvest rates were highest for hookah (2.1 and 2.8 Rock Lobster for Eastern and Western regions, respectively), followed by scuba (1.6 and 2.0 Rock Lobster) and snorkel (0.6 and 1.5 Rock Lobster). Overall, hookah was the most popular dive method, accounting for 40% of the total dive effort and 52% of the dive harvest. Scuba was next in importance, representing 36% of the effort and 34% of the harvest, while snorkel divers contributed 24% of the effort and 15% of the dive harvest.

¹⁰ Limited data were available for rings in the Eastern region, the maximum daily reported catch being two lobster.

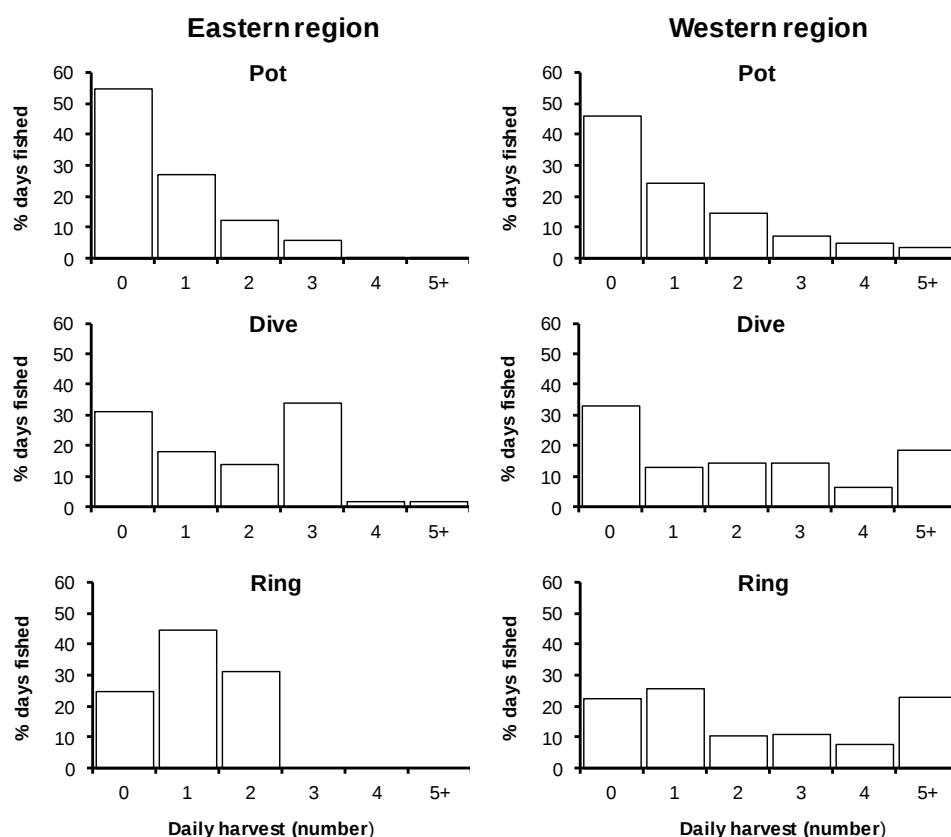


Fig. 9. Distribution of daily Rock Lobster harvest by fishing method and management region.

3.2.7 Individual season harvest estimates

In a recent review of the Rock Lobster fishery, maximum individual season limits for recreational fishers was flagged as a potential management option. It was, therefore, considered worthwhile to report on the numbers of Rock Lobster retained by individual fishers during the 2012-13 fishing season (Fig. 10). Overall almost one in five active fishers harvested no Rock Lobster while a further 40% harvested between 1 and 5 lobsters for the entire season, with proportionally fewer active fishers who harvested six or more lobsters from east coast compared with the catches taken from all areas (35% compared with 39%). About 7% of active fishers reported catches of more than 20 lobsters, accounting for 33% of the total catch, and around 3% took more than 30 lobsters, accounting for 16% of the total catch. This pattern was generally consistent for fishing off the east coast (Areas 1-3), with fishers taking more than 20 Rock Lobster accounting for 20% of the east coast catch and those taking more than 30 Rock Lobster accounting for 9% of the total.

Should individual season catch limits be implemented as a management measure the impact on overall catch levels will depend on many factors; the limit chosen, how easy it is to catch the limit (linked in part to catch rates), any changes in fisher behaviour (e.g. there is a possibility that some fishers may fish more in an effort to take their limit), the degree of adherence to the limits (related to enforcement), and so on. Notwithstanding this and assuming no changes in fisher behaviour or illegal activity, the theoretical catch savings would have been in the order of 11 and 4%, respectively had seasonal limits of 20 or 30 Rock Lobster been applied during 2012-13.

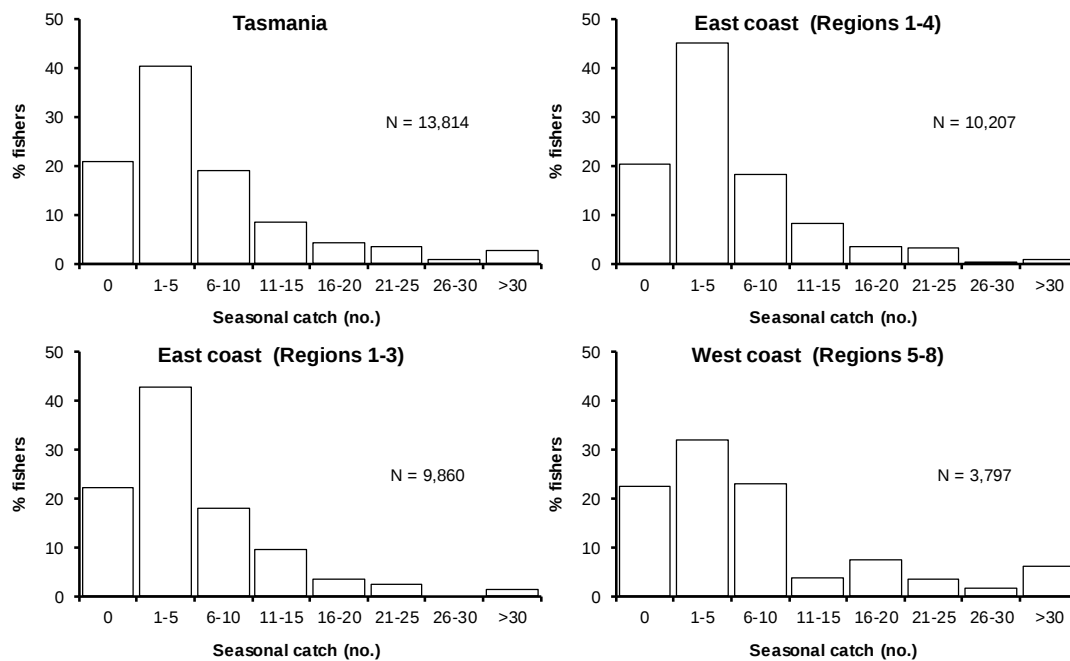


Fig. 10. Seasonal harvest of Rock Lobster for fishers who were active within specific fishing regions and for the whole fishery. N is estimated number of active licence-holders.

3.2.8 Released catch

A total of 71,578 Rock Lobster were estimated to have been released or discarded from pot catches, equivalent to 1.3 for every retained Rock Lobster. About 93% of pot releases were in response to undersized Rock Lobster, 3% were berried females, 2% of releases were due to over bag limit catches and 1% were dead or damaged.

Although divers may release Rock Lobster, i.e. the catch is landed and then sorted with the possibility of high-grading, 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 990 pot caught, 344 dive caught and 79 ring caught Rock Lobster from around Tasmania. Overall, pot caught Rock Lobster ranged between 101–215 mm carapace length (CL), with an average estimated weight of 876 g. Dive caught Rock Lobster had a similar size range, 106–210 mm CL, but were larger on average, with an estimated average weight of 1196 g. Ring caught lobster also ranged between 106–181 mm CL, with an average weight of 1022 g. However, as relatively few ring caught Rock Lobster were measured¹¹, data for pots and rings have been combined in subsequent analyses. Male to female sex ratios for pot (1:0.91) and did not differ significantly from 1:1, whereas dive (1:0.61) and ring (1:0.32) catches were comprised of significantly more males than females.

¹¹ Measurements of ring caught lobster were mainly derived from Areas 6 & 7.

Length frequency distributions by region are presented in Fig. 11. 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 lobster taken off the north coast (refer Table 4). There was 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.

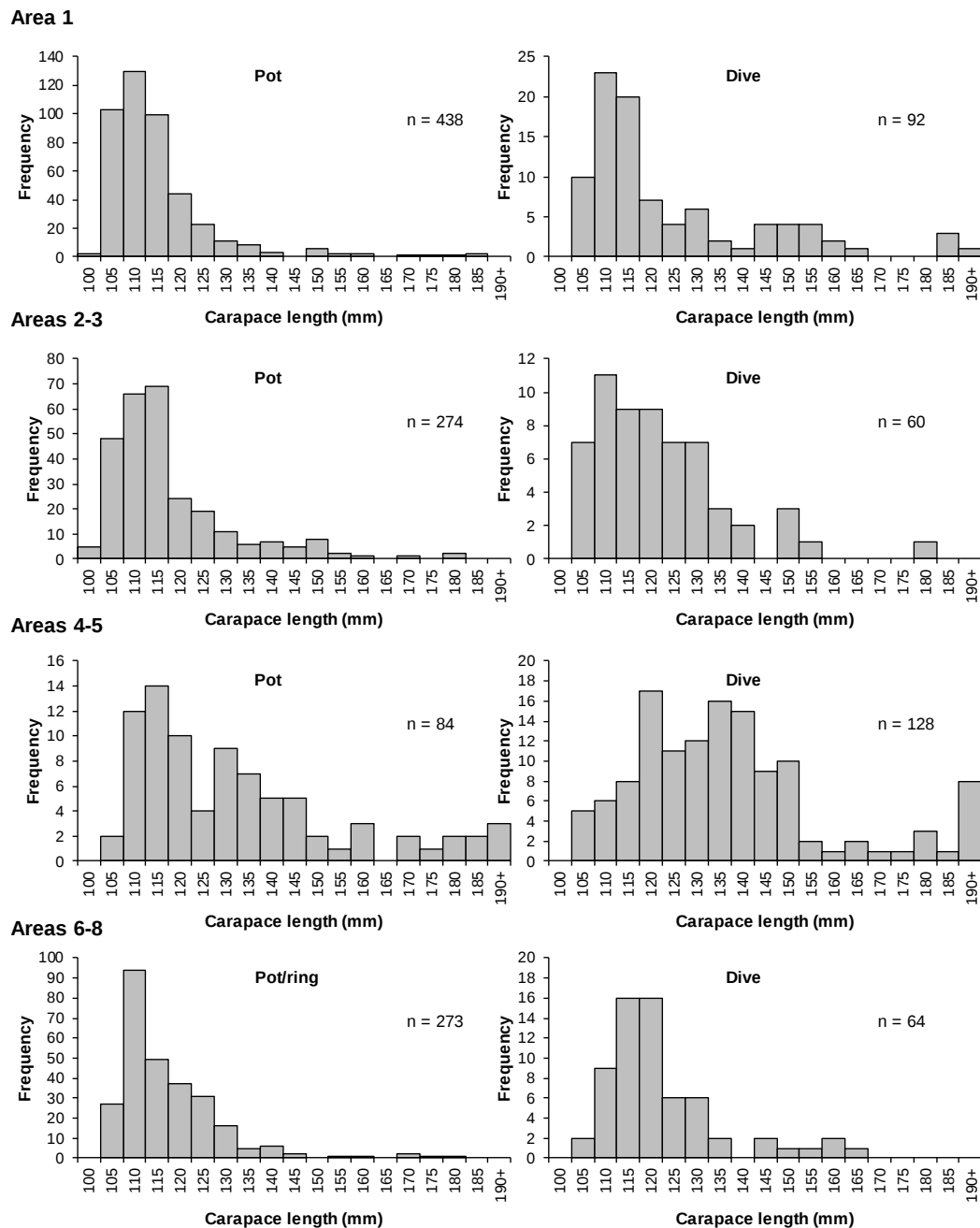


Fig. 11. Length frequency distributions by 5 mm size class for recreationally caught Rock Lobster taken by dive, pot and pot/ring fishing methods by assessment area(s). n is sample size.

3.2.10 Estimated harvest weight

The weight of the 2012-13 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 4.

The state-wide harvest was estimated to be 81.8 tonnes¹², equivalent to 48.1% of the TARC. Regional harvest estimates ranged between 29 tonnes (Area 1) and 3.4 tonnes (Area 8) (Table 4). As a proportion of the recreational harvest, the east coast (Areas 1-3) accounted for 54%, north coast (Areas 4&5) 25%, and west coast (Areas 6-8) 21% 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 3).

Table 4. Average Rock Lobster weight (g) by method and estimated harvest (kg) by area

Area	Av. weight (g)		Harvest (kg)	% total
	Pot/Ring	Dive		
1	815	1098	28,973	35.4
2	880	991	9,022	11.0
3	880	991	5,930	7.2
4	1362	1464	6,037	7.4
5	1362	1464	14,301	17.5
6	863	993	6,036	7.4
7	863	993	8,112	9.9
8	863	993	3,448	4.2
Total			81,849	

3.2.11 Comparison with commercial catches

The recreational harvest represented 5.6% of the notional 2012-13 TAC and 7.6% of the actual combined recreational and commercial catch¹³. Regionally, there was marked variability in the recreational share of the total harvest, ranging from 17-26% in the east (Areas 1-3) to 1% in the south-west (Area 8) (Fig. 12A).

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 15.7% of the combined shallow water catch of 522

¹² 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.

¹³ The commercial catch taken between November 2012 and September 2013 was 999 tonnes..

tonnes¹⁴ (Fig. 12B). The recreational harvest in Area 1 represented over 40% of the total catch from inshore waters, whereas in Areas 2 and 3 the recreational catch accounted for a quarter of the total shallow water catch. Recreational catches also represented relatively a significant component of the inshore harvest from the north west and west coasts (>10%). The significance of the recreational catch in Area 6, however, was more a function of the low shallow water commercial catch than indicative of a large recreational take. The recreational share of the inshore catch was relatively minor in the north east and south west coastal fishing areas.

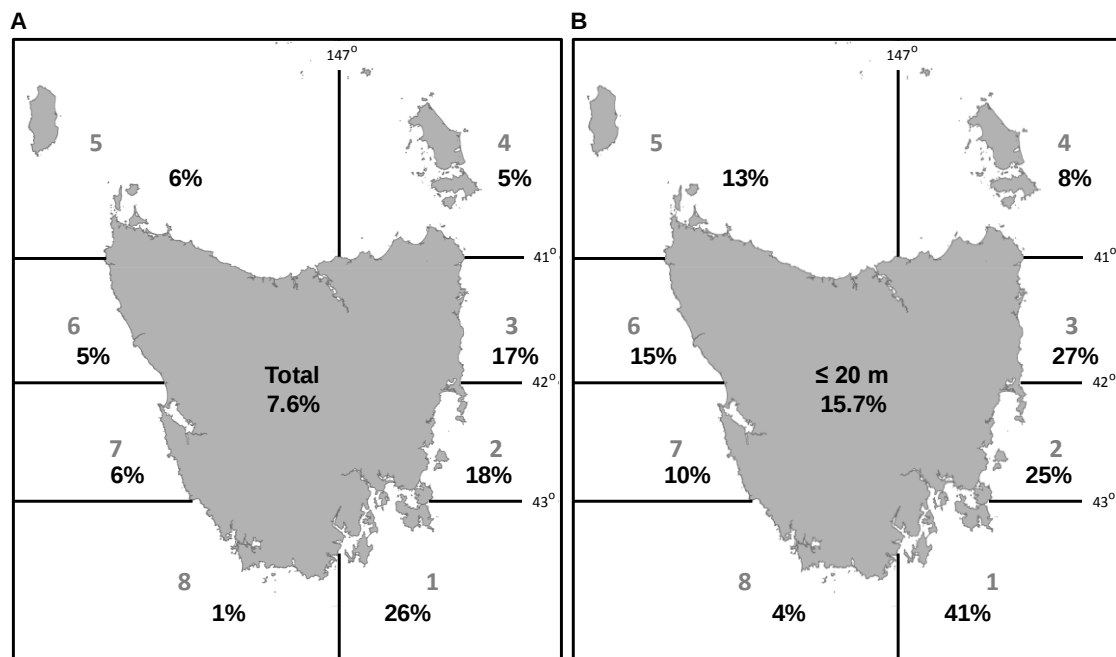


Fig. 12. 2012-13 recreational Rock Lobster harvest (weight) expressed as a percentage of the total Rock Lobster catch (commercial plus recreational) by area: (A) based on total catch (all depths); and (B) shallow water ($\leq 20\text{m}$) catches (refer text).

3.3 Abalone

3.3.1 2011-12 participation

Information provided in the screening survey suggested that 62.2% (SE 2.2%) of 2011-12 licence holders fished for Abalone during that season and that 59.2% (SE 2.3%) kept at least one Abalone. That is, out of 11,512 persons licensed in 2011-12, an estimated 7163 fished for Abalone with 6811 harvesting at least one Abalone. However, as this information was collected retrospectively at the end of the 2011-12 season it is subject to recall bias and as such is considered indicative only.

¹⁴ The commercial catch reported from $\leq 20\text{ m}$ was 440 tonnes in 2012-13, equivalent to 44% of the total commercial catch for the period November 2012 – September 2013.

3.3.2 2012-13 State-wide catch and effort

Information reported in this and subsequent sections relates to analyses of diary survey data provided by fully responding licence holders, and is presented as expanded estimates representing 2012-13 recreational Abalone licence holders.

During 2012-13 an estimated 42.0% (SE 2.9%) of Abalone licence holders (i.e. 4682 out of the 11,157 licence-holders) fished for Abalone with 35.8% (SE 2.8%) (3990 persons) harvesting at least one Abalone.

The total estimated harvest for 2012-13 was estimated to be 66,438 Abalone (95% CI: 50,940 – 84,357), the result of 11,428 (95% CI: 9113 – 13,941) fisher days¹⁵ of effort. This represented an average harvest rate of 5.8 Abalone for each day fished. The catch was taken almost exclusively by dive collection, though a small proportion (~0.2%) was taken by hand collection (wading). Blacklip Abalone dominated the catch, accounting for 83% of the total catch numbers (54,950; 95%CI: 41,814 – 67,717) while Greenlip Abalone represented 17% of the statewide total (11,488; 95%CI: 4576 – 22,100).

3.3.3 Regional catch and effort

Regional catch, effort and harvest rates for Abalone are presented in Table 5. Recreational effort and harvest was concentrated in the southeast, with over 40% of the harvest and of the effort reported from Area 1. The remaining east coast areas (Areas 2 & 3) collectively accounted for a further 8 and 12%, the north coast (Areas 4 & 5) 31 and 29%, and the west coast (Areas 6 - 8) about 18 and 15% of the catch and effort, respectively. Blacklip Abalone were taken statewide whereas Greenlip Abalone catches were restricted to the north coast (Areas 4 & 5), and in particular the northwest (Area 5). Regional harvest rates varied between 3 - 6 Abalone per day off the east coast (Areas 1 - 3), 5 - 7 per day off the north coast (Areas 4 - 5) and 6 - 8 per day off the west coast (Areas 6 - 8).

¹⁵ A fishing day was defined as one in which Abalone was a nominated target species and/or Abalone were caught.

Table 5. Recreational Abalone harvest, effort and harvest rates by fishing area for 2012-13

Values in parentheses represent the 95% confidence intervals, * average weight based on commercial catch sampling data (D Tarbath, IMAS); ** weighted in accordance to the proportion of Blacklip and Greenlip Abalone in the catch and average species weight; *** no diarists reported fishing for Abalone

Area	Harvest (no.)		Effort (fisher days)	Harvest rate (no. per fisher day)	Av. weight (g)*	Harvest (kg)
	Blacklip Abalone	Greenlip Abalone				
1	28,233 (18,421 – 38,368)	-	4,899 (3,421– 6,317)	5.8	522	14,738
2	2,244 (710 – 4,021)	-	833 (401 – 1,288)	2.7	517	1,160
3	3,342 (804 – 7,264)	-	600 (227 – 1,107)	5.6	528	1,765
4	2,393 (506 – 5,050)	1,996 (548 – 3,847)	843 (481 – 1,270)	5.2	389**	1,706
5	6,782 (2,321 – 12,801)	9,492 (2,952 – 19,467)	2,476 (1,153 – 4,069)	6.6	410**	6,678
6	8,577 (3,036 – 16,053)	-	1,334 (509 – 2,452)	6.4	501	4,297
7	***	-	***			
8	3,378 (1,381 – 6,041)	-	443 (180 - 766)	7.6	531	1,794

3.3.4 Southeast coast fishery

Data for Area 1 were disaggregated into five sub-areas to better define the spatial characteristics of the fishery in the south east (Fig. 13). The D'Entrecasteaux Channel was the most important sub-area, accounting for over half of the total harvest, followed by Norfolk-Frederick Henry Bay, Tasman Peninsula and outside of Bruny Island in decreasing importance. Catches from the Derwent Estuary were relatively insignificant.

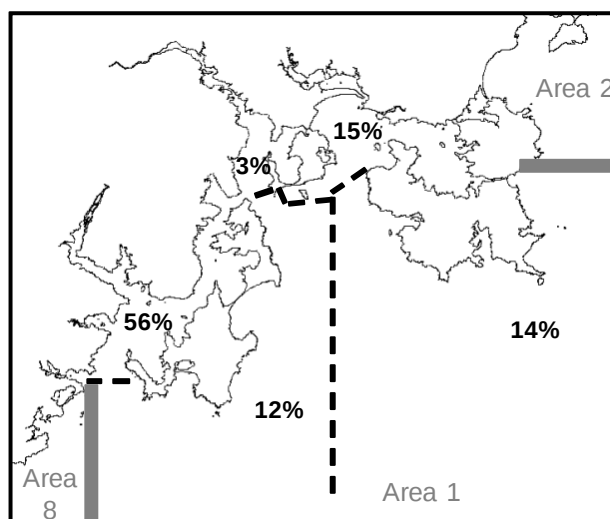


Fig. 13. Regional distribution of Area 1 Abalone harvest.

3.3.5 Seasonal catch and effort

The fishery for Abalone exhibited a strong seasonal pattern, with a marked increase in effort between November and December, and peak catches in December (Fig. 14). The first three months of the licensing year accounted for 58% of the annual harvest and effort. There was minor increase in the level of fishing activity during March, mainly associated with Easter fishing. The February to April period contributed around 35% of the annual harvest and effort. There was very limited fishing for Abalone during the final six months of the licensing year.

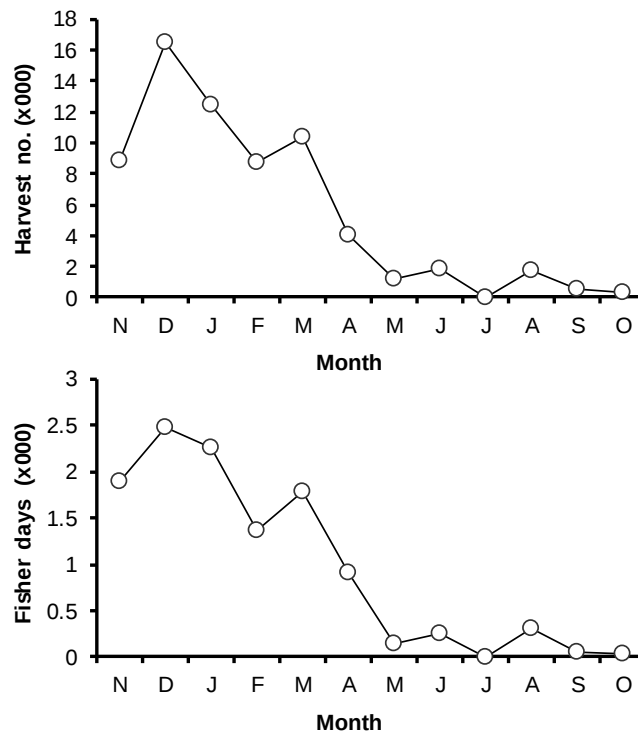


Fig. 14. Recreational Abalone harvest (numbers) and effort (days fished) by month for the 2012-13 fishing season.

3.3.6 Daily harvest

Over a third of all dives targeting Abalone resulted in the daily bag limit of ten Abalone being achieved, whereas less than one in five dives resulted in no harvest (Fig. 15). Snorkel divers reported the highest catch rates (6.4 Abalone per day), with 39% of diver-days of effort achieving the bag limit. Average daily catch rates for hookah (5.8) and scuba (4.6) were slightly lower, as was the proportion of effort that resulted in ten Abalone being taken (38% for hookah and 23% for scuba).

Of the three dive methods snorkel accounted for 47% of the harvest and 42% of effort (diver days), hookah 32% of the harvest and 31% of the effort, and scuba contributed 21% of retained catch and 27% of the effort.

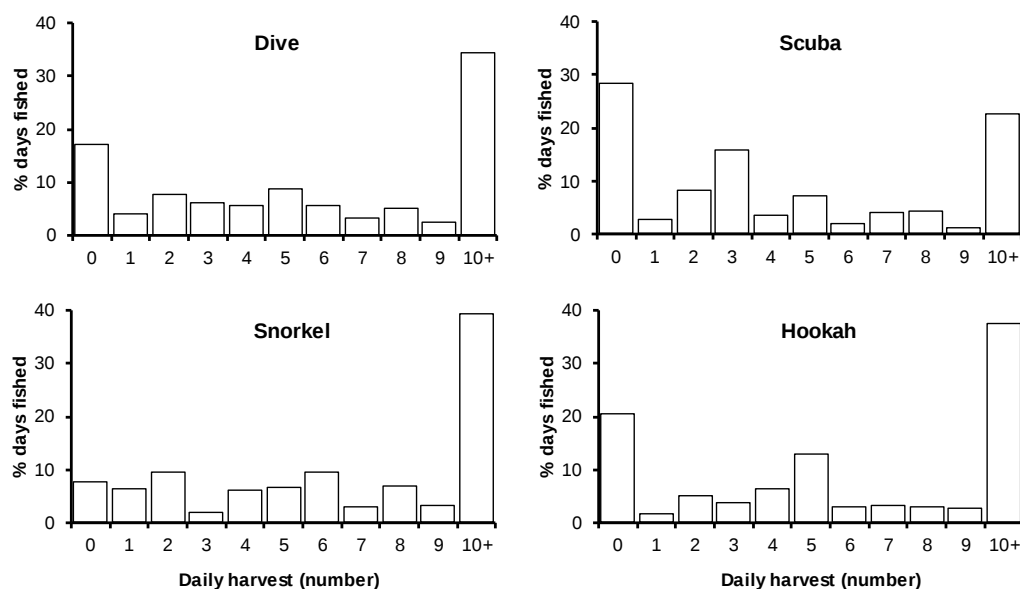


Fig. 15. Distribution of daily Abalone harvest by dive methods for 2012-13 licence holders

3.3.7 Estimated harvest weight

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 388 g¹⁶ off the northeast coast (Area 4) (Table 5). Using these values, the recreational harvest during 2012-13 was estimated to be about 32.1 tonnes. Regionally, harvest estimates ranged from almost 15 tonnes in Area 1 to just over one tonne in Area 2 (Table 5). The catch for the combined east coast (Areas 1-3) was 17.7 tonnes, the north coast (Areas 4&5) 8.4 tonnes, and the west coast (Areas 6-8) 6.1 tonnes.

3.3.8 Comparison with commercial catches

The commercial Abalone catch for the period November 2012 to October 2013 was 2105 tonnes¹⁷, indicating that the recreational harvest was equivalent to 1.5% of the combined state-wide catch. Regionally, the recreational component of the fishery accounted for over 3.7% of the combined commercial and recreational harvest in Area 1 and over 2.5% in Areas 3 and 6, whilst in all other regions the recreational contribution was relatively low (<2%) (Fig. 16).

¹⁶ This value representing the catch weighted average for Blacklip and Greenlip Abalone.

¹⁷ Based on estimated weights - Blacklip Abalone accounted for 1961 tonnes and Greenlip 144 tonnes.

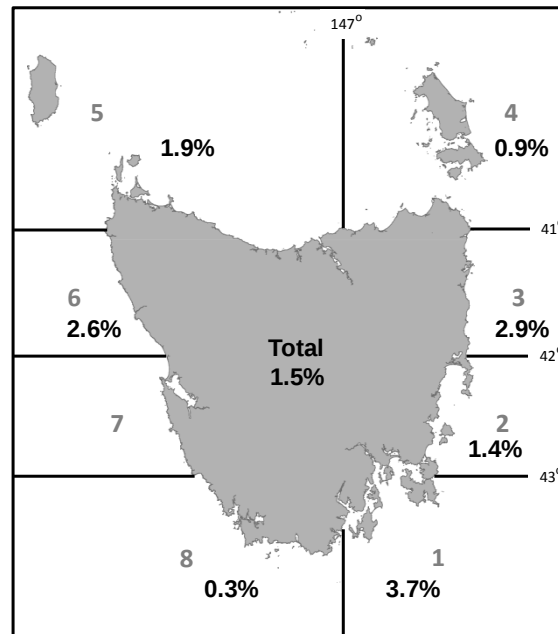


Fig. 16. 2012-13 recreational harvest (weight) of Abalone expressed as a percentage of the total catch (commercial plus recreational) by area.

3.4 Wash-up survey

3.4.1 General

The overall response rate to the wash-up survey was 93% (717 out of a net eligible sample of 770)¹⁸; non-contacts accounted for 5.5% and non-response 1.2% of the combined diary survey and supplementary samples. As indicated in Section 3.1.2 not all diarists took out licences during 2012-13 and, unless otherwise indicated, responses to questions have been restricted to licence-holders only.¹⁹

Licensed respondents who did not fish for Rock Lobster during 2012-13 were asked, as an open ended question, about their main reasons for not fishing for Rock Lobster. Lack of time due to work and/or family commitments was the most commonly cited reason followed by the east coast closure due to the toxic algal bloom (Table 6). Health and weather were the next most commonly cited reason for not fishing for Rock Lobster. Although the proportion of licence-holders who did not fish for Rock Lobster during the season was comparable across each of the regions of residence (i.e. 20-25%) it is noteworthy that just under half of the non-fishers who were resident of the Launceston and North East region cited the east coast closure as their main reason for not fishing, this was more than double the rate reported by residents of any of the other regions.

¹⁸ Full response rates were 96% for diary survey respondents (506 out of 526 eligible respondents) and 86% (211 out of a net sample of 244) for supplementary sample respondents.

¹⁹ There were 72 unlicensed respondents (diarists) who fully responded to the wash-up survey.

Table 6. Main reasons for not fishing for Rock Lobster during 2012-13 (licence-holders only)

Total respondents = 147

Reason	No. respondents	%
Lack of time/work and family commitments	55	37.4
East coast closure	38	25.9
Health	13	8.8
Weather	13	8.8
Lack of boat or equipment	7	4.8
Not resident in Tasmania	6	4.1
Lack of interest	4	2.7
Alternative interests	2	1.4
Fires	2	1.4
Other	2	1.4
Reason not given	5	3.4

Amongst those respondents who fished for Rock Lobster during 2012-13, only a small proportion (12%) reported that the overall quality of the fishery was better when compared with the previous season, with almost a third of respondents suggesting that the quality was worse in 2012-13 and about half suggesting that it was about the same as for 2011-12 (Table 7). Based on area of residence, the most conspicuous difference was in the proportion of respondents who rated the 2012-13 season as being worse than 2011-12; 19% of West and North West residents compared with 42% for South East and 32 and 34% for Hobart and Launceston and North East residents, respectively.

Table 7. Response to the question relating to the perceived quality of the 2012-13 Rock Lobster season relative to 2011-12

Total respondents = 498

Response	No. respondents	%
Better	59	11.8
Worse	155	31.1
(About the) Same	238	47.8
Unsure	46	9.2

Respondents who fished for Rock Lobster during 2012-13 were informed that there have been concerns about the declining state of the Rock Lobster stocks in Tasmania in recent years. They were then asked whether, based on personal experience, they had noticed that legal-sized Rock Lobster were less abundant and/or more difficult to catch during 2012-13. Respondents were more or less equally divided between those who indicated that they had noticed declines and those who had not observed any real change (decline) (Table 8).

Table 8. Response to whether fishers had noticed that legal-sized Rock Lobster were less abundant and/or more difficult to catch in 2012-13

Total respondents = 363		
Noticed decline	No. respondents	%
Yes	166	45.7
No/not really	154	42.4
Unsure	43	11.8

3.4.2 East coast algal event emergency closure and bush fires

In order to better understand the impacts of the east coast fishery closure and the east coast fires on fisher behaviour, respondents were asked a series of questions relevant to these events.

Almost 40% of licence-holders indicated that the east coast closure and/or bush fires had some influence on where, when or how often they went fishing/diving for Rock Lobster during 2012-13 (Table 9). Of those respondents who actually fished for rock lobster, 40% indicated that these events had impacted their fishing, while for those respondents who did not fish for Rock Lobster, a similar proportion indicated that these events had been influential in their decision not to fish. When asked which of the events had impacted their Rock Lobster fishing activities, the vast majority (89%) indicated that the closure was a factor while 21% indicated that the bush fires were an issue (i.e. 11% of those affected indicated that both events had impacted their fishing). Based residence, these events had the greatest impacts on licence-holders resident in the Launceston and North East SA (62%), followed by the South East SA (45%) and Hobart SA (38%). Residents of the West and North West SA were least impacted (17%).

Table 9. Responses to whether the east coast closure or bush fires had any influence on where, when or how often licence-holders went fishing/diving for Rock Lobster during 2012/13.

Total respondents = 640		
Influenced fishing	No. responses	%
Yes (but fished for RL)	187	29.2
Yes (did not fish for RL)	68	10.6
No (fished for RL)	282	44.1
No (did not fish for RL)	100	15.6
Unsure	3	0.5

Amongst those who fished for Rock Lobster and reported being impacted by the events, just 12% indicated that they fished for Rock Lobster in areas they would not normally have expected, 10% indicated that they fished at times of the season that they would not normally have expected while the vast majority (89%) indicated that they fish fewer days for Rock Lobster than they would normally have expected to had these events not occurred. Furthermore, when asked whether the closure between late November and

early February had influenced other fishing activities they would normally have expected to have done, just 10% indicated that they fished more than expected (Table 10), primarily fishing for flathead, with gamefishing next in importance. Those who fished less (including those who did no other fishing during the closure) accounted for about half of all affected respondents.

Table 10. Implications of east closure for other fishing activities

Total respondents = 186		
Response	No. respondents	%
No other saltwater fishing	12	6.5
Fished more	18	9.7
Fished less	82	44.1
Fish about the same	74	39.8

Respondents who fished for Rock Lobster as well as those who indicated that they did not fish due to the east coast fishery closure/bush fires were asked whether they had personally observed evidence of recreational fishers shifting effort into areas unaffected by these events, in particular the southeast, north and west coasts. In addition, these respondents were asked whether they had observed commercial fishers increasing effort in the unaffected areas, and in particular inshore waters. While most respondents indicated that they had not personally observed evidence of effort shift, proportionally more respondents reported effort shifts amongst the commercial sector (37%) than other recreational fishers (28%) (Table 11). When area of residence is considered, it was apparent that proportionally more West and North West residents (41%) reported observing increased effort by other recreational fishers compared with residents from areas (23-26%), whereas proportionally more residents of the South East (48%) reported observing effort shift by commercial fishers compared with residents of other regions (31-39%).

Table 11. Perceptions about whether effort shift had occurred into areas unaffected by the east coast closure by other recreational fishers and by commercial operators.

Total respondents = 537				
Response	Recreational		Commercial	
	No. respondents	%	No. respondents	%
Yes	148	27.6	200	37.2
No	372	69.3	313	58.3
Unsure	17	3.2	24	4.5

For those respondents who reported some evidence of effort shift, almost two-thirds noted increased crowding or competition in the areas they fished, around a third noted increased congestion at boat ramps or access points and just under half reported experiencing lower than expected catch rates (Table 12).

Table 12. Types of observed impacts on fishing due to the increased activity of other fishers.
Total respondents = 240

Statement	Yes		No	
	No. respondents	%	No. respondents	%
Increased crowding or competition in areas you fished	151	62.9	89	37.1
Increased congestion at boat ramps/landings	81	33.8	159	66.2
Lower than expected catch rates	113	47.1	127	52.9

Given the unexpected nature of the toxic algae outbreak and need to introduce emergency measures, all respondents (regardless of whether or not they were licensed) were asked how they first heard about the closure and whether they believed that the government had done enough to communicate information about the closure. The traditional media (television, radio and newspapers) represented an important source of initial information about the closure, with almost two-thirds of all respondents citing one or more media sources (Table 13). Information sourced directly from government, while obviously critical in informing the media about the situation, was a relatively minor first point of contact for recreational fishers, by contrast information passed on by family, friends and other fishers was clearly important.

Table 13. Respondent's initial source of information about the east coast closure.
Total respondents = 710. Note: some respondents cited multiple sources.

Response	No. respondents	%
TV	210	29.6
Radio	177	24.9
Newspaper	140	19.7
Media (unspecified)	45	6.3
DPIPWE (incl. website, Fishing News, Licensing, Fishcare)	38	5.4
Other government (MAST, Police)	11	1.5
Friends/family/other fishers	159	22.4
Fishing Associations	10	1.4
Internet (incl. fishing forums)	8	1.1
Email (unspecified)	8	1.1
Other	8	1.1
Unaware of closure	9	1.3

Overall, the great majority (71%) of respondents indicated that they considered the government had done enough to communicate information about the closure (Table 14). Amongst those respondents who did not think the government had done enough, a third suggested that individual licence-holders should have been contacted directly using email, SMS or a letter, a further quarter indicated that they would have preferred more regular updates and increased media coverage, in particular in relation to the re-opening

of the fishery. Other suggestions included, a clearer message about the situation, signage at ramps, information about food safety and maps of the closed area.

Table 14. Responses to the question “Do you think the government did enough to communicate information about the closure?”

Total respondents = 707		
Response	No. respondents	%
Yes	505	71.4
No	126	17.8
Unsure	76	10.8

3.4.3 Management of Rock Lobster

Respondents were reminded of recent management changes that apply to the Eastern Region, namely the reduction in bag and possession limits and introduction of a boat limit. They were then asked whether they considered that these changes would be effective in “substantially” reducing recreational catches. Just over half of the respondents (including non-licensed respondents) agreed that the measures would substantially reduce recreational catches, whereas 30% did not think the measures would be effective in reducing catches (Table 15). Interestingly, 36% of those respondents who did not think that the measures would be effective suggested that since the catch limits are rarely attained on the east coast they would make little difference to the overall catch level. Consistent with this theme, a further 5% suggested that limits should be stricter (further reduced). A further 19% of respondents suggested that recreational fishers would simply fish more often (including shifting effort to the west coast), while 13% suggested that illegal fishing (and lack of enforcement) would be an issue and 10% were concerned about the impact divers would have in increasing their catches.

Table 15. Responses to the question “Do you think that these measures will be effective in substantially reducing recreational catches?”

Total respondents = 711		
Response	No. respondents	%
Yes	402	56.5
No	214	30.1
Unsure	95	13.3

Respondents who had fished in the Eastern Region during 2012-13 were asked whether the new management measures had impacted on the number of Rock Lobster they were able to retain during the season. Out of 339 respondents, just 45 (13%) indicated that the management measures had impacted on their catches; all reported they had exceeded the bag limit and 15% exceeded the boat limit on at least one occasion so had to release legal-sized individuals.

As part of a strategy to limit future catches in the Eastern Region, the start of the 2013-14 Rock Lobster season is to be delayed by two weeks while the Western Region will open as usual on the first Saturday in November. Respondents were asked whether they expected that this measure would influence how often they went fishing during 2013-14. Based on respondents who indicated a likelihood to renew their Rock Lobster licence in 2013-14, just 12% indicated that they considered the delay to the opening of the season would have an impact on how many days they fished for Rock Lobster, mostly because the opening weekend has traditionally coincided with a long weekend and many fishers take the opportunity to fish at this time as well as later in the season. By contrast, the vast majority of respondents (87%) believed the delay would not influence how much fishing for Rock Lobster they expected to do (Table 16).

Table 16. Response to the question “Do you expect that this change alone [*i.e. delayed start to the Eastern Region fishery*] will have any effect on how often you go fishing for Rock Lobster next season [*i.e. 2013-14*]?”

Total respondents = 655

Response	No. respondents	%
Yes	80	12.2
No	569	86.9
Unsure	6	0.9

Finally, respondents who were licensed during 2012-13 were asked to rate their overall satisfaction with the management of the Rock Lobster fishery. Over three quarters indicated at least general satisfaction, with almost 20% not satisfied (Table 17). Reasons for dissatisfaction were varied, with the need for further restrictions, including further reductions in bag limits, implementation of individual season catch limits and area closures, greater restrictions on divers, and need for greater enforcement of regulations in addition to further restrictions on the commercial operations amongst the main issues identified (Table 18). By comparison, comparatively few respondents considered that management regulations were too restrictive, although some considered that due to the closure of the fishery there should have been some compensation paid or licence refunds offered.

Table 17. General satisfaction with the management of the Rock Lobster fishery during 2012-13

Total respondents = 643		
Satisfaction	No. respondents	%
Very satisfied	104	16.2
Quite satisfied	398	61.9
Not very satisfied	91	14.2
Not at all satisfied	27	4.2
Unsure	23	3.6

Table 18. Reasons cited for dissatisfaction with the management of the Rock Lobster fishery

Total respondents = 109		
Reason for dissatisfaction	No. respondents	%
Need for further restrictions (lower bag limit, seasonal catch limits, closures)	22	20.2
Regulations too restrictive	14	12.8
Lack of control over commercial catches	14	12.8
Failure of management to prevent overfishing	11	10.1
Costs (incl. licence fees and lack of compensation for closures)	10	9.2
Commercials permitted to fish too close inshore	9	8.3
Inadequate enforcement	7	6.4
Greater controls required for divers	5	4.6
Management bias in favour of commercial fishers	4	3.7
Management measures have forced effort shift to the west coast	3	2.8
Other	10	9.2

4 DISCUSSION

4.1 Catch and effort

4.1.1 General trends

To date, nine 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. 17). The catch estimate for current season was very similar to that for 2010-11 despite a 7% reduction in licence numbers and the closure of much of the east coast during the much of the peak fishing period.

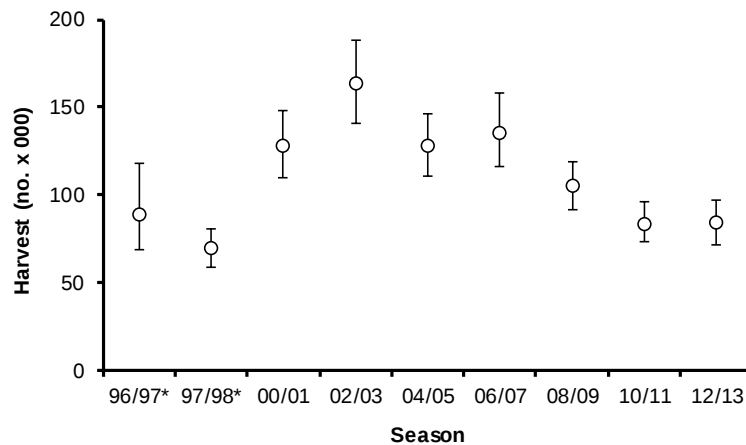


Fig. 17. Estimated Rock Lobster harvest plotted against fishing season. Error bars represent 95% confidence limits. * indicates partial season surveys.

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.18). The decline in catches continued in Areas 2-4 during 2012-13, no doubt influenced by the east coast fishery closure that effectively shut down all Area 3 and most of Area 2 between 22 November and 9 February, and a significant portion of Area 4 between 21 December and 19 January. In response to these closures and, as suggested by the wash-up survey results, there was some shift of effort into areas that remained unaffected by the closure. This shift is likely to have contributed to increased production in the northwest (Area 5), west (Area 7) and southeast (Area 1) coastal regions.

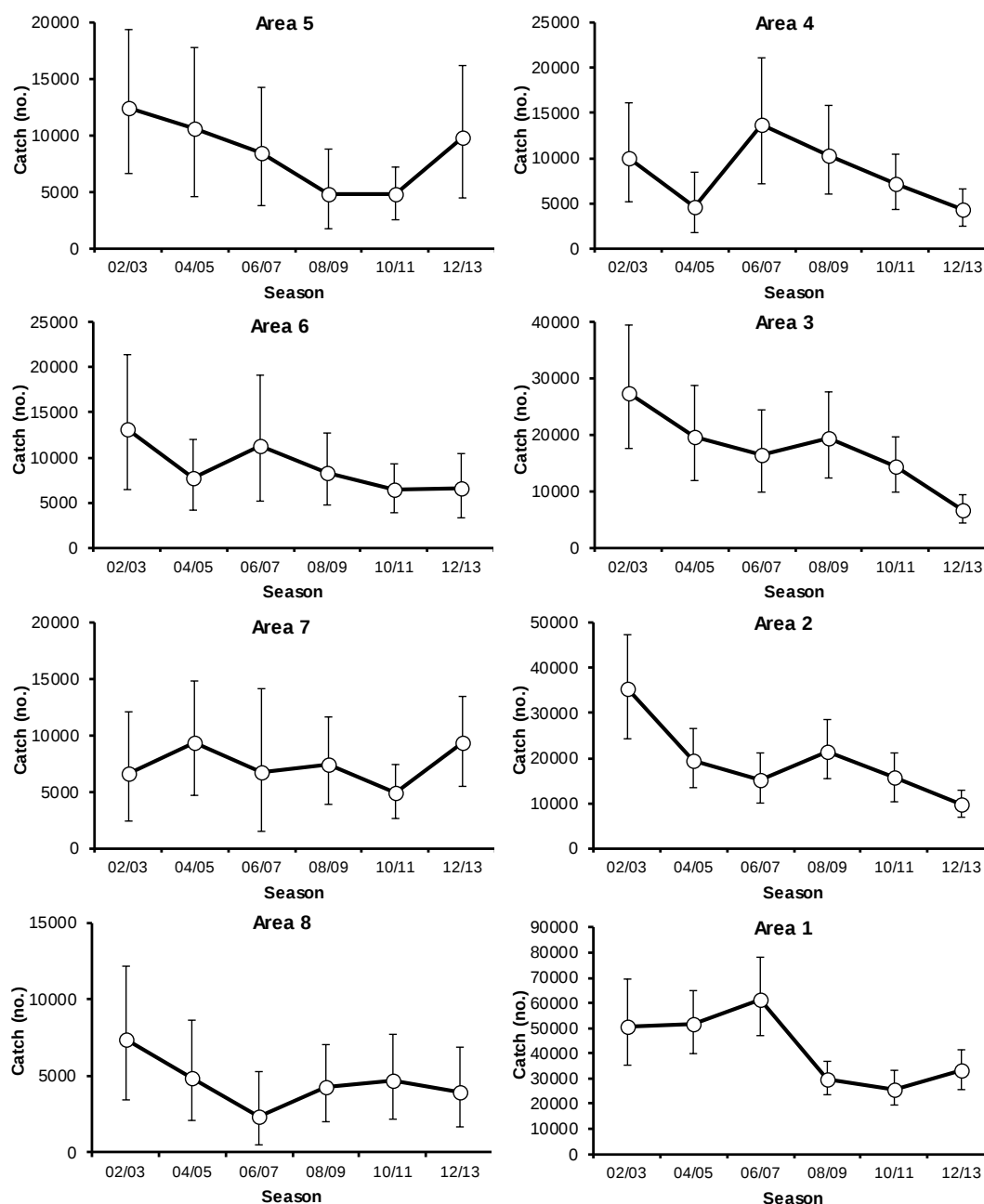


Fig. 18. Regional Rock Lobster harvest estimates (numbers) by recreational fishing season. Error bars represent 95% confidence limits.

Abalone harvest levels have also declined since the early 2000s even though licence numbers continued to grow up until 2008-09 (Fig. 19). Despite a 7% reduction in licence numbers compared with 2010-11, the 2012-13 harvest estimate was 9% higher. On one hand, a large area of the east coast (part of Area 2 and all of Area 3) was closed to fishing for Abalone between 22 November and 13 December due to the toxic algae bloom and would have influenced fishing effort. On the other hand, it is possible that the more protracted closure for Rock Lobster may have provided impetus for some divers to target Abalone rather than Rock Lobster. This change in behaviour may have contributed to the slight increase in catches when compared to the 2010-11 season.

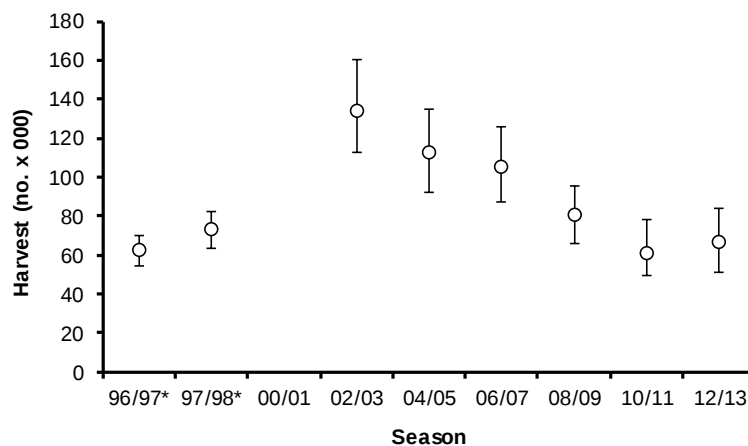


Fig. 19. Estimated Abalone harvest plotted against fishing season. Error bars represent 95% confidence limits. * indicates partial season surveys.

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 76% for Rock Lobster, and from 63 to 42% for Abalone (Table 19). This has had the effect of slowing growth or even resulting in a decline in the numbers of active fishers despite increased licence sales. Lack of time (due work and/or family commitments) and the effects of the east coast closure were the most commonly cited reasons as to why licence-holders do not fish for Rock Lobster during 2012-13.

Coupled with this has been a general decline in the average number of days fished per season by active fishers for both Rock Lobster (8.8 down to 6.2 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 6 for Rock Lobster, and from 23 to 14 for Abalone) (Table 19). Furthermore, daily harvest rates for Rock Lobster have declined since the early 2000s (1.3 down to 0.98 per day); this decline being most influenced by pot catch rates which had fallen from 1.0 in 2002-03 to less than 0.8 lobster per day in 2012-13 (Table 19). 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, have tended to fluctuate without obvious trend through time. The difference in trends for the two methods arises because divers actively search for Rock Lobster and are able, to some extent, to maintain stability in 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, the current catch rate being the second highest on record and again reflecting the fact that divers regularly attain the bag limits.

Given the above, the general growth in licence numbers up until 2008-09 has not translated 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 19. 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.

	Licence year						
	2000-01	2002-03	2004-05	2006-07	2008-09	2010-11	2012-13
Rock lobster							
No. licence holders	13,265	15,580	16,710	20,008	21,351	19,519	18,185
% fished	86.5	88.4	81.9	78.4	75.2	71.7	76.0
No. active fishers	11,408	14,308	13,679	15,687	16,050	13,997	13,814
Harvest (nos.)	128,219	163,454	127,987	135,592	105,538	83,472	83,772
Av. catch per active fisher	11.2	11.4	9.4	8.6	6.6	6.0	6.1
Fisher days	100,866	125,898	109,788	124,305	103,985	87,617	85,849
Av. days per active fisher	8.8	8.8	8.0	7.9	6.5	6.3	6.2
Av. daily harvest (nos)	1.27	1.30	1.17	1.09	1.01	0.95	0.98
Av. daily pot-harvest	0.87	1.00	0.90	0.94	0.75	0.68	0.78
Av. daily dive-harvest	2.61	2.30	2.31	2.15	2.27	2.36	1.83
Abalone							
No. licence holders		9,272	10,133	12,514	12,976	11,972	11,157
% fished		63.5	55.8	52.3	38.8	36.3	42.0
No. active fishers		5,853	5,653	6,542	5,033	4,349	4,682
Harvest (nos.)		133,711	112,571	105,515	81,021	60,943	66,438
Av. catch per active fisher		22.8	19.9	16.1	16.1	14.0	14.2
Fisher days		25,342	18,185	23,201	14,445	12,117	11,428
Av. days per active fisher		4.3	3.2	3.5	2.9	2.8	2.4
Av. daily harvest (nos)		5.28	6.19	4.55	5.61	5.03	5.8

In relation to the perceived quality of the Rock Lobster fishery in 2012-13, almost half of the active fishers considered that it was about the same as in the previous season, a third indicated that it was worse and only 11% considered it to be better. A similar pattern was reported during the 2010-11 season (Lyle and Tracey, 2012). Fishers were more or less evenly divided between those who considered that legal-size lobsters were less abundant and more difficult to catch and those who had not observed any real change.

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 59-66% of the total harvest numbers in each of the years surveyed (Fig. 20). 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.

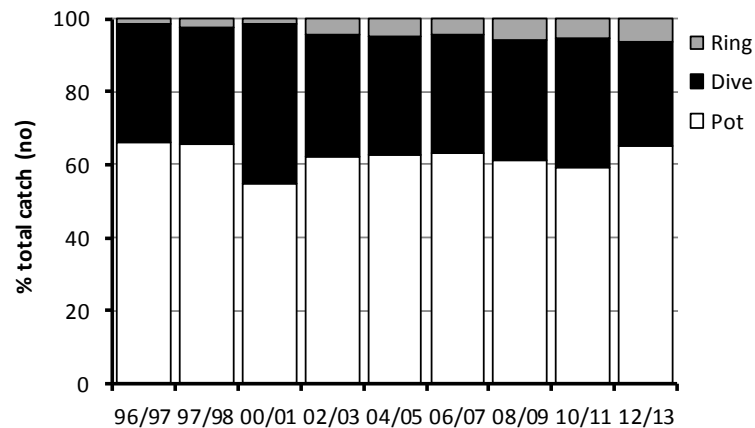


Fig. 20. Proportion of the Rock Lobster harvest by method and fishing season

The average daily harvest rate for pots (0.78 Rock Lobster) during 2012-13 represented a slight increase compared with 2010-11 but remained substantially lower than catch rates the prior to 2008-09 (Table 19). The dive harvest rate (1.83 Rock Lobster) was outside of the range determined for previous seasons (i.e. 2.1-2.6) but appears to have been influenced by the reduction in bag limit for the Eastern region. For instance, the average dive catch rate for the Eastern region was 1.6 and compared with 2.1 lobster per day for the Western region. The average daily harvest rate for Abalone (5.8 Abalone) was also within the range of that reported in previous years (4.5-6.2 Abalone).

Bag limits represent the primary management strategy to constrain recreational Rock Lobster and Abalone catches in Tasmania. Pot fishers rarely (<3% days fished) attained the bag limits applying to the two management regions. By contrast, bag limits had a more obvious impact on dive catches, with over a third of the dive effort for Rock Lobster in the Eastern region and almost 20% of the dive effort in the Western region resulting in the respective 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. Abalone catch rates were in fact highest for snorkel divers and not unexpected given that Abalone are sessile and common in shallow waters.

4.1.3 Regional patterns

The recreational Rock Lobster and Abalone fisheries are concentrated off the southeast and east coasts of Tasmania. In 2012-13, about 40% of the Rock Lobster and Abalone harvests (by numbers) were taken from Area 1, with a further 20% and 8%, respectively, derived from the remaining east coast areas (Areas 2 & 3). Rock Lobster catches from the north coast (Areas 4 & 5) were comparatively low (17%), whereas this region was more significant for Abalone (31%). The west coast (Areas 6 - 8) produced 24% of the Rock Lobster and 18% of the Abalone 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 around 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, the region representing a very significant area for both commercial Rock Lobster and Abalone fisheries (Hartmann *et al.* 2013, Tarbath & Gardner 2013).

There was considerable regional variability in the relative importance of the various Rock Lobster fishing methods. Pot catches clearly dominated the harvest off the southeast and east coasts, whereas dive collection was the dominant method off the north coast. Pots, dive collection, and rings were 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).

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. Typically Rock Lobster fishing effort has tended to peak during December/January with catches peaking between November and January (Lyle 2000, 2008, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010, 2012). In the current season, however, the expected increase in effort during December and January did not occur, almost certainly influenced by the closure of a large area of the fishery during this period. Even though there was some evidence of effort shift into areas that remained unaffected by the closure and an increase in east coast activity immediately following the lifting of the closure, it is likely that had the closure not occurred greater catches would have been taken from the Eastern region.

Catch and effort levels for Abalone have typically peaked during January in each of the seasons surveyed previously (Lyle 2000, 2008, Lyle & Morton 2004, 2006, Lyle & Tracey 2010, 2012). In 2012-13, however, peak activity occurred during December followed by a general decline in catch and effort during January. It is unclear how much this changed pattern was influenced by the Rock Lobster closure, noting that the fishery for Abalone had reopened prior to the Christmas holiday period, but it is significant that many divers also target Abalone when diving for Rock Lobster. Reduced effort for Rock Lobster during summer may have translated into reduced effort for Abalone during the peak month of January.

4.1.5 Comparison with commercial fisheries

The estimated recreational Rock Lobster harvest of 81.8 tonnes was clearly below (48%) the TARC of 170 tonnes and represented 6.4% of the notional 2012-13 TAC and therefore did not exceed management reference points. Comparisons based on state-

wide catches can, however, underestimate regional impacts and interactions between sectors. This was particularly evident for eastern Tasmania where the recreational fishery accounted for 17-26% of the total Rock Lobster catch depending on assessment region. Furthermore, recognising depth limitations on diving and 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 such that during 2012-13 just 44% 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 and, representing about 16% of the total Rock Lobster take and over a third of the total Rock Lobster catch taken from waters off the east coast of Tasmania during 2012-13.

The estimated recreational Abalone harvest of 32 tonnes in 2012-13 was equivalent to 1.5% of the total Abalone catch for the state. Regionally, as a proportion of the total harvest, the recreational catch was most significant (3.7%) in the southeast (Area 1) followed by the north-east (2.9%) (Area 3). In the latter instance this reflects the comparatively low level of commercial catch rather than 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 consider recreational catches into on-going stock assessment and future management strategies for 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.

4.2 Impacts of the east coast fishery closure

The closure of much of the east coast during the peak of the fishing season represented a very significant event during 2012-13, with about 40% of licence-holders interviewed indicating that this and the east coast bush fires impacted on their fishing activities in some way. Residents of the regions adjoining the east coast (Launceston and North East, and South East statistical areas) were clearly most affected; with between 45 - 62% suggesting that their fishing plans had been impacted in some way. Residents of the West and North West region reported being the least affected by the closure. The vast majority of affected fishers reported that they either did not fish for Rock Lobster or fished less than they would have done had the closure not occurred. A small proportion of licence-holders shifted their fishing activities to areas that were open, or fished at times of the season than they would not normally have done.

Interestingly, concerns over effort shifts by other recreational fishers was greatest amongst residents of the West and North West statistical area (who mainly fish the northwest and west coasts) whereas greatest concern over effort shift (increased effort) by commercial fishers was expressed by residents of the South East statistical area (who mainly fish the east and southeast coasts). Increased on water crowding or competition was the most commonly observed impact attributed to the closure, this was followed by lower than expected catch rates and increased congestion at boat ramps or landing points. Relatively few affected licence-holders substituted fishing for Rock Lobster by increasing effort in other fisheries during the closure.

Initial communication about the east coast toxic algal bloom event appears to have been effective, with the general coverage provided by the media being the most important point of initial information. Overall the majority of licence-holders considered that the government had done enough to communicate information about the closure, though amongst those respondents who considered more should have been done, key suggestions to improve communication included direct contact with licence-holders directly using email, SMS or by mail, more regular updates and greater media coverage.

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