TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES: 2014-15 FISHING SEASON

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Executive Summary

Rock Lobster and Abalone are highly prized by recreational fishers as well as supporting major commercial fisheries in Tasmania. This report provides an assessment of the 2014-15 recreational Rock Lobster and Abalone fisheries and forms part of a time series that commenced in the mid-1990s, monitoring trends in these fisheries.

In 2014-15 there were 19,300 persons holding at least one recreational Rock lobster licence and almost 12,100 holding a recreational Abalone licence. Although this represented a general increase in licenced numbers compared with 2013-14 it was still about 10% below the peak of the late 2000s.

A random sample of licence-holders was contacted by telephone prior to the start of the 2014-15 licensing year and invited to participate in the survey. A total of 567 licence-holders completed the survey (80% effective response rate), representing about one in 35 licence holders.

During the 2014-15 Rock Lobster season (Eastern region: 15 Nov 2014 – 31 Aug 2015; Western region: 1 Nov 2014 – 31 Aug 2015), licensed recreational fishers harvested an estimated 98,441 (95% CI: 82,006 – 119,132) lobster, based on 99,941 fisher days of effort. Potting was the dominant method, representing 80% of the effort (days fished) and 58% of the estimated harvest. Dive collection accounted for about 20% of the effort and 39% of the harvest, while ring usage contributed 2% of the effort and 3% of the harvest.

The overall average harvest rate for the season was 0.98 lobster per day fished, with daily harvest rates of 0.71 for pots, 1.93 for dive collection, and 1.73 for rings. Daily bag limits of three lobster in the Eastern region and five in the Western region were rarely attained for pots (<5% of pot days) but were achieved for about 30% of the dive effort in the Eastern region and 50% in the Western region.

The Rock Lobster fishery was concentrated off the east coast, in particular the southeast, with this area accounting for 60% 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 119 tonnes for 2014-15, with catches from the east coast accounting for 47%, the north coast 32%, and west coast 21% by weight.

The 2014-15 harvest estimate represented about 70% of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to about 10% of the notional total allowable catch (TAC) of 1221 tonnes (which includes the total allowable commercial

catch of 1051 tonnes). Any illegal harvest taken by recreational fishers, whether due to fishing whilst unlicensed or catches in breach of management regulations, is not included in the harvest estimates. Although the TARC was not exceeded, the east coast catch did exceed the notional recreational east coast catch share of 42 tonnes by 13.6 tonnes or 32%. This occurred despite a reduced daily bag limit of 3 being in place for the Eastern region and highlights the need for further management restrictions if the recreational catch share is not to be exceeded in the future.

Regionally, there was marked variability in the relative size of the recreational component of the total harvest (commercial plus recreational). Off the east coast recreational catches represented between 18 and 30% of the total depending on assessment area, whereas in the southwest the recreational catch represented just 1% of the total. By restricting comparisons to the commercial catch from shallow inshore waters, the area of greatest overlap between recreational and commercial sectors, the recreational component of the state-wide total was 21% overall, and of more or less equal magnitude to the commercial catch in the southeast.

During 2014-15 recreational fishers harvested an estimated 74,769 (95% CI: 59,898 – 95,609) Abalone, based on 15,311 fisher days of effort. Blacklip Abalone accounted for 86% and Greenlip Abalone 14% of the total numbers. Over 60% of the catch was taken from the east coast, with a further 29% from the north and 10% from the west coasts. About one in four dives 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 2014-15 recreational harvest of Abalone was estimated at 36 tonnes, equivalent to 1.9% of the combined recreational and commercial catch of 1891 tonnes. There are currently no explicit performance indicators relating to the recreational fishery for Abalone.

Catches of Rock Lobster and Abalone in 2014-15 were slightly higher than in 2012-13 but still substantially lower than levels 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 licensed fishers), lower avidity (average days fished) and, in the case of Rock Lobster, lower catch rates.

Fisher attitudes to proposed management changes were canvassed, with support for further reductions in Eastern region bag, possession and boat limits generally divided, with approximately half supporting and slightly fewer (~ 40%) not supporting each of the proposed changes. There was, however, quite strong support for a winter closure of the Eastern region. Not unexpectedly, the reduced bag limit was the measure most commonly identified as having greatest impact for recreational fishers whereas the winter closure was considered to have the least direct impact for most respondents.

Individual seasonal catch limits, although not canvassed as part of a recent management review have been raised on several occasions by stakeholders as a management measure to limit the recreational catch. There was considerable support for this measure, with almost two thirds of respondents in favour and about a quarter opposed. Expectations about the size of any seasonal limits varied widely amongst respondents, with averages of 37 lobster (fair and reasonable) and 24 (lowest acceptable) for the Eastern region, and 57 (fair and reasonable) and 36 (lowest acceptable) for the Western region.

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1 INTRODUCTION

Rock Lobster and Abalone are highly prized by recreational fishers in Tasmania. Southern Rock Lobster (*Jasus edwards*ii) 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. laevigata*), 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, 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 year[1]. 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 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. In 2014-15 there were 19,300 persons holding at least one recreational Rock Lobster licence, with about 16,200 pot, 8700 dive and 4600 ring licences issued. Abalone licence numbers have followed a similar trend, almost tripling to about 13,500 between 1995-96 and 2007-08, before stabilising in the following two seasons and then declining up until 2012-13 (Fig. 1). Licence numbers have increased slightly over the past two seasons, with almost 12,100 recreational abalone licences issued in 2014-15.

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

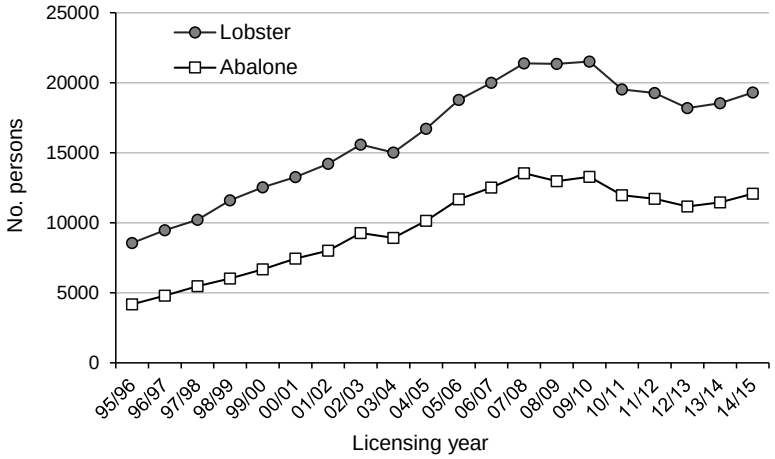

Fig. 1. Number of persons holding Tasmanian recreational Rock Lobster and Abalone licences by licensing year.

Giving consideration to where licence-holders reside, defined by the Australian Statistical Geography Standard (ASGS) (Pink 2011), lobster licence-holders are concentrated in the south east of the state; 41% of 2014-15 licence-holders resided in the Hobart statistical area with a further 15% in the surrounding South East statistical area (Fig. 2). The Launceston and North East, and West and North West statistical areas each accounted for a further 21% and 19% of licence holders, respectively. 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 (94%) of abalone licence-holders also hold at least one Rock Lobster licence.

Concurrent with 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 2013-14 and then further reduced to 1050.7 for the 2014-15 season.

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 2014-15 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).

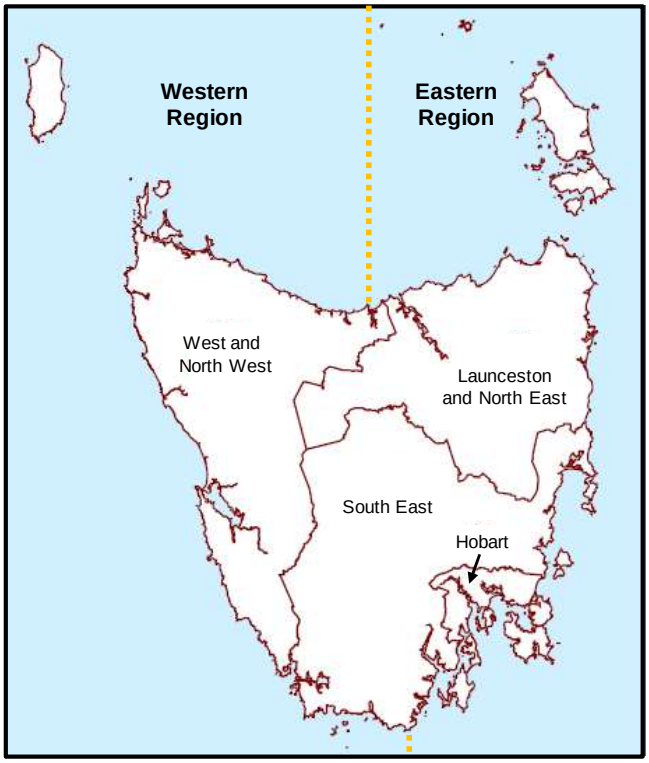

Fig. 2 Map showing Tasmanian ASGS Statistical Areas (Level 4) (adapted from Pink, 2011) and Rock Lobster Fishing Regions.

Concerns over the status of the Rock Lobster stocks, in particular stocks off the east coast of Tasmania, provided impetus for management to implement an east coast stock rebuilding strategy (DPIPWE, 2015a). 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 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. The rebuilding strategy also 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).

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 tenth in a series for Rock Lobster and the eighth for Abalone undertaken since 1996. Key objectives include characterisation of the 2014-15 recreational Rock Lobster and Abalone fisheries in terms of participation, fishing effort and catch.

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 2014-15 licensing year.

2.1.1 Survey sample

The survey sample was selected from the 2013-14 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 2012-13 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 (two thirds 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, lobster licence-holders were treated as if they were derived from three strata, namely 'Hobart', 'Elsewhere Tasmania' and 'Interstate'. By undertaking the initial regional stratification within the 'Elsewhere Tasmania' 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.

2.1.2 Screening survey

Respondents were contacted by telephone during October 2014 and asked about their fishing for Rock Lobster and Abalone during 2013-14 (numbers of days fished and estimated retained catch for either species) and their intention to renew their lobster and/or abalone licences for the 2014-15 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 2014-15 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 maximising overall data quality and completeness.

In practice, most diarists were contacted at least once a month between November 2014 and April 2015, 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.

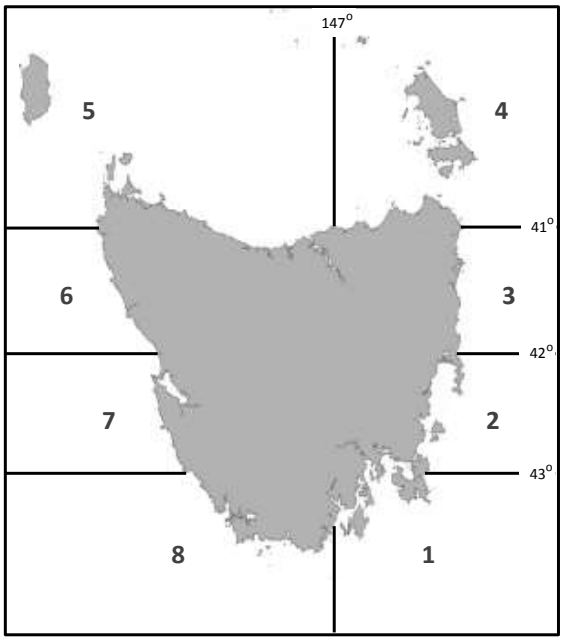

Fig. 3. Map of Tasmania showing fishery assessment areas referred to in the text.

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 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 2014-15 fishing season (1 Nov 2014 - 31 Aug 2015 for the Western region, 15 Nov 2014 – 31 Aug 2015 for the Eastern region) while the enumeration period for Abalone was the licensing year (1 Nov 2014 - 31 Oct 2015).

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 2014-15, perceptions relating to the quality of the fishery and opinions on a series of proposed management changes to Rock Lobster bag and possession limits and fishing season being canvassed by DPIPWE for implementation in the 2015-16 fishing season (DPIPWE 2015b).

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2013-14 licence database, licence details for 2014-15 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 2014-15 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 2014, these proportions increased to 85 and 83% by the end of December and 92 and 91% by the end of January 2015. Very few additional licences were issued after April 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 2013-14 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:

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

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

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 ½ degree fishing blocks and for this analysis relate to logbook catch and effort data for the 2014-15 quota year (March 2014 to February 2015, 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 corresponding to the 2014-15 recreational licensing year (i.e. November 2014 to October 2015).

3 RESULTS

3.1 Response rates

3.1.1 Screening survey

From a random sample of 1175 licence-holders selected from the 2013-14 licence database, 134 (11.4%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 1041. Contact was made with 944 licence-holders, of whom 913 fully responded, representing a screening survey response rate of 87.7%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 9.3% of the net sample and refusals or other non-response a further 3.0% (Table 1).

Amongst the respondents, 78 indicated that they were not likely to renew their licence(s) in 2014-15 and hence were not eligible for inclusion in the diary survey. The balance (835) indicated they were likely to renew their licence(s) (Table 1). Of the respondents who indicated they were likely to renew their licences in 2014-15 85.1% did so, this compared with just 23.1% 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 of 2013-14 licence-holders	% sample	Licence renewed 2014-15	Not renewed 2014-15	% renewed
Screening survey					
Gross sample	1175		924	251	78.6
Sample loss	134	11.4	102	32	76.1
Net sample	1041		822	219	79.0
Full response	913	87.7	729	184	79.8
Non-response	31	3.0	22	9	71.0
Non contact	97	9.3	71	26	73.2
Eligible for diary					
Y- Likely to renew	835		711	124	85.1
N - Not likely to renew	*78*		*18*	*60*	*23.1*
Diary Survey					
Full response	648	77.6	567	81	87.5
Partial response	47	5.6	40	7	85.1
Refuse diary	140	16.8	104	36	74.3

3.1.2 Telephone-diary survey

In total 695 respondents eligible to participate in the diary survey accepted the diary, 648 (93.2%) of whom completed the survey. This represented an effective response rate of 77.5% based on the number of eligible respondents (Table 1). 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.

Of the responding diarists, 81 (12.5%) did not take up a licence during 2014-15 despite rating themselves as 'quite likely' or 'very likely' to do so. Among the remaining 495 respondents, 483 held at least one category of lobster licence while 295 had an abalone licence. The numbers of individual lobster and abalone licences (population) and the sample of responding diarists are presented in Table 2. Overall, about one in 35 licence holders participated in the survey.

Table 2 Total number of 2014-15 lobster and abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.

Licence type	Licence holders	Diarists	% sampled
Rock Lobster pot	16,228	477	2.94
Rock Lobster dive	8,742	261	2.99
Rock Lobster ring	4,582	147	3.21
Abalone	12,083	370	3.06
Total licences	41,635	1,255	3.01
Total persons	20,052	567	2.83

Fully responding diarists reported a total of 3389 fishing events during the survey period, 3327 (98%) of which were valid events[2]. In total, 74% 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 2013-14 seasonal participation

Information provided in the screening survey indicated that 81.8% (SE 1.3%) of 2013-14 Rock Lobster licence holders fished for Rock Lobster during that season, with 68.6% (SE 1.6%) harvesting at least one lobster. That is, out of the 18,550 persons licensed in 2011-12, 15,172 fished for Rock Lobster but only 12,732 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.

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

3.2.2 2014-15 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 2014-15.

An estimated 75.4% (SE 1.8%) of licence holders fished for Rock Lobster at least once during the fishing season and just 59.7% (SE 2.1%) of all licence holders harvested at least one lobster. That is, out of 19,306 licence-holders, 14,552 fished for Rock Lobster and 11,532 reported some harvest.

Overall, total fishing effort was estimated to be 99,941 fisher days[3] for the season, yielding a harvest of 98,441 Rock Lobster[4] (Table 3). This represented an average seasonal harvest rate of 0.98 Rock Lobster per day fished. Pots were the most popular fishing method (accounting for 58% of the total harvest) followed by dive collection (39%) 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 1.5 times greater than that taken by diving. Ring harvest and effort was low by comparison with the other methods. Mean daily harvest rates for dive (1.93 lobster) and ring (1.73 lobster) methods were more than double that compared with pots (0.71 lobster).

Table 3. Rock Lobster effort, harvest and harvest rates for the 2014-15 season
Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day^{-1})
Pot	57,077 (48,673 – 65,574)	79,976 (67,889 – 92,806)	0.71
Dive	38,194 (23,517– 57,672)	19,816 (14,836 – 25,301)	1.93
Ring	3,169 (1,544 – 5,068)	1,834 (1,083– 2,729)	1.73
Total	98,441 (82,006– 119,132)	99,941 (88,211 – 113,325)	0.98

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 60% of the total estimated harvest (59,185 Rock Lobster) and attracted over three-quarters of the total effort (76,659 fisher days) during 2014-15. Area 1 alone accounted for 36% of the total harvest and 42% the total state-

[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 undoubtedly Southern Rock Lobster, diarists did report three catches of Eastern Rock Lobster, two occurred off St Helens and the third off Iron Pot in Storm Bay (southeastern Tasmania).

wide effort. The north coast (Areas 4 & 5) accounted for 20% of the harvest (19,537 Rock Lobster) and 11% of effort (11,490 fisher days) while the west coast (Areas 6 - 8) contributed 20% of the total harvest (19,718 Rock Lobster) and 12% of total effort (11,792 fisher days).

Table 4. Recreational Rock Lobster effort, harvest and harvest rates by fishing area for 2014-15
Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	35,040 (27,540 – 43,739)	41,830 (32,508 – 53,075)	0.84
2	12,079 (8,842 – 15,338)	15,293 (11,343– 19,835)	0.79
3	12,066 (7,892 – 16,985)	19,536 (13,413– 26,887)	0.62
4	7,544 (3,951– 11,634)	7,418 (4,549– 10,601)	1.02
5	11,993 (4,065 – 24,118)	4,071 (2,112– 6,787)	2.95
6	11,876 (5,786 – 18,825)	5,939 (3,381– 8,835)	2.00
7	4,383 (2,347 – 6,902)	2,064 (1,242– 2,962)	2.12
8	3,459 (1,465 – 6,306)	3,790 (1,786– 6,321)	0.91

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 for Areas 1 - 3 (61-91%) and Area 4 (56%), whereas dive collection was the primary capture method in Area 5 (95%). Dive methods dominated the catch (60%) in Area 6, whereas in Area 7 pot and ring methods dominated. In Area 8, pots accounted for the vast majority of the catch.

Mean daily harvest rates were highly variable around the state, ranging from almost three Rock Lobster per day in Area 5 to 0.6 in Area 3 (Table 4). Stock abundance and total fishing pressure (including commercial activity), along differing regional bag limits and the relative mix of fishing methods used (Fig. 4), noting significantly higher harvest rates for dive collection and rings compared with pots (Table 3), represent key factors contributing to this regional variability.

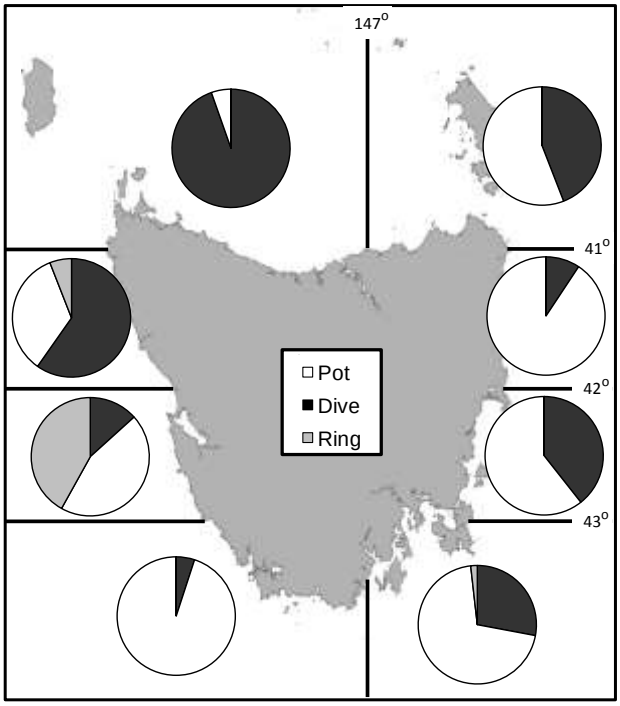

Fig. 4. Proportion of regional harvest by fishing method (pie charts).

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 Channel[5] 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 western Storm Bay whereas dive catches were more or less comparable to those taken by pots in the D'Entrecasteaux Channel (Fig. 5). Dive collection was the dominant capture method in Norfolk- Frederick Henry Bay and the Derwent Estuary. Rings accounted for a very minor proportion of the catch.

[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.

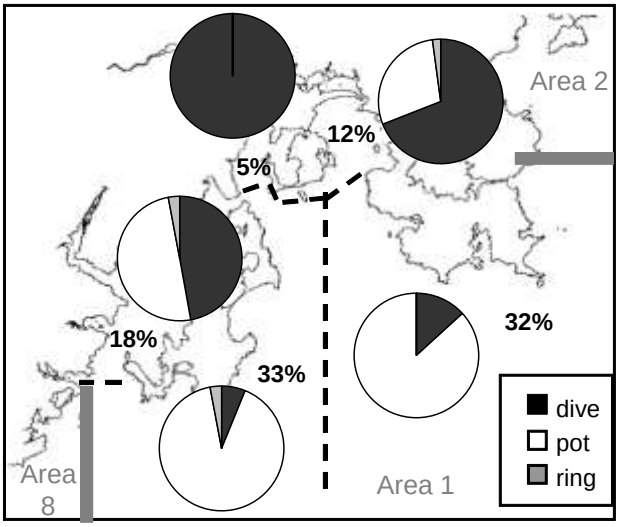

Fig. 5. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

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 December (Fig. 6). Fishing activity slowed dramatically after January and stabilised between February and April. There was relatively limited fishing during the final four 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 78% of the pot catch taken between November and January and 19% between February and April (Fig. 6). Although pot effort was highest during December, catches peaked during November, reflecting a steady decline in pot catch rates as the season progressed (from 0.97 to 0.4 lobsters per pot day between November and April). 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 62% of the catch taken in the first three months and a further 36% in the following three months. Unlike pot catch rates, dive catch rates did not display a clear trend over the first six months of the season.

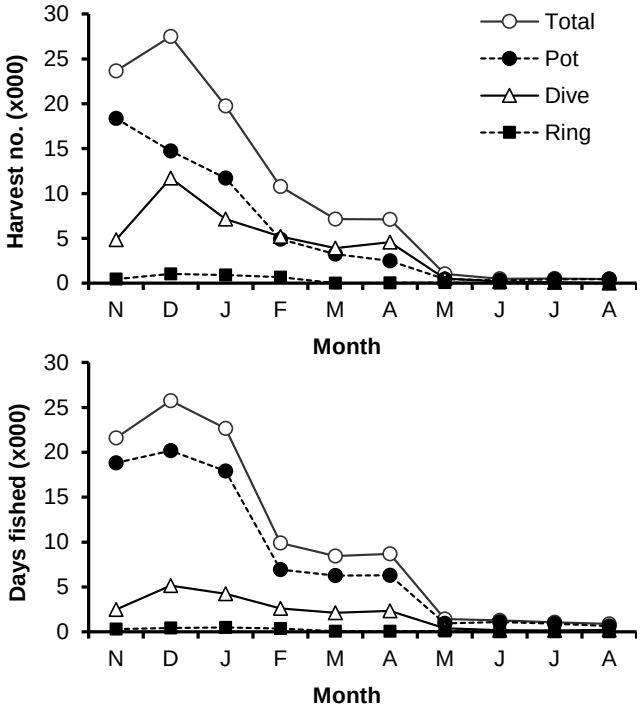

Fig. 6. Recreational Rock Lobster harvest (numbers) and effort (days fished) by month and method for the 2014-15 fishing season.

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method and between management regions (Fig. 7). Overall about 57% of Eastern region (Areas 1-4) pot-days yielded no retained catch, with the daily bag limit of three Rock Lobster achieved in about 5% of pot sets (Fig. 7). This compared with the Western region (Areas 5-8) where 41% of pot effort resulted in no retained catch but over 13% of the effort resulted in catches of at least three Rock Lobster (2% resulting in the bag limit of five lobster being taken). Divers had higher success rates, with almost 30% of dives in the Eastern region taking the bag limit of three lobster compared to over two-thirds of dive effort in the Western region (almost half of the dive effort in the Western region resulted in daily catches of five lobsters). Although nil catches were reported for around 40% of the ring effort in both regions, rings proved relatively effective, with catches of three or more lobster per day achieved for 11% and 40% 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 (1.6 and 4.0 Rock Lobster for Eastern and Western regions, respectively), followed by scuba (1.5 and 3.1 Rock Lobster) and snorkel (0.9 and 1.8 Rock Lobster). Overall, hookah was the most popular dive method, accounting for 37% of the total dive effort and 54% of the dive harvest. Scuba was next in importance, representing 32% of the effort and 27% of the harvest, while snorkel divers contributed 30% of the effort and 18% of the dive harvest.

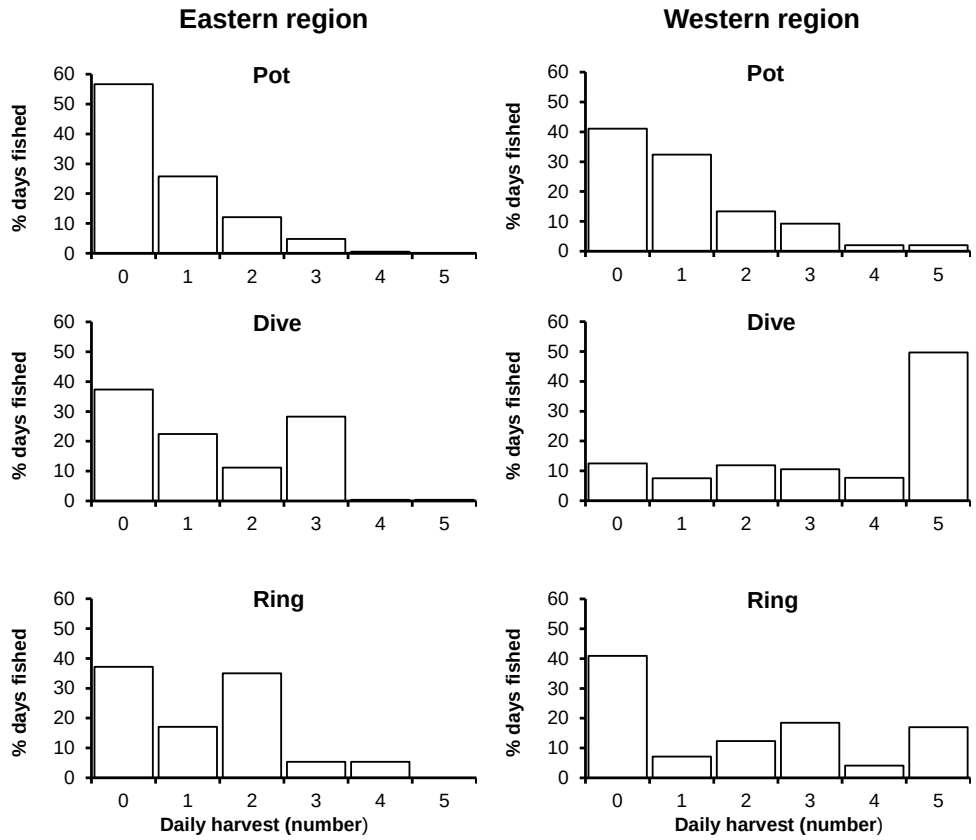

Fig. 7. Distribution of daily Rock Lobster harvest by fishing method and management region.

3.2.7 Individual season harvest estimates

Individual season limits for recreational fishers have been flagged as a potential management option to restrict the overall recreational harvest and share catches between fishers more equitably. It was, therefore, worthwhile to report on the numbers of Rock Lobster retained by individual fishers during the 2014-15 fishing season (Fig. 8). Overall almost one in five active fishers harvested no lobsters while a further 38% harvested between one and five 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 (37% compared with 42%). About 6% of active fishers reported catches of more than 20 lobsters, accounting for 41% of the total catch, and around 3% of fishers took more than 30 lobsters, accounting for 21% of the total catch. This pattern was generally consistent for fishing off the east coast (Areas 1-3), with fishers taking more than 20 lobsters accounting for 27% of the east coast catch and those taking more than 30 accounting for 11% of the total. This analysis clearly demonstrates the impact that a relatively small number of active fishers has on the recreational catch of Rock Lobster in Tasmania.

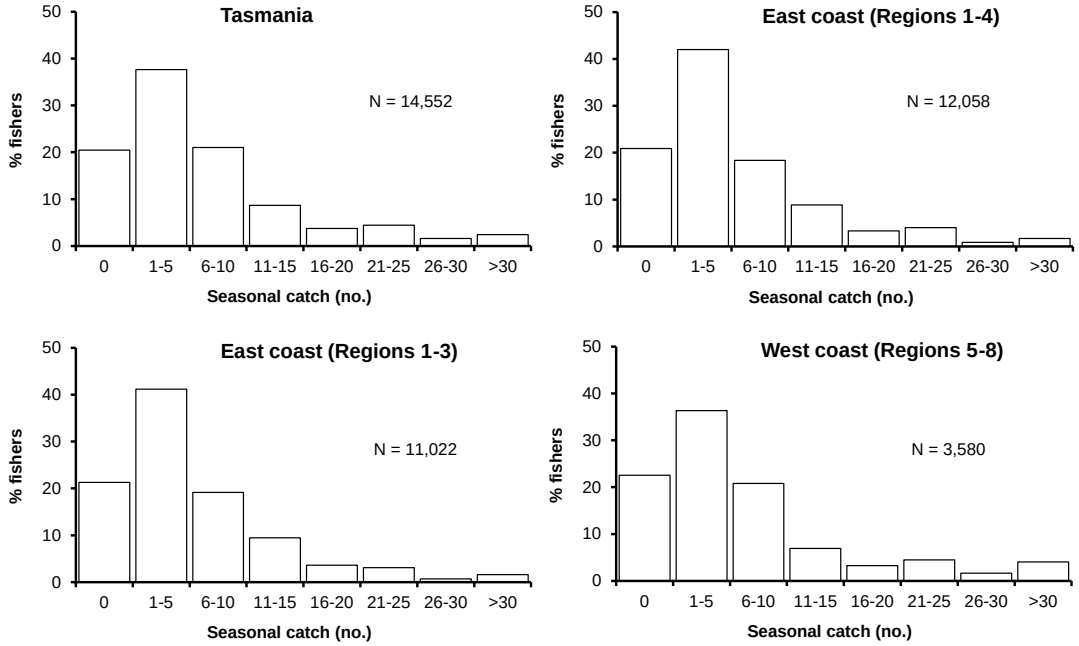

Fig. 8. Seasonal harvest of Rock Lobster for fishers who were active within specific fishing regions and for the whole fishery. N is estimated number of active licence-holders.

3.2.8 Released catch

A total of 66,734 Rock Lobster (95%CL 53,994 – 82,190) were estimated to have been released or discarded from pot catches, equivalent to 1.17 for every retained Rock Lobster. About 93.7% of pot releases were due the capture of undersized Rock Lobster, 2.2% were berried females, 2.1% of releases were due to over bag limit catches and 1.8% 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 892 pot caught, 435 dive caught and 61 ring caught Rock Lobster from around Tasmania. Overall, retained pot caught Rock Lobster ranged between 105-220 mm carapace length (CL), with an average estimated weight of 953 g. Dive caught Rock Lobster had a similar size range,105–260 mm CL, but were larger on average, with an estimated average weight of 1566 g. Ring caught Rock Lobster also ranged between 105–165 mm CL, with an average weight of 972 g. However, as relatively few ring caught Rock Lobster were measured[6], data for pots and rings have been combined in subsequent analyses. Male to female sex ratios for pot (1.0:1.0) and dive (1:0.0.89) did not differ significantly from 1:1, whereas ring (1:0.42) catches were comprised of significantly more males than females.

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

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 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.

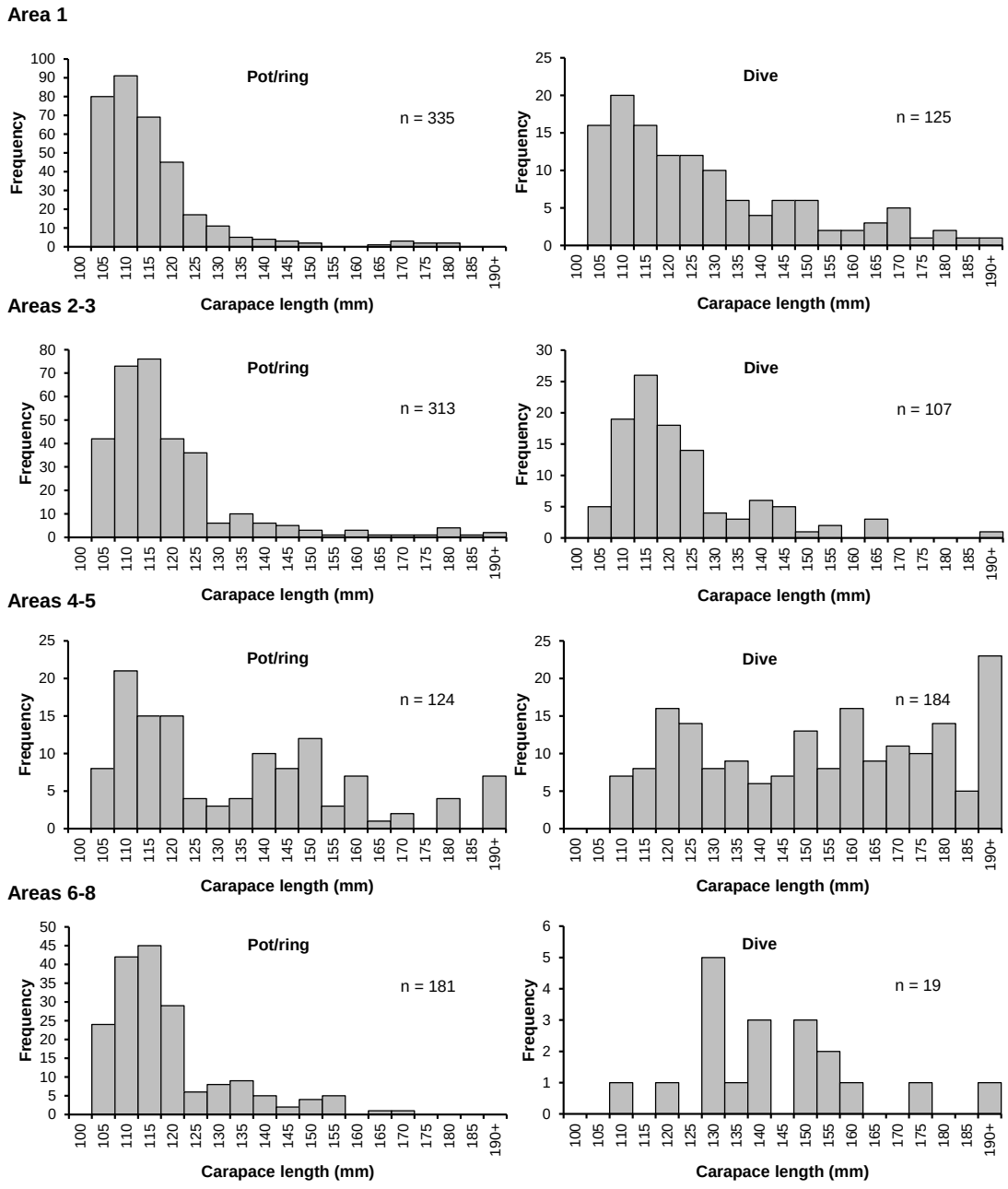

Fig. 9. Length frequency distributions by 5 mm size class for recreationally caught Rock Lobster taken by dive, pot and ring fishing methods by assessment area(s). n is sample size.

3.2.10 Estimated harvest weight

The weight of the 2014-15 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 119 tonnes[7], equivalent to 70% of the TARC. Regional harvest estimates ranged between 32.6 tonnes (Area 1) and 3.4 tonnes (Area 8) (Table 5). As a proportion of the recreational harvest, the east coast (Areas 1-3) accounted for 47%, north coast (Areas 4&5) 32%, 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 (20% of the retained numbers, refer Table 5).

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

	Av. weight (g)			%
Area	Pot/Ring	Dive	Harvest (kg)	total
1	833	1183	32,620	27.4
2	929	1025	11,680	9.8
3	929	1025	11,320	9.5
4	1409	2111	12,962	10.9
5	1409	2111	24,857	20.9
6	902	1870	17,581	14.8
7	902	1870	4,519	3.8
8	902	1870	3,456	2.9
Total			118,996	

3.2.11 Comparison with commercial catches

The recreational harvest represented 9.7% of the notional 2014-15 TAC and 10.4% of the actual combined recreational and commercial catch[8]. Regionally, there was marked variability in the recreational share of the total harvest, ranging from 18-30% 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 20.7% of the combined shallow water catch of 574 tonnes[9] (Fig. 10B). The recreational harvest represented almost half of the total catch

[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 2014 and February 2015 was 1026 tonnes.
[9] The commercial catch reported from ≤ 20 m was 456 tonnes, equivalent to 44% of the total commercial catch for the period March 2014 – February 2015.

from inshore waters in Area 1 and almost 40% of the catch in Areas 3 and Areas 6, the latter influenced by the relatively low commercial catch from that area. Recreational catches also represented relatively a significant component (> 19%) of the inshore harvest from the central east (Area 2) and north coast (Areas 4 & 5) but were a relatively minor component in the central and south west coastal fishing areas (Areas 6 & 7).

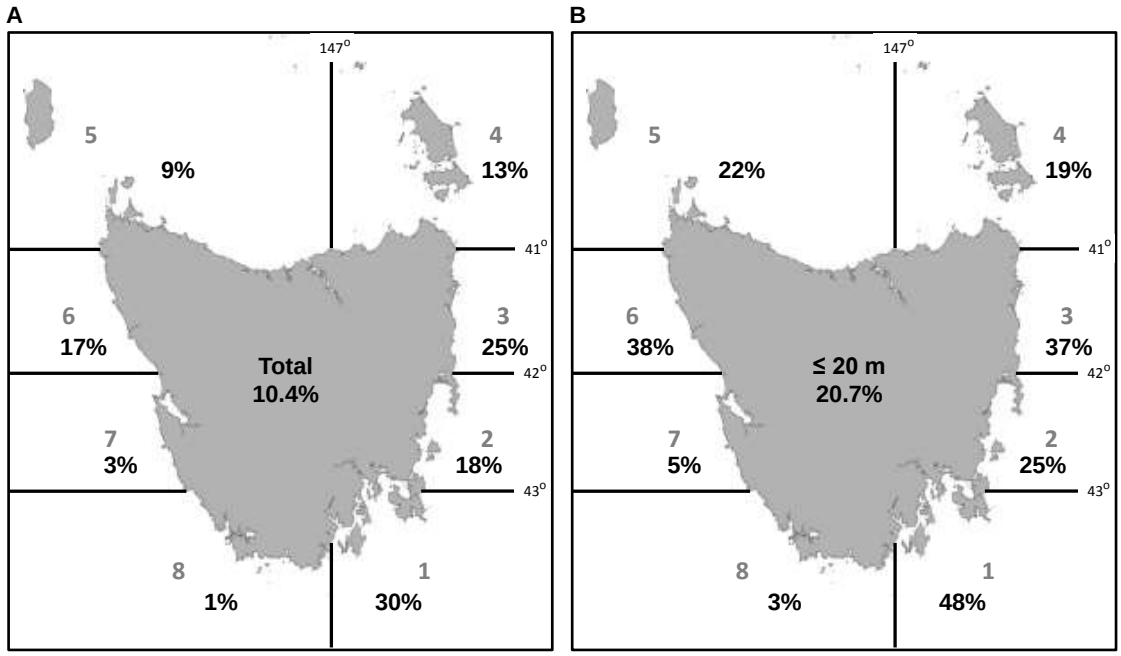

Fig. 10. 2014-15 recreational Rock Lobster harvest (weight) expressed as a percentage of the total Rock Lobster catch (commercial plus recreational) by area: (A) based on total catch (all depths); and (B) shallow water (≤ 20m) catches (refer text).

3.3 Abalone

3.3.1 2013-14 participation

Information provided in the screening survey suggested that 66.0% (SE 2.0%) of 2013-14 licence holders fished for Abalone during that season and that 62.0% (SE 2.1%) kept at least one Abalone. That is, out of 11,460 persons licensed in 2013-14, an estimated 7563 fished for Abalone with 7104 harvesting at least one Abalone. However, as this information was collected retrospectively at the end of the 2013-14 season it is subject to recall bias and as such is considered indicative only.

3.3.2 2014-15 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 2014-15 recreational abalone licence holders.

During 2014-15 an estimated 42.4% (SE 2.6%) of Abalone licence holders (i.e. 5126 out of the 12,084 licence-holders) fished for Abalone with 37.7% (SE 2.6%) (4557 persons) harvesting at least one Abalone.

The total estimated harvest for 2014-15 was estimated to be 74,769 Abalone (95% CI: 59,898 – 95,609), the result of 15,311 fisher days[10] of effort. This represented an average harvest rate of 4.9 Abalone for each day fished. Blacklip Abalone dominated the catch, accounting for 86% of the total catch numbers (64,092) while Greenlip Abalone represented 14% of the state-wide total (10,676) (Table 6).

Table 6. Recreational Abalone harvest, effort and harvest rates by fishing area for 2014-15
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.

	Harvest (no.)					
Area	Blacklip Abalone	Greenlip Abalone	Effort (fisher days)	Harvest rate (no. per fisher day)	Av. weight (g)*	Harvest (kg)
1	24,291 (15,819 – 33,235)	-	5,178 (3,623– 6,502)	4.73	522	12,680
2	12,965 (8,252 – 20,237)	-	3,016 (1,964 – 4,422)	4.51	517	6,703
3	8,358 (4,148– 14,605)	-	1,501 (756 – 2,726)	5.57	528	4,413
4	6,940 (3,341 – 14,175)	5,129 (1,514 – 8,613)	2,201 (1,294 – 3,769)	5.48	384**	4,629
5	4,645 (1,290 – 9,255)	5,547 (1,955 – 9,830)	2,245 (1,139 – 3,362)	4.54	404**	4,114
6	4,786 (2,219 – 8,258)	-	854 (479 – 1,407)	5.60	501	2,398
7	264	-	52	5.09	501	132
8	1,842 (422– 3,494)	-	264 (66 - 475)	6.98	531	978
Total	64,092 (51,194 – 83,244)	10,676 (4,920 – 16,524)	15,311 (12,401 – 18,787)			36,047

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) (> 60% of the catch and effort), with Area 1 alone accounting for a third of the state-wide totals. The north coast (Areas 4 & 5) accounted for a further 29% and the west coast (Areas 6 - 8) under 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 4.4 and 7.0 Abalone per day and exceeded five per day off the north east (Areas 3 & 4) and the west coasts (Areas 6 – 8).

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

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 south east (Fig. 11). The D'Entrecasteaux Channel and Norfolk-Frederick Henry Bay were the most important sub-areas, collectively accounting for two-thirds of the total harvest. The Tasman Peninsula and outside of Bruny Island were next in importance, catches from the Derwent Estuary were relatively insignificant.

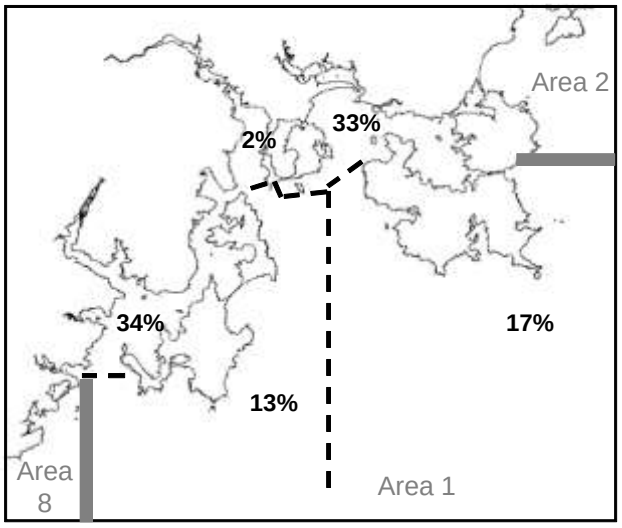

Fig. 11. Regional distribution of Area 1 Abalone harvest.

3.3.5 Seasonal catch and effort

The fishery for Abalone exhibited a strong seasonal pattern, with a marked increase in effort between November and January, and peak catches in January (Fig. 12). The first three months of the licensing year accounted for just over half of the annual harvest and effort. There was secondary increase in the level of fishing activity during April, mainly associated with Easter fishing. The February to April period contributed around 36% of the annual harvest and effort. There was limited fishing for Abalone during the final six months of the licensing year during which less10% of the total catch was taken.

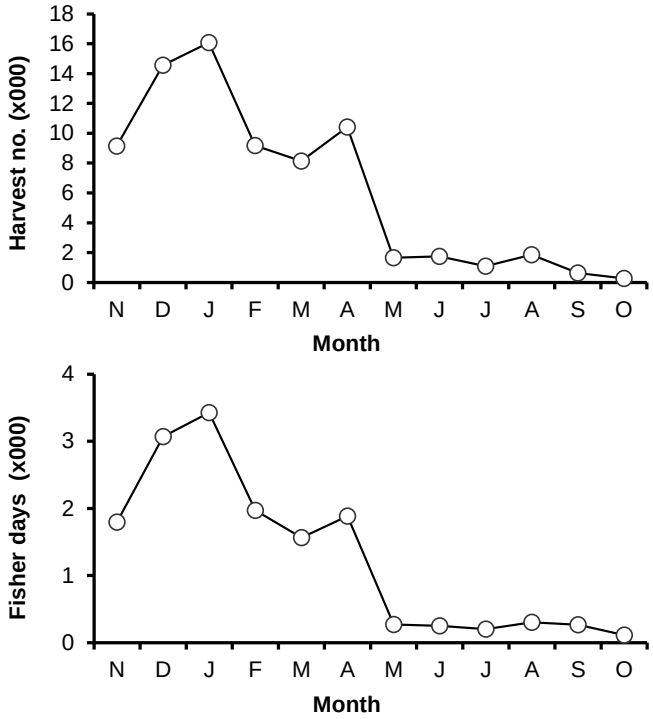

Fig. 12. Recreational Abalone harvest (numbers) and effort (days fished) by month for the 2014-15 fishing season.

3.3.6 Daily harvest

One quarter of all dives targeting Abalone resulted in the daily bag limit of ten Abalone being achieved, whereas just over one in five dives resulted in no harvest (Fig. 13). Hookah divers reported the highest catch rates (5.9 Abalone per day), with 41% of diver-days of effort achieving the bag limit. Average daily catch rates for snorkel (4.9) and scuba (4.3) were considerably lower, as was the proportion of effort that resulted in ten Abalone being taken (22% for snorkel and 14% for scuba). However, of the three dive methods snorkel dominated, accounting for 53% of the harvest and 54% of effort (diver days). Hookah dive effort was next in importance, representing 26% of the harvest and 22% of the effort, while scuba divers contributed 21% of retained catch and 24% of the effort.

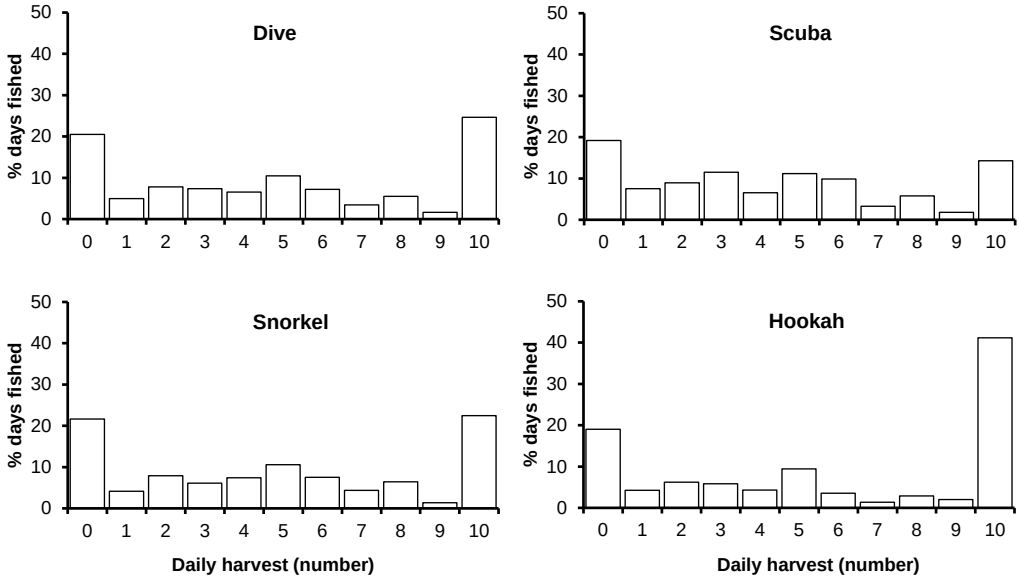

Fig. 13. Distribution of daily Abalone harvest by dive methods for 2014-15 licence holders

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 384 g off the northeast coast (Area 4) (Table 6). Using these values, the recreational harvest during 2014-15 was estimated to be about 36.0 tonnes. Regionally, harvest estimates ranged from 12.7 tonnes in Area 1 to just less than one tonne in Areas 7 and 8 (Table 6). The catch for the combined east coast (Areas 1-3) was 23.8 tonnes, the north coast (Areas 4&5) 8.7 tonnes, and the west coast (Areas 6-8) 3.5 tonnes.

3.3.8 Comparison with commercial catches

The commercial Abalone catch for the period November 2014 to October 2015 was 1855 tonnes[11], suggesting that the recreational harvest accounted for 1.9% of the combined state-wide catch. Regionally, the recreational component of the fishery accounted for about 9% of the combined commercial and recreational harvest in Areas 2 and 3, and over 2.5% in Areas 1 and 4. In all other regions the recreational contribution was relatively low (<1.5%) (Fig. 14).

[11] Blacklip Abalone accounted for 1711 tonnes and Greenlip 144 tonnes.

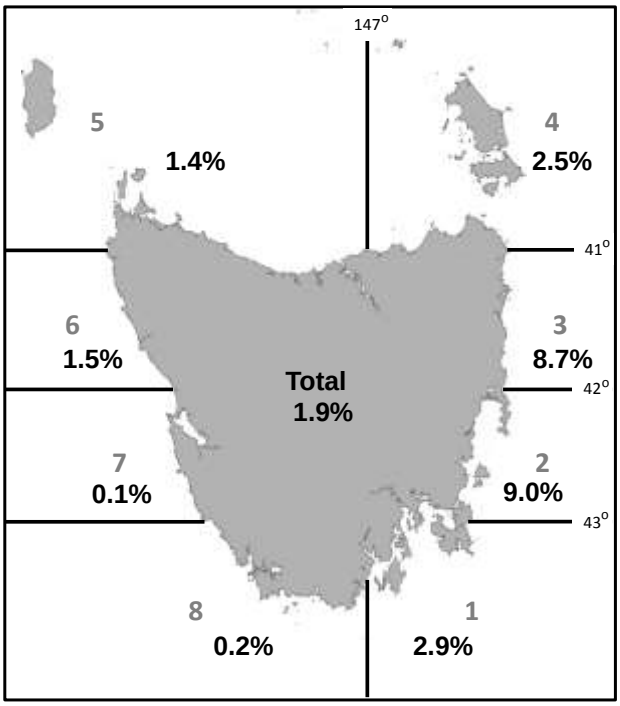

Fig. 14. 2014-15 recreational harvest (weight) of Abalone expressed as a percentage of the total catch (commercial plus recreational) by area.

3.4 Wash-up survey

3.4.1 General

The overall response rate to the wash-up survey was 92.5% (557 out of a net eligible sample of 622)[12]; non-contacts accounted for 6.1% and refusals 1.3% of the combined diary survey sample.

3.4.2 Constraints to fishing

Diarists who did not fish for Rock Lobster during 2014-15 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 health and weather as the next most important reasons for not fishing (Table 7). Lack of time followed by health and weather were also the main reasons diarists did not take out a lobster licence during 2014-15 (Table 7). Lack of time due to other commitments has been identified as the major constraint to fishing in previous surveys.

[12] Eligible respondents were those who completed the diary survey and were over 18 years of age.

Table 7. Main reasons for not fishing for Rock Lobster during 2014-15

Reasons	Not licensed	%	Licensed	%	Combined	%
Lack of time/work and family commitments	24	60.0	59	52.2	83	54.2
Health	5	12.5	14	12.4	19	12.4
Weather	5	12.5	14	12.4	19	12.4
Lack of boat or equipment	1	2.5	8	7.1	9	5.9
Lack of opportunity	2	5.0	5	4.4	7	4.6
Lack of interest/ alternative interests	2	5.0	5	4.4	7	4.6
Poor catch rates	1	2.5	2	1.8	3	2.0
Catches provided by others			3	2.7	3	2.0
No longer resident in Tasmania			2	1.8	2	1.3
Other			1	0.9	1	0.7
Total	40		113		153	

3.4.3 Fishery quality

Amongst those respondents who had fished for Rock Lobster during the diary period, slightly more respondents suggested that the quality was worse (23%) rather than better (18%) in 2014-15 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.

Table 8. Response to the question relating to the perceived quality of the 2014-15 Rock Lobster season relative to 2013-14

Total respondents = 307

Response	No.	%
Better	54	17.6
Worse	70	22.8
(About the) Same	164	53.4
Unsure	19	6.2

3.4.4 Policing

Out of 303 active fishers who responded to questions about policing, 102 (33.7%) indicated that they were checked by Marine Police whilst fishing for lobster during 2014-15. Based on the region these diarists had fished (diary survey data), those who fished in the eastern region were significantly more likely to have been inspected (38%) compared with those who fished the western region (20%) ($\chi 2$ 8.71, df 3 P=0.03). Inspections occurred mostly on water (75 responses or 73%) and to a lesser extent off water (41 responses or 40%), noting that some respondents reported being checked both on and off water. Of those individuals checked whilst in possession of Rock Lobster, almost 90% indicated that their catch was inspected by the marine police.

3.4.5 Impacts of current Eastern Region management

Respondents were reminded of management changes that were introduced in November 2012, specifically the reduction in the daily bag limit from 5 to 3 and the introduction of a maximum boat limit of 15 Rock Lobster for the Eastern region. Respondents were then asked whether any of these revised limits had had a direct impact on their fishing for Rock Lobster during 2014-15. Of those respondents who fished the Eastern region, just 18% (43 fishers) indicated that they had exceeded one or both of these limits at least once during the season, resulting in the release of legal sized lobsters or cessation of fishing. The bag limit was the more commonly achieved limit by east coast fishers (15%), relatively few fishers reached the new boat limit (4%).

3.4.6 Proposed management changes

At the time of the survey DPIPWE were canvassing stakeholder views on a number of proposed management measures primarily intended to limit recreational catches in the Eastern region because of on-going concerns over the status of the east coast Rock Lobster stocks (DPIPWE, 2015a). Respondents were asked whether or not they supported each of the key management measures; this information was provided to DPIPWE and the Recreational Fishery Management Advisory Committee to assist in their deliberations.

Respondents were generally divided in their support for the bag, possession and boat limit reductions for the Eastern region, with approximately half of the respondents supporting and about 40% not supporting each of the changes (Table 9). There was, however, strong support (>70% respondents) for the winter closure (1st May to 31th October) of the Eastern Region and the reduction in the Western region boat limit from 50 to 25 lobsters[13].

Table 9 Support for proposed management changes to the recreational Rock Lobster fishery.

Management measure		Support	Do not support	Neutral/ don't care	Unsure	Total
Reduce eastern region bag limit from 3 to 2	No.	285	218	38	15	556
	%	51.3	39.2	6.8	2.7	
Reduce eastern region on water possession limit from 6 to 4	No.	279	227	36	14	556
	%	50.2	40.8	6.5	2.5	
Reduce eastern region maximum boat limit from 15 to 8.	No.	270	239	36	11	556
	%	48.6	43.0	6.5	2.0	
Winter closure of the eastern region	No.	396	98	47	14	555
	%	71.4	17.7	8.5	2.5	
Reduce western region maximum boat limit from 50 to 25.	No.	396	57	71	26	550
	%	72.0	10.4	12.9	4.7	

[13] With the exception of the Eastern region boat limit, each of the proposed management changes were adopted and implemented for the 2015-16 fishing season. The Eastern region boat limit was reduced from 15 to 10 (not 8) Rock Lobster.

Respondents were then asked to consider the following: which of the proposed Eastern region management changes would most effect (impact) their fishing for Rock Lobster in the future; which would have least effect on their fishing activities and which change would be most effective in restricting the overall recreational catch, regardless of whether or not they supported the measure. The bag limit was identified by almost half of the respondents to be the change that would have greatest impact on their fishing activities and was also considered to be the most effective measure in restricting the overall catch by 40% of respondents (Table 10). Of the other measures, the winter closure was considered to be the next most effective measure overall, this was despite almost half of the respondents identifying that the closure would least impact their own fishing activities. The reduced possession limit, followed by the boat limit, were considered to be the least effective measures in restricting catches.

Table 10 Response to questions regarding the perceived impacts and effectiveness of proposed Eastern Region management changes

	Most impact on own fishing activity		Least impact on own fishing activity		Most effective in restricting overall catch	
Proposed management change	No.	%	No.	%	No.	%
Reduced bag limit	230	48.8	50	10.3	200	40.2
Reduced possession limit	17	3.6	12	2.5	20	4.0
Reduced boat limit	61	13.0	101	20.9	66	13.3
Winter closure	85	18.0	235	48.6	139	28.0
Unsure	78	16.6	86	17.8	72	14.5
Total	471		484		497	

Respondents were offered a number of statements suggesting how they might respond to the proposed reduced Eastern region catch limits. It was evident that the majority (>83%) of respondents considered the changes would have some impact on their fishing, but only a minority agreed with the statement that they would fish more to make up for the lower bag limits (19%) or fish less for lobster and switch to other types of fishing (26%) (Table 11). There was greater agreement (64%) with the statement that fishers would try to limit the number of persons on a trip (maximum of four) so as to allow everyone the opportunity to take their bag limit (i.e. not exceed the boat limit). A third of respondents indicated that they may stop fishing for Rock Lobster because they considered it would be no longer worthwhile with the lower catch limits.

Table 11 Agreement with statements relating to the proposed Eastern Region management changes.

Statement		Agree	Disagree	Neutral	Unsure	Total
The changes won't affect you directly as you don't fish the east coast.	No.	61	413	19	2	495
	%	12.3	83.4	3.8	0.4	
You are likely to fish more to make up for the lower daily catch limits.	No.	96	378	20	5	499
	%	19.2	75.8	4.0	1.0	
You are likely to fish less for lobster and switch to other types of fishing.	No.	132	344	15	6	497
	%	26.6	69.2	3.0	1.2	
You will try and ensure that no more than four persons go on a trip so everyone can take their daily bag limit.	No.	319	107	65	7	498
	%	64.1	21.5	13.1	1.4	
You may do more fishing in the western region where catch limits are higher.	No.	92	388	16	2	498
	%	18.5	77.9	3.2	0.4	
You may stop fishing for lobsters because the allowable catches are so low that it's no longer worthwhile.	No.	168	304	20	6	498
	%	33.7	61.0	4.0	1.2	

3.4.7 Seasonal catch limits and catch tags

The option of seasonal catch limits to share the catch more equally between recreational fishers and limit the overall catch was not canvassed as part of the recent management review but has been raised by stakeholders on a number of occasions. Respondents were advised that the objective of any such seasonal limit would be to restrict the total number of Rock Lobster an individual could take during the fishing season. They were also informed that catch tags have been suggested as an option that could be used to monitor and enforce seasonal limits. As demonstrated in section 3.3.5, seasonal catch limits would have greatest impact on the more avid fishers who account for a disproportionately large share of the recreational catch.

In order to gauge the level of support for seasonal catch limits, respondents were asked whether they were supportive of such a measure rather than further reductions in daily bag limits. Almost two thirds of respondents indicated that they were supportive, with about one quarter of respondents not supportive (Table 12).

Table 12 Level of support for a seasonal catch limit for Rock Lobster as a measure to share the catch more equally and restrict the overall recreational catch.

Total respondents = 552

Response	No.	%
Support	348	63.0
Do not support	145	26.3
Unsure	59	10.7

Respondents were then asked what they considered would be a fair and reasonable number of lobsters and what would be the lowest acceptable number of lobsters if seasonal catch limits were introduced. These questions were asked in the context of

limits that would apply to the Eastern and Western regions separately. The distribution of suggested limits are provided in Fig. 15 and indicate a wide range of responses, ranging from limits of less than 10 to over 100 lobster per season. Average seasonal limits were 37 (fair and reasonable) and 24 (lowest acceptable) for the Eastern region, with over half of respondents suggesting that 30 or fewer was reasonable and 20 or fewer lobster was the lowest acceptable limit. Suggested season limits tended to be higher for the Western region, averaging 57 (fair and reasonable) and 36 (lowest acceptable), with over half of respondents suggesting limits of 50 or fewer as fair and reasonable and 30 as the lowest acceptable.

It was proposed that there would be additional management costs associated with the implementation and administration of a system of catch tags. Respondents were then asked to consider the maximum they would be willing to pay for each batch of five catch tags. Responses ranged between 0 and $100 per five tags, with 41% of the 503 respondents indicating they would not be willing to pay anything extra over and above the current licence costs. For those respondents indicating willingness to pay at least a minimum of $1 (289 respondents), the overall average was $14.90 although it should be noted that two thirds of this group nominated values of $10 or less.

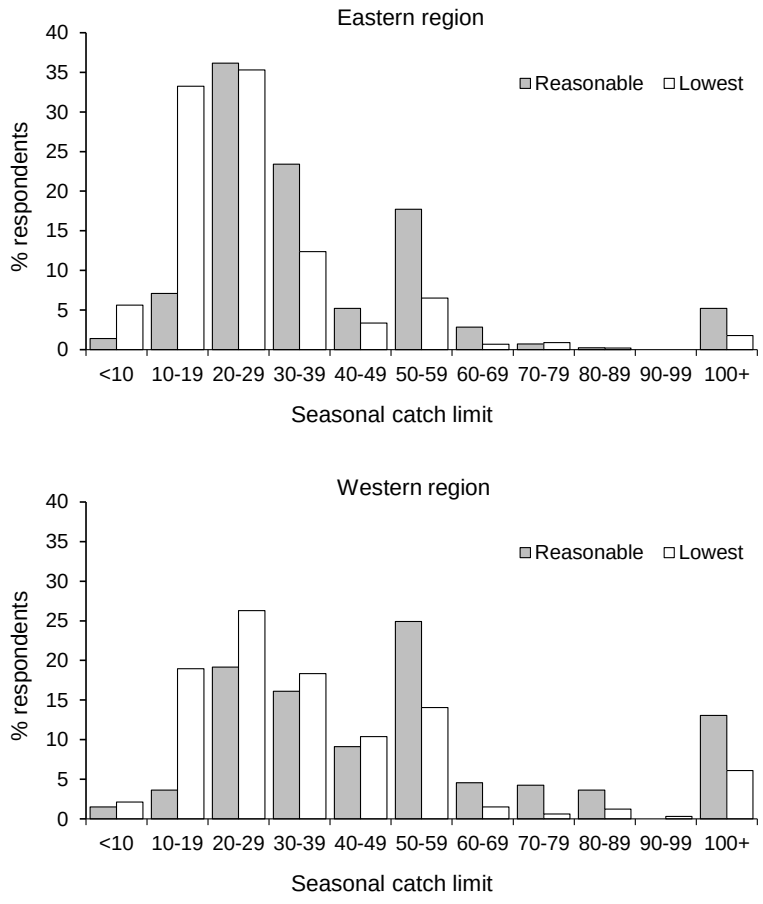

Fig. 15. Relative distribution of seasonal catch limits proposed by survey respondents and considered to be fair and reasonable (Reasonable) and the lowest acceptable (Lowest) by management region. (Sample sizes: Eastern Region - Reasonable = 443, Lowest = 445; Western Region – Reasonable = 329, Lowest = 327)

3.4.8 Likelihood to renew licences

Respondents were asked about their likelihood to take out a Rock Lobster licence for the 2015-16 season. Overall the vast majority of respondents (>90%) indicated that they were likely to re-licence (Table 13). Not unexpectedly, proportionally fewer (79%) of those respondents who did not renew their licence in 2014-15 considered they would take a licence in 2015-16. The main reasons given for being unlikely to take out a licence included the (proposed) restrictive catch limits, lack of access (boat), health, lack of time, and not expecting to be resident or visit Tasmania.

Table 13 Likelihood to renew Rock Lobster licences in 2015-16 based on licence status in 2014-15.

	All respondents		Licensed 2014/15		Not licensed 2014/15	
	No.	%	No.	%	No.	%
Likely	502	91.3	464	92.4	38	79.2
Not likely	34	6.2	25	5.0	9	18.8
Unsure	14	2.5	13	2.6	1	2.1
Total	550		502		48	

4 DISCUSSION

4.1 Catch and effort

4.1.1 General trends

To date, ten 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 2014-15 was 17% higher by number and 45% by weight than that for 2012-13, reflecting an 18% increase in effort (Table 14) but also a general increase in the average size of Rock Lobster. The relative increase in the proportion of the catch taken by divers coupled with higher catches from the north coast (Areas 4 & 5) (Fig. 17) represent key contributing factors to the average size increase.

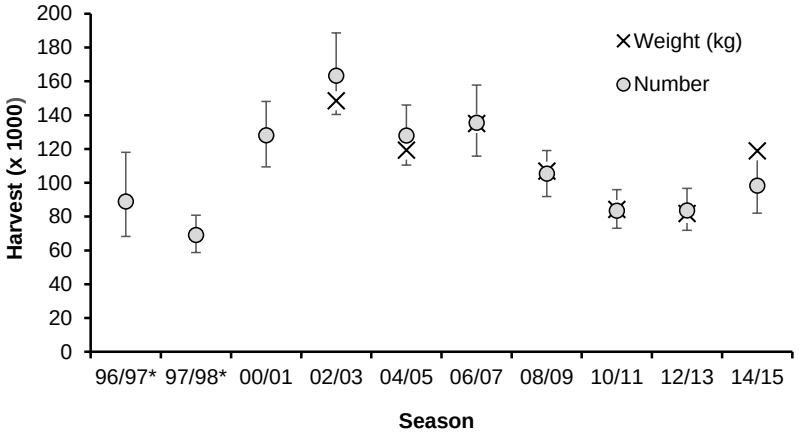

Fig. 16. Estimated Rock Lobster harvest (number and weight) plotted against fishing season. Error bars represent 95% confidence limits for numbers. * indicates partial season surveys.

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). Although catches were higher in most areas in 2014-15 compared with 2012-13, the only region that appears to have experienced a general trend of catches returning to early 2000 levels has been in the northwest of the state (Areas 5 & 6).

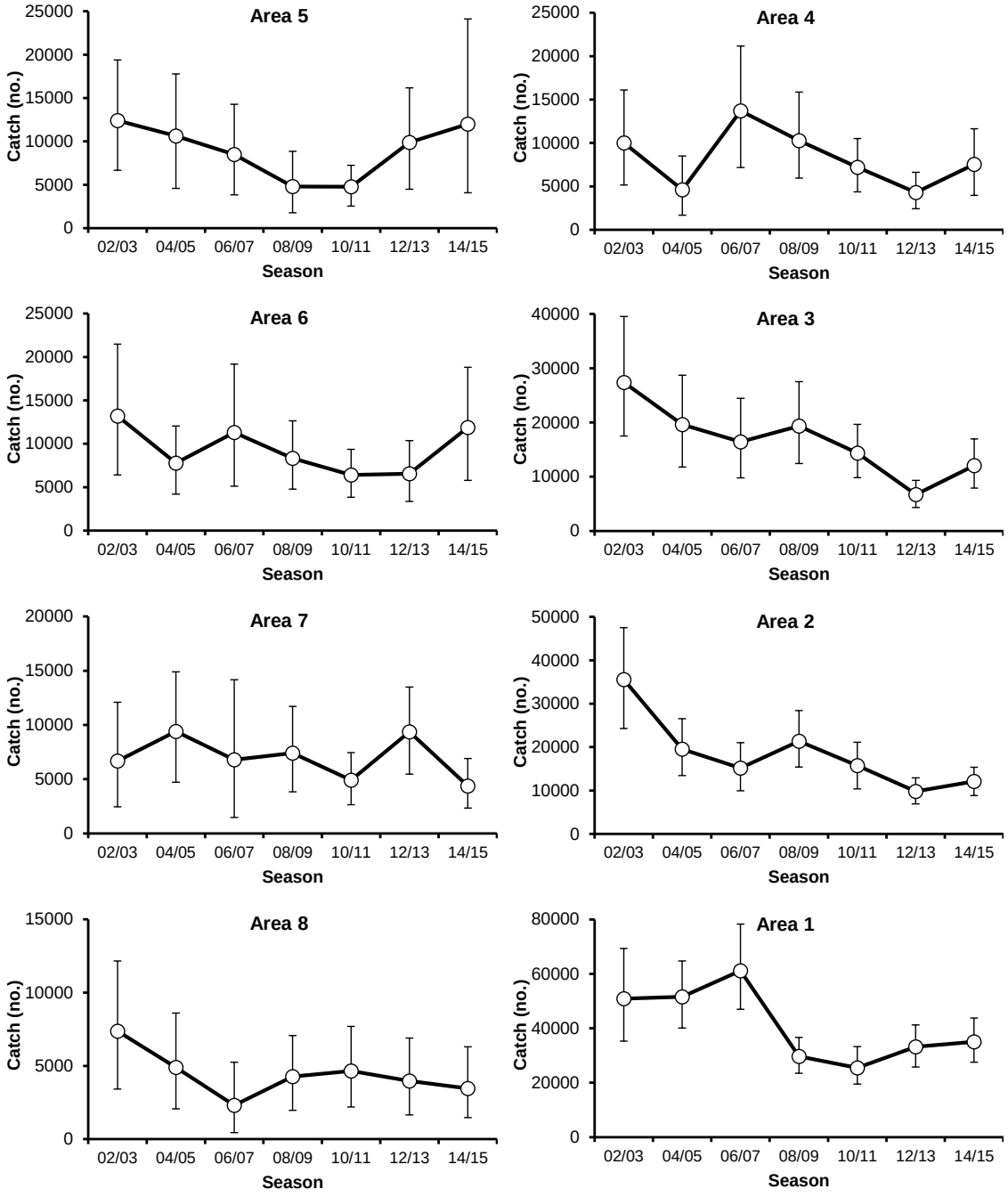

Fig. 17. Regional Rock Lobster harvest estimates (numbers) by recreational fishing season. Error bars represent 95% confidence limits.

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 12% higher (by weight and numbers) than that for 2012-13, reflecting a 32% increase in effort (Table 14).

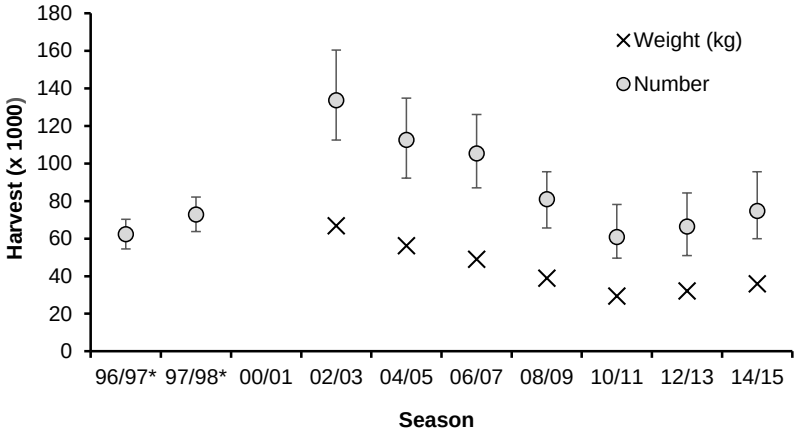

Fig. 18. Estimated Abalone harvest (number and weight) plotted against fishing season. Error bars represent 95% confidence limits for numbers. * indicates partial season surveys.

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 75% for lobster, and from 63 to 42% for abalone (Table 14). 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) were the most commonly cited reasons for not fishing for lobster during 2014-15.

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 7.0 days) and abalone (4.3 down to 2.9 days), contributing to declines in average seasonal harvest per fisher (from greater than 11 to about 7 for lobster, and from 23 to 14 for abalone) (Table 14). Furthermore, daily harvest rates for lobster have declined since the early 2000s (1.3 down to 0.97 per day); this decline being most influenced by pot catch rates which fell from 1.0 in 2002-03 to 0.7 lobster per day in 2014-15 (Table 14). 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 the reduction 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 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 14. 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. ne – not estimated

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

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.

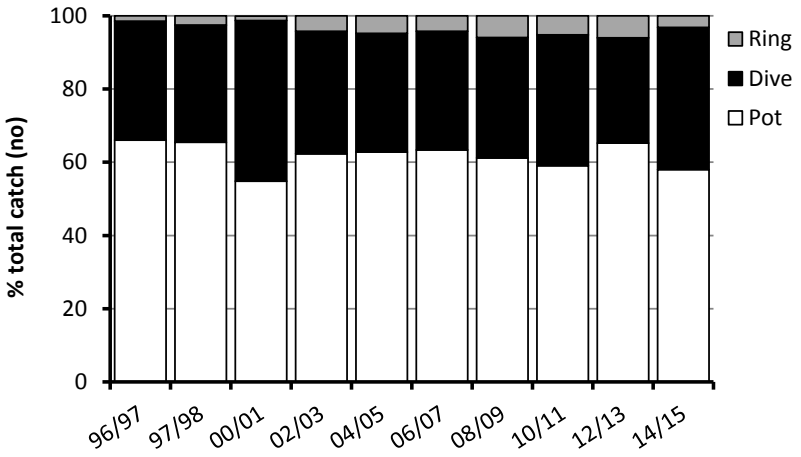

Fig. 19. Proportion of the Rock Lobster harvest by method and fishing season

The average daily harvest rate for pots (0.71 lobster) during 2014-15 represented a slight fall compared with 2012-13 and was substantially lower than catch rates prior to 2008-09 (Table 14). The dive harvest rate (1.92 per day) was comparable to that for 2012-13 but outside of the range for the earlier years (i.e. 2.1-2.6) and was likely influenced by the reduction in bag limit for the Eastern region. For instance, the average dive catch rate for the Eastern region was 1.3 and compared with 3.4 lobster per day for the Western region. The average daily harvest rate for Abalone (4.95) 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. Pot fishers rarely (<5% 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 30% of the dive effort in the Eastern region and almost 50% 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.

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 30% and the latter less than 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).

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 2014-15 was consistent with previous years in that effort for lobster peaked between November and January while catches were highest in November and December, and for Abalone catch and effort peaked during January (Lyle 2000, 2008, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010, 2012, 2014). A notable exception to this pattern occurred in 2012-13 when much of the east coast was closed due to harmful algal bloom during the peak fishing period (Lyle and Tracey, 2014). In that season the catch and effort peaks occurred in November and December for Rock Lobster and Abalone, respectively.

4.1.5 Comparison with commercial fisheries

The estimated recreational Rock Lobster harvest of 119 tonnes was below (70%) the TARC of 170 tonnes and represented 9.7% of the notional 2014-15 TAC or 10.4% of the actual catch for both sectors combined. In this regard, recreational catches did not breach these 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 18-30% of the total Rock Lobster catch depending on assessment area. 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, during 2014-15just 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, representing about 21% of the total Rock Lobster take and almost half of the catch taken in the southeast and almost 40% off the northeast and northwest coasts.

The estimated recreational Abalone harvest of 36 tonnes in 2014-15 was equivalent to 1.9% of the total Abalone catch for the state. Regionally, as a proportion of the total harvest, the recreational catch was most significant (~ 9%) in the east (Areas 2 & 3) followed by the southeast (2.9%) (Area 1) and northeast (2.5%) (Area 4). The relatively high contributions made by the recreational sector in the east are, however, more a reflection of the comparatively low commercial catch taken in those areas rather than indicating areas of particularly 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.

4.1.6 East coast stock rebuilding strategy

The 2014-15 recreational harvest from the east coast (Areas 1-3) represented 47% of the total for the sector and was estimated at 55.6 tonnes. This exceeded the notional recreational east coast catch share allocation of 42 tonnes by 13.6 tonnes or 32%, highlighting the need for further restrictions if this share is not to be routinely exceeded. In line with discussions about reducing total recreational catch from the east coast, DPIPWE requested advice on the effect of reducing the Eastern Region daily bag limit from 3 to 2. Survey data was reanalysed by applying a daily maximum catch of 2 lobsters to the east coast area (catches in excess of this are assumed to have been released). Assuming no compensatory changes in fishing behaviour, a bag limit of 2 lobster would theoretically have resulted in a 12% reduction in the east coast catch (Areas 1-3) to 48.7 tonnes. Furthermore, if the Eastern Region had been closed on 1st May the catch would have been reduced by an additional 3%, to 47.3 tonnes. This analysis suggests that even with these relatively drastic changes to the recreational fishery it will be difficult to restrict the total east coast catch to the notional recreational catch share. 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 14). As stocks start to rebuild and catch rates to improve it will become increasingly difficult to constrain catches.

4.2 Attitudes to future management options

Respondents were generally divided in their support for the bag, possession and boat limit reductions for the Eastern region, with approximately half supporting and slightly

fewer (~ 40%) not supporting each of the proposed changes. These results are in broad agreement with a general stakeholder survey which included non-recreational licence holders and was conducted by DPIPWE as part of the consultation process (DPIPWE 2015c). In the stakeholder survey there were, however, slightly more respondents who were not supportive of the bag and possession limit changes (~ 48%). In both surveys, strongest support was given to the winter closure (71% this survey and 68% the stakeholder survey). The greatest discrepancy related to support for the suggested changes to the Western region boat limit (72% this survey and 55% stakeholder survey), although opposition to the change was low in both instances (10% this survey and 15% stakeholder survey). As a package, the proposed management changes were adopted and implemented for the 2015-16 fishing season with one modification - the Eastern region boat limit was reduced from 15 to 10 (not 8) lobster.

Not unexpectedly, the reduced bag limit was the measure most commonly identified as having greatest impact for recreational fishers whereas the winter closure was considered to have the least direct impact for most respondents. Overall, the reduced on-water possession limit was considered to have least impact for individual fishers. This is not unexpected since most fishers undertake day trips rather than trips extending over several days at sea when fishing for Rock Lobster.

The vast majority of respondents indicated that the proposed management changes would have some impact on their fishing, but only a minority agreed that they may fish more to make up for the lower bag limits or fish less for lobster and switch to other types of fishing. There was greater agreement with the statement that fishers would try to limit the number of persons on a trip so as to allow everyone the opportunity to take their bag limit (i.e. not exceed the boat limit). A third of respondents did, however, agree that they may stop fishing for lobster because they considered it may not be worthwhile with the lower catch limits. Notwithstanding this, the vast majority of respondents still indicated that they were likely to re-licence for the 2015-16 fishing season.

Individual seasonal catch limits, although not canvassed as part of the management review, have been raised on several occasions by stakeholders as a management measure that could be used to limit the recreational catch. There was considerable support for this measure, with almost two thirds of respondents in favour and about a quarter opposed to seasonal limits. Expectations about the size of any seasonal limits varied widely amongst respondents, with averages of 37 lobster (fair and reasonable) and 24 (lowest acceptable) for the Eastern region, and 57 (fair and reasonable) and 36 (lowest acceptable) for the Western region. Comparing expectations with reported behaviour, it is interesting to note that during 2014-15 only 3% of active fishers took more than 30 lobsters. This compares with 8% of active fishers for 2013-14 based on the screening survey. This latter estimate is, however, likely to be inflated owing to recall bias, where respondents were expected to recall their total catch of lobsters for the entire 2013-14 fishing season. Notwithstanding the fact that there would be additional costs if catch tags were implemented to manage the season limits, many fishers expressed an unwillingness to pay extra over and above the current licencing fee. Amongst those willing to pay extra for tags, most indicated that they would be willing only to pay $10 or less for a set of five tags. Thus, general acceptance of individual seasonal limits is likely to be influenced by the size of the proposed limits and the direct cost to fishers of implementing and managing the system. Stakeholders

and managers also need to be confident that catch tags are practical and the system can be adequately monitored and enforced. This too represents a significant challenge given the large number of Rock lobster fishers and wide range of access points around Tasmania.

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Finally, thanks are extended to the recreational fishers who participated in the survey.

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