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UNIVERSITY OF TASMANIA

TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES: 2010-11 FISHING SEASON

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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 eighth survey of the recreational rock lobster fishery and the seventh for the recreational abalone fishery undertaken since the mid-1990s.

Following a long period of increased licence sales, 2010-11 saw a decline in sales of around 10% compared to 2009-10, with around 19,500 persons issued one or more rock lobster licences and just over 12,000 persons issued an abalone licence.

A random sample of licence-holders was contacted by telephone in October 2010 and invited to participate in the survey in which fishing activity was monitored throughout the 2010-11 season. A total of 603 licensed respondents completed the survey, representing about one in 32 licence holders and an effective response rate of 88%.

During the 2010-11 rock lobster season (5 November 2010 – 31 August 2011), recreational fishers harvested an estimated 83,472 (95% CI: 73,129 – 95,875) rock lobster, based on 87,617 fisher days of effort. Potting was the dominant method, representing 83% of the effort (days fished) and 59% of the estimated harvest. Dive collection accounted for about 14% of the effort and 36% of the harvest, while ring usage contributed 2% of the effort and 5% of the harvest. The overall average harvest rate for the season was 0.95 rock lobster per day fished, with daily harvest rates of 0.68 for pots, 2.36 for dive collection, and 2.11 for rings. The daily bag limit of five rock lobster was rarely attained for pots (<1% of pot days) but was achieved in about 20% of the dive and ring effort.

Seasonally the rock lobster fishery exhibited three distinct phases: intense activity early in the season (November to January) that accounted for about 72% of the total harvest; a period of intermediate fishing activity (February to April) that contributed a further 24%; and a phase of low activity (May to August) that accounted around 4% of the season's total.

Conversion of numbers to weights produced a total recreational harvest estimate of 84.3 tonnes, with catches from the east coast accounting for 59%, the north coast 22%, and west coast 19% of the total weight. The catch represented just half of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to almost 6% of the notional total allowable catch (TAC) (inclusive of the commercial catch) of 1494 tonnes.

An estimated 60,943 (95% CI: 49,623 – 78,164) abalone, based on 12,117 diver days of effort, were harvested by recreational fishers between 1 November 2010 and 31 October 2011. About 58% of the catch was taken between November and January, 30% between February and April, and 12% in the final six months of the season. 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.

Almost one in four dives that were targeted at abalone resulted in the daily bag limit (10 abalone) being taken; the overall average daily harvest rate was 5.0 abalone.

By converting numbers to weights, the 2010-11 recreational harvest of abalone was estimated as 29.4 tonnes, equivalent to 1.1% of the combined recreational and commercial catch of 2687 tonnes. There are currently no explicit performance indicators relating to the recreational fishery for abalone.

Catches of both rock lobster and abalone in 2010-11 were lower than estimated for 2008-09, in part a consequence of fewer licence-holders but also due to the combined effects of lower participation rates (i.e. proportion of active fishers), lower avidity (average days fished) and, in the case of rock lobster, lower catch rates for pots. In fact pot catch rates during 2010-11 were at their lowest level since surveys commenced and consistent with the trend observed in the commercial fishery. In addition to the lower abundance/availability of rock lobster during 2010-11 (confirmed by stock assessment), unfavourable weather conditions along with work and family commitments appeared to represent important constraints for many fishers.

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1 INTRODUCTION

Rock lobster and abalone are highly prized by recreational fishers in Tasmania. Southern rock lobster (*Jasus edwardsii*) and occasionally the Eastern rock lobster (*J. verreauxi*) are taken by a variety of methods, including pots, ring or hoop nets and dive collection. Two species of abalone, blacklip (*Haliotis rubra*) and greenlip (*H. laevigata*), 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 rock lobster 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 between November and 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. At the time of the current survey, a daily bag limit of five rock lobster and ten abalone applied, with a possession limit of ten rock lobster per licence-holder (five for non-licence holders) and twenty abalone per licence holder (ten for non-licence holders).

Following the introduction of the present licensing system, the number of persons holding at least one recreational rock lobster licence increased steadily from about 8500 to 21,000 by 2007-08, representing a more than doubling of numbers since 1995-96 (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 before declining by about 10% in 2010-11, with 19,500 persons licenced and 16,800 pot, 8300 dive and 5000 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 2010-11 abalone licence numbers fell by almost 10%, to just over 12,000.

¹ Note, the licensing system also includes net and scallop licence categories.

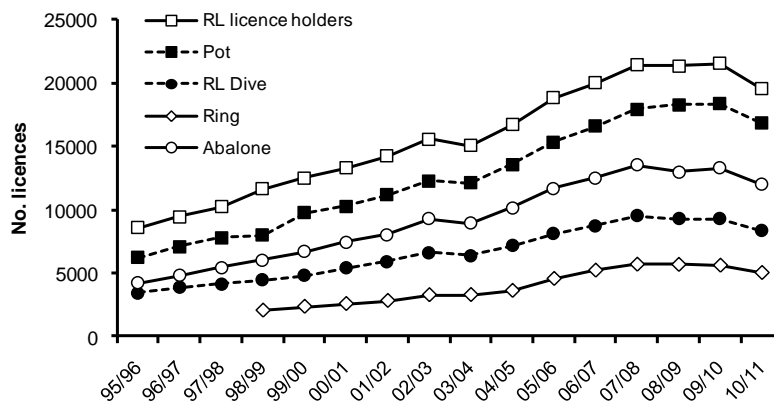


Fig. 1. Numbers of recreational rock lobster (RL) and abalone licences issued annually since 1995-96. RL licence holders refers to the number of persons holding at least one recreational rock lobster licence.

Giving consideration to where licence-holders reside, and defined using Statistical Sub-Divisions (SSD)², it is apparent that rock lobster licence-holders are concentrated in the south east of the state; 39% of 2010-11 licence-holders were from Greater Hobart and 15% from the surrounding Southern SSD (Fig. 2). Greater Launceston and Burnie-Devonport SSDs each accounted for over 10% of licence-holders, with a further 6-7% residing in the North Eastern and North Western Rural SSDs. A similar pattern applies for holders of 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 effectively 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. The TACC was reduced to 1470 tonnes in 2009-10 and again in 2010-11 to 1324 tonnes in response to concerns about declining stock levels, a situation exacerbated by a protracted period of poor recruitment (Linnane *et al.* 2010).

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 2010-11 which, when added to the TACC, resulted in a notional TAC of 1494 tonnes for 2010-11. Recreational catch information is thus required to evaluate performance against the TARC and also as an input into the rock lobster assessment developed to assess stock

² Statistical Sub-division is an Australian Standard Geographical Classification defined area used by the Australian Bureau of Statistics.

status and undertake risk assessments under different management scenarios (Gardner *et al.* 2011).

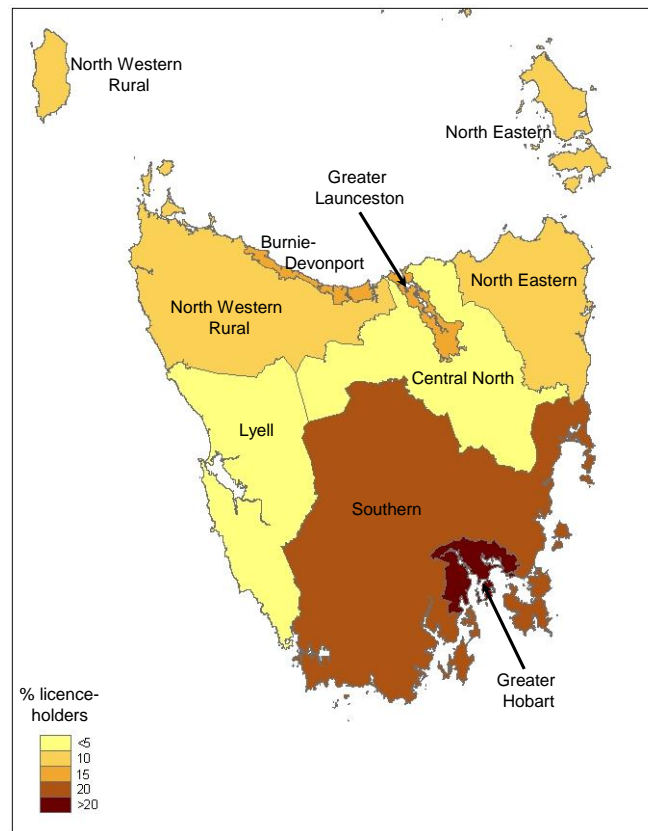


Fig. 2 Map showing the relative numbers of recreational rock lobster licence-holders in 2010-11 by area of residence (Statistical Sub-division). A further 4% of licence-holders reside interstate.

Since 1995, the TACC for abalone has varied between 2,100 – 2,800 tonnes and was set at 2659.5 tonnes (2526.8 tonnes for blacklip and 132.7 tonnes for greenlip abalone) in 2010. 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 2011).

The current survey represents the eighth in a series for rock lobster and the seventh for abalone undertaken since 1996. Key objectives include characterisation of the 2010-11 rock lobster and abalone fisheries in terms of participation, fishing effort and catch.

2 METHODS

2.1 Survey design

The methodology applied was based on that used successfully in previous surveys and involved 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 2010-11 licensing year. In addition, a supplementary survey was conducted to examine whether there were differences in effort and catches between renewing licence-holders and ‘new’ licence holders (i.e. persons not licensed in 2009-10).

2.1.1 Survey sample

The primary survey sample was selected from the 2009-10 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 2009-10 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 ABS statistical divisions (SDs), namely Greater Hobart, Southern, Northern and Mersey-Lyell³. 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 the Greater Hobart SD, where a lower sampling fraction (65% of that for all other strata) was applied. The higher sampling rate for strata outside of the Greater Hobart region was intended to improve the precision of estimates of fishing activities in areas away from the south-east coast. For analytical purposes, rock lobster data were treated as if they were derived from two strata, namely ‘Greater Hobart’ and ‘Elsewhere’. 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. 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 previous surveys 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

³ Northern SD is comprised of the Greater Launceston, North Eastern and Central North SSDs; Mersey-Lyell SD is comprised of the Burnie-Devonport, North Western Rural and Lyell SSDs, refer Fig. 2

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 2010 and asked about their intention to renew their rock lobster and/or abalone licences for the 2010-11 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 2010-11 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 problems 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, diarists were contacted at least once a month between November 2010 and April 2011, 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, fishing 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.

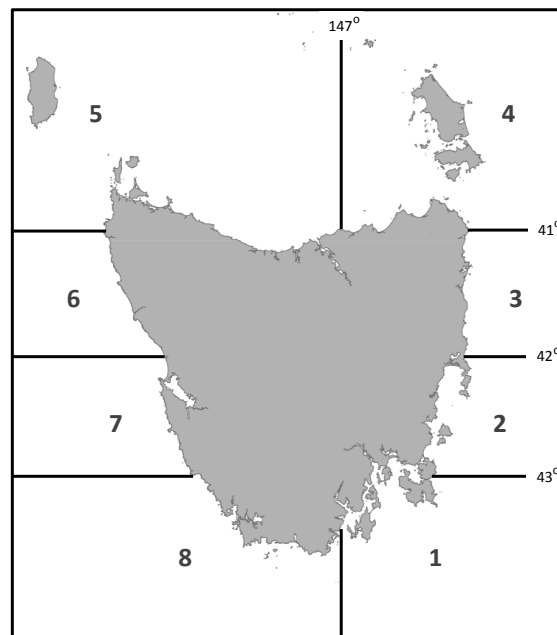


Fig. 3. Map of Tasmania showing fishery assessment areas

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 2010-11 fishing season (5 November 2010 to 31 August 2011) while the enumeration period for abalone was the licensing year (1 November 2010 to 31 October 2011).

2.1.4 Supplementary survey

Out of the 19,519 rock lobster licence-holders in 2010-11, 3953 (20.3%) did not hold a rock lobster licence during 2009-10, indicating that the licence population is quite dynamic, with an influx of 'new' entrants as well as the exit (non-renewal) of previous licence-holders. Pollock (2010) recommended that consideration be given to testing the assumption that fishing characteristics (effort and catch) for new licence-holder are similar to previous licence holders. Note, while the former group is excluded from the screening survey they are accounted for in the analyses on the assumption that their behaviour is similar to renewing fishers.

A random sample of 'new' rock lobster licence holders who had taken out a licence in prior to the end of December 2010 was selected and interviewed in a supplementary screening interview conducted between mid-January and early February 2011. This screening interview established the number of years of prior experience respondents had had fishing for rock lobster, whether they had already fished for rock lobster during the 2010-11 season and if so how many lobster they had caught. Interviewers attempted to collect this information on the basis of individual fishing events (as per the diary survey) but, recognising that the information was collected retrospectively, each response was rated based on the interviewer's confidence in the accuracy of the reported data (as reliable or not very reliable). Respondents were then asked to participate in a follow-up supplementary diary survey which was administered in the same manner as the main telephone-diary survey.

2.1.5 Wash-up survey

At the completion of the rock lobster fishing season all diarists were asked a series of questions relating to their fishing activity during 2010-11, perceptions relating to the quality of the fishery and status of rock lobster stocks and general satisfaction with the management of the fishery.

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2009-10 licence database, licence details for 2010-11 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 2010-11 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 69% of rock lobster and abalone licences were issued by the end of November 2010, this proportion increased to 87% by the end of December and 94% by the end of January 2011. Very few additional licences were issued after April 2011. 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 spatial 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 5000 simulations were conducted.

2.2.2 Supplementary survey

Total retained catch (numbers) and effort (days fished) was determined for fully responding diarists involved in the supplementary survey (i.e. ‘new’ licence-holders), and compared with comparable information from fully responding diarists from the primary survey (i.e. renewing licence-holders). Since the selection of ‘new’ licence-holders was restricted to those who had taken out licences prior the end of December 2010, the comparison with renewing licence-holders was restricted to those who were also licenced by the end of December. Furthermore, the residential strata used in the selection of respondents was also recognised in the analysis. A generalised linear model (GLM) with a poisson link function was used to explore differences in catch and effort between groups with i) different renewal month, ii) residential strata and iii) renewing and ‘new’ licence-holders. These groups were analysed as the sample sizes in each combination were not proportionally representative to those within the population (a consequence of stratification and response profiles).

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 2009-10 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 event, 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 the 2010-11 quota year (March 2010 to February 2011). 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 2010-11 recreational licensing year (i.e. November 2010 to October 2011).

3 RESULTS

3.1 Response rates

3.1.1 Screening survey

From a random sample of 1171 licence-holders selected from the 2009-10 licence database, 153 (13.1%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 1018. Contact was made with 940 licence-holders, of whom 901 fully responded, representing a screening survey response rate of 88.5%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 7.7% of the net sample and refusals or other non-response a further 3.8% (Fig. 4).

Amongst the respondents, 66 indicated that they were not likely to renew their licence(s) in 2010-11 and hence were not eligible for inclusion in the diary survey⁴. The balance (835)⁵ indicated they were likely to renew their licence(s) and 91% (759) agreed to participate in the diary survey (Fig. 4).

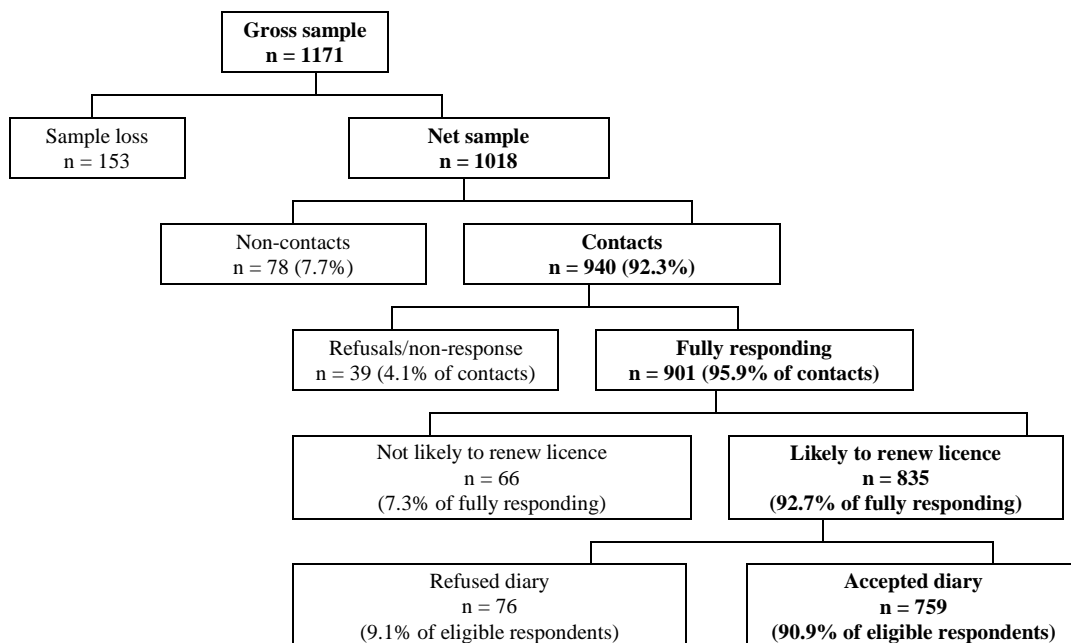


Fig. 4. Diagrammatic representation of the screening survey response profile (n is sample size).

⁴ The licence status of these respondents was checked at the end of the 2010-11 season and 16 renewals (24%) were identified.

⁵ In practice only 673 (81%) of those who expected to renew their licence in 2010-11 did so.

3.1.2 Telephone-diary survey

Diary response was high, with 732 diarists or 96% 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 (835), the effective response rate for the diary survey was 87.7%. 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.

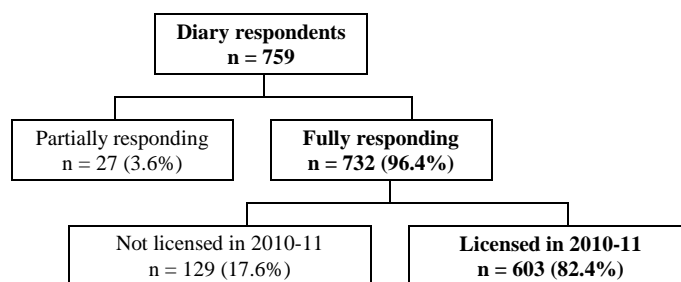


Fig. 5. Diagrammatic representation of the diary survey response profile (n is sample size).

Of the responding diarists, 18% (129) did not take up a licence during 2010-11 despite rating themselves as ‘quite likely’ or ‘very likely’ to do so. Among the remaining 603 respondents, 593 held at least one category of rock lobster licence while 347 had an abalone licence. The numbers of rock lobster and abalone licences in the licensed population and the sample of responding diarists are presented in Table 1. Overall, about one in 32 licence holders participated in the survey.

Table 1 Total number of 2010-11 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	16,804	522	3.1
Rock lobster dive	8,308	261	3.1
Rock lobster ring	5,021	164	3.3
Abalone	11,972	347	2.9
Total licences	42,105	1,294	3.1
Total persons	19,519	603	3.1

Fully responding diarists reported a total of 2976 fishing events during the survey period, 2935 (>98%) of which were valid events⁶. In total, 88% 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).

⁶ Events reported by diarists whilst unlicensed were considered out of scope and invalid.

3.1.3 Supplementary survey

From a supplementary sample of 311 ‘new’ licence-holders selected from the 2010-11 licence database, 82 (26.4%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 229. Contact was made with 193 licence-holders, of whom 171 fully responded, representing an effective screening survey response rate of 74.7%. Non-contacts accounted for 15.7% of the net sample and refusals or other non-response a further 9.6% (Fig. 6). The diary was accepted by 148 respondents and completed by 135, representing an effective response rate of 70.0% based on initial contact.

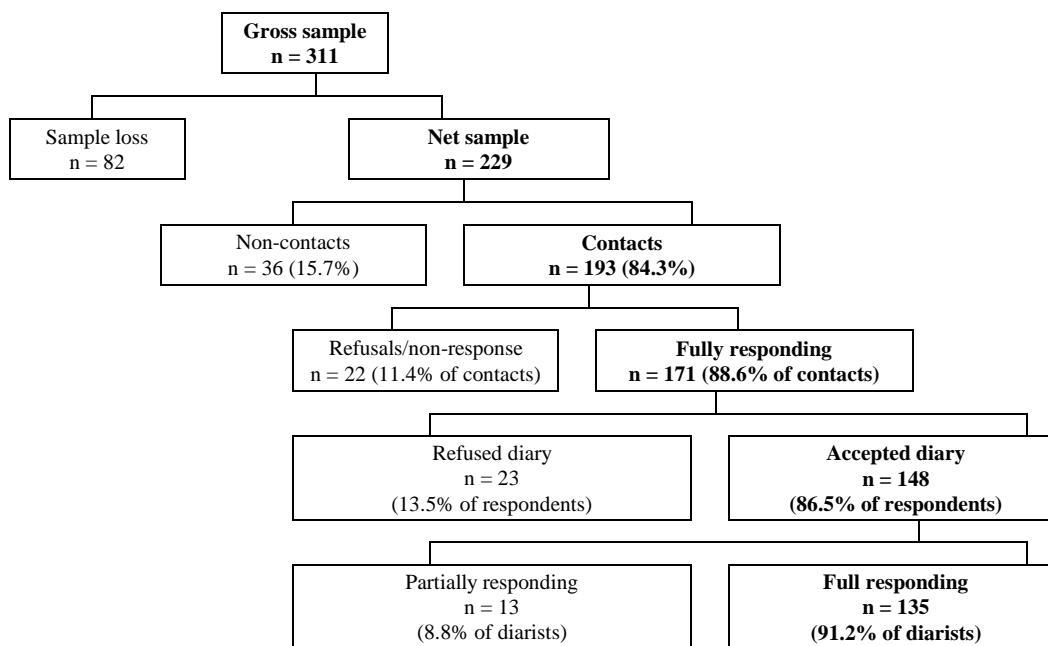


Fig. 6. Diagrammatic representation of the screening survey response profile (n is sample size).

Fully responding supplementary survey diarists reported a total of 514 fishing events, 74% of which were reported (retrospectively) at the screening interview, the remainder were reported while participating in the diary phase (70% of these being diarised).

3.2 Rock lobster

3.2.1 2009-10 participation

Information provided in the screening survey indicated that 83.2% (SE 1.3%) of 2009-10 rock lobster licence holders fished for rock lobster during that season, with 71.1% (SE 1.5%) harvesting at least one lobster. That is, out of the 21,512 persons licensed in 2009-10, 17,889 fished for rock lobster and only 15,295 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.

3.2.2 2010-11 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 representing the population of recreational rock lobster licence holders during 2010-11.

An estimated 71.7% (SE 1.8%) of licence holders fished for rock lobster at least once during the fishing season and just 55.2% (SE 2.0%) of all licence holders harvested at least one lobster. That is, out of 19,519 licence-holders, 13,997 fished for rock lobster and 10,773 reported some harvest.

Overall, total fishing effort was estimated to be 87,617 fisher days⁷ for the season, yielding a harvest of 83,472 rock lobster (Table 2). This represented an average seasonal harvest rate of 0.95 rock lobster per day fished. Pots were the most popular fishing method (accounting for 59% of the total harvest) followed by dive collection (36%) and rings (5%) (Table 2). Although almost six times as many fisher days of effort were spent using pots compared with diving, pots yielded less than double the number of rock lobster. Ring harvest and effort was low by comparison with the other methods. Mean daily harvest rates were over three times higher for dive (2.36 rock lobster) and ring (2.11 rock lobster) methods compared with pots (0.68 rock lobster).

Table 2. Rock lobster effort, harvest and harvest rates for the 2008-09 season
Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day ⁻¹)
Pot	49,282 (42,257 – 56,972)	72,917 (63,585 – 84,091)	0.68
Dive	29,815 (21,535 – 38,907)	12,624 (9,583 – 15,993)	2.36
Ring	4,374 (2,205 – 7,113)	2,076 (1,214 – 2,965)	2.11
Total	83,472 (73,129 – 95,875)	87,617 (76,456 – 98,717)	0.95

3.2.3 Seasonal catch and effort

Intense fishing activity corresponded with the opening of the season and the summer holiday period, with greatest levels of effort and harvest during November (Fig. 7). Fishing activity slowed dramatically in February and March, followed by a slight increase in activity in April corresponding with the Easter holiday period. There was relatively limited fishing during the final four months of the season, related to the closure of the fishery for female rock lobster and the onset of cooler and unsettled weather.

⁷ A fisher day is defined as a day in which lobster was a nominated target species and/or lobsters were caught.

The underlying seasonal pattern of catch and effort in the fishery was influenced strongly by monthly variation in pot fishing activity, with 77% of the pot catch taken between November and January and 20% between February and April (Fig. 7). 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 63% of the catch taken in the first three months and a further 29% in the following three months.

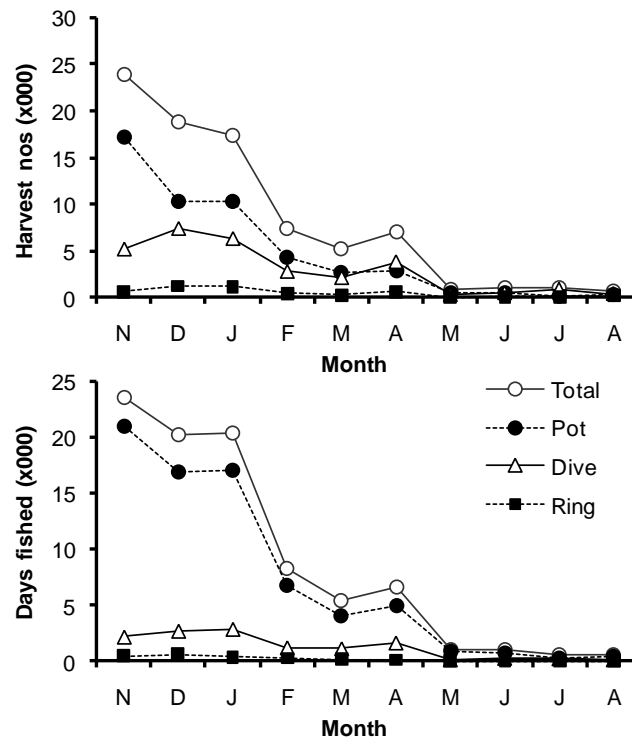


Fig. 7. Recreational rock lobster harvest (numbers) and effort (days fished) by month and method for the 2010-11 fishing season.

3.2.4 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 focused off the east coast (Areas 1-3). This combined region accounted for two-thirds of the total estimated harvest (55,528 rock lobster) and attracted three-quarters of the total effort (65,834 fisher days) during 2010-11. Area 1 alone accounted 30% to the total harvest. The north coast (Areas 4&5) accounted for 14% of the harvest (11,973 rock lobster) and 11% of effort (10,106 fisher days) while the west coast (Areas 6-8) contributed 19% of the total harvest (15,971 rock lobster) and 13% of total effort (11,725 fisher days).

Table 3. Recreational rock lobster effort, harvest and harvest rates by fishing area for 2010-11
 Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	25,458 (19,465 – 33,244)	28,941 (23,208 – 36,115)	0.88
2	15,717 (10,363 – 21,111)	14,901 (10,360 – 20,278)	1.05
3	14,352 (9,844 – 19,663)	21,943 (15,627 – 29,158)	0.65
4	7,208 (4,354 – 10,501)	6,926 (3,758 – 10,816)	1.04
5	4,765 (2,541 – 7,239)	3,181 (1,896 – 4,998)	1.50
6	6,400 (3,847 – 9,349)	4,756 (2,956 – 6,808)	1.35
7	4,919 (2,646 – 7,448)	2,672 (1,381 – 4,006)	1.84
8	4,652 (2,189 – 7,699)	4,298 (2,103 – 7,043)	1.08

Marked regional differences were evident in the proportion of the rock lobster harvest taken by different fishing methods (Fig. 8). Pots accounted for the bulk (59-88%) of the harvest from the east coast (Areas 1-3), whereas off the north coast (Areas 4&5) dive collection was the primary capture method (65-79%). All three methods were of significance in the west coast fishery (Areas 6-8); pots accounted for 36-72%, rings 13-27% and dive collection 14-43% of the harvest by number.

Mean daily harvest rates were highly variable around the state, ranging from 1.8 rock lobster per day in Area 7 to 0.65 in Area 3. Harvest rates for the remaining areas were intermediate, between 0.9-1.5 rock lobster per day (Table 3). Stock abundance and total fishing pressure (including commercial activity), along with the relative mix of fishing methods used (Fig. 8), noting significantly higher harvest rates for dive collection and rings compared with pots (Table 2), represent key factors contributing to this regional variability.

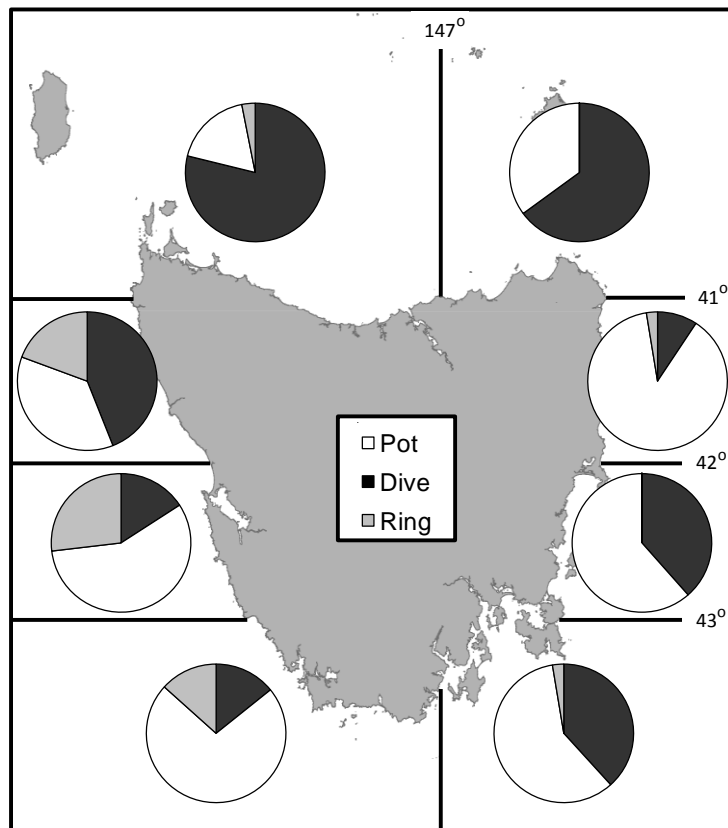


Fig. 8. Proportion of regional harvest by fishing method (pie charts).

3.2.5 South-east coast fishery

Catch data for Area 1 have been disaggregated into five sub-areas to better describe the spatial characteristics of the fishery off the south-east coast (Fig. 9). Waters surrounding the Tasman Peninsula and the western area of Storm Bay (including Bruny Island) collectively accounted for over half (55%) of the catch, with the D'Entrecasteaux Channel region contributing a further 24%. Norfolk-Frederick Henry Bay and the Derwent were comparatively minor areas in terms of catch.

Pots accounted for the majority of the Tasman, western Storm Bay and D'Entrecasteaux Channel catches whereas dive collection was the dominant method in Norfolk-Frederick Henry Bays and the Derwent (Fig. 9).

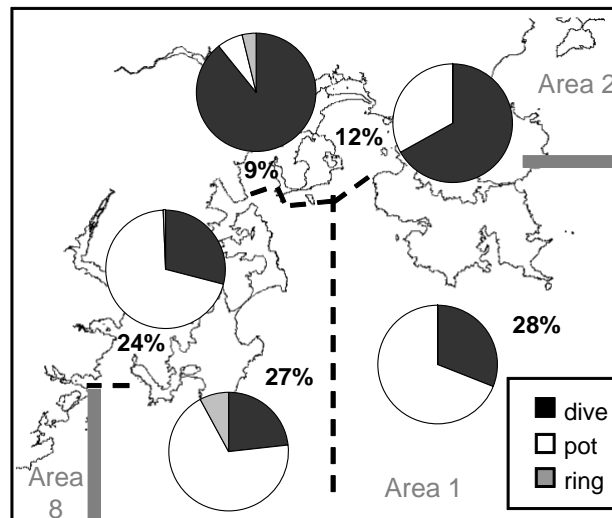


Fig. 9. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method (Fig. 10). Overall almost 60% of pot-days yielded no retained catch, with the daily bag limit of five rock lobster rarely achieved (<1% of pot-days). By contrast, divers took the bag limit in over 20% of the days fished, nil catches were reported on about a quarter of the days dived for lobster. Rings also proved relatively effective, with the bag limit achieved on 17% of day fished with rings, whereas nil catches were reported for 28% of the effort.

When dive effort, is split into snorkel, scuba and hookah methods, a strong effect of dive method was evident (Fig. 10). Overall, average daily harvest rates were highest for hookah (3.2 rock lobster), followed by scuba (2.2 rock lobster) and snorkel (1.3 rock lobster). The bag limit was attained in one third of all hookah dives, compared with 17% of scuba and 8% of the snorkel effort. Overall, hookah proved the most popular dive method for rock lobster, accounting for 41% of the total dive effort and 56% of the harvest. Scuba was next in importance, representing 30% of the effort and 28% of the harvest, while snorkel divers contributed 29% of the effort and 16% of the dive harvest.

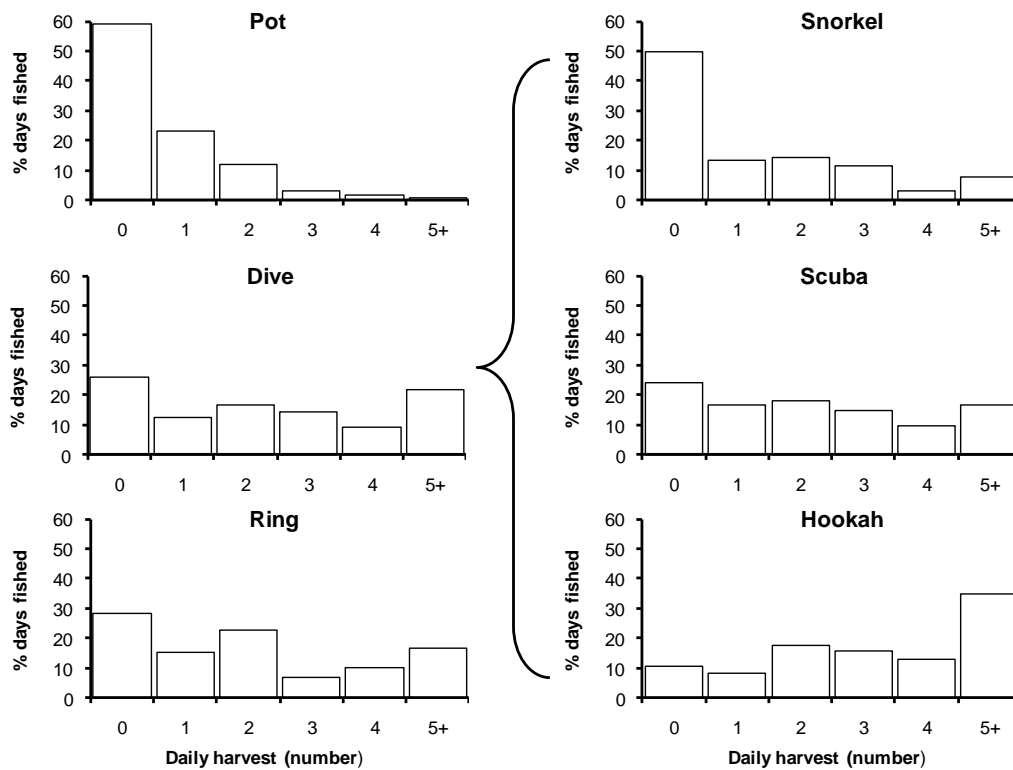


Fig. 10. Distribution of daily rock lobster harvest by fishing method for 2010-11 licence holders.

3.2.7 Individual fisher 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 2010-11 fishing season (Fig. 11). Overall almost one in four active rock lobster fishers harvested no rock lobster while a further 40% harvested between one and five lobsters for the entire season, with proportionally fewer active fishers who harvested six or more lobsters from east coast (31% of fishers) compared with the catches taken from all areas (36% of fishers). About 6% of fishers reported catches of more than 20 lobsters (accounting for 29% of the total catch) and around 3% took more than 30 lobsters (accounting for 18% of the total catch). This pattern was generally consistent for fishing off the east coast (Areas 1-3), with fishers who took more than 20 lobster accounting for 30% of the east coast catch and those taking more than 30 lobsters accounting for 21% of the total.

The impact of individual season catch limits, if implemented, on the overall catch 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), etc. Notwithstanding the above and assuming no change in behaviour or illegal activity, the theoretical savings for seasonal limits of 20 or 30 lobster during 2010-11 would have been in the order of 11% and 6%, respectively.

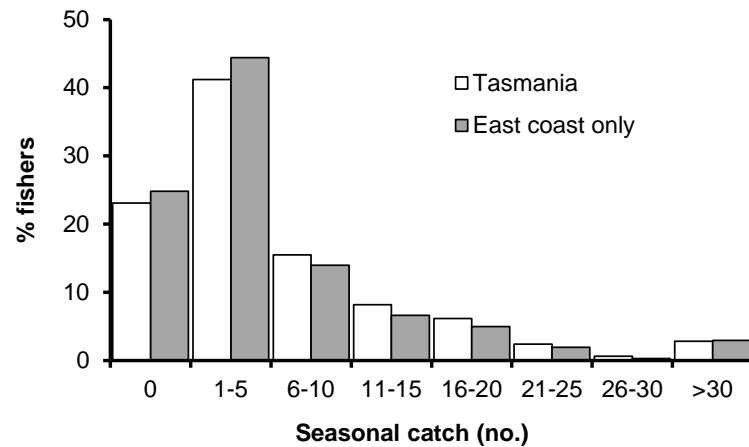


Fig. 11. Seasonal harvest of rock lobster for active fishers, based on all areas (Tasmania) and limited to fishing activity off the east coast.

3.2.8 Released catch

A total of 50,660 rock lobster were estimated to have been released or discarded from pot catches, equivalent to 1.03 for every retained rock lobster. About 95% of pot releases were in response to undersized rock lobster, 3% were berried females, 1% were dead or damaged lobsters and just 0.2% of releases were due to over bag limit catches.

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 968 pot caught, 585 dive caught and 111 ring caught rock lobster from around Tasmania. Overall, pot caught rock lobster ranged between 105–220 mm carapace length (CL), with an average estimated weight of 883 g. Dive caught rock lobster had a similar size range, 105–240 mm CL, but were larger on average, with an estimated average weight of 1200 g. Ring caught lobster also ranged between 105–240 mm CL, with an average weight of 1173 g. However, as relatively few ring caught rock lobster were measured⁸, data for pots and rings have been combined in subsequent analyses. Male to female sex ratios for pot (1:1.04) and rings (1:0.71) did not differ significantly from 1:1, whereas dive catches (1:0.73) were comprised of significantly more males than females.

Length frequency distributions by region are presented in Fig. 12. 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.

⁸ Measurements of ring caught lobster were mainly derived from Areas 6&7.

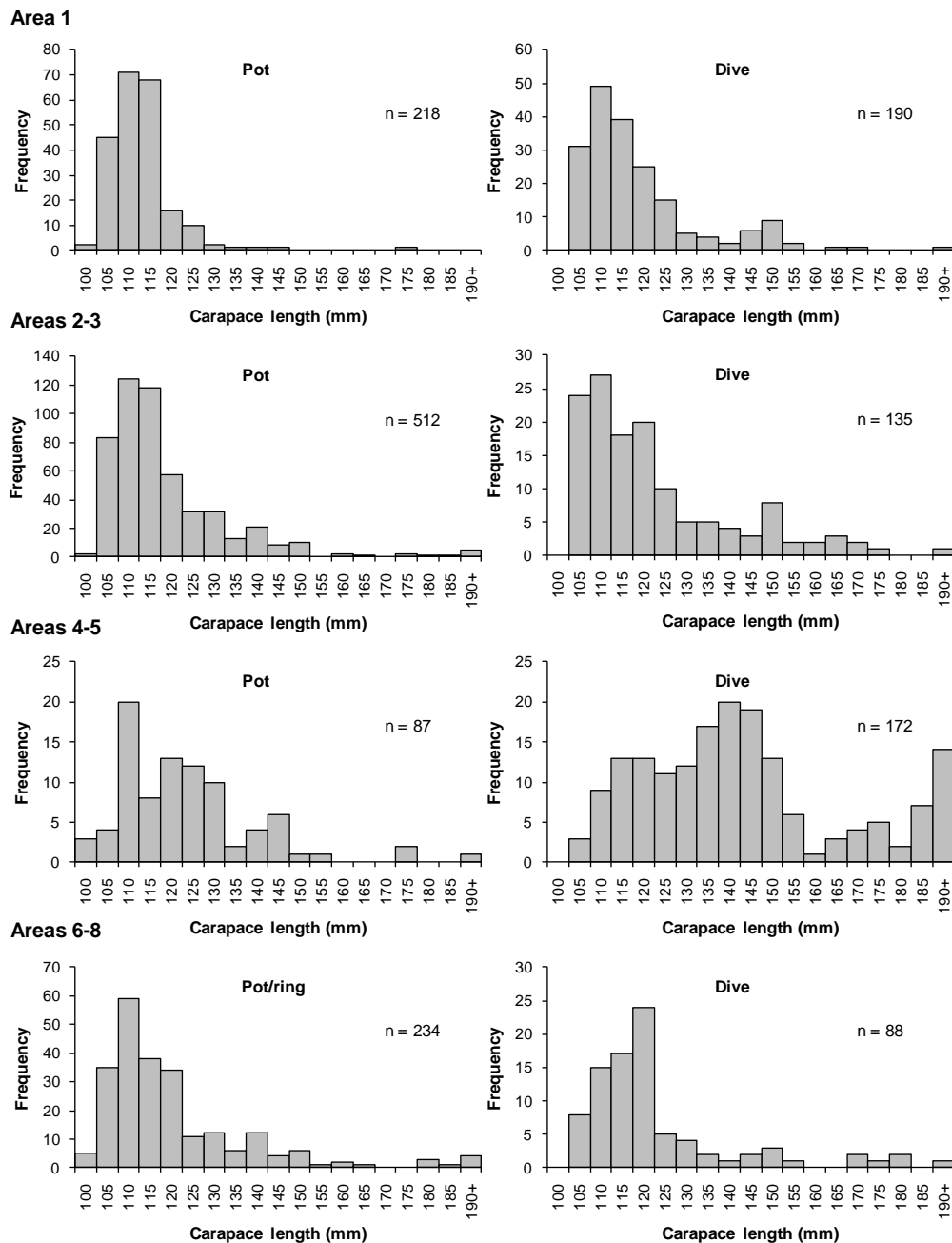


Fig. 12. Length frequency distributions by 5 mm size class for recreationally caught rock lobster taken by dive, pot and pot/ring fishing methods by assessment area(s). n is sample size.

3.2.10 Estimated harvest weight

The weight of the 2010-11 recreational harvest was estimated by multiplying the average rock lobster weights by the numbers harvested by method and region. Average weights by area and method used to determine harvest weights are presented in Table 4.

The state-wide harvest was estimated to be just over 84 tonnes, equivalent to 49.6% of the TARC. Regional harvest estimates ranged between 21.4 tonnes (Area 1) and 4.6 tonnes (Area 8) (Table 4). As a proportion of the recreational harvest, the east coast (Areas 1-3) accounted for 59%, north coast (Areas 4&5) 22%, and west coast (Areas 6-8) 19% 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 (14% 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	795	916	21,417	25.4
2	915	1044	15,161	18.0
3	915	1044	13,305	15.8
4	1114	1720	10,869	12.9
5	1114	1720	7,584	9.0
6	983	1036	6,441	7.6
7	983	1036	4,877	5.8
8	983	1036	4,607	5.5
Total			84,261	

3.2.11 Comparison with commercial catches

The recreational harvest represented 5.6% of the notional 2010-11 TAC and 6.4% of the actual combined recreational and commercial catch⁹. Regionally, there was marked variability in the recreational share of the total harvest, ranging from 14-21% in the east (Areas 1-3) to 2% in the south-west (Area 8) and north-west (Area 5) (Fig. 13A).

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 13.8% of the combined shallow water catch of 611 tonnes¹⁰ (Fig. 13B). The recreational harvest in Areas 1 and 3 represented about a third of the total catch from inshore waters, and just over a fifth of the catch from Area 2. Recreational catches also represented a relatively significant component of the inshore harvest from Area 6 (18%) and Area 4 (12%). 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 remaining west and north coast fishing areas.

⁹ The 2010/11 commercial catch was 1222 tonnes, equivalent to 92% of the allocated TACC.

¹⁰ The 2010/11 quota year catch reported from shallow water as 527 tonnes for the commercial sector.

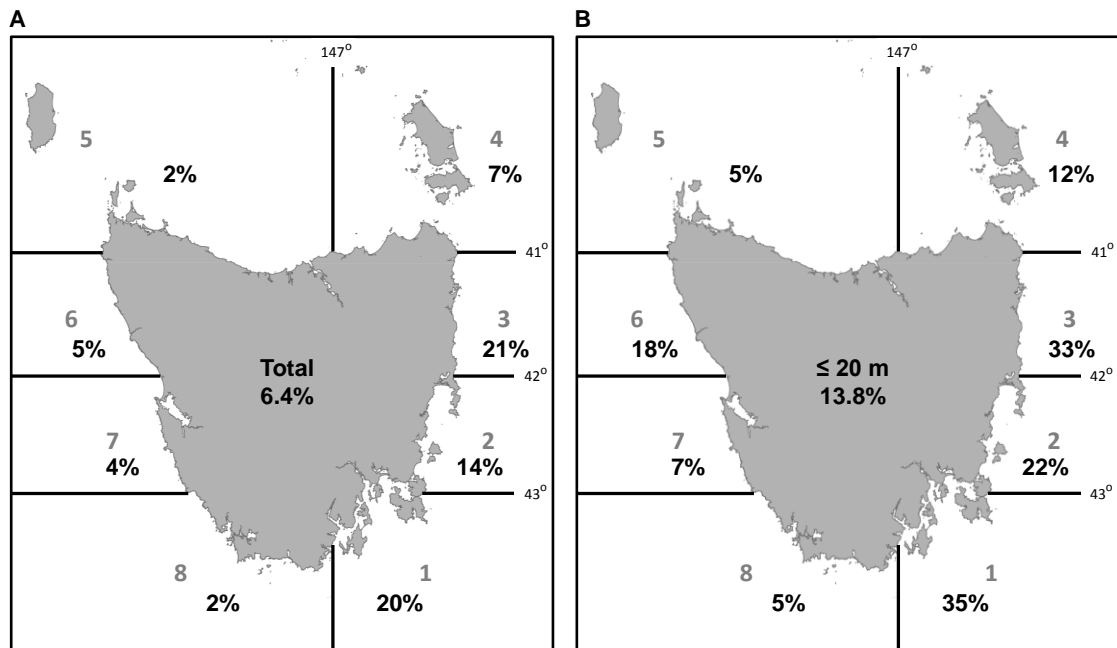


Fig. 13. 2010-11 recreational rock lobster harvest (weight) expressed as a percentage of the total rock lobster catch (commercial plus recreational) by area: (A) based on total catch (all depths); and (B) shallow water ($\leq 20\text{m}$) catches (refer text).

3.2.12 Supplementary survey

Just over one third of 'new' rock lobster licence-holders in 2010-11 (i.e. not licensed in 2009-10) reported no prior experience of fishing for rock lobster in Tasmania (Table 5). Conversely two thirds of these 'new' fishers had previous experience (20% reported in excess of 10 years) indicating that the majority were not novice fishers, rather many may have skipped taking out a licence during 2009-10.

Table 5. Years of prior rock lobster fishing experience for 'new' licence-holders in 2010-11
Number of respondents = 171

Years of prior experience	No. responses	%
0	57	35.8
1-5	53	33.3
6-10	18	11.3
11-15	6	3.8
16-20	9	5.7
>20	16	10.1
Not answered	12	-

The GLM indicated significant effects of residential stratum ($p=0.015$), renewal month ($p<0.0001$) and renewing verses new licence-holders ($p<0.002$) on catches. Furthermore the month and stratum were found to have a significant interaction effect. Similar effects were evident for effort (days fished). While residential stratum and

renewal month are factors that are taken into account in the analysis of the primary survey data, the significant effect of previous licencing status suggests a bias in catch and effort estimates (new licence holders tending to fish less and catch less than renewing fishers). The extent of this bias was assessed by multiplying average days fished and average harvest for renewing and new licence holders in proportion with their numbers within the 2010-11 licensed population. By comparing these estimates with those that assume that renewing fishers are representative of both groups (basis of the current analysis approach) a minor positive bias in the order of 3.0% for effort and 6.3% for harvest was established in reported estimates. In practice this uncertainly falls well within the error range of the reported estimates but does suggest future consideration of this issue would be desirable.

3.2.13 Wash-up survey

Diarists (including supplementary survey participants) who did not fish for rock lobster during 2010-11 were asked, as an open ended question, about their reasons for not fishing. Weather was the most commonly cited reason followed by work/business/study commitments, home/family commitments and a general lack of time (Table 6). Comments relating to fishing quality or catch rates represented a minor reason category.

Table 6. Reasons for not fishing for rock lobster during 2010-11
Number of respondents =293, multiple reasons were accepted

Reason	No. responses	%
Weather	83	28.3
Work/business/study commitments	75	25.6
Home/family commitments	47	16.0
Lack of time (unspec.)	37	12.6
Personal health/fitness	30	10.2
Lack of access (boat)	19	6.5
Alternative activities/interests	18	6.1
Lack of fishing partner	11	3.8
Lack of access (other)	11	3.8
Other	10	3.4
Fishing quality/catch rates	9	3.1

Amongst those respondents who fished for rock lobster during 2010-11, most (60%) reported that they had fished less than during the previous season while 29% considered that they had fished about the same (Table 7). Less than 10% of diarists reported fishing more than during 2009-10 and, significantly, over one third of this group had not fished during 2009-10.

Diarists who fished less cited that work/business/study commitments and/or weather were the most common contributing factors (Table 8). Home/family commitments and general lack of time were also important but secondary constraints.

Table 7. Response to the question relating to whether active fishers had fished more, less, or about the same for rock lobster in 2010-11 than in 2009-10

Number of respondents = 478

Response	No.	
	responses	%
More	46	9.6
Less	286	59.8
Same	140	29.3
Unsure	6	1.3

Table 8. Reasons for fishing less for rock lobster during 2010-11 compared with 2009-10

Number of respondents = 281, multiple reasons were accepted.

Reason	No.	
	responses	%
Work/business/study commitments	93	33.1
Weather	80	28.5
Home/family commitments	31	11.0
Lack of time (unspec.)	31	11.0
Fishing quality/catch rates	22	7.8
Personal health/fitness	21	7.5
Other	15	5.3
Lack of access (boat)	13	4.6
Alternative activities/interests	14	5.0
Lack of access (other)	6	2.1
Lack of fishing partner	5	1.8

Of those respondents who had fished during 2009-10 as well as 2010-11, just over half indicated that they considered that the quality of the fishery during 2010-11 was about the same as in 2009-10, a quarter indicated it was worse and 12% considered that it was better (Table 9).

Table 9. Perceptions about the quality of the rock lobster fishery during 2010-11 compared with 2009-10

Number of respondents = 368

Quality of fishery	No.	
	responses	%
Better	43	11.7
Worse	93	25.3
Same	196	53.3
Unsure	36	9.8

Diarists who had fished during 2010-11 were asked to rate their overall satisfaction with the management of the rock lobster fishery. Over three quarters of respondents indicated at least general satisfaction, with almost 20% not satisfied (Table 10). Reasons for dissatisfaction were varied, with a need for greater control over catches

taken by divers, concerns over commercial vessels operating close to shore in areas frequented by recreational fishers and the inability of management to prevent overfishing, including recognition that further restrictions were required, were the main issues identified (Table 11). In contrast, some of the dissatisfaction was related to plans to reduce bag limits for recreational fishers and the general complexity of the existing and proposed rules and regulations.

Table 10. General satisfaction with the management of the rock lobster fishery during 2010-11

Number of respondents = 494

Satisfaction	No. responses	%
Very satisfied	69	14.0
Quite satisfied	308	62.3
Not very satisfied	75	15.2
Not at all satisfied	19	3.8
Unsure	23	4.7

Table 11. Reasons cited for dissatisfaction with the management of the rock lobster fishery

Number of respondents = 93, multiple reasons were accepted

Reason for dissatisfaction	No. responses	%
Greater controls required for divers	18	19.4
Commercials permitted to fish too close inshore	16	17.2
Management has not prevented overfishing	14	15.1
Need for further restrictions (bag limit, size limits closures)	14	15.1
Opposed bag limit reductions proposed for 2011-12	9	9.7
Management bias in favour of commercial fishers	8	8.6
Regulations too complex and confusing	3	3.2
Inadequate enforcement	2	2.2
Other	11	11.8

Respondents were informed that there have been concerns about the declining state of the rock lobster stocks in Tasmania in recent years and 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 2010-11. A significant majority (60%) indicated that they had noticed declines whereas 30% indicated that they had not observed any real change (decline) (Table 12). Respondents who had observed a decline were asked what they considered to be the main reason(s) for the trend. Overfishing was overwhelmingly identified as the main reason, with over half of this group suggesting that it was due to overfishing by commercial fishers, overfishing by divers was identified as a secondary cause (Table 13). Interestingly a small number of respondents identified non-fishing related factors, including reduced recruitment, environmental variability and reduce catchability (a behavioural factor).

Table 12. Response to whether fishers had noticed that legal-sized rock lobster were less abundant and/or more difficult to catch in 2010-11

Number of respondents = 480

Noticed decline	No. responses	%
Yes	288	60.0
No/not really	145	30.2
Unsure	47	9.8

Table 13. Reasons cited by fishers for the decline in abundance and/or difficulty in catching legal-sized rock lobster

Number of respondents = 260, multiple reasons were accepted

Reason	No. responses	%
Overfished	195	75.0
Reduced biomass (incl poor recruitment)	19	7.3
Other	18	6.9
Environmental	15	5.8
Uncertain	13	5.0
Reduced catchability	11	4.2

3.3 Abalone

3.3.1 2009-10 participation

Information provided in the screening survey suggested that 66.3% (SE 2.1%) of 2009-10 abalone licence holders fished for abalone during that season and that 63.4% (SE 2.1%) kept at least one abalone. That is, out of 13,277 persons licensed in 2009-10, an estimated 8801 fished for abalone with 8440 harvesting at least one abalone. However, as this information was collected retrospectively at the end of the 2009-10 season it is subject to recall bias and as such is considered indicative only.

3.3.2 2010-11 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 2010-11 recreational abalone licence holders.

During 2010-11 an estimated 36.3% (SE 2.6%) of abalone licence holders (i.e. 4349 out of the 11,972 licence-holders) fished for abalone during 2010-11 with 30.1% (SE 2.5%) (3615 persons) harvesting at least one abalone.

The total estimated harvest for 2010-11 was estimated to be 60,943 abalone (95% CI: 49,623 – 78,164), the result of over 12,117 (95% CI: 9,719 – 15,808) fisher days¹¹ of effort. This represented an average harvest rate of 5.0 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).

3.3.3 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. 14). The first three months of the licensing year accounted for 58% of the annual harvest and 63% of the effort. There was a sharp decline in effort and harvest in February/March and a minor increase in the level of fishing activity during April, mainly due to Easter fishing. The February to April period contributed around 30% of the annual harvest and effort. There was very limited fishing for abalone during the final six months of the licensing year.

¹¹ A fishing day was defined as one in which abalone was a nominated target species and/or abalone were caught.

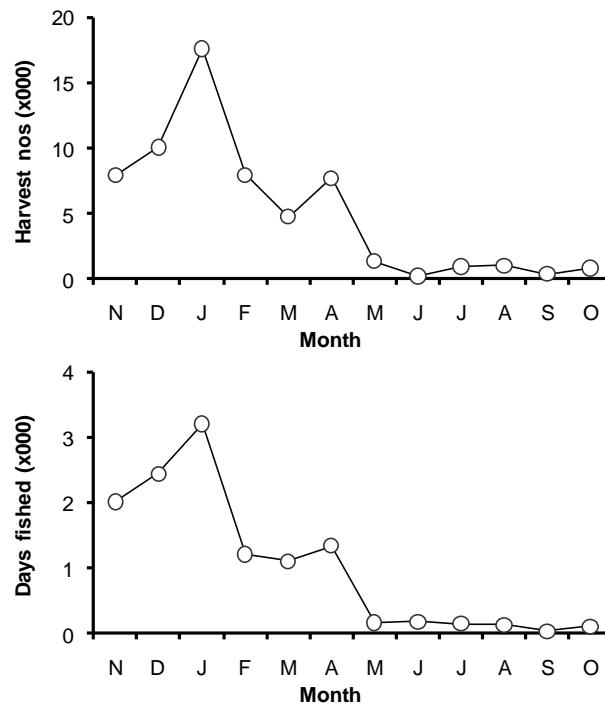


Fig. 14. Recreational abalone harvest (numbers) and effort (days fished) by month for the 2010-11 fishing season.

3.3.4 Regional catch and effort

Regional catch, effort and harvest rates for abalone are presented in Table 14. Recreational effort and harvest was concentrated in the south-east, with 36% of the harvest and 37% of the effort reported from Area 1. The remaining east coast areas (Areas 2&3) collectively accounted for a further 15 and 20%, the north coast (Areas 4&5) 26 and 24%, and the west coast (Areas 6-8) about 24 and 18% of the catch and effort, respectively. Regional harvest rates varied between 3-5 abalone per day off the east coast (Areas 1-3), around 5 per day off the north coast (Areas 4-5) and 6-8 per day off the west coast (Areas 6-8).

Table 14. Recreational abalone effort, harvest and harvest rates by fishing area for 2010-11
 Values in parentheses represent the 95% confidence intervals, * average weight based on commercial catch sampling data (D Tarbath, IMAS)

Area	Harvest (no.)	Effort (fisher days)	Harvest rate		Harvest (kg)
			(no. per fisher day)	Av. weight (g)*	
1	21,817 (14,070 – 30,583)	4,481 (2,569– 7,492)	4.9	512	11,179
2	3,934 (1,042 – 7,250)	1,338 (683 – 2,231)	2.9	463	1,821
3	5,233 (2,264 – 9,446)	1,117 (609 – 1,803)	4.7	463	2,423
4	4,678 (2,605 – 7,459)	929 (529 – 1,463)	5.0	393	1,838
5	10,906 (6,702 – 16,875)	2,018 (1,235 – 3,071)	5.4	393	4,286
6	7,344 (2,909 – 12,528)	1,290 (605 – 2,105)	5.7	549	4,031
7	3,345 (295 – 6,680)	409 (68 - 785)	8.2	549	1,836
8	3,687 (1,480 – 6,533)	536 (215 - 944)	6.9	549	2,024

3.3.5 South-east 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. 15). The Tasman Peninsula was the most important sub-area, accounting for almost a third of the total harvest, followed by the D'Entrecasteaux Channel, Norfolk-Frederick Henry Bay, and Bruny Island in decreasing importance. Catches from the Derwent Estuary were relatively insignificant.

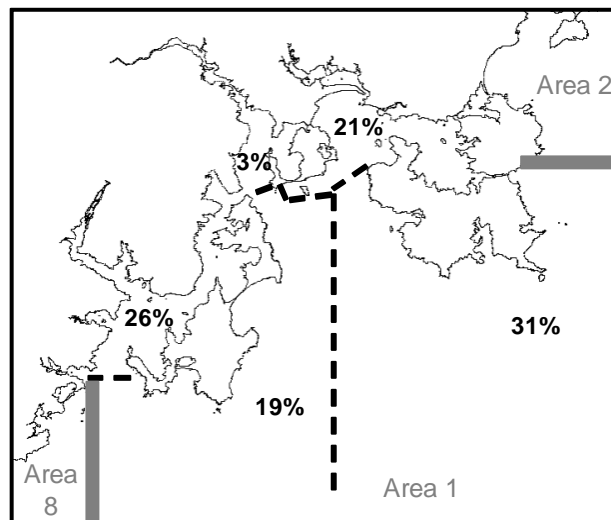


Fig. 15. Regional distribution of Area 1 abalone harvest.

3.3.6 Daily harvest

Over one in four dives targeting abalone resulted in the daily bag limit of ten abalone being achieved, whereas just under one in four dives resulted in no harvest (Fig. 16). Divers using hookah achieved the highest catch rates (5.3 abalone per day), with 34% of diver-days of effort achieving the bag limit. Average daily catch rates for scuba (5.1) and snorkel (4.8) were slightly lower, as was the proportion of effort that resulted in at least ten abalone being taken (23% for scuba and 25% for snorkel).

Of the three dive methods snorkel accounted for 45% of the harvest and 47% of effort (diver days), hookah 33% of the harvest and 31% of the effort, and scuba contributed 22% of retained catch and 22% of the effort.

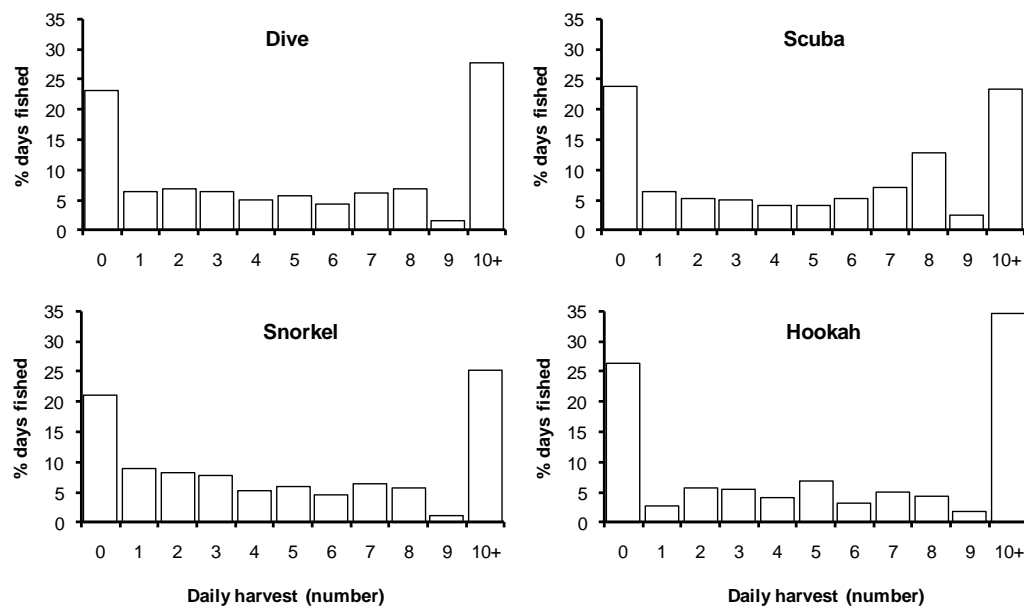


Fig. 16. Distribution of daily abalone harvest by dive methods for 2010-11 licence holders

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 549 g off the west coast (Areas 6-8) and 393 g off the north coast (Areas 4&5) (Table 14; D. Tarbath, pers. comm.). Using these values, the recreational harvest during 2010-11 was estimated to be about 29.4 tonnes. Regionally, harvest estimates ranged from 11 tonnes in Area 1 to less than 2 tonnes in each of Areas 2, 4 and 7 (Table 14). The catch for the combined east coast (Areas 1-3) was 15.4 tonnes, the north coast (Areas 4&5) 6.1 tonnes, and the west coast (Areas 6-8) 7.9 tonnes.

3.3.8 Comparison with commercial catches

The commercial abalone catch for the period November 2010 to October 2011 was 2658 tonnes¹², indicating that the recreational harvest was equivalent to 1.1% of the combined state-wide catch. Regionally, the recreational component of the fishery accounted for over 11% of the combined commercial and recreational harvest in the north east (Area 3) and almost 5% in the south-east (Area 1), whilst in all other regions the recreational contribution was relatively low (<2%) (Fig. 17). The significance of the recreational catch in Area 3 was more a function of the low commercial catch from that region than indicative of a large recreational take.

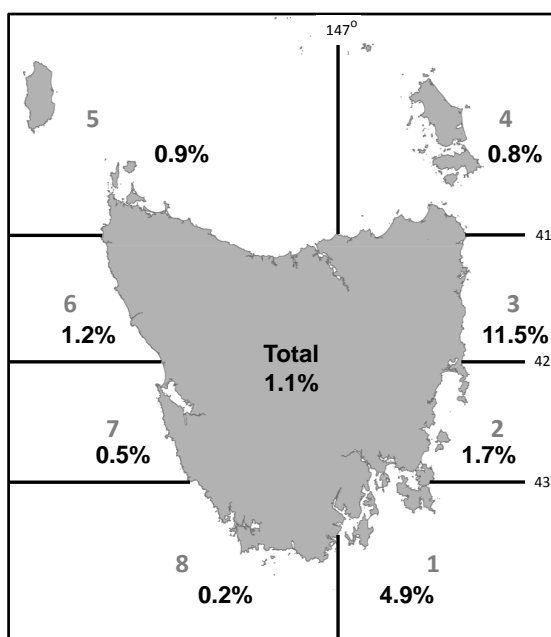


Fig. 17. 2010-11 recreational harvest (weight) of abalone expressed as a percentage of the total catch (commercial plus recreational) by area.

¹² Based on estimated weights - blacklip abalone accounted for 2502 tonnes and greenlip 156 tonnes.

4 DISCUSSION

To date, eight 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 (Fig. 18). The most recent catch estimate was 21% lower than for 2008-09 and coincided with a 9% reduction in licence numbers.

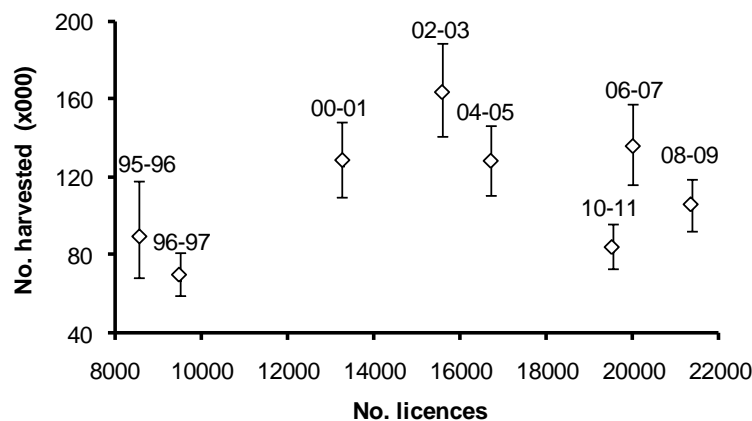


Fig. 18. Estimated rock lobster harvest (season indicated) plotted against number of licence holders. Error bars represent 95% confidence limits.

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 trend (Fig.19). Furthermore, in those years when catches have fallen between survey periods (i.e. 2002-03 and 2004-05 and all years post 2006-07), the overall decline in east coast catches (Areas 1-3) has accounted for between 65-75% of the fall state-wide, highlighting the significance of the east coast in driving trends within the recreational fishery.

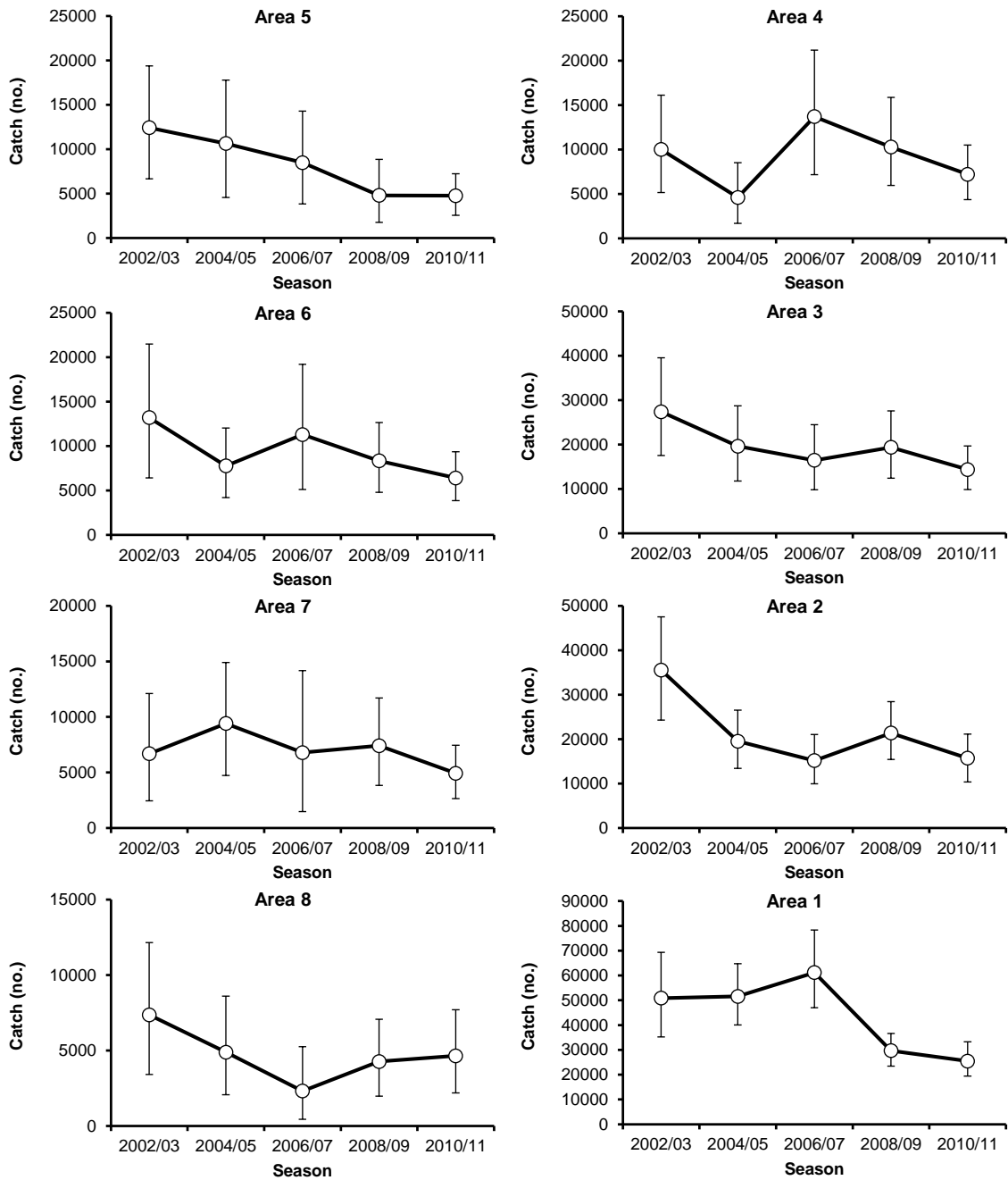


Fig. 19. Regional rock lobster harvest estimates (numbers) by recreational fishing season. Error bars represent 95% confidence limits.

Abalone harvest levels have also declined since the early 2000s even though licence numbers continued to grow up until 2008-09 (Fig. 20). Despite an 8% reduction in licence numbers the 2010-11 harvest estimate was about 25% lower than that for 2008-09, to a level comparable with the late 1990s at which time there were about a third as many licences issued.

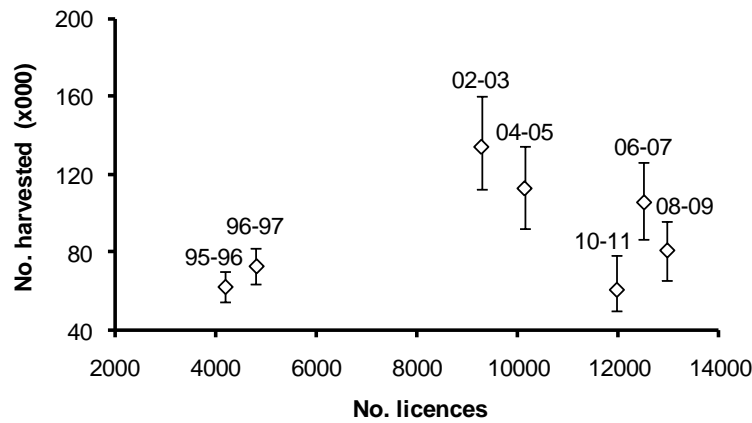


Fig. 20. Estimated abalone harvest (season indicated) plotted against number of licence holders. Error bars represent 95% confidence limits.

Information about the behaviour of fishers is particularly useful in explaining some of the observed changes in catches. 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 72% for rock lobster, and 63 to 36% for abalone (Table 15). This has had the effect of slowing growth or even resulting in a decline in active fisher numbers despite increased licence sales. 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 6.3 days) and abalone (4.3 down to 2.8 days), contributing to declines in average seasonal harvest per fisher (11.4 down to 6.0 for rock lobster, and 22.8 down to 14.0 for abalone) (Table 15). Furthermore, daily harvest rates for rock lobster have declined since the early 2000s (1.3 down to 0.95 per day), this decline being most influenced by pot catch rates which had fallen from 1.0 in 2002-03 to less than 0.7 lobster per day in 2010-11. By contrast, dive catch rates have tended to fluctuate without obvious trend though time, a similar observation applying for abalone catch rates. Thus the general growth in licence numbers over the past decade has not translated into comparable increases in effort or harvest levels. On the contrary, declines in participation rates, general reduction in avidity (days fished) and falling (or stable) catch rates have tended to dampen any influence of increased licence sales. Social (e.g. motivations, availability of time, access), biological (e.g. stock size, catch rates) and environmental (weather) factors all appear to play a role in influencing fisher behaviour and highlight the need to better understand the dynamics and drivers of recreational fishers.

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

To understand why not all licence-holders fished or dived for rock lobster during 2010-11, non-fishing respondents were asked for their main reason(s) for not fishing. Weather and lack of time (due work and/or family commitments) were the most commonly cited reasons. For respondents who had fished, each was asked at the end of the season whether they had spent more, less or about the same amount of time fishing or diving for rock lobster compared with the previous season (2009-10). The majority (60%) indicated that they had fished less, just 10% reported that they had fished more than in 2009-10. Lack of time due to other work and/or family commitments followed by weather emerged as the most frequently cited reasons for fishing less. The role of weather conditions in influencing whether or how much licence-holders fished during 2010-11 appeared to be more influential as a factor than in previous surveys, highlighting that factors other than resource status have an influence on effort in the Tasmanian recreational rock lobster fishery. In relation to the perceived quality of the rock lobster fishery, just over half of the fishers considered that it was about the same as in the previous season, 25% indicated that it was worse and only 11% that was better. Significantly, the majority (60%) of fishers had observed that legal-sized rock lobster were less abundant and/or more difficult to catch in 2010-11, with overfishing identified as the major cause.

Pots represent the main method for catching rock lobster by the recreational sector, accounting for 59-64% of the total harvest numbers in each of the years surveyed apart from 2000-01, when pots represented 55% of the total catch (Fig. 20). Dive methods

have typically accounted for about one 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.

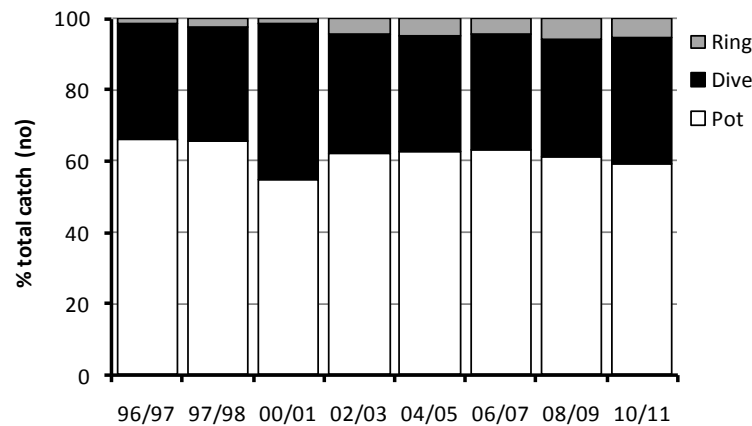


Fig. 20. Proportion of the rock lobster harvest by method and fishing season

Consistent with previous seasons, fishing activity for rock lobster and abalone was highly seasonal, being most intense immediately following the opening of the season (or licensing year) and over the summer holiday period, with peaks in effort and catches generally during December and January. This was followed by sharp falls in catch and effort in February before a slight increase in activity over the Easter holiday period. Activity levels from May to the end of the season (or licensing year) typically remain low and contribute very little in terms of harvest.

The recreational rock lobster and abalone fisheries are concentrated off the south-east and east coasts of Tasmania. In 2010-11, about 30% of the rock lobster and 36% of the abalone harvest (by numbers) was taken off the south-east coast (Area 1), with a further 36% and 15%, respectively, derived from the remaining east coast areas (Areas 2&3). Rock lobster catches from the north coast (Areas 4&5) were comparatively low (14%), whereas this region was more significant for abalone (26%). The west coast (Areas 6-8) produced about 19% of the rock lobster and 23% of the abalone harvest.

The intensity of the fishing activity off the south-east 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 these regions. However, 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 (Gardner *et al.* 2011, Tarbath & Gardner 2011).

There was considerable regional variability in the relative importance of the three rock lobster fishing methods. Pot catches clearly dominated the harvest off the south-east 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 each of the previous surveys (Lyle 2000, 2008, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010).

The average daily harvest rate for pots (0.68 rock lobster) during 2010-11 was the lowest recorded since surveys commenced (Table 15) and is consistent with the observation that commercial catch rates were also poor during 2010-11 (C. Gardner, pers. comm.). By contrast, the dive harvest rate (2.36 rock lobster) was within the range determined for previous seasons (i.e. 2.1-2.6). The average daily harvest rate for abalone (5.0 abalone) was also within the range of that reported in previous years (4.5-6.2 abalone). These differences are likely due to the active nature of dive collection, whereby divers are able to compensate to some extent for lower abundances through increased search times. Pots on the other hand represent a passive fishing method and thus catch rates are more influenced changes in stock abundance.

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 achieved, but was less of a factor for abalone, where catch rates for snorkel divers were comparable with those for scuba. This is not unexpected given that abalone are sessile and common in shallow waters. Of the dive methods, harvest rates were consistently higher for hookah, an observation that has been noted in previous years (Lyle 2000, 2008, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010).

As a general rule divers often target both rock lobster and abalone on a dive and, in 2010-11, two thirds of dives targeting rock lobster also included abalone as a target species, with such effort accounting for 62 and 68% of the dive harvest of rock lobster and abalone, respectively. Recognition of this behaviour has implications for the future management of the fishery, especially in terms of the possible impacts of management change for one or other species.

Bag limits represent the primary management strategy to constrain recreational rock lobster and abalone catches in Tasmania. Pot fishers rarely (<1% days fished) attained the bag limit of five rock lobster. By contrast, bag limits had a more obvious impact on rock lobster and abalone dive catches, with over 20% of the dive effort for both species resulting in the bag limits being achieved. Thus the proposed reduction in bag limit to three lobster per day to be implemented in 2011-12 for the east coast can be expected to have greatest impact on divers catches but will have little impact on pot catch rates.

The estimated recreational rock lobster harvest of 84 tonnes was clearly below (49%) the TARC of 170 tonnes and represented about 6% of the notional 2010-11 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 14-21% of the total rock lobster catch. 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 with about 43% of the commercial harvest taken from depths of less than or equal to 20 m during 2010-11. Thus, where the sectors overlap (based on depth), the recreational proportion of the shallow water catch was higher than implied by comparisons of overall catch levels. If only shallow-water catches are considered, then the recreational fishery was more significant, representing about 14% of the total rock lobster take and almost a third of the rock lobster catch from the east coast of Tasmania.

The estimated recreational abalone harvest of 29 tonnes in 2010-11 was equivalent to 1% of the total abalone catch for the state. Regionally, as a proportion of the total harvest, the recreational catch was most significant (12%) off the north-east coast (Area 3), reflecting the comparatively low commercial catch from that area, rather than a high recreational catch in absolute terms. There are no management performance indicators relating to the recreational fishery in the Abalone Management Plan but 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.

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References

- Anon. (1997). Rock lobster fishery policy document. Unpublished report of the Rock Lobster Working Group, Tasmanian Department of Primary Industry and Fisheries.
- Ford, W. (2001). Restructuring the Tasmanian rock-lobster fishery – the effect of two years of management under individual transferable quotas. *Marine and Freshwater Research* **52**: 1641-1648.
- Forward, J., and Lyle, J.M. (2002). A survey of the 2000-01 Tasmanian recreational rock lobster fishery and options for future assessment. Tasmanian Aquaculture and Fisheries Institute Final Report to the Marine Recreational Fishery Council, 36p.
- Gardner, C. Hartmann, K, and Hobday, D. (2011). Tasmanian rock lobster fishery 2009/10. Tasmanian Aquaculture and Fisheries Institute Fishery Assessment Report, 64.
- Haddon, M. (2001). *Modelling and Quantitative Methods in Fisheries*. Chapman and Hall/CRC, Florida, 406p.
- Linnane, A., Gardner, C., Hobday, D., Punt, A., McGarvey, R., Feenstra, J., Matthews, J. and Green, B. (2010) Evidence of large-scale spatial declines in recruitment patterns of southern rock lobster *Jasus edwardsii*, across south-eastern Australia', *Fisheries Research* **105**: 163-171.
- Lyle, J.M. (2000). Assessment of the licensed recreational fishery of Tasmania (Phase 2). Tasmanian Aquaculture and Fisheries Institute Final Report to FRDC, Project 1996/161.
- Lyle, J.M. (2008). Tasmanian recreational rock lobster and abalone fisheries - 2006/07 fishing season. Tasmanian Aquaculture and Fisheries Institute Report, 22p.
- Lyle, J.M. and Morton, A.J. (2004). Survey of the 2002/03 Tasmanian recreational rock lobster and abalone fisheries. Tasmanian Aquaculture and Fisheries Institute, Technical Report 22.
- Lyle, J.M. and Morton, A.J. (2006). Survey of the 2004/05 Tasmanian recreational rock lobster and abalone fisheries. Tasmanian Aquaculture and Fisheries Institute Internal Report.
- Lyle, J.M., Morton, A.J, and Forward, J. (2005). Characterisation of the recreational fishery for southern rock lobster, *Jasus edwardsii*, in Tasmania, Australia. *New Zealand Journal of Marine and Freshwater Research* **39**: 703-714.
- Lyle, J.M. and Tracey, S.R. (2010). Tasmanian recreational rock lobster and abalone fisheries: 2008-09 fishing season. Tasmanian Aquaculture and Fisheries Institute Report, 29p.
- Pollock, K.H. (2010). Review of the telephone diary survey of the Tasmanian recreational rock lobster fishery . Report to Tasmanian Association for Recreational Fishing Inc. Murdoch University
- Punt, A.E. and Kennedy, R.B. (1997): Population modelling of Tasmanian rock lobster, *Jasus edwardsii*, resources. *Marine and Freshwater Research* **48**: 967-980.
- Tarbatch, D., and Gardner, C. (2011). Tasmanian abalone fishery 2010. Institute for Marine and Antarctic Studies Fishery Assessment Report, 110p.