

# **INTERNAL REPORT**

## **TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES – 2004/05 FISHING SEASON**

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# Tasmanian recreational rock lobster and abalone fisheries – 2004/05 fishing season

Jeremy Lyle and Alastair Morton

## Executive Summary

Southern rock lobster and abalone (blacklip and greenlip) are highly prized by recreational fishers in Tasmania. The numbers of rock lobster and abalone licences issued have increased steadily since the introduction of the present recreational licensing system in 1995, with 16,700 persons holding at least one rock lobster licence and 10,100 persons licensed for abalone during 2004/05. This represents increases of over 95% for lobster and 140% for abalone since 1995. Rock lobster are taken by a variety of methods, including pots, ring or hoop nets, and dive collection. Abalone are primarily harvested by divers.

The current study represents the fifth survey of the lobster fishery and the fourth for the abalone fishery undertaken since 1996 using the telephone/diary survey methodology. A random sample of licence holders was contacted by telephone in October 2004 and invited to participate in the survey in which fishing activity was monitored throughout the 2004/05 season. A total of 447 licensed respondents completed the survey, representing about one in 40 licence holders and a response rate of over 90%.

Between November 2004 and August 2005, recreational fishers harvested an estimated 128,000 lobsters, based on 109,800 fisher days of effort. Potting was the dominant method and represented over 80% of the effort (days fished) but only 63% of the estimated harvest. Dive collection accounted for about 16% of trips and 32% of the harvest, while ring usage contributed 2% of trips and 5% of the harvest. The overall average harvest rate for the season was 1.2 lobster per day, with harvest rates averaging 0.9 lobster per day for pots, 2.3 for dive collection, and 2.5 for rings. The daily bag limit of five lobster was rarely attained for pots (< 3% of pot days) whereas the bag limit was attained in about one in four trips based on dive and ring methods.

Seasonally the lobster fishery exhibited three distinct phases; intense activity early in the season (November to January) that accounted for about 65% of the total harvest; a period of intermediate fishing activity (February to April) that contributed a further 30%; and finally, a phase of low activity (May to August) that accounted around 5% of the season's total.

Conversion of numbers to weights produced a total recreational harvest estimate of 119 tonnes for 2004/05, with catches from the south-east and east coasts accounting for 63%, the north coast 20% and west coast 17% of the total harvest weight. The size of the recreational lobster catch relative to the total allowable commercial catch (TACC) has been identified as a management performance indicator. In the current season the recreational harvest represented 7.8% of the 2004 TACC of 1523 tonnes and was thus below the 10% TACC trigger level.

An estimated 112,500 abalone were harvested by recreational fishers between November 2004 and October 2005, based on 18,100 diver days of effort. About 64% of the total abalone harvest was taken between November and January, 30% between February and April, and 6% between May and October. In total, 40% of the catch was taken from the south-east coast, with catches from the east coast and north-west also significant.

Almost one-fifth of all dives that were targeted at abalone resulted in no retained catch. By contrast, the daily bag limit of 10 abalone was achieved in almost half of all dives and the overall average daily harvest rate was 6.2 abalone.

By converting numbers to weights the 2004/05 harvest was determined to have been 56 tonnes, equivalent to 2.5% of the 2004 commercial catch of 2270 tonnes. There are currently no explicit performance indicators relating to the recreational fishery for abalone.

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## 1 INTRODUCTION

Rock lobster and abalone are highly prized by recreational fishers in Tasmania. Southern rock lobster (*Jasus edwardsii*) are taken by a variety of methods, including lobster pots, ring or hoop nets and dive collection<sup>1</sup>. Two species of abalone, blacklip (*Haliotis rubra*) and greenlip (*H. laevisgata*), are targeted by recreational divers, the former dominating the catch and the latter generally restricted to the north coast of Tasmania. In addition to recreational importance, rock lobster and abalone support major commercial fisheries in Tasmania, with both fisheries subject to quota management.

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 comprised rock lobster pot and general dive licences, 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, abalone and scallop dive licences. In 1998, a ring net licence was introduced, effectively closing a loophole in the legal take of rock lobster. Pot fishers are permitted to use one pot, ring net fishers up to four rings, and divers can use artificial breathing apparatus (scuba and surface air supply or hookah).

Licences are issued annually, with the licensing year extending between November to and the following October. Recreational fishers may hold up to three categories of rock lobster licence and/or abalone dive licences in a given fishing year<sup>2</sup>. In addition to licensing, minimum size limits, closed seasons, and a ban on the taking of females in berry apply to lobster. Minimum size limits apply for abalone. Recreational fishers are also subject to daily bag limits of five lobster and ten abalone and possession limits of ten lobster and twenty abalone.

Since the introduction of the present licensing system, the number of persons holding at least one recreational lobster licence has increased steadily from about 8500 to 16,700 in 2004/05, representing an overall increase of more than 95% since 1995 (Fig. 1). Increases have occurred in each of the licence categories, with about 13,600 pot, 7,100 dive and 3600 ring net licences issued in 2004/05. Set against this trend was the introduction in 1998 of quota management for the commercial fishery, with objectives to reduce catches to sustainable levels and to allow for 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.

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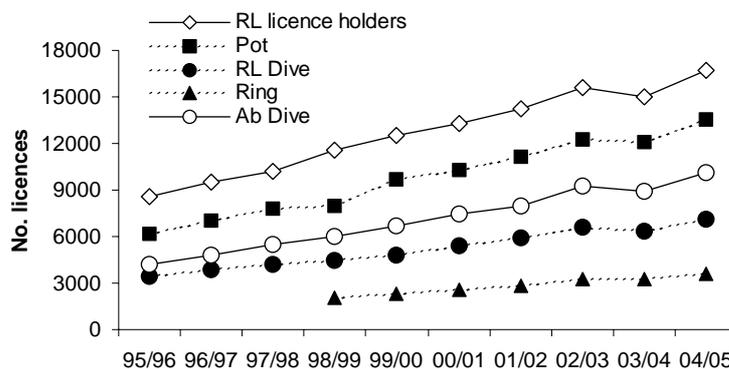
<sup>1</sup> Occasional catches of eastern rock lobster (*Jasus verreauxi*) also occur.

<sup>2</sup> Note, the licensing system also includes net and scallop licence categories.

Abalone dive licence numbers have increased by over 140% since 1995, with about 10,100 issued in 2004/05 (Fig. 1). Between 1995 and 2002 the TACC for abalone varied between 2100 – 2800 tonnes and in 2004 was set at was set at 2370 tonnes for blacklip and almost 130 tonnes for greenlip abalone.

The size of the recreational harvest has been identified as a management performance indicator for the rock lobster fishery. Specifically, if the recreational harvest exceeds 10% of the TACC in a year, recreational management arrangements will be reviewed (Anon. 1997). The recreational catch was estimated to be close to this trigger level in 2002/03 (Lyle & Morton 2004) and, as part of the current review of the rock lobster management plan, consideration is being given to an explicit allocation to the recreational sector in the form of a total allowable recreational catch (TARC). A formal position on this issue is expected to be implemented during 2006.

Recreational catches also represent an input into the rock lobster assessment model developed to assess stock status and undertake risk assessments under different management scenarios (Gardner *et al.* 2005). There are no specific management performance indicators relating to the recreational fishery for abalone though recreational catch data are taken into account in the annual assessment process (Tarbath *et al.* 2005).



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

The current recreational fishing survey represents the fifth in a series for rock lobster and the fourth for abalone undertaken since 1996. Key objectives include characterisation of the 2004/05 rock lobster and abalone fisheries in terms of participation, fishing effort and catch, and a comparison between commercial and recreational sectors based on catches.

## 2 METHODS

### 2.1 Survey design

The methodology adopted 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; and follow-up telephone-diary survey in which fishing activity was monitored in detail.

#### 2.1.1 Survey sample

The survey sample was selected from the 2003/04 recreational licensing database administered by the Department of Primary Industries, Water and Environment. While the majority of licence holders in any licensing year 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 rock lobster or abalone licences.

All fishers with rock lobster and/or abalone licences were included in the ‘population’ of licence-holders. The database was then split into three strata based on licence(s) held; Stratum 1 - holders of at least a rock lobster dive licence (may or may not also possess pot, ring and/or abalone licences); Stratum 2 - all remaining rock lobster licence-holders (may or may not also possess an abalone licence); and Stratum 3 - abalone only licence holders. A sample was randomly selected from each stratum, with higher sampling rates for strata 1 and 3, intended to improve precision in dive harvest estimates.

#### 2.1.2 Screening survey

Respondents were contacted by telephone in October 2004 and asked about their intention to renew their lobster and/or abalone licences for the 2004/05 fishing season. Sampling was conducted without replacement, i.e. persons without a telephone listing or those who could not be contacted were not substituted in the sample.

#### 2.1.3 Telephone-diary survey

All respondents who indicated that they were “quite likely” or “very likely” to renew their licences were deemed eligible and were invited to participate in the diary survey. Those who accepted were mailed a diary and letter of introduction. Diarists were contacted by telephone shortly afterwards to confirm receipt of 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 any 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.

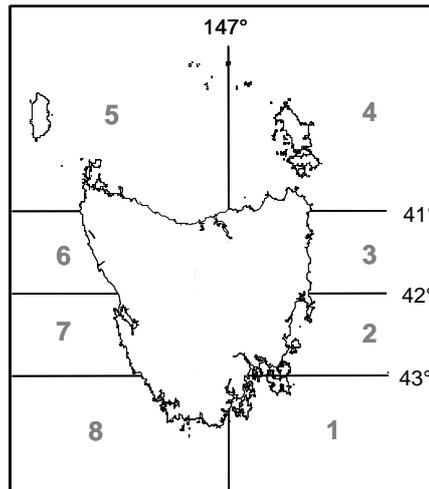
In practice, diarists were contacted at least once a month between November 2004 and May 2005, even if no fishing activity was planned. In June 2005, all diarists were contacted as usual and asked whether they anticipated any more fishing trips during the remainder of the season. Regular contact was maintained with those who expected to fish, whereas those not planning to fish again were not contacted again until September 2005 (after the closure of the rock lobster season) when details of any unexpected fishing activity were collected. Diarists who held abalone licences were contacted again in November 2005 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, target species 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 then allocated into the eight areas used for rock lobster assessment reporting (Fig. 2), though further spatial disaggregation was feasible since quite specific location information was routinely collected.

By definition, a fishing event was described in terms of method, if more than one method was used 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 to each method.

Pots were generally fished overnight. In a small number of instances pots were not checked for several days, usually because of unfavourable weather conditions. 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 lobster taken that 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 2004/05 fishing season (6 November 2004 to 31 August 2005) while for abalone the enumeration period was the licensing year (1 November 2004 to 31 October 2005).



**Fig. 2.** Map of Tasmania showing fishing areas

## 2.2 Data analysis

### 2.2.1 Catch and effort

Although initial sample selection was based on the 2003/04 licence database, licence details for 2004/05 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 2004/05 licence database and expansion factors calculated as the size of the licensed population divided by the number of licensed diarists. A small number of diarists, by virtue of licences actually held in the diary survey period, changed strata for the purposes of data analysis. As initial sample selection was random these effects are not assumed to have introduced systematic biases.

Since the number of licensed fishers increased progressively during the year, the sample size (i.e. number of licensed diarists) and total number of licensed fishers changed within the diary enumeration period. About 62% of lobster and abalone licences were issued by the end of November 2004, this proportion increased to 83% by the end of December 2004 and 90% by the end of January 2005. Very few additional licences were issued after April 2005. In order to account for this dynamic, the number of licence holders registered on the licence database and the number of licensed respondents at the end of each month 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 to harvest lobster and dive methods to harvest lobster and/or 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.

### **2.3 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. Catches are reported in terms of numbers and weights. Abalone divers report daily catch weights taken by fishing block or sub-block. For regional comparisons between commercial and recreational catches, if commercial fishing blocks were bisected by recreational area boundaries (defined in Fig. 2), commercial catches within such blocks were apportioned equally between the two adjacent recreational areas.

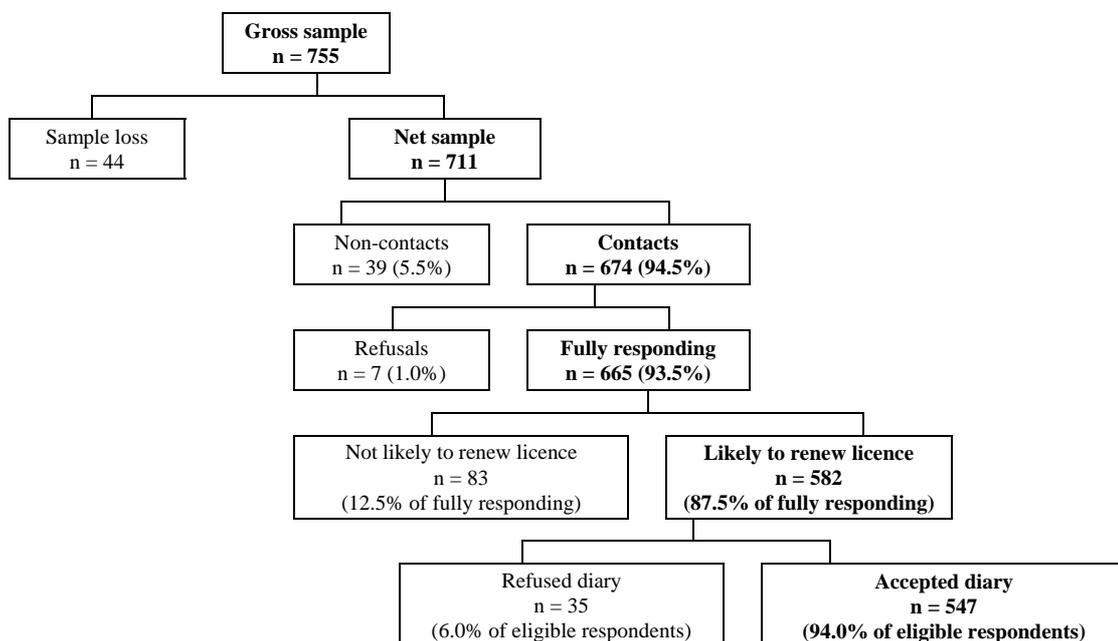
### 3 RESULTS

#### 3.1 Response rates

##### 3.1.1 Screening survey

From a random sample of 755 licence-holders selected from the 2003/04 database, 44 (7%) either had no telephone listing or the number was disconnected. This represented sample loss and reduced the effective sample size to 711. Contact was made with 674 licence-holders, of whom 665 fully responded, representing a screening survey response rate of over 94%. Non-contacts (despite at least ten attempts by telephone over a period of several weeks) accounted for 5% of the sample and refusals just 1% (Fig. 3).

Amongst the respondents, 83 indicated that they were not likely to renew their licence(s) in 2004/05 and hence were not eligible for inclusion in the diary survey<sup>3</sup>. The balance (582) indicated they were likely to renew their licence(s) in 2004/05 and 94% (547) agreed to participate in the diary survey (Fig. 3).



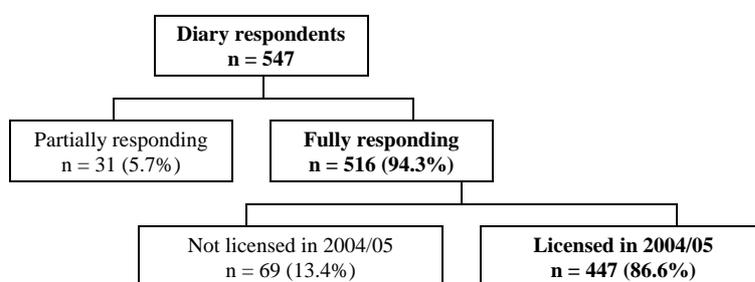
**Fig. 3.** Diagrammatic representation of the screening survey response profile (n is sample size).

<sup>3</sup> The licence status of these respondents was checked at the end of the 2004/05 season and 27 renewals were identified.

### 3.1.2 Telephone-diary survey

Diary response was high, with 516 diarists or 94% of respondents who accepted the diary participating for the entire survey period (Fig. 4). Respondents who went out of scope during the diary period (e.g. moved overseas or interstate with no intention to fish in Tasmania for the remainder of the 2004/05 season) were treated as fully responding if complete information was collected up until the time they went out of scope. Based on the total number of eligible respondents identified in the screening survey (582), the effective response rate for the diary survey was 88.6%. Given such a high response rate, possible biases arising from non-response were not considered to be a significant problem in this study.

Data for the few 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. 4.** Diagrammatic representation of the diary survey response profile (n is sample size).

Of the responding diarists, 13% did not take up a licence during 2004/05, despite rating themselves as ‘quite likely’ to ‘very likely’ to do so. Among the remaining 447 respondents, 400 held at least one category of lobster licence while 301 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 and indicate, as mentioned in Section 2.1.1, that dive licence holders were over sampled (through stratification). Overall, about one in 40 licence holders participated in the survey.

**Table 1 Total number of 2004/05 lobster and abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.**

Licence type	Licence holders	Diarists	% sampled
Rock lobster pot	13560	341	2.5
Rock lobster dive	7150	237	3.3
Rock lobster ring	3599	94	2.6
Abalone dive	10133	312	3.1
Total licences	34442	984	2.9
Total persons	17336	447	2.6

In total, diary survey respondents reported 3298 fishing events for the survey period, 3253 (99%) of which were within survey scope. In total, respondents noted that details for 76% of all valid fishing events reported were recorded in their diaries, the balance were based on recalled fishing activity (typically collected by survey interviewers within a few weeks of the activity taking place).

### 3.2 Rock lobster

Information reported in this section relates to analyses of diary survey data provided by fully responding licence holders, and is presented as expanded estimates for the total population of recreational rock lobster licence holders in 2004/05.

#### 3.2.1 State-wide catch and effort

During the 2004/05 fishing season an estimated 81.9% (SE 1.7%) of rock lobster licence holders (equivalent to 13,679 persons) fished for rock lobster. Estimates of total recreational effort (expressed in terms of fisher days) and harvest for the 2004/05 season are presented in Table 2. Overall, total fishing effort was estimated at 109,788 fisher days<sup>4</sup> for the season, yielding an estimated harvest of 127,987 lobsters, representing an average seasonal harvest rate of 1.2 lobster per day fished.

Lobster pots were the most popular fishing method (accounting for 63% of the total harvest) followed by dive collection (32%) and rings (5%) (Table 2). Although almost five times as many fisher days of effort were spent using lobster pots (89,373 days) compared with diving (17,960 days), the pot effort yielded less than double the number of lobsters (80,327 for pots and 41,473 for divers). Lobster ring harvest and effort were low by comparison with the other methods. Mean daily harvest rates were over two times higher for dive (2.3 lobster) and ring (2.5 lobster) methods compared with pots (0.9 lobster).

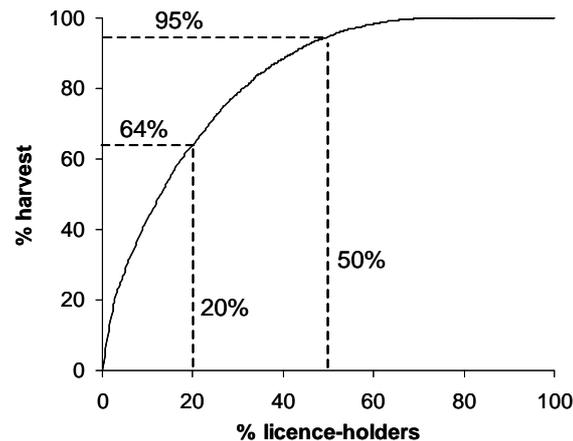
**Table 2. Rock lobster effort, harvest and harvest rates for the 2004/05 season**

Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Av. harvest rate (no. day <sup>-1</sup> )
Pot	80327 (66987 - 94431)	89373 (75321 - 104585)	0.9
Dive	41473 (31402 - 52704)	17960 (14489 - 21751)	2.3
Ring	6186 (2970 - 10046)	2455 (1316 - 3808)	2.5
Total	127987 (110520 - 146005)	109788 (95179 - 125477)	1.2

<sup>4</sup> A fisher day is defined as a day in which lobster was a nominated target species and/or lobsters were caught.

The relative contribution that individual licence-holders made to the total harvest can be represented by sorting on the basis of the number of lobster harvested by each fisher for the entire season and then plotting the cumulative harvest (Fig. 6). It is apparent that the harvest was not spread evenly amongst fishers, such that a small number of fishers accounted for a disproportionately large share of the total catch. For instance, 20% of licence-holders caught almost two thirds of the total harvest, while 29% of licence holders harvested no lobster for the season (inclusive of the 18% who did not fish, refer above). Overall, half of all licence-holders accounted for about 95% of the total seasonal harvest.

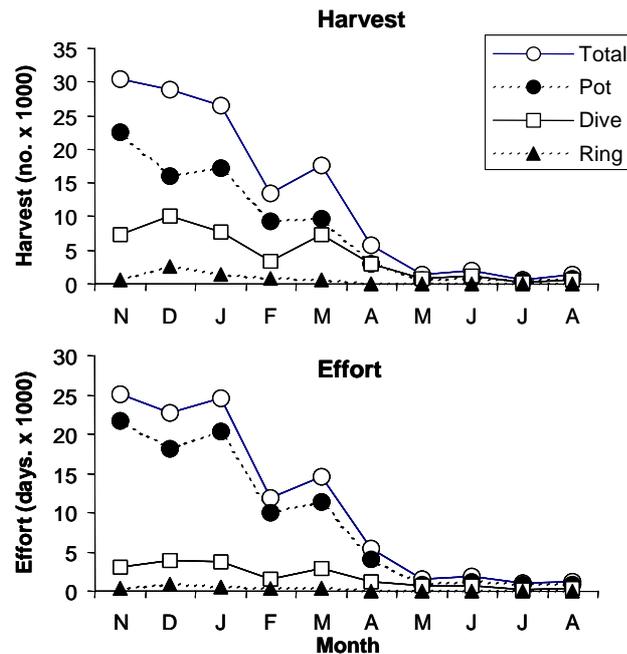


**Fig. 6.** Cumulative contribution to the total 2004/05 recreational lobster harvest by holders of lobster licences. Dotted lines indicate the proportions of the total harvest taken by the top 20 and 50% of licence holders (ranked according to the size of their seasonal lobster catches).

### 3.2.2 Seasonal catch and effort

Intense fishing activity corresponded with the opening of the season and the summer holiday period, with greatest effort and harvest during November (Fig. 7). Overall, fishing activity slowed dramatically in February but there was 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, corresponding to closure of the fishery for female lobsters and the onset of cooler and unsettled weather.

The underlying pattern of catch and effort in the fishery was influenced strongly by monthly variation in pot fishing activity, with almost 70% of the catch taken between November and January and just 28% between February and April (Fig. 7). Dive catch and effort was more evenly distributed between November and April, with 58% of the catch taken in the first three months and a further 33% in the following three month period.



**Fig. 7** Recreational rock lobster harvest (numbers) and effort (days fished) by month and method for the 2004/05 fishing season.

### 3.2.3 Regional catch and effort

Effort, catch and catch rates by fishing areas (refer Fig. 2) are summarised in Table 3 and indicate that the fishery was centred primarily off the south-east (Area 1) and east (Areas 2 & 3) coasts. This combined region accounted for 70% of the total estimated lobster harvest (90,682 lobster) and attracted 76% of the total effort (83,249 fisher days) during 2004/05. Area 1 alone contributed 40% to the total harvest.

The north coast (Areas 4 & 5) accounted 12% of the total harvest (15,423 lobster) and 11% of effort (11,932 fisher days) while the west coast (Areas 6,7 & 8) contributed 17% of the total harvest (22,062 lobster) and 13% of total effort (14,608 fisher days).

Marked regional differences were evident in the proportion of rock lobster harvested by the various methods (Fig. 8). Lobster pots accounted for the bulk of the harvest from the south-east and east coasts (69-81%) whereas dive collection was the primary capture method (62-88%) off the north coast. All three methods were of significance in the west coast fishery. Off the west coast, pots contributed up to and 93% (Area 8), dive collection up to 48% (Area 6) and lobster rings up to 44% (Area 7) of harvest.

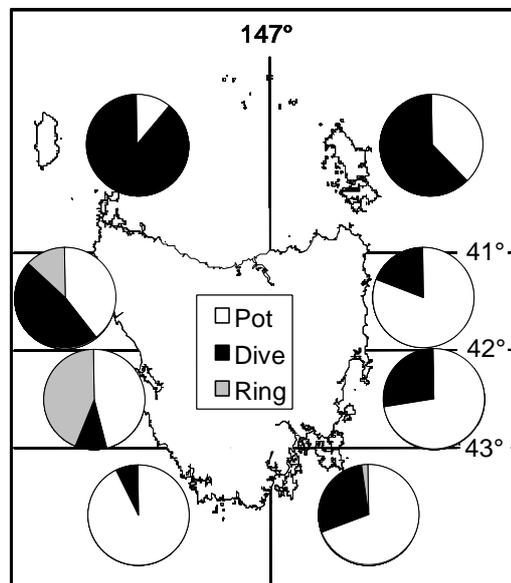
Mean daily harvest rates were highly variable around the State, ranging from over three lobster per day off the west coast (Area 7) to less than one lobster per day off the north-east (Area 3 & 4) and south-west (Area 8) coasts. Harvest rates for the remaining areas were intermediate, between 1.2-1.5 lobster per day (Table 3). Stock abundance and total fishing pressure (including commercial activity), along with the relative mix of fishing methods used, noting significantly higher harvest rates for dive collection and

rings compared with pots (Table 2), represent key factors contributing to the regional variability observed in harvest rates.

**Table 3. Recreational rock lobster effort, harvest and harvest rates by fishing area for 2004/05**

Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	51551 (40059 - 64737)	37988 (30770 - 46446)	1.36
2	19526 (13416 - 26531)	15854 (11227 - 20985)	1.23
3	19604 (11791 - 28713)	29407 (18036 - 42606)	0.67
4	4605 (1676 - 8503)	4795 (2279 - 7791)	0.96
5	10638 (4570 - 17780)	7137 (2700 - 14384)	1.49
6	7765 (4188 - 12036)	5501 (3033 - 8536)	1.41
7	9403 (4725 - 14898)	3042 (1581 - 4807)	3.09
8	4894 (2069 - 8597)	6065 (2507 - 10972)	0.81

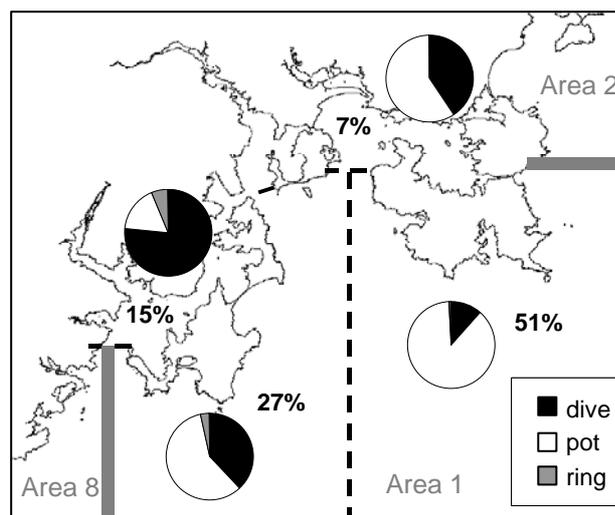


**Fig. 8.** Proportion of regional harvest by fishing method.

### 3.2.4 South-east coast fishery

Catch data for Area 1 have been disaggregated into four sub-areas to better define the spatial characteristics of the recreational fishery off the south-east coast (Fig. 9). Over half of the harvest was derived from waters around the Tasman Peninsula, with the western Storm Bay next in importance, accounting for over a quarter of the catch. The D'Entrecasteaux Channel/Derwent contributed a further 15% while catches from Norfolk/Frederick Henry Bays were relatively minor.

Pots accounted for the majority of the Tasman catches whereas dive collection clearly dominated the D'Entrecasteaux/Derwent catch, not an unexpected finding since pots are prohibited in much of the latter sub-area (Fig. 9). Pots took the majority of the catch from the two remaining sub-areas, though dive collection remained significant. Ring catches were comparatively small throughout Area 1.

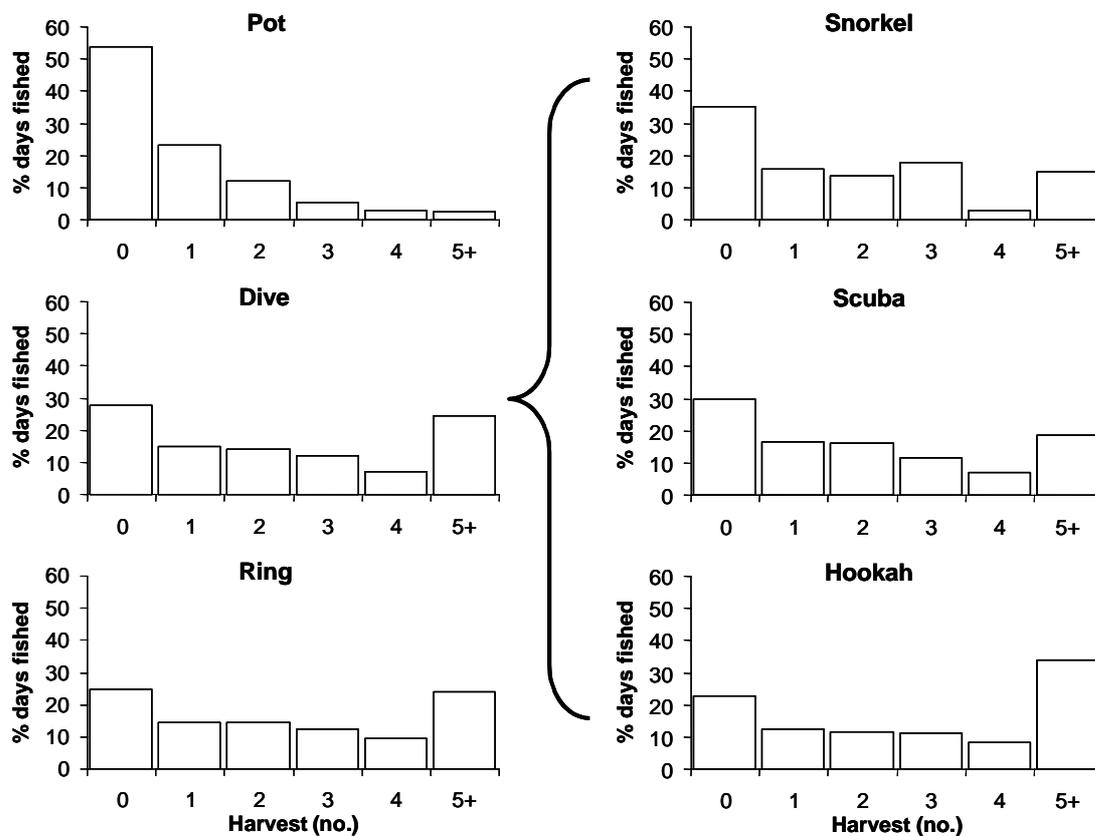


**Fig. 9.** Regional distribution of the Area 1 harvest (% values) and proportional harvest by fishing method (pie charts).

### 3.2.5 Daily harvest

Daily catch distributions differed markedly by fishing method (Fig. 10). Overall more than half of all pot-days yielded no retained catch with the daily bag limit of five lobster rarely achieved (< 3% of all fishing days). By contrast, divers and fishers using rings took the bag limit on about one in four days fished, with nil catches reported for about the same proportion of the effort.

Dive effort, which can be split into snorkel, scuba or hookah methods, revealed a strong method effect on catch rates (Fig. 10). Overall, average daily harvest rates were highest for hookah (2.7 lobster) followed by scuba (2.1 lobster) and snorkel (1.8 lobster). The bag limit was attained in 34% of hookah effort, compared with 19% of scuba and 15% of the snorkel effort. Overall, scuba proved the most popular dive method for lobster, accounting for 49% of the total dive effort and 44% of the harvest. Hookah was next in importance, representing 39% of the effort but 47% of the harvest while snorkel contributed 11% of the effort and just 9% of the dive harvest.

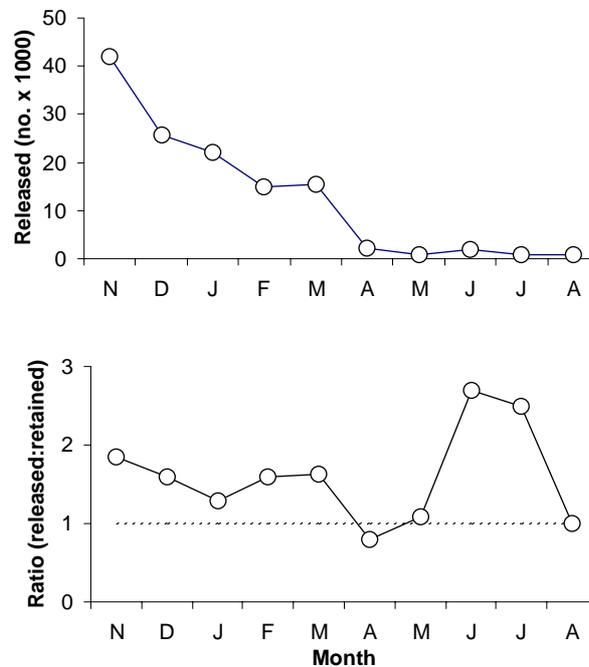


**Fig. 10.** Distribution of daily lobster harvest by fishing method for 2004/05 licence holders.

### 3.2.6 Released catch

In total, 154,108 lobsters (95% confidence interval [CI]:123,781 – 186,363) were estimated to have been released or discarded during 2004/05, equivalent to 1.2 for every lobster retained. Not unexpectedly, pots accounted for the majority of releases, the method involving passive collection as opposed to the active selection of individual lobsters by divers. During the fishing year an estimated 127,028 lobster (95% CI: 99,516 - 156,356) were released or discarded from pots. That is, for every retained pot-caught lobster, 1.5 lobster were released or discarded. The seasonal pattern of lobster releases from pots (Fig. 11) indicated that highest quantities of lobsters were released

early in the season when effort was high. The ratio of released to retained lobster peaked above 2.0 late in the season (June and July) (Fig. 11), largely influenced by the seasonal closure of the fishery to the taking of females (see below).



**Fig. 11.** Numbers of rock lobster released (top) and ratio of released to retained catch (bottom) by month for recreational pot fishing during the 2004/05 season. The dashed line represents a ratio of 1.0 (i.e. one lobster released for each lobster retained).

About 93% of pot releases were reported to be due to undersized lobsters, 6% were berried females and 1% because lobsters were dead or damaged. Just 0.1% of all released lobster were as a result of over bag limit catches. Between November and April, 95% of the pot releases were reported as being under the legal minimum size, 2% were berried females and 1% were discarded because they were dead or damaged. In the latter part of the season (May to August), the percentage of releases due to undersized lobsters fell to 72%, with releases due to berried females and the closure of the fishery to females (effectively the same thing) increasing in significance to 25%.

Although divers may release lobsters, i.e. the catch is landed and then sorted, most of this sorting occurs underwater and therefore a similar analysis of reasons for release by divers was not attempted.

### 3.2.7 Estimated harvest weight

The weight of the 2004/05 recreational harvest was estimated by multiplying the average weight of a lobster, specified by method and area caught, by the numbers harvested. Average weights for the east and south west coasts (Areas 1-3, and 8) were based on a sample of recreationally caught lobster collected from these areas during 2002/03 (Lyle *et al.* 2005). For the remaining areas, area specific average weights were determined based on commercial catch returns for catches taken by pots from shallow coastal waters (< 20 m) during 2004. Since dive caught lobster tend to be larger than pot caught individuals, these weights were adjusted by the average dive to pot weight ratio (1.33) established by Lyle *et al.* (2005). In the absence of information about the size composition of ring catches it was assumed that ring caught lobsters averaged the same weight as pot caught individuals. Average weights by area and method used to determine harvest weight are presented in Table 4.

The state-wide harvest was estimated to be 119.3 tonnes, with regional harvests ranging between 42.7 tonnes (Area 1) and 3.8 tonnes (Area 8) (Table 4). As a proportion of the recreational harvest, the south-east and east coast (Areas 1, 2 & 3) accounted 63%, the north coast (Areas 4 & 5) 20% and the west coast (Areas 6, 7 & 8) 17%. The combined effects of dive collection and presence of large lobsters off the north coast was particularly evident, with this region accounting for just 12% of the numbers (refer Table 3).

**Table 4. Average lobster weight (g) by method and total estimated harvest (kg) by area**

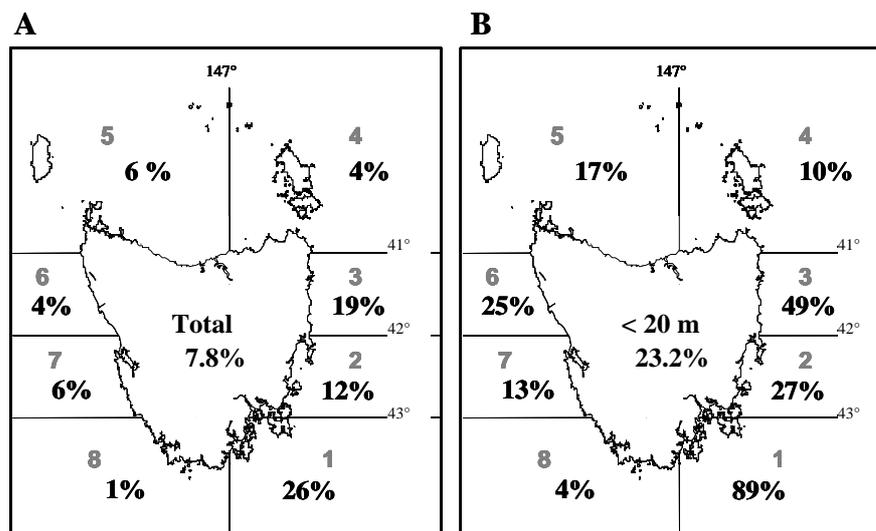
<sup>#</sup>Av. weight based on Lyle *et al.* (2005); \* av. weight based on commercial catch weights from shallow water; <sup>1</sup> av. weight calculated by multiplying av. pot weight by 1.33 (conversion ratio between pot and dive weights).

Area	Av. weight (g)		Total harvest (kg)
	Pot/Ring	Dive	
1	757 <sup>#</sup>	1006 <sup>#</sup>	42777
2	757 <sup>#</sup>	1006 <sup>#</sup>	16113
3	757 <sup>#</sup>	1006 <sup>#</sup>	15781
4	1323*	1760 <sup>1</sup>	7343
5	1268*	1687 <sup>1</sup>	17437
6	915*	1217 <sup>1</sup>	8225
7	812*	1080 <sup>1</sup>	7889
8	757 <sup>#</sup>	1006 <sup>#</sup>	3791
Total			119354

### 3.2.8 Comparison with commercial catches

The recreational harvest relative to the 2004 TACC of 1523 tonnes<sup>5</sup> was 7.8% (95% CI 6.7 - 8.9%). Regionally there was marked variability in the relative size of the recreational catch relative to the reported commercial catch<sup>6</sup>, ranging from 26% in the south-east (Area 1) to less than 6% for the north and west coasts (Areas 4-8) (Fig. 12A).

Since the majority (here assumed to be all) of the recreational catch is taken from shallow coastal waters (< 20 m) it is appropriate to compare catches at the spatial scale (depths) at which the two sectors of the fishery overlap and therefore interact. On this basis, the recreational harvest represented 23% of the shallow water commercial catch of 515 tonnes (Fig. 12B). The recreational catch almost equalled (89%) the size of the shallow water commercial catch from the south-east (Area 1), and was about half the size of the north-east coast (Area 3) catch. Central east (Area 2) and north-west (Area 6) catches equated to about one-quarter of the commercial take while in all remaining areas the recreational catch was comparatively small (<17%) by comparison with the commercial take.



**Fig. 12.** 2004/05 recreational lobster harvest (weight) expressed as a percentage of the commercial rock lobster catch by area: (A) based on total catches; and (B) based on catches from shallow water (< 20m).

<sup>5</sup> The quota year covered the period March 2004 to February 2005.

<sup>6</sup> Based on commercial catches taken during the 2004 quota year.

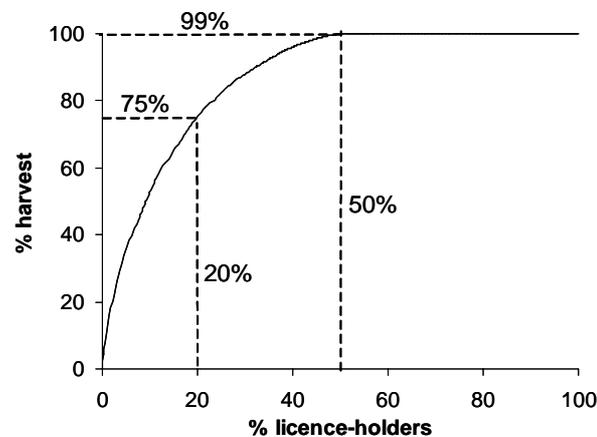
### 3.3 Abalone

Information reported in this section relates to analyses of diary survey data provided by fully responding licence holders, and is presented as expanded estimates for the total population of recreational abalone licence holders during 2004/05.

#### 3.3.1 State-wide catch and effort

An estimated 55.8% (SE 2.8%) of abalone licence holders (equivalent to 5653 persons) actually fished for abalone during 2004/05, harvesting 112,571 abalone (95% CI: 92,262 – 134,795) for 18,185 fisher days<sup>7</sup> (95% CI: 15,369 – 21,210) of effort. This represented an average harvest rate of 6.2 abalone for each day fished. The catch was taken almost exclusively by dive collection methods, though a small quantity (1%) was taken by hand collection (wading).

The relative contribution that individual licence-holders made to the total harvest is presented in Fig. 13 and revealed a pattern similar to that observed for lobster (refer Fig. 6). Overall, 20% of abalone licence-holders accounted for 75% of the total harvest while 99% of the harvest was taken by just half of all licence-holders. Almost half of all abalone licence-holders (49%) actually harvested no abalone during 2004/05 (inclusive of the 44% who did not fish for abalone).

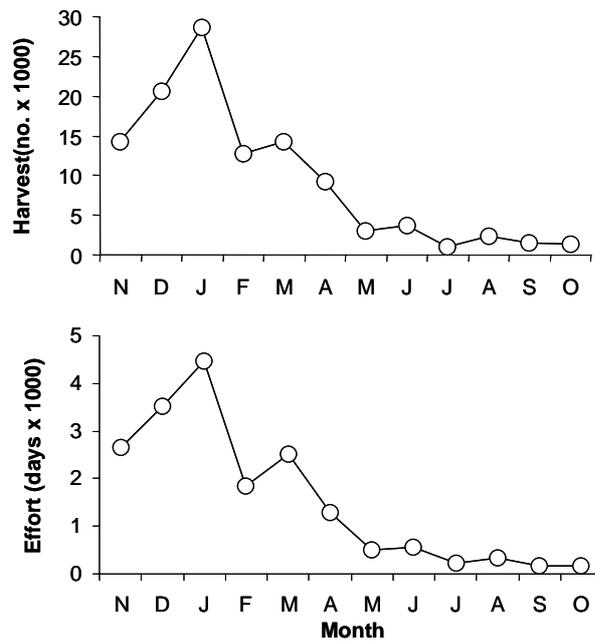


**Fig. 13.** Cumulative contribution to the total 2004/05 recreational abalone harvest by licence holders. Dotted lines indicate the proportions of the total harvest taken by the top 20 and 50% of licence holders (ranked according to the size of their seasonal abalone catches).

<sup>7</sup> A fishing day was defined as one in which abalone was a nominated target species and/or abalone were caught.

### 3.3.2 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 December and January (Fig. 14). The first three months of the licensing year accounted for 56% of the harvest and 58% of the effort. There was a sharp decline in effort and harvest in February and a minor increase in the level of fishing activity during April, mainly due to Easter fishing. The February to April period contributed just 30% of the annual harvest and effort. There was very limited fishing for abalone during the final six months of the licensing year.



**Fig. 14** Recreational abalone harvest (numbers) and effort (days fished) by month for the 2004/05 fishing season.

### 3.3.3 Regional catch and effort

Regional catch, effort and harvest rates for abalone are presented in Table 5. Recreational effort and harvest was concentrated in the south-east of the State, with just under half of the effort and harvest reported from Area 1. The east coast (Areas 2 & 3) accounted for a further 27%, the north coast (Areas 4 & 5) 17% and the west coast (Areas 6, 7 & 8) about 7% of the effort and harvest. Regional harvest rates varied between 5 and 7 abalone per day, being highest off the west coast (Areas 6-7) (7.2 and 6.9 respectively).

**Table 5. Recreational abalone effort, harvest and harvest rates by fishing area for 2004/05**  
 Values in parentheses represent the 95% confidence intervals, \* based on an average whole weight of 0.5 kg per abalone

Area	Harvest (no.)	Effort (fisher days)	Harvest rate (no. per fisher day)	Harvest (kg)*
1	53686 (38466 - 70906)	8996 (6746 - 11478)	6.0	26843
2	16068 (10086 - 22970)	2676 (1763 - 3756)	6.0	8034
3	14579 (6444 - 25033)	2137 (999 - 3602)	6.8	7289
4	5530 (783 - 11867)	915 (250 - 1853)	6.0	2765
5	14266 (7080 - 23516)	2229 (1307 - 3270)	6.4	7133
6	5709 (2362 - 9878)	805 (382 - 1305)	7.1	2854
7	1744 (358 - 3596)	238 (57 - 501)	7.3	872
8	990 (204 - 2066)	191 (54 - 366)	5.2	495

### 3.3.4 Daily harvest

Just over 40% of the dive effort targeted at abalone resulted in the bag limit being achieved (or exceeded) whereas less than 20% of dives resulted in no harvest (Fig. 15). Catch distributions for snorkel and hookah were very similar, with over 45% of dives resulting in catches of at least ten abalone and catch rates of 6.8 and 6.4 abalone per day for snorkel and hookah dive methods, respectively. The average daily catch rate for scuba was 5.2 abalone, with 20% of dives resulting in no catch, and at least ten abalone taken on 32% of the days dived.

Both effort and catch were fairly evenly distributed between the three dive methods. Scuba contributed 36% of the effort and 31% of retained catch, hookah 34% of the effort and 35% of the harvest, and snorkel accounted for 29% of effort and 32% of the harvest.

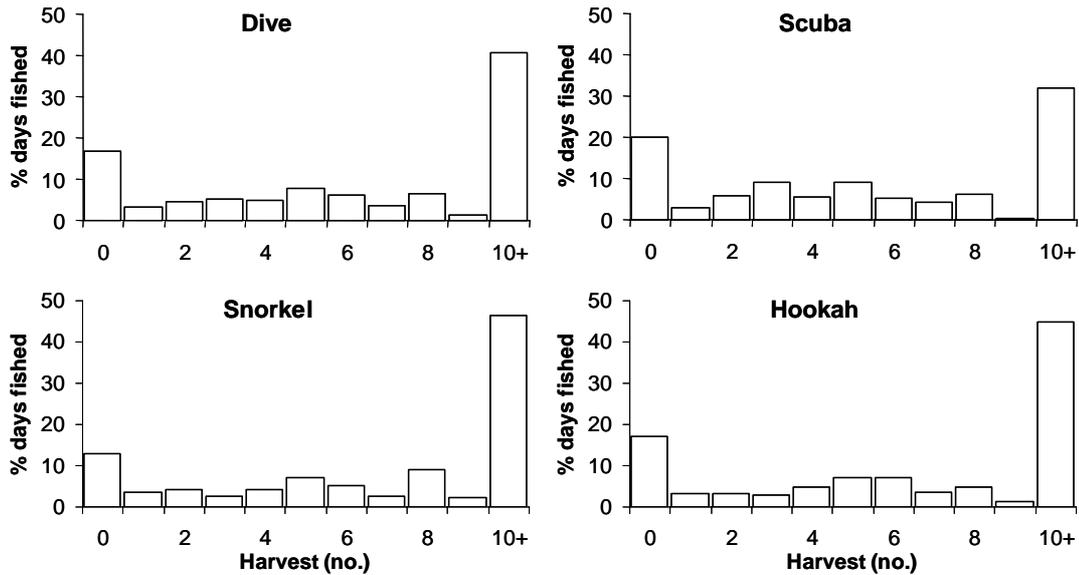


Fig. 15. Distribution of daily abalone harvest by dive methods for 2004/05 licence holders

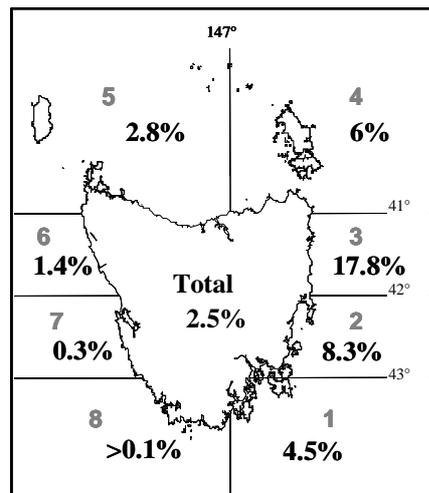
### 3.3.5 Estimated harvest weight

Size composition information was not available for recreationally caught abalone. However, based on research sampling, the average, legal sized abalone has been estimated to have a whole weight equivalent to 500 g (D Tarbath, pers. comm.), giving an estimated recreational harvest of about 56.2 tonnes during 2004/05. Regionally, harvest estimates ranged from 26.8 tonnes in Area 1 to just 0.4 tonnes in Area 8 (Table 5). The catch for the combined south-east and east coasts (Areas 1-3) was 42 tonnes, the north coast (Areas 4-5) 9.8 tonnes, and the west coast (Areas 6-8) 4.2 tonnes.

### 3.3.6 Comparison with commercial catches

The 2004 commercial abalone catch was 2270 tonnes<sup>8</sup>, indicating that the recreational harvest was 2.5% (95% CI 2.0 - 3.0%) of the commercial catch. Regionally, the size of the recreational catch ranged from almost 18% of the commercial catch in Area 3 to less than 0.3% for Areas 7 & 8 (Fig. 16). Despite the importance of Area 1 to the recreational fishery, the recreational catch in this area was equivalent to just 4.5% of the commercial catch, reflecting the significance of this region to the commercial abalone fishery.

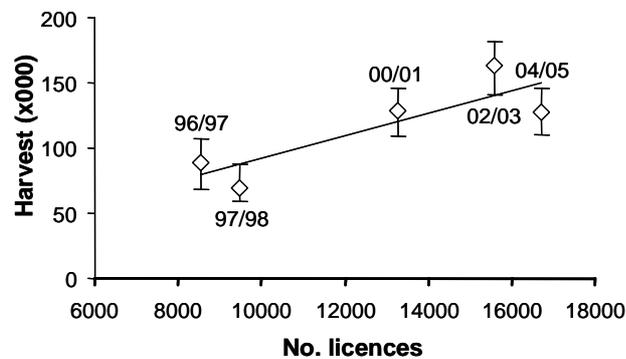
<sup>8</sup> Based on estimated weights (verified landed weight was 2397 tonnes of blacklip abalone; Tarbath *et al.* 2005).



**Fig. 16** 2004/05 recreational harvest (weight) of abalone expressed as a percentage of the 2004 commercial catch by area.

## 4 DISCUSSION

To date, five estimates of recreational rock lobster harvest are available based on the methodology applied in this survey. The surveys have indicated an underlying significant positive correlation between catch and licence numbers ( $r = 0.85$ ), although catches do exhibit some inter-seasonal variability not directly linked to licence numbers (e.g. 1996/97 compared with 1997/98, 2002/03 compared with 2004/05) (Fig. 17). Available data imply that if licence numbers continue to rise, catches are also likely to increase. A similar analysis has not been attempted for abalone since only four harvest estimates were available, though there has been a similar trend of increasing harvest with growth in licence numbers, from between 50-60,000 in the mid-1990s (Lyle 2000) to more than 110,000 abalone in recent years.



**Fig. 17** Estimated rock lobster harvest (season indicated) plotted against number of licence holders. Error bars represent 95% confidence limits and linear regression line has been plotted.

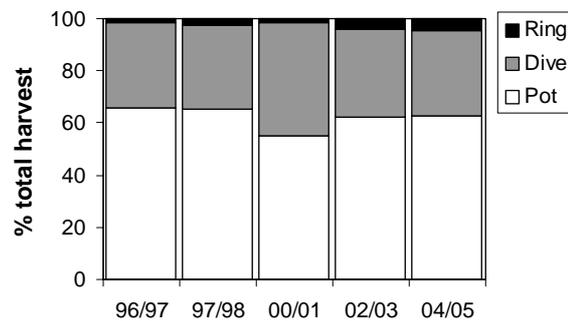
Rock lobster and abalone catches were lower in 2004/05 than in 2002/03 despite increased licence numbers. Overall there were 7% more rock lobster and almost 9% more abalone licences issued in 2004/05 but catches were 22 and 19% lower for rock lobster and abalone, respectively (Table 6). Lower participation rates represented a major contributing factor such that, in practice, around 4% fewer licence holders actually fished for either of the species during 2004/05 than in 2002/03 (Table 6). In addition, average catch and days fished for active fishers were lower during 2004/05, though the extent of these changes was less pronounced than changes in overall effort or harvest (% change). For instance, the average catch of lobster fell from 11.4 to 9.4 (-18%) while abalone fell from 22.8 to 19.9 (-15%) per active fisher in 2004/05. While reasons for lower participation rates and generally lower effort were not canvassed with respondents, they were asked (at the end of the survey) whether they had fished more, less or about the same number of days for lobster as in the previous (2003/04) season. Over 61% of diarists considered that they had fished less, almost 28% about the same and only 10% reported that they had fished more than in 2003/04. Similar questioning conducted as part of the 2002/03 survey revealed that only 52% considered that they

had fished less in 2002/03 compared with 2001/02, while 32% about the same and 15% fished more. The higher proportion of fishers indicating lower effort in 2004/05 provides circumstantial support for the notion that 2004/05 may have been a moderate or relatively poor season for lobsters.

**Table 6. Number of lobster and abalone licence holders, estimated number and proportion who fished, total and average harvest and effort per fisher for 2002/03 and 2004/05.**

	Rock lobster			Abalone		
	2002/03	2004/05	% change	2002/03	2004/05	% change
No. licence holders	15580	16710	+7.3	9272	10133	+8.5
% fished	88.4	81.9	-7.4	63.5	55.8	-13.8
No. fishers	14308	13679	-4.4	5853	5653	-3.5
Harvest (nos.)	163454	127987	-21.7	133711	112571	-18.8
Av. catch per fisher	11.4	9.4	-18.1	22.8	19.9	-14.7
Fisher days	125898	109788	-12.8	25342	18185	-39.4
Av. days per fisher	8.8	8.0	-8.8	4.3	3.2	-34.6

Pots have been found repeatedly to represent the main method for catching rock lobster by the recreational sector, the method accounting for 62-64% of the total numbers in each of the years surveyed apart from 2000/01, when pots represented 55% of the total catch (Fig. 18). Dive methods typically accounted for about one third of the harvest in all seasons but 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 but has not been evident in subsequent seasons.



**Fig. 18** Proportion of the lobster harvest by method and fishing season

Fishing activity for rock lobster and abalone is 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 during January and highest catches taken

in December and January (Lyle *et al.* 2005, present study). This was followed by sharp falls in catch and effort in February and then 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 lobster and abalone fisheries are concentrated off the south-east and east coasts of Tasmania (Lyle *et al.* 2005, present study). In 2004/05, about 40% of the lobster and almost 50% of the abalone harvest (by numbers) was taken off the south-east coast, with a further 30% and 27%, respectively, derived from the east coast. Lobster catches from the north coast were comparatively low (12%), whereas this region was slightly more significant to the abalone fishery (17%). The west coast produced about 17% of the lobster and 7% 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. In contrast, the west coast represents a very significant region for both the commercial rock lobster and abalone fisheries (Gardner *et al.* 2005, Tarbath *et al.* 2005).

There was considerable regional variability in the relative importance of the three lobster fishing methods. Pot catches clearly dominated the 2004/05 harvest off the south-east and east coasts (>69% of numbers by area), whereas dive collection was the dominant method off the north coast (>60% of numbers). Pots, dive collection, and rings were each locally important in the west coast areas. Such regional differences based on fishing method were consistent with patterns observed in previous surveys (Lyle 2000, Forward & Lyle 2002, Lyle & Morton, 2004).

Average daily lobster harvest rates in 2004/05 for pots (0.9 lobster) and diving (2.3 lobster) were within the range determined for previous seasons (i.e., 0.9-1.2 for pots and 2.1-2.6 for dive). The average harvest rate for abalone (6.2 abalone) was within the range determined for 1996/97 and 1997/98 (6.0-6.6 abalone), but higher than in 2002/03 (5.3 abalone).

Artificial breathing apparatus (hookah and scuba) conferred a clear advantage when targeting lobster (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 almost as high as those for hookah. This is not unexpected given that abalone are sessile and often common in shallow waters. Of the dive methods, harvest rates were highest for hookah divers, an observation that has been noted in previous surveys (Lyle 2000, Forward & Lyle 2002, Lyle & Morton 2004).

Divers often target rock lobster and abalone on a dive and during 2004/05 over half (53%) of all dives involved targeting both species, with this combined effort accounting for 69% and 63% of the dive harvest of lobster and abalone, respectively. Recognition of this fishing behaviour has implications for the 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 lobster and abalone catches in Tasmania. In practice, being restricted to a single pot, pot fishers rarely (<3% days fished) attained the bag limit of five lobster. By contrast, bag limits had a more obvious impact on lobster and abalone dive catches, with about one quarter of the dive effort for either species resulting in the bag limit being achieved.

Relative to the commercial lobster catch, the recreational harvest has more than doubled since the late 1990s, reflecting the combined effects of increased recreational catches and reduction in the commercial catch following the introduction of catch limits (quota). The estimated recreational catch of 119 tonnes represented less than 8% of the 2004 TACC of 1523 tonnes. Comparisons based on state-wide catches can, however, underestimate regional impacts. This was particularly evident off south-eastern Tasmania where, in 2004/05, the recreational catch exceeded one quarter of the commercial take from that area but was comparatively small (<6%) in areas such as the north and west coasts. Furthermore, depth limitations on diving and practicalities of hauling pots and ring nets imply that the recreational rock lobster fishery operates primarily in shallow waters, presumably at depths of less than about 20 m. By contrast, commercial fishers operate over wider areas, including deeper offshore reefs and typically only about one third of their harvest is taken in depths of less than 20 m. Thus where the sectors overlap (based on depth) the recreational proportion of the catch was higher than implied by comparison of total catches. If only shallow-water catches were considered, then the state-wide recreational catch was just under one quarter of size of the commercial take in 2004/05 and almost equivalent to the commercial catch off the south-east coast (the majority of which was taken from the Tasman Peninsula).

The recreational rock lobster harvest relative to the total allowable commercial catch (TACC) has been identified as a management performance indicator, with a trigger reached when the recreational catch equals or exceeds 10% of the TACC. Based on the 2004 TACC, the recreational harvest for 2004/05 clearly did not exceed the trigger level. By contrast, the higher 2002/03 recreational catch was close to this trigger, and highlighted the need for on-going assessments and to review management arrangements, a process that should be completed during 2006.

The recreational abalone harvest in 2004/05 was equivalent to less than 3% of the 2004 commercial abalone catch. Regionally, as a proportion of the commercial harvest, the recreational catch was most significant (around 8% or greater) off the east coast. Significantly, recent assessments have indicated that some abalone stocks off the east coast (particularly abalone fishing block 30, which is in Area 3) are depressed (Tarbath *et al.* 2005). The impacts of fishing pressure in this region are likely to be exacerbated since recreational fishers may continue to fish an area even when abalone densities are reduced to below levels that are typically classed as commercially viable. There are no management performance indicators relating to the recreational fishery in the Abalone Management Plan but recreational catches need to be explicitly factored into on-going stock assessment and future management strategies.

## Acknowledgments

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

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