TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES: 2018-19 FISHING SEASON

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July 2019

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Executive Summary

This report provides an assessment of the 2018-19 recreational Rock Lobster and Abalone fishing season and continues the time series monitoring trends in these fisheries commenced in the mid-1990s.

During 2018-19 more than 18,000 persons held at least one recreational Rock Lobster licence and over 11,000 persons held a recreational Abalone licence, an increase of approximately 5% when compared with 2017-18.

The assessment is provided by a survey involving a random sample of licence-holders who were contacted by telephone prior to the start of the 2018-19 fishing season and invited to participate in a phone-diary survey to monitor their Rock Lobster and Abalone fishing activity between November 2018 and April 2019. A total of 477 respondents (385 valid licence-holders) completed the survey (80% effective response rate), providing detailed catch and effort information for each fishing trip undertaken. These data were scaled up to represent the activity of all licence-holders.

The 2018-19 Rock Lobster season for all waters outside of the East Coast Stock Rebuilding Zone (ECSRZ) opened on 3 Nov 2018 and closed on 30 Apr 2018 in the Eastern region and 31 Aug 2019 in the Western region. The ECRSZ opened on 8 Dec, representing the first time that a split season opening has been applied in the Eastern region. Rock lobster fishing activity was monitored up to the end of April, which meant complete coverage of the fishery in the Eastern region but partial coverage of the Western region fishery. Up until the end of April, licensed recreational fishers were estimated to have harvested 70,100 (95% CI: 59,545 – 80,670) lobster, based on 73,327 fisher days of effort. Potting was the dominant method, representing 79% of the effort (days fished) and contributing 62% of the harvest. Dive collection accounted for 21% of the effort and 37% of the harvest, while ring usage contributed <1% of the effort and 1% of the harvest. The state-wide average catch rate was 0.96 lobster per day fished, with daily harvest rates for dive collection (1.67 lobster) more than double that for pots (0.74 lobster).

The Rock Lobster fishery was concentrated off the east coast with this area accounting for 78% of the harvest (by number). The remaining harvest was split more or less evenly between the north and west coasts. Conversion of lobster numbers to weight produced a state-wide harvest estimate of 74.7 tonnes for the survey period, with catches from the east coast accounting for 72%, the north coast 18%, and the west coast 10% by weight. Overall, the recreational catch represented about 44% of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to about 6% of the 2018-19 total allowable catch (TAC) of 1221 tonnes, which includes the total allowable commercial catch (TACC) of 1051 tonnes.

A key component of the East Coast Stock Rebuilding Strategy has been the implementation of an east coast recreational catch share target, set at 40 tonnes for the stock rebuilding zone in 2018-19. The catch for the zone was, estimated at 48.6 tonnes indicating that the catch target was exceeded by 8.6 tonnes or about 20%. This compares with “over-catches” of 13.6 and 8.2 tonnes in 2014-15 and 2016-17, respectively. By contrast, there was an “under-catch” of 6.3 tonnes in 2015-16 while in 2017-18 the catch target was effectively equalled (refer table). In both of these seasons, however, biotoxin closures during peak fishing periods resulted in marked reductions in recreational effort (and catch), indicating that current management settings alone have been insufficient to constrain east coast catches to within recreational catch targets.

East Coast Stock Rebuilding Zone recreational catches relative to catch targets.

Season	2014-15	2015-16	2016-17	2017-18	2018-19
Catch target	42 t	42 t	42 t	41 t	40 t
Catch estimate	55.6 t	35.7 t	50.2 t	40.4 t	48.6 t
Over/under catch	+13.6 t	- 6.3 t	+ 8.2 t	- 0.6 t	+ 8.6 t
Relative difference	+ 32%	- 15%	+ 19%	- 1%	+ 21%

Respondents were asked a range of questions relevant to the management and state of the Rock Lobster fishery, key findings included:

- Almost three-quarters of the respondents indicated that the overall quality of the fishery in 2018-19 was about the same or better than in the previous year.
- In relation to the split opening of the Eastern region, about one in five fishers indicated that their fishing behaviour had been affected, mainly through fishing less (presumably due to the delayed opening of the stock rebuilding zone), although some fishers had clearly taken advantage of the split opening and travelled to the open areas. The majority of those who fished in areas of the east coast that had opened earlier indicated no obvious problems (e.g. congestion at ramps, competition with other fishers) arising from increased numbers of fishers directing effort into these areas.
- In relation to the split opening, almost twice as many respondents indicated they thought it would have been better for the east coast to have opened at the same time (43%) than those who considered it to be a positive thing (24%). However, a third of respondents were unsure, suggesting a relatively high level of uncertainty about the efficacy of management approach.
- There was a high level of general awareness amongst fishers (77% respondents) of the long spined sea urchin issue affecting the east coast reef systems, in particular respondents highlighted concern over the impact on the reefs (barren formation) and the implications for fisheries.

The recreational Abalone harvest up until the end of April 2019 was estimated at 44,740 (95% CI: 31,246 – 56,660) individuals, based on 10,081 diver days of effort. Blacklip Abalone accounted for almost 80% and Greenlip Abalone 20% of the total numbers. Over 61% of the catch was taken from the east coast, with a further 27% from the north and 12% from the west coasts. About one in five dives resulted in the daily bag limit of 10 abalone being taken; the overall average daily harvest rate was 4.5 abalone.

By converting numbers to weights, the recreational harvest was estimated at 21.0 tonnes, equivalent to just under 2% of the 2018 TACC (1,333 tonnes), noting however, the survey only accounts for recreational harvest up until April rather than the full year. There are currently no performance indicators or a TARC for the Tasmanian recreational Abalone fishery.

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1 INTRODUCTION

Rock Lobster and Abalone have long represented an important food source for the local Aboriginal population as well as being highly prized by recreational fishers in Tasmania. Southern Rock Lobster (*Jasus edwards*ii) and occasionally the Eastern Rock Lobster (*Sagmariasus verreauxi*) are taken by a variety of methods including pots, ring nets and dive collection. Two species of Abalone, Blacklip Abalone (*Haliotis rubra*) and Greenlip Abalone (*H. laevigata*), are targeted by recreational divers; the former species harvested around the state and dominating the catch and the latter species generally restricted to the north coast and Bass Strait Islands. In addition to recreational importance, Rock Lobster and Abalone support major commercial fisheries in Tasmania, both of which are subject to catch quotas.

Recreational licences (first introduced in the late 1970s) are required to harvest Rock Lobster and Abalone in Tasmania. The licences are method-based and prior to the mid-1990s consisted of a pot and a general dive licence; the latter permitting the capture of Rock Lobster, Abalone, and Scallops by diving. The licensing system was revised in 1995 and the general dive licence was split into lobster dive, scallop dive and abalone licences. In 1998, a lobster ring licence was introduced to formally recognise this capture method in the licensing system. Pot fishers are permitted to use one pot, ring fishers up to four rings, and divers can use artificial breathing apparatus (scuba or surface air supply, the latter commonly known as hookah). Although a licence is not required for Aboriginal persons, rock lobster pots and rings used by Aboriginal fishers must be marked with a Unique Identifying Code (approximately 1,700 have been issued since 2014).

Recreational licences are issued annually, with the licensing year extending from November to the following October. In a given year, recreational fishers may hold up to three categories of lobster licence (pot, ring and/or dive) and/or an abalone licence[1]. In addition to licensing, minimum size limits, closed seasons, and a ban on the taking of females carrying eggs, referred to as in 'berry', apply to Rock Lobster. Minimum size limits apply for Abalone. Recreational fishers are also subject to daily bag and possession limits for both Rock Lobster and Abalone and a boat limit for Rock Lobster.

Following the introduction of the current licensing system, the number of persons holding recreational Rock Lobster licences more than doubled from about 8500 in 1995-96 to 21,000 by 2007-08 (Fig. 1). Increases occurred in each of the licence categories, with over 18,000 pot, 9,000 dive and 5,600 ring net licences issued in 2007-08. Rock Lobster licence numbers remained relatively stable up until 2009-10, then declined over the following three seasons before increasing slightly to levels comparable to the mid-2000s. A sharp fall in licence numbers was experienced in 2015-16, largely influenced by closures of parts of the east coast early in the season due to harmful algal blooms (biotoxin events). Similar biotoxin events were experienced during the 2017-18 season, contributing to a 5% decline in licence sales compared with 2016-17. In the current season almost 18,100 persons held at least one Rock Lobster licence category, with 15,000 pot, 8,450 dive and 4,360 ring licences issued. Abalone licence sales have followed a similar trend, almost tripling between 1995-96 and 2007-08, to a peak of 13,500 licences (Fig. 1). Sales have remained relatively stable since 2010-11 but at a lower level, with about 11,200 licences issued in 2018-19.

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

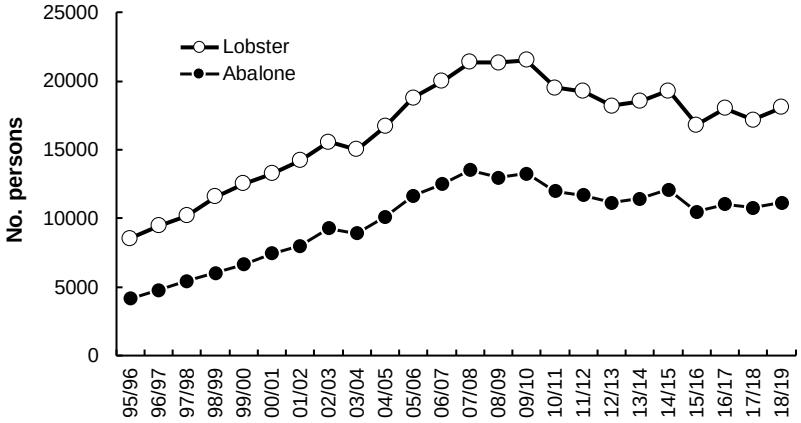

Fig. 1. Number of persons holding recreational Rock Lobster and Abalone licences by licensing year.

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

In the 2005 management review of the Tasmanian Rock Lobster fishery, provision was made for an explicit allocation to the recreational sector. Under these arrangements, a notional total allowable recreational catch (TARC) was set at 170 tonnes or 10% of the total allowable catch (TAC), whichever is the larger quantity. Based on these criteria, the TARC defaulted to 170 tonnes for 2018-19 which, when added to the TACC, resulted in a notional TAC of 1220.7 tonnes. Recreational catch information is required to evaluate performance against the TARC and also as an input into the Rock Lobster assessment developed to model stock status and undertake risk assessments under different management scenarios (Hartmann *et al.* 2013).

Concerns around declining rock lobster stocks in Tasmania were identified in the late 2000s and in 2011-12 east coast stocks were assessed to have hit historically low levels, attributed to a combination of years of below average recruitment and heavy fishing pressure (Hartmann et al., 2013). In response, a formal stock rebuilding strategy was implemented in 2013 with a goal to rebuild east coast stocks to greater than 20% of the unfished stock level by 2023 (DPIPWE 2013). A key element of this strategy, referred to as the East Coast Stock Rebuilding Strategy (ECSRS), is to limit the average annual total catch (recreational and commercial) off the east coast of Tasmania to 200 tonnes. However, because the rebuilding strategy was judged to be behind schedule this catch target was lowered to 195 tonnes in 2018 (DPIPWE 2018).

In order to focus management in the area of most concern, the fishery was split into two regions in 2011 (Fig. 2) and in the Eastern region bag and possession limits were reduced from 5 to 3 and from 10 to 6, respectively and the season opening was delayed by two weeks. Bag and possession limits for the Western region remained unchanged at 5 and 10 lobsters, respectively. Boat limits were also introduced for the first time and

were set at 15 lobsters for the Eastern region and 25 for the Western region. Eastern region daily bag, possession and boat limits were further reduced to 2, 4 and 10 lobsters, respectively in 2015 and the fishing season closed on 30th April, some four months earlier than in previous years. These more recent changes were implemented to further constrain recreational catches from the east coast. Under the rebuilding strategy, the commercial fishery is subject to an East Coast catch cap which is monitored within the quota management system.

In 2016, the Minister for Primary Industries and Water (Tasmania) determined that the catch limit for the east coast stock rebuilding zone (ECSRZ) be split 79% to commercial and 21% to recreational sectors, reflecting the historic proportion of commercial and recreational catches from within the rebuilding zone. This sharing arrangement meant that the east coast catch target was initially split 158 tonnes to the commercial fishery and 42 tonnes to the recreational fishery. From 2017-18 the southern boundary of the ECSRZ was adjusted to a line running south from Southport to Bruny Island and then east from Tasman Head (Fig. 2b) (DPIPWE 2018). The revised ECSRZ catch split for 2017-18 was determined to be 134 tonnes for the commercial fishery and 41 tonnes for the recreational fishery while for 2018-19 the catch split was revised to 131 tonnes for the commercial fishery and 40 tonnes for the recreational fishery.

In 2018, a split season opening was applied for the Eastern region, with waters outside of the ECSRZ opening on the same date as the Western region (3 November 2018) while opening of the ECSRZ was delayed by five weeks (8 December 2018) as a further measure to help constrain recreational catches from within the rebuilding zone.

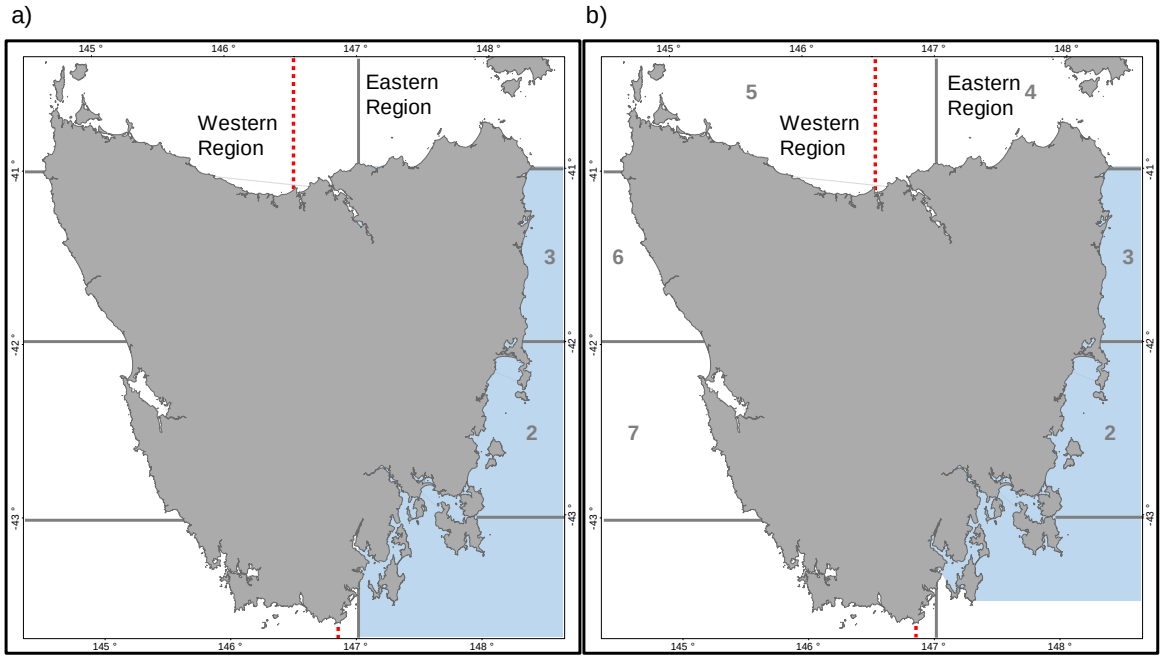

Fig 2. Map of Tasmania showing assessment areas (numbered), stock rebuilding zone (ECSRZ) (shaded) and the Eastern and Western Region boundary (red dotted line): a) ECSRZ that applied between 2013/14 and 2016/17; b) adjusted ECSRZ that applied from 2017/18.

The TACC for Abalone has been reduced progressively since 2010, from 2660 to 1333.5 tonnes in 2018 (1200.5 tonnes for Blacklip and 133 tonnes for Greenlip Abalone). While there are no specific management performance indicators relating to the recreational fishery for Abalone, recreational catch data are taken into account in the annual assessment process (Mundy & Jones 2017).

This survey represents the fourteenth in a series for Rock Lobster and the thirteenth for Abalone undertaken since 1996. Key objectives include characterisation of the 2018-19 Rock Lobster and Abalone fisheries in terms of participation, fishing effort and catch, with particular focus on the fishery off the east coast.

2 METHODS

2.1 Survey design

The methodology applied is based on that used successfully in previous surveys and independently reviewed by Pollock (2010). The design involves a two-stage process; an initial telephone interview to profile licence-holders and establish eligibility for a telephone-diary survey in which fishing activity is monitored in detail. The diary period included the 2018-19 licensing year up until the closure of the Eastern region Rock Lobster fishery (i.e. between 1 November 2018 and 30 April 2019).

2.1.1 Survey sample

The survey sample was selected from the 2017-18 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 residents also take out licences. Commercial fishers are eligible to hold recreational licences, although restrictions controlling recreational gear and its use on commercial fishing trips apply. Persons under 10 years of age are not eligible to hold a licence.

The database of all persons holding a 2017-18 recreational rock lobster licence was divided into five regional (i.e. residential) strata. For Tasmanian residents, regions corresponded to the Australian Bureau of Statistics (ABS) ASGS Statistical Areas (Level 4), namely Hobart, South East, Launceston and North East, and West and North West. Interstate residents were grouped into a fifth 'Interstate' stratum. A stratified random sample was selected from the database, with a constant sampling fraction applied to each of the South East and Launceston and North East strata and a lower sampling fraction (two thirds of that for the South East and Launceston and North East) applied to the three remaining strata. Higher sampling rates for residents of the South East and Launceston and North East strata were intended to improve the precision of estimates of east coast fishing activity.

2.1.2 Screening survey

Respondents were contacted by telephone during October 2018 and asked about their fishing for Rock Lobster and Abalone during the 2017-18 season (number of days fished and estimated retained catch for either species) and whether they expected to renew their fishing licences for the 2018-19 fishing season. Sampling was conducted without replacement, i.e. persons without a telephone listing or those who did not respond were not substituted in the sample.

2.1.3 Telephone-diary survey

Respondents who indicated an intention to renew their licences were deemed eligible and were invited to participate in the diary survey. Those who accepted were mailed a simple diary and letter of introduction. Diarists were contacted by telephone shortly afterwards to confirm receipt of their survey kit and have reporting requirements explained. Diarists were then contacted regularly by telephone throughout the survey period by experienced interviewers who recorded details of any Rock Lobster and/or Abalone fishing activity since last contact. The frequency of the contact was tailored to the needs and behaviour (level of fishing activity) of individual respondents and thus detailed information was routinely collected soon after each fishing event, minimising recall bias for non-diarised data. By maintaining regular contact, typically at least once

a month, interviewers were also able to clarify any misunderstandings or inconsistencies at the time of the interview, thereby maximising overall data quality and completeness.

Information collected for each fishing activity or 'event' included the date, location, method used, target species for divers, start and finish times (including any significant breaks from fishing), and the numbers of lobster and/or abalone kept (harvested). In addition, the numbers of lobster released and reason(s) for release were recorded. Fishing locations were allocated into the eight areas used for lobster fishery assessment reporting (refer Fig. 2), though further disaggregation was feasible since more specific location information was routinely collected.

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

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

The enumeration period for lobster was from the opening of the season (3 Nov 2018 for all waters outside of the ECSRZ; 8 Dec 2018 for waters within ECSRZ) until closure of the Eastern region fishery (30 Apr 2018). The survey period was from 1 Nov 2018 to 30 Apr 2019 for abalone, and thus only providing a partial season estimate.

2.1.4 Wash-up survey

At the completion of the diary survey fully responding diarists aged 18 years and older were asked a series of questions relating to their fishing activity, perceptions relating to the quality of the fishery, and opinions regarding recent management changes.

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2017-18 licence database, licence details for 2018-19 were used for data expansion. That is, the licence status (licences held and dates of issue) was established for all diarists by reference to the 2018-19 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, 42% of licences were issued by the end of November, 81% by the end of December 2018 and 91% by the end of January 2019. In order to account for this dynamic, the number of licence holders registered on the licence database and the number of licensed diarists at the end of each month (sensitive to the stratification) provided the basis for calculating expansion factors that were applied to fishing activity for the given month.

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

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

2.3 Size composition

Size composition information for recreationally caught Rock Lobster was provided by volunteer diarists. At screening, potential diarists who had reported substantial fishing activity during the 2017-18 fishing season were asked whether they would also measure their catch as part of the survey. Respondents who expressed an interest were provided with a set of callipers and an instruction sheet showing how to measure and sex Rock Lobster. Sex and carapace length (mm) information reported by respondents was linked to capture events, enabling size composition information to be made sensitive to fishing method and region.

Lengths were converted into weights using the following relationships:

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

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

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

3 RESULTS

3.1 Response rates

3.1.1 Screening survey

From a random sample of 899 licence-holders selected from the 2017-18 licence database, 75 (8.3%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 824. Contact was made with 745 licence-holders, of whom 687 fully responded, representing a screening survey response rate of 82.9%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 9.6% of the net sample and refusals or other non-response a further 7.5% (Table 1).

Amongst the respondents, 71 indicated that they were not likely to renew their licence(s) in 2018-19 and hence were not eligible for inclusion in the diary survey. The balance (616) indicated they were likely to renew their licence(s) (Table 1). Of this latter group, 78.4% were determined to have renewed their licence(s) based on the 2018-19 licence database, this compared with a renewal rate of 36.6% for those respondents who did not expect to take out a licence in 2018-19.

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

	Sample	% sample/ % eligible	Licence renewed 2018-19	Licence not renewed	% renewed
Screening survey					
Gross sample	899		626	273	69.6
Sample loss	75	8.3			
Net sample	824		583	241	70.8
Full response	687	82.9	509	178	74.1
Non-response	58	7.5	30	28	51.7
Non-contact	79	9.6	44	35	55.7
Eligible for diary					
Y- Likely to renew	616		483	133	78.4
N - Not likely to renew	*71*		*26*	*45*	36.6
Diary Survey					
Full response	477	77.4	385	92	80.7
Partial response	43	7.0	32	11	74.4
Refuse diary	96	15.6	66	30	68.8

3.1.2 Telephone-diary survey

In total 616 respondents were deemed eligible to participate in the diary survey (i.e. likely to renew), of whom 520 accepted the diary with 477 completing the survey. Of the responding diarists, 92 (19.3%) did not take up a licence during 2018-19 despite rating

themselves as 'quite likely' or 'very likely' to do so. Among the remaining 385 respondents, 374 held at least one category of lobster licence and 239 were licensed for abalone. Considering the total number of eligible respondents who renewed their licences (483) this represented an effective survey response rate of 79.7% (Table 1). Data for the diarists who partially responded (i.e. declined to participate for the full period or with whom contact was lost) have been excluded from all analyses.

The numbers of individual lobster and abalone licences (population) and the sample of responding diarists are presented in Table 2. Overall, about one in 50 of all 2018-19 licence holders were involved in the survey.

Table 2 Total number of 2018-19 lobster and abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.

Licence type	Licence holders	Diarists	% sampled
Rock Lobster pot	15,011	323	2.15
Rock Lobster dive	8,450	171	2.02
Rock Lobster ring	4,361	83	1.90
Abalone	11,127	239	2.15
Total licences	38,949	816	2.10
Total persons	18,792	385	2.05

Fully responding diarists reported a total of 1927 fishing events during the survey period, 1830 (95%) of which were considered valid events[2]. In total, 79% of all valid fishing events were reported as being diarised, the balance was based on recalled fishing activity (typically collected by survey interviewers within a few weeks of the activity taking place).

3.2 Rock Lobster

3.2.1 2017-18 participation

Information provided in the screening survey indicated that 78.2% (SE 1.6%) of 2017-18 Rock Lobster licence holders fished for Rock Lobster during that season, with 67.6% (SE 1.8%) harvesting at least one lobster. That is, out of the 17,162 persons licensed in 2017-18, 13,423 fished for Rock Lobster with 11,599 harvesting one or more lobster during that season. This information is, however, subject to recall bias as it was collected retrospectively and as such is considered indicative only.

3.2.2 2018-19 catch and effort

Information reported in this and following sections relates to diary survey data provided by fully responding licence holders and is presented as expanded estimates representative of the activities of all recreational Rock Lobster licence holders between November 2018 and April 2019, inclusive.

An estimated 73.2% (SE 2.3%) of licence holders fished for Rock Lobster at least once during the fishing season with 61.4% (SE 2.5%) harvesting at least one lobster during the diary period. That is, out of the 18,080 licence-holders, 13,329 actually fished for lobster with 11,097 retaining at least one for the period.

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

Overall, total fishing effort was estimated to be 73,327 fisher days[3] for the period November to April, yielding a total harvest of 70,010 lobster (Table 3). This represented an average harvest rate of 0.96 lobster per day fished. Pots were the most popular fishing method (accounting for 62% of the total harvest) followed by dive collection (37%) and rings (1%) (Table 3). Although almost four times as many fisher days of effort were spent using pots compared with diving, the catch taken by pots was only 1.7 times greater than the dive catch. Average catch rates for divers (1.67 lobster per day) were more than double that for potters (0.74 lobster per day), accounting for the discrepancy between method-based contributions to total catch and effort. The average daily harvest for rings was similar to that for divers (1.45 lobster).

Table 3. Rock Lobster effort, harvest and harvest rates for the 2018-19 season up until 30 April

Values in parentheses represent the 95% confidence intervals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day^{-1})
Pot	43,243 (35,244 – 51,841)	58,131 (48,455 – 69,694)	0.74
Dive	25,823 (18,480 – 34,194)	15,448 (11,522 – 19,953)	1.67
Ring	1,034 (154 – 2,154)	711 (179 – 1,352)	1.45
Total	70,100 (59,545 – 80,670)	73,327 (63,250 – 84,808)	0.96

3.2.3 Regional catch and effort

Catch, effort and catch rates by fishing areas are summarised in Table 4 and Fig. 3a and indicate that the fishery was primarily concentrated on the east coast (Areas 1-3). This combined region accounted for 78% of the total estimated harvest (54,522 lobster) and attracted 86% of the total effort (62,946 fisher days) during the survey period. Area 1 accounted for 44% of the state-wide harvest and 48% the total effort. The north coast (Areas 4 & 5) accounted for 13% of the harvest (8,841 lobster) and 10% of effort (7,572 fisher days) while the west coast (Areas 6 - 8) contributed 10% of the total harvest (6,737 lobster) and 4% of total effort (2,810 fisher days).

Marked regional differences were evident in the proportion of the Rock Lobster harvest taken by different fishing methods (Fig. 4). Pots accounted for the bulk of the harvest in Areas 1 - 3 (62 - 78%) and Area 7 (70%), while dive collection was the primary capture method in Areas 4-5 (57-80%) and Area 6 (61%). Rings were most commonly used off the west coast, accounting for up to 8% of the harvest in Areas 6 and 7.

Mean daily harvest rates were highly variable around the state, ranging from over 1.5 lobster per day in Areas 5-8 to 0.7 in Area 3 (Table 4). Stock abundance and fishing pressure (including commercial activity), along with differing regional bag limits and the relative mix of fishing methods used (Fig. 4), represent key factors contributing to this regional variability.

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

Table 4. Recreational Rock Lobster effort, harvest and harvest rates by fishing area for 2018-19

Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	31,074 (24,544 – 37,822)	35,044 (27,222 – 44,638)	0.89
2	10,640 (6,476 – 15,489)	9,493 (6,136 – 13,602)	1.12
3	12,807 (7,806 – 18,874)	18,409 (12,900 – 24,496)	0.70
4	5,078 (3,273 - 7,476)	5,160 (3,286 -7,287)	0.98
5	3,673 (1,129 – 7,595)	2,412 (997 – 4,585)	1.56
6	3,561 (1,269 – 6,765)	1,813 (783 – 3,161)	1.96
7	2,660 (480 – 5,499)	721 (126 – 1,396)	3.69
8	516 (0 – 1,392)	276 (0 - 627)	1.87

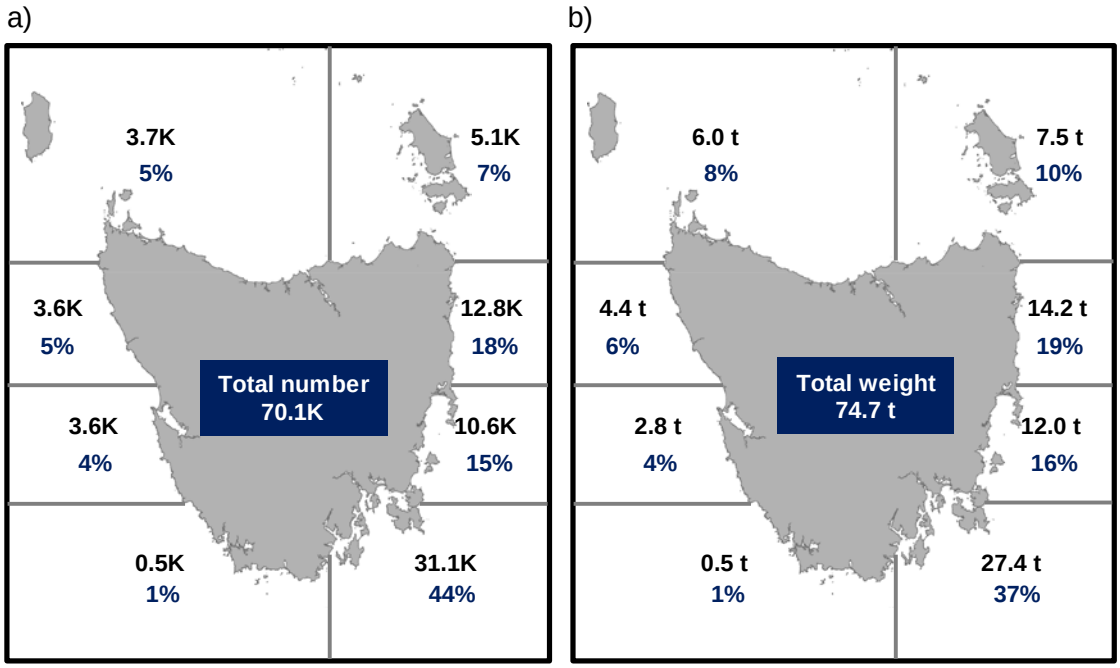

Fig. 3. Recreational harvest of Rock Lobster by assessment area: a) Numbers harvested (in 1000s or K) and proportion (%) of total number; b) Estimated harvest weight and proportion (%) of total weight.

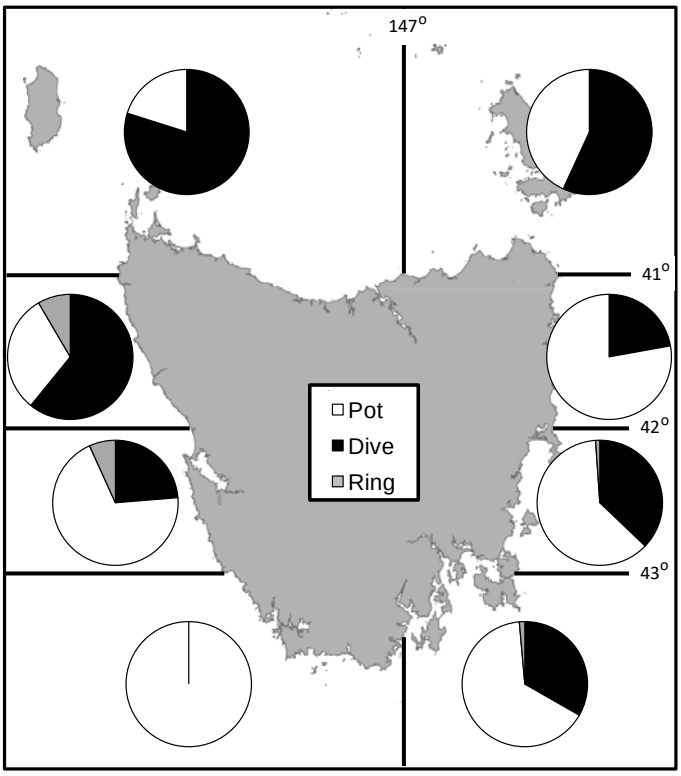

Fig. 4. Proportion of regional harvest by fishing method (pie charts).

3.2.4 Southeast coast

Catch data for Area 1 have been disaggregated into five sub-areas to better describe the spatial characteristics of the fishery in the southeast (Fig. 5). Waters surrounding the Tasman Peninsula and Storm Bay (including eastern Bruny Island) accounted for over half of the catch, with the area to the south of Bruny Island and the D'Entrecasteaux Channel collectively accounting for a 30% of the harvest. Norfolk-Frederick Henry Bay contributed 11% while comparatively low catches were reported from the Derwent Estuary.

Pots accounted for the majority of the catch taken from all areas apart from the Derwent Estuary and Norfolk-Frederick Henry Bay where dive collection accounted for most of the catch (Fig. 5).

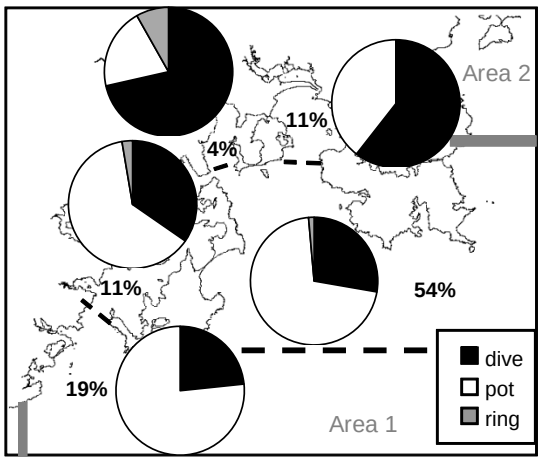

Fig. 5. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

3.2.5 Seasonal catch and effort

The Western region along with waters north of Eddystone Point and waters south of Bruny Island were opened during the first weekend in November (Fig. 6). The remainder of the east coast (the East Coast Stock Rebuilding Zone) was not opened until the 8 December. However, owing to a harmful algal bloom event affecting the Maria Island Zone (within Area 2), this biotoxin zone remained closed for a further two weeks, opening on 21 December. The delay in opening of these key areas of the fishery resulted in the peak in fishing activity occurring in December/January, rather than November/December (Fig. 6). Overall catch and effort peaked in December and fell away dramatically in February (Fig. 7).

The underlying seasonal pattern of catch and effort in the fishery was influenced most strongly by variation in pot fishing activity, with 78% of the pot catch taken between November and January (Fig. 7). By contrast, variability in monthly dive catch estimates was less pronounced, with just over half (58%) the dive catch taken in the first three months.

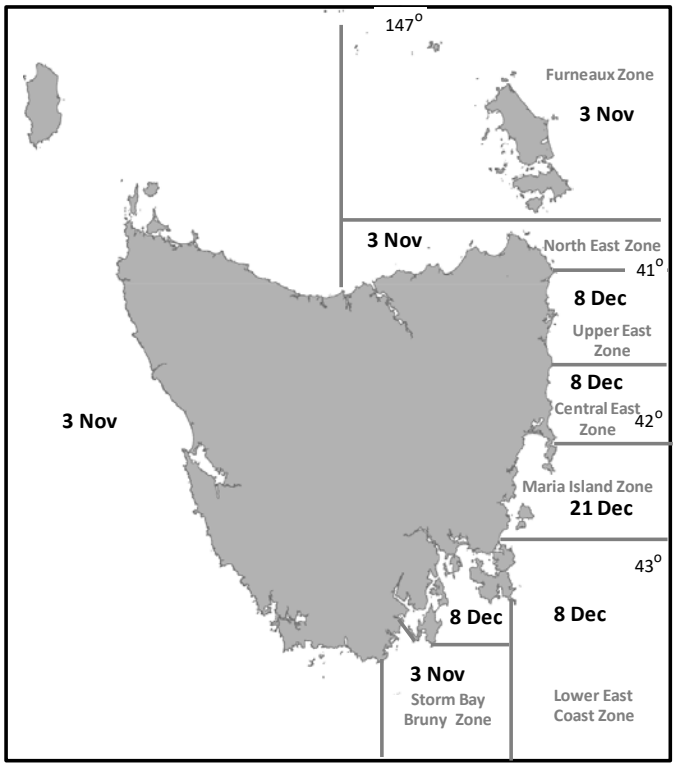

Fig. 6. Map showing the biotoxin management zones and dates on which the zones were opened for fishing during 2018-19.

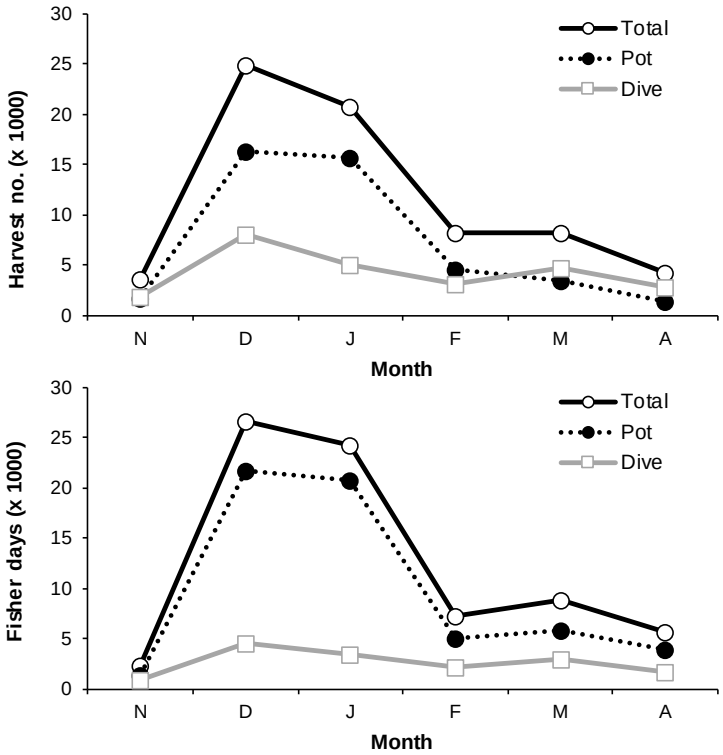

Fig. 7. Recreational Rock Lobster harvest (numbers) and effort (days fished) by month and method for the 2018-19 fishing season.

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method and between management regions (Fig. 8). For instance, over half of the total pot effort in the Eastern region (Areas 1-4) resulted in no retained catch, this compared with 34% for the Western region (Areas 5-8) (Fig. 8). The Eastern region daily bag limit of two lobster was achieved on 20% of the days fished whereas in the Western region 39% of pot-days resulted in catches of at least two lobster, with 5% resulting in the Western region bag limit of five being taken. Divers had higher success rates, with over two thirds of all dives in the Eastern region producing at least two lobster compared with 60% for the Western region. Overall, 15% of dives in the Western region resulted in the bag limit of five lobster being attained. There was limited reported ring effort, in the Eastern region almost half of which resulted in a catch of two lobster while in the Western region a third of the fishing days resulted five lobster being caught.

The actual dive method used had a strong effect on catch rates. Average daily harvest rates were highest for hookah (1.83 lobster state-wide; 1.78 and 2.17 for Eastern and Western regions, respectively), followed by scuba (1.66 lobster state-wide; 1.53 and 2.41 for Eastern and Western regions, respectively) and snorkel (1.36 lobster state-wide; 1.06 and 2.13 for Eastern and Western regions, respectively). Catches taken using scuba accounted for 46% of the total dive harvest; hookah contributed 38% and snorkel a further 16% to the total.

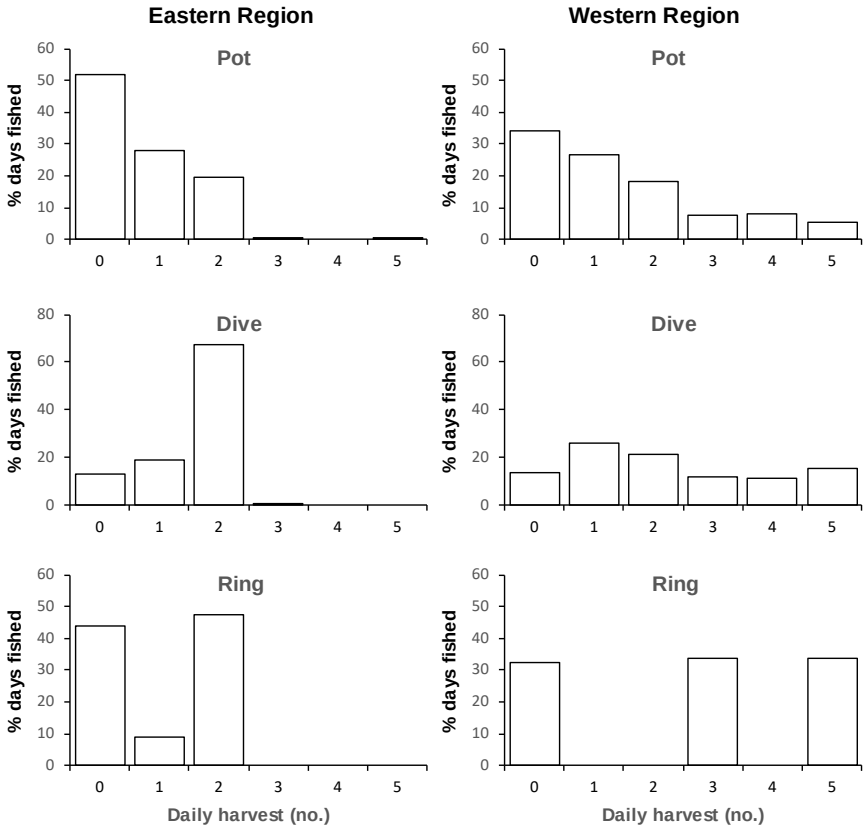

Fig. 8. Distribution of daily Rock Lobster harvest by fishing method and management region.

3.2.7 Individual seasonal harvest

Individual season limits for recreational fishers have been flagged as a potential management option to constrain the overall recreational harvest and share the catches more equitably between fishers. It was, therefore, worthwhile to report on the numbers of rock lobster retained by individual fishers up to the end of April (Fig. 9). State-wide 14% of the active fishers harvested no legal sized lobsters, half harvested 5 or fewer lobsters and just 9% took 16 or more lobsters during the survey period. The proportional breakdown was very similar when limited to the fishery off the east coast. In both instances, fishers taking 16 or more lobsters for the season accounted for more than one third (35%) of the total harvest, highlighting the influence that a relatively small number of avid fishers can have in determining the total harvest.

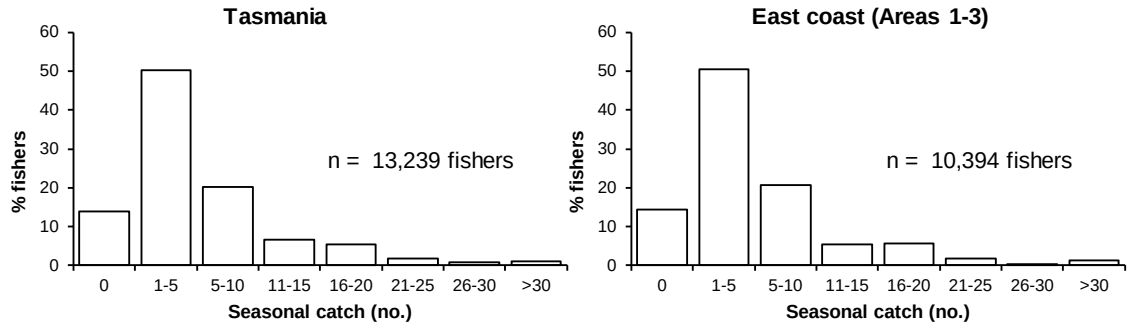

Fig. 9. Seasonal harvest of Rock Lobster for fishers who were active within the east coast (Areas 1-3) and for the whole fishery. n is estimated number of active licence-holders.

3.2.8 Released catch

A total of 31,069 Rock Lobster (95%CL 23,552 – 40,951) were estimated to have been released from pot catches, equivalent to 0.7 for every retained lobster. About 88% of pot releases were due the capture of undersized Rock Lobster, 11% of releases were due to over bag limit catches, and 1% were discarded dead or damaged.

Although divers release some Rock Lobster much 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 706 pot caught, 395 dive caught and two ring caught Rock Lobster from around Tasmania. Pot caught Rock Lobster ranged between 105-185 mm carapace length (CL), when converted to weight this equated to an overall average of 972 g. Dive caught Rock Lobster had a broader size range,105–200 mm CL, and were larger, with an average weight of 1258 g. The two measured ring caught Rock Lobster were combined with the measured catch caught in pots in subsequent analyses. Male to female sex ratios for pot (1.0:0.74) and for dive (1.0:0.65) catches indicated that significantly more males than females were retained for both methods. Length frequency distributions by region are presented in Fig. 10. Apart from the east coast (Areas 1-3) data were limited and may not be representative.

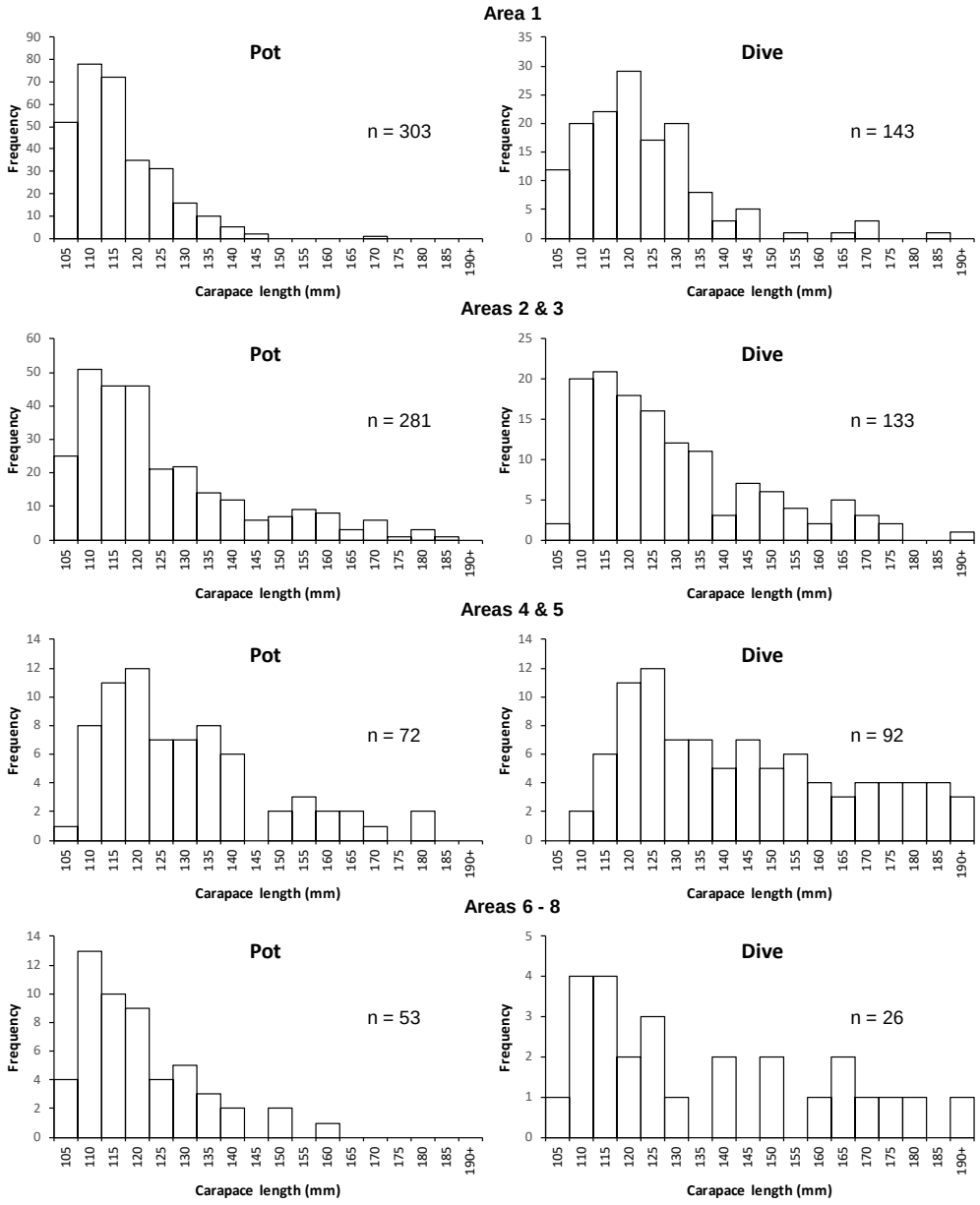

Fig. 10. Length frequency distributions by 5 mm size class for recreationally caught Rock Lobster taken by dive, pot and ring fishing methods by assessment area(s). n is sample size.

3.2.10 Harvest weights

The weight of the 2018-19 recreational harvest was estimated by multiplying the average Rock Lobster weights by the numbers harvested by method and area. Average weights by area and method used to determine harvest weights are presented in Table 5.

The state-wide harvest was estimated to be 74.7 tonnes[4], equivalent to 44% of the TARC. Regional harvest estimates ranged from 27.4 tonnes (Area 1) to less than one tonne (Area 8) (Table 5 and Fig. 3b). As a proportion of the recreational harvest, the east coast (Areas 1-3) accounted for 72%, north coast (Areas 4&5) 18%, and west coast

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

(Areas 6-8) 10% 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 (12% of the retained numbers, refer Table 4 and Fig. 3 & 4).

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

	Av. weight (g)			%
Area	Pot/Ring	Dive	Harvest (kg)	total
1	823	998	27,376	36.6
2	1086	1192	11,977	16.0
3	1086	1192	14,214	19.0
4	1205	1685	7,507	10.0
5	1205	1685	5,978	8.0
6	907	1470	4,449	6.0
7	907	1470	2,767	3.7
8	907	1470	468	0.6
Total			74,736	

3.3 Abalone

3.3.1 2017-18 participation

Information provided in the screening survey suggested that 62.2% (SE 2.5%) of 2017-18 licence holders fished for Abalone during that season and that 60.9% (SE 2.5%) kept at least one Abalone. That is, out of 10,797 persons licensed in 2017-18, an estimated 6,711 fished for Abalone with 6,577 harvesting at least one Abalone. However, as this information was collected retrospectively at the end of the 2017-18 season it is subject to recall bias and as such is considered indicative only.

3.3.2 2018-19 catch and effort

Information reported in this and following sections relates to diary survey data provided by fully responding licence holders and is presented as expanded estimates representative of the activities of recreational abalone licence holders between November 2018 and April 2019, inclusive.

During the survey period an estimated 35.9% (SE 3.1%) of Abalone licence holders (i.e. 3,990 out of the 11,127 licence-holders) fished for Abalone with 34.0% (SE 3.1%) (3,780 persons) harvesting at least one Abalone.

The total estimated harvest was estimated to be 44,740 Abalone (95% CI: 31,246 – 58,660), the result of 10,081 fisher days of effort[5]. This represented an average harvest rate of 4.4 Abalone for each day fished. Blacklip Abalone dominated the catch, accounting for almost 80% of the total catch numbers (34,585) while Greenlip Abalone represented just over 20% of the state-wide total (9,255) (Table 6).

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

Table 6. Abalone harvest, effort and harvest rates by fishing area for 2018-19
Values in parentheses represent the 95% confidence intervals, * average weight based on commercial catch sampling data; ** weighted in accordance to the proportion of Blacklip and Greenlip Abalone in the catch and average species weight.

Area	Harvest (no.) Blacklip Abalone	Greenlip Abalone	Effort (fisher days)	Harvest rate (no. per fisher day)	Av. weight (g)*	Harvest (kg)
1	20,339 (11,772 – 27,916)	1,081 (0 – 2,674)	4,229 (2,834 – 5,749)	4.81	510**	10,378
2	2,365 (1,060 – 4,036)	-	962 (473 – 1,520)	2.46	517	1,222
3	2,967 (896– 5,187)	-	751 (307 – 1,340)	3.95	528	1,567
4	1,793 (266 – 3,997)	4,435 (748 – 9,677)	1,770 (505 – 3,859)	3.52	353**	2,201
5	4,779 (617 – 10,347)	3,013 (193 – 6,768)	1,333 (384 – 2,653)	5.86	412**	3,220
6	4,116 (732 – 8,947)	726 (0 – 1,949)	931 (215 – 2,083)	5.20	471**	2,281
7	188 (0 – 576)	-	47 (0 - 144)	4.00	501	94
8	-	-	-	-	-	-
Total	35,485 (24,769 – 46,776)	9,255 (3,901 – 15,460)	10,081 (7,431 – 13,355)	4.44		20,963

3.3.3 Regional catch and effort

Regional catch, effort and harvest rates for Abalone are presented in Table 6. The recreational fishery was concentrated in the southeast (Area 1, 45% total harvest) and, to a lesser extent, on the north coast (Areas 4-5, 31% total harvest) (Fig. 11a). Blacklip Abalone were taken from all areas whereas Greenlip Abalone were mainly restricted to the north coast. Regional harvest rates varied between 2.5 and ~ 5 Abalone per day, the highest catch rates were in the northwest (Areas 5 & 6) of the state.

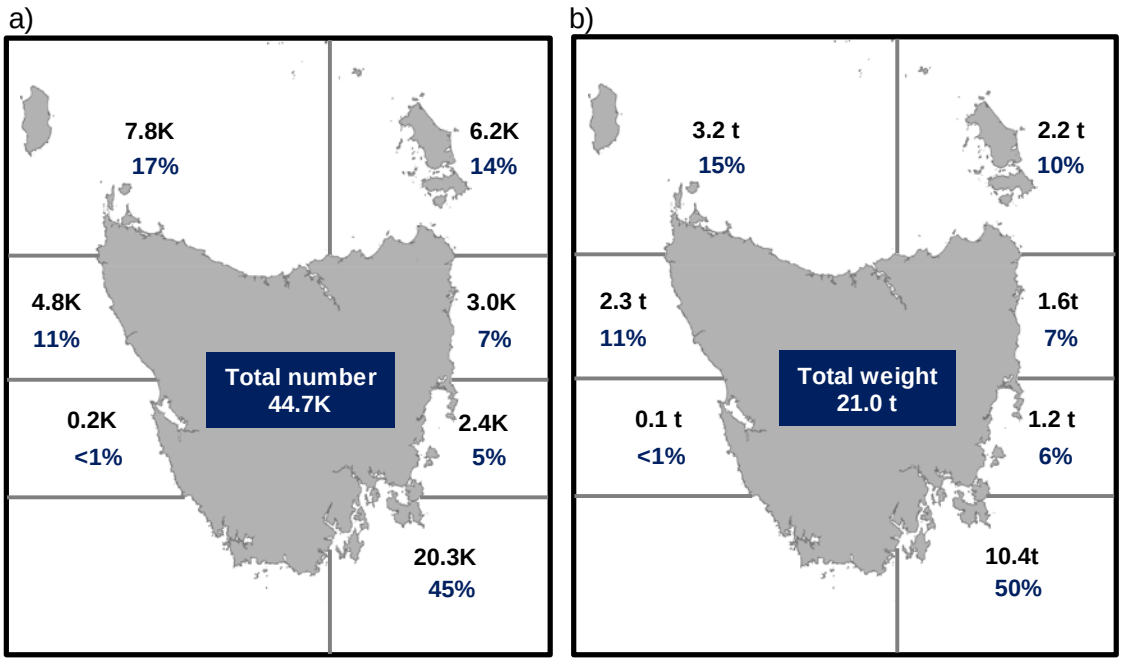

Fig. 11. Recreational harvest of Abalone by assessment area: a) Numbers harvested (in 1000s or K) and proportion (%) of total number; b) Estimated harvest weight and proportion (%) of total weight.

3.3.4 Southeast coast

Data for Area 1 were disaggregated into five sub-areas to better define the spatial characteristics of the fishery in the southeast of the state (Fig. 12). Tasman Peninsula/Storm Bay and Norfolk-Frederick Henry Bay sub-areas accounted for two-thirds of the harvest, with the D'Entrecasteaux Channel and area south of Bruny Island accounting for the bulk of the remainder.

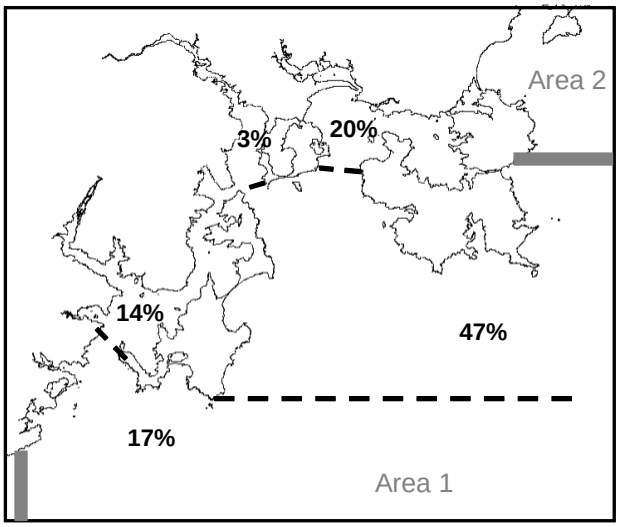

Fig. 12. Regional distribution (% total numbers) of Area 1 Abalone harvest.

3.3.5 Seasonal catch and effort

The fishery for Abalone exhibited a strong seasonal pattern, with catches peaking in December and effort peaking in January (Fig. 13). The traditional peak in catch and effort during November was not evident in 2018, highlighting the links between the Rock Lobster and Abalone fisheries (the majority of Abalone licence-holders also hold Rock Lobster dive licences).

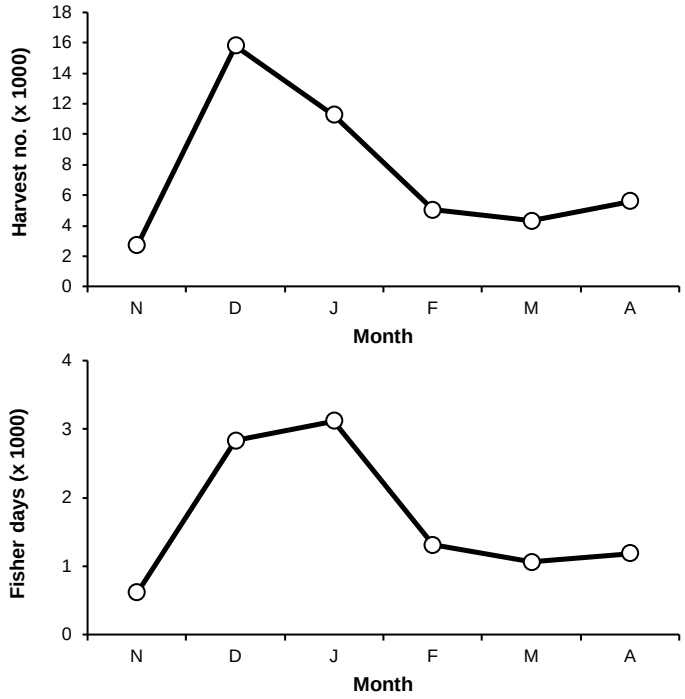

Fig. 13. Recreational Abalone harvest (numbers) and effort (days fished) by month during the 2018-19 fishing season.

3.3.6 Daily harvest

About one in five targeted dives resulted in the daily bag limit of ten Abalone being achieved, with a similar proportion resulting in no catch (Fig. 14). Hookah divers reported the highest average catch rate (4.9 Abalone per day) and took the bag limit of 10 abalone more frequently (29% of dives) that either of the other two dive methods. Average daily catch rates for scuba (4.4) were slightly higher than for snorkel divers (4.2) although snorkel divers took the bag limit (18% dives) more frequently than scuba divers (15.5%). Overall, snorkel diving accounted for 43% of the harvest and 45% of effort (diver-days), scuba was next in importance (33% of the harvest and effort) followed by hookah (21% of the retained catch and 19% of the effort).

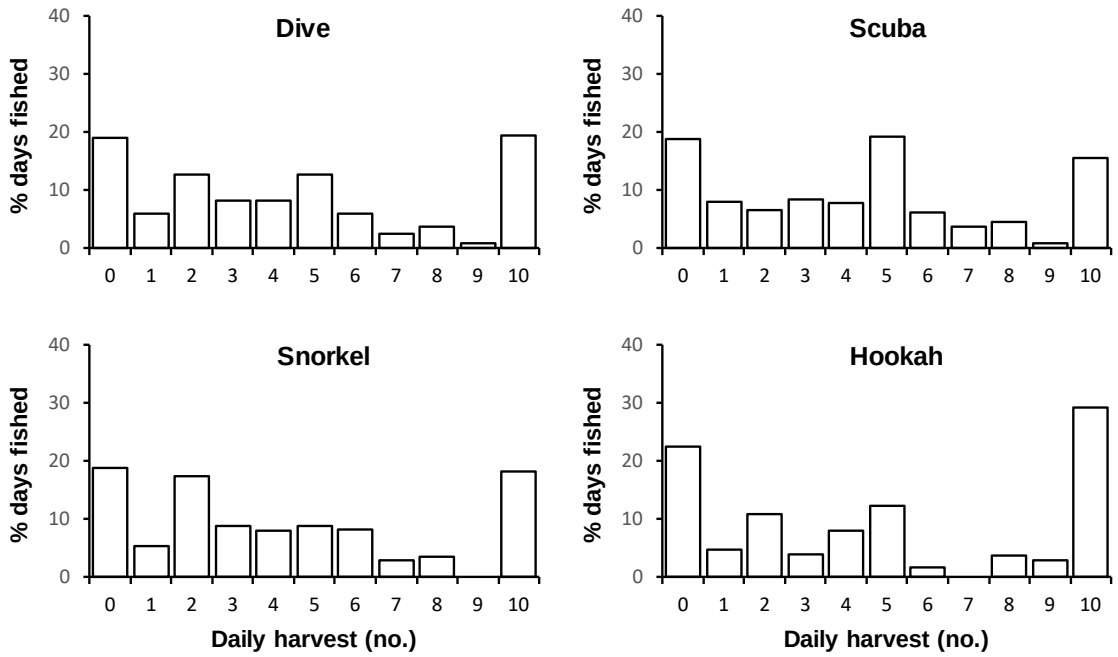

Fig. 14. Distribution of daily Abalone harvest by dive methods for 2018-19 licence holders

3.3.7 Harvest weights

Size composition information was not available for recreationally caught Abalone. However, based on commercial catch sampling, the average legal-sized Abalone by the major fishing regions was estimated to vary between 528 g off the south coast (Area 3) and 353 g off the north coast (Area 4) (Table 6). Using these values, the recreational harvest between November and April was estimated to be about 21.0 tonnes. Regionally, harvest estimates ranged from 10.4 tonnes in Area 1 to just less than two tonnes in Areas 2-3 and 7 (there were no reports from Area 8) (Table 6 and Fig. 11b). The catch for the combined east coast (Areas 1-3) was 13.2 tonnes, the north coast (Areas 4&5) 5.4 tonnes, and the west coast (Areas 6-8) 2.4 tonnes.

3.4 Wash-up survey

3.4.1 General

The overall response rate to the wash-up survey was 84.7% (376 out of an eligible sample of 444)[6].

3.4.2 Constraints to fishing

Diarists who did not fish for lobster during 2018-19 were asked, as an open ended question, about their main reasons for not fishing during the season. Lack of time due to work and/or family commitments was the most commonly cited reason for licensed respondents, followed by health and age concerns (Table 7). Lack of time was also the most commonly cited reason for not renewing licences, with health and age concerns and lack of a fishing partner of equal secondary importance.

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

Table 7. Main reasons for not fishing for Rock Lobster during 2018-19

Reasons	Not Licensed	%	Licensed	%	Combined	%
Lack of time/work and/or family commitments	29	54.7	43	51.2	72	52.6
Health/age	5	9.4	14	16.7	19	13.9
Lack of opportunity/fishing partner	5	9.4	6	7.1	11	8.0
Weather	3	5.7	7	8.3	10	7.3
Lack of boat or equipment	2	3.8	7	8.3	9	6.6
Lack of interest, alternative interest	3	5.7	3	3.6	6	4.4
Moved interstate, travelling did not visit Tasmania	3	5.7	2	2.4	5	3.6
Other	3	5.7	2	2.4	5	3.6
No. Respondents	53		84		137	

3.4.3 Fishery quality

Almost three-quarters of the respondents who fished for Rock Lobster in 2018-19 indicated that the overall quality of the fishery was about the same or better than in the previous year (Table 8); itself a slight improvement over the same question posed to survey respondents in 2017-18. Less than one in five indicated that the current season was worse than the previous which compares with more than one in four respondents in the 2017-18 survey (Lyle 2018).

Table 8. Response to the question relating to the perceived quality of the 2018-19 Rock Lobster season relative to 2017-18

Response	No.	%
Better	54	22.3
Worse	46	19.0
(About the) Same	125	51.7
Unsure	17	7.0
Total respondents	242	

3.4.4 Policing and enforcement

Out of 240 active fishers who responded to questions about policing, only 15% indicated that they had been checked by Marine Police (85% were not checked) whilst fishing for lobster during 2018-19. Comparable figures for the previous three seasons are 25% in 2017-18, 23% in 2016-17, 20% in 2015-16, all higher than for the current year.

3.4.5 Management Changes

3.4.5.1 Changes to fisher behaviour

The most recent season was the first time that the opening of the east coast was split, with areas outside of the East Coast Stock Rebuilding Zone (ESCRZ) opened at the same time as the Western region (first weekend in November) and the ECSRZ opening delayed to early December. This meant that the area south of Dover and the southern

shore of Bruny Island as well as the area north of Eddystone Point were opened some five weeks earlier than the rest of the east coast. To better understand the impact of the split opening on fisher behaviour, respondents were asked whether the staggered opening had influenced when, where or how often they fished. Of 375 responses, 19.2% indicated that they changed their fishing patterns in response to the split opening, 57.1% did not change their fishing behaviour and 22.9% were unaffected by changes because they did not fish on the east coast.

Of the 72 respondents who indicated that they had changed their fishing behaviours as a result of the delayed opening, 29% indicated that they fished in a different area (presumably taking advantage of areas that were opened from early November), 14% fished about the same while 79% did less fishing because of the extended closure. None of the respondents indicated that they had fished more often as a result of the split opening (Table 9).

Table 9. Fishing behaviour response to delayed east coast season opening

Response	No.	%
Fished more	0	0
Fished less	57	79.2
Fished about same	10	13.9
Fished different place	23	29.2

***(Note:** some respondents indicated more than 1 altered behaviour)*

Of the 23 respondents who indicated that they had fished outside of their usual locations because of split east coast closures, seven indicated that they redirected fishing effort to the region south to Dover/ southern Bruny Island, one went to the open area off the north-east and one fished off the west coast.

Fishers who indicated that they had fished the areas south of Dover or off Southern Bruny Island or the north east coast during the 2018-19 were asked whether they had noticed any issues around congestion at boat ramps, crowding on the fishing grounds and/or area saturation with recreational or commercial pots, especially since these areas were opened five weeks earlier than the rest of the east coast.

In both areas, most respondents did not identify specific issues that could be linked to increased effort and competition with other fishers. Of the issues identified, however, crowding of the fishing grounds was more commonly cited as an issue off the south coast whereas congestion at boat ramps and area saturation (with pots) were a more common issue off the north east coast (Table 10).

Table 10: Crowding, congestion and saturation issues

	South of Dover & Southern coast of Bruny Island		North of Eddystone Point	
	No.	%	No.	%
Congestion at Boat Ramps	7	19.4	8	28.6
Crowding on Fishing Grounds	9	25.0	5	17.9
Areas saturated with pots	6	16.7	7	25.0
No Issues reported	22	61.1	18	64.3
Total number of respondents	36		28	

***(Note:** some respondents indicated more than 1 issue)*

3.4.5.2 Issues with spilt opening

Although most respondents (73%) indicated that they were unaware of any issues or problems with the split east coast opening, 15% expressed concern that the split opening was not fair to those fishers who could not easily access the fishing grounds that were opened earlier and 7% considered that the earlier opening led to greater crowding and congestion on open grounds. Issues relating to transiting between open and closed areas (6%) and confusion about regulations, boundary lines (3%) and poor compliance (1%) were also noted (Table 11). "Other" issues included concern that increased fishing pressure from both commercial and recreational fishers in the open areas would impact local fishers.

Table 11: Issues with split opening (n=376)

Perceived issue	No.	%
No problems identified	273	72.6
Not fair to those who can't access	58	15.4
Leads to crowding & congestion	28	7.4
Transiting issues	22	5.9
Regulations & boundary lines confusing	13	3.5
Poor compliance	3	0.8
Other	9	2.4
Unsure	10	2.7

***(Note:** some respondents indicated more than 1 issue)*

In relation to the question as to whether the split opening was considered to be a good thing or it have been better to open the entire eastern region at the same time as in previous seasons, almost twice as many respondents indicated they thought it was better to have opened at the same time (42.6%) as considered it to be a good thing (24.2%). A third of respondents (33.2%) were unsure, suggesting a relatively high level of uncertainty about the management approach, which could be linked to its recent introduction or, as suggested above (section 3.4.5.1), many fishers were not directly affected by the measure.

3.4.6 Compliance with Regulations

Diarists were asked for their opinions regarding levels of non-compliance with various fisheries regulations using a four-point scale ranging from "very common" to "not at all common". Catching lobsters for other licence-holders and pulling other fishers gear and stealing the catch were considered at least quite common forms of non-compliance by over 44% of respondents, retaining more than the bag limit was next importance (19%) while retaining undersized lobsters was perceived as the least common form of non-compliance (10%) (Table 12). These findings are generally consistent with those from a previous survey conducted in 2018 (Lyle unpubl. data) and indicate that recreational fishers recognise non-compliance as an issue in this fishery. The actual magnitude of the issue in terms of unaccounted harvest, however, cannot be inferred from these surveys.

Table 12: Respondents' opinions about non-compliance with certain regulations (n=391)

Compliance aspect	Very common		Quite common		Not very common		Not at all common		Unsure	
	No.	%	No.	%	No.	%	No.	%	No.	%
Keeping more than daily bag limit	19	5.1	52	13.8	196	52.1	74	19.7	35	9.3
Keeping undersized lobster	5	1.3	33	8.8	181	48.1	123	32.7	34	9.0
Pulling other fishers' gear & stealing catch	29	7.7	136	36.2	124	33.0	61	16.2	26	6.9
Catching lobsters for other licence holders	32	8.5	138	36.7	72	19.1	76	20.2	58	15.4

3.4.7 Sources of information about fishing

Diarists were asked about the sources of information used to find out about fishing regulations such as opening dates, bag and size limits. The Sea Fishing Guide was most commonly cited source of information and deemed useful by the greatest proportion of respondents (Table 13). The licence renewal newsletter, DPIPWE website and email alerts were also identified as useful sources of information by at least one third of respondents. The Tas Fish phone app and Fisheries Tas Facebook page were least commonly cited (< 25%) of the other departmental information sources.

Table 13: Sources of information about fishing (n=376)

Source	%	
	Used	Most useful
Sea fishing guide	50.0	43.4
Licence renewal newsletter	41.8	35.4
DPIPWE Website	40.4	35.9
DPIPWE fishing news email alerts	36.7	33.0
Friends/family	31.9	25.3
Tas Fish phone app	25.0	21.8
Fisheries Tas Facebook page	12.0	8.5
Newspaper	15.7	11.2
TV	8.2	5.3
Unsure	1.6	

***(Note:** multiple responses allowed)*

3.4.8 Long Spined Sea Urchin (*Centrostephanus*)

Respondents were asked if they are aware of the incursion of long-spined sea urchins and the risk to the ecological balance of rocky reef systems (formation of urchin barrens). Of the 376 respondents who answered this question, 77% indicated some awareness of the issue, 20% were unaware and 3% were unsure. When asked an open-ended question about perceptions regarding the risks posed by long-spined sea urchins, half of those who responded identified habitat damage as the main risk, almost 25% identified some concerns about impacts on fisheries (Table 14). Only a small proportion

of the respondents, despite being aware of the issue, suggested that the long spined sea-urchin did not pose a significant environmental risk.

Table 14: Perceptions about risks posed by long spined sea urchins

Perceived risk	No.	%
Habitat impact	147	50.9
Habitat impact leading to fishery impact	42	14.5
Fishery negatively impacted	27	9.3
Did not provide a 'risk'	36	12.5
unsure	37	12.8

4 DISCUSSION

4.1 Catch and effort

4.1.1 General trends

The recreational fishery has been monitored using fisher surveys since the mid-1990s during which time rock lobster stock abundances have varied markedly and there have been several management changes, mainly centred on the east coast. State-wide recreational catch, effort and catch rates have declined since the early 2000s, from a peak catch of almost 150 tonnes in 2002-03 (Fig. 15). The initial decline occurred despite a steady increase in licence numbers, which peaked during the late 2000s (refer Fig. 1), and corresponded with a general decline in overall stock abundance (Hartmann *et al.* 2013) but was also influenced by changed management settings introduced as a component of the ECSRS. Overall, the state-wide harvest has not exceeded the TARC allocation of 170 tonnes in any year for which there is survey data. Estimated catches since 2015-16 have equalled about half of the TARC level.

Abalone catches have also declined since the early 2000s (Fig. 16) even though licence numbers continued to grow up until 2008-09 (Fig. 1). The current harvest estimate was very similar to those for the previous three seasons, making catches since 2015-16 amongst the lowest since surveys commenced (Table 12). The decline in catch has been linked to a decline in effort, and although catch rates have varied slightly between years it has only been the last two seasons that the average catch has fallen to less than 4.5 abalone per dive-day.

Social (e.g. motivations, availability of time, access), biological (e.g. stock size, catch rates) and environmental (weather) factors all play a role in influencing fisher behaviour and highlight the need to understand the dynamics and drivers of this behaviour. For instance, since the early 2000s the proportion of licence-holders who utilised their licences (i.e. fished) has varied between 86-68% for lobster, and from 63-31% for abalone (Table 15). In the two seasons especially impacted by biotoxin closures (2015-16 and 2017-18) more than 30% of licence-holders did not fish for lobster. Lack of time (due work and/or family commitments) and age/health issues were the most commonly cited reasons for not fishing for lobster (and not renewing licences) during 2018-19.

Coupled with this trend has been a general decline in the average number of days fished per season by active fishers for both lobster (8.8 down to 5.5 days) and abalone (4.3 down to 2.4 days), contributing to declines in average seasonal harvest per fisher (from greater than 11 to 5-6 for lobster, and from 23 to 11-14 for abalone) (Table 15). Furthermore, daily harvest rates for lobster have declined since the early 2000s (1.3 to less than 1.0 per day); this decline being most influenced by pot catch rates which fell from 1.0 in 2002-03 to 0.65 lobster per day in 2015-16 before recovering to above 0.7 per day (Table 15).

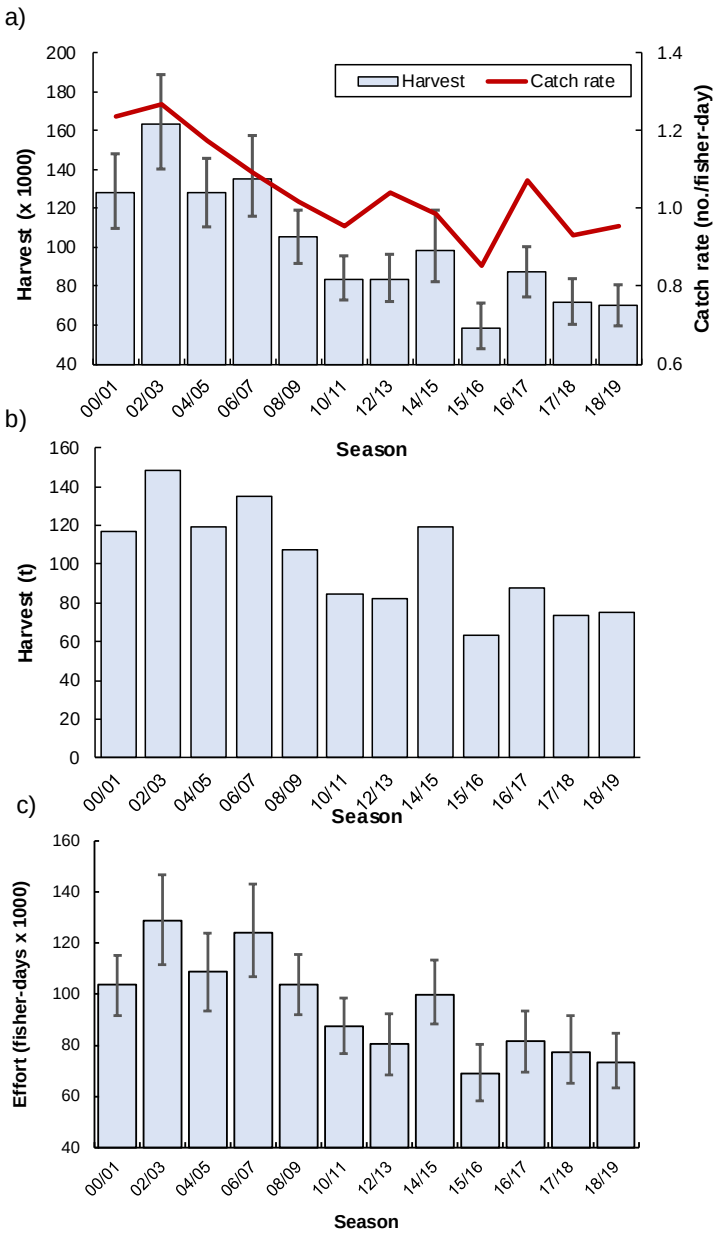

Fig. 15. Tasmanian recreational rock lobster fishery: a) estimated state-wide harvest (numbers) and average catch rate (number per fisher-day); b) estimated state-wide harvest (tonnes), c) effort (fisher days) by fishing season. Error bars indicate 95% confidence intervals.

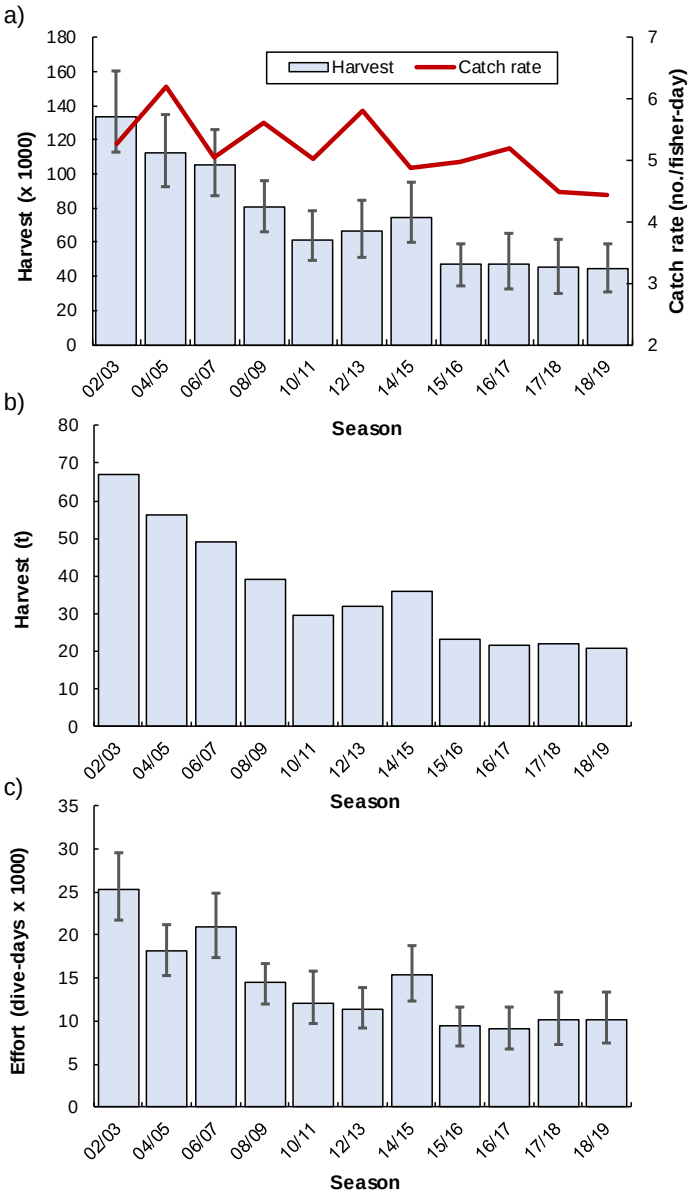

Fig. 16. Recreational abalone fishery: a) estimated state-wide harvest (numbers) and average catch rate (number per dive-day); b) estimated state-wide harvest (tonnes), c) effort (drive-days) by fishing season. Error bars indicate 95% confidence interval on estimates.

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 year and average daily harvest rates. * part year (Nov-Apr); nd not determined

	Licence year											
	2000-01	2002-03	2004-05	2006-07	2008-09	2010-11	2012-13	2014-15	2015-16*	2016-17*	2017-18*	2018-19*
Rock lobster												
No. licence holders	13,265	15,580	16,710	20,008	21,351	19,519	18,185	19,306	16,810	18,009	17,162	18,080
% fished	86.5	88.4	81.9	78.4	75.2	71.7	76.0	75.4	68.4	76.0	69.9	73.2
No. active fishers	11,408	14,308	13,679	15,687	16,050	13,997	13,814	14,552	11,500	13,686	12,004	13,239
Harvest (no.)	128,219	163,454	127,987	135,592	105,538	83,472	83,772	98,442	58,805	87,650	72,009	70,100
Harvest (kg)	nd	148,526	119,354	135,067	107,027	84,261	81,849	118,996	63,022	87,941	73,187	74,982
Av. no. per active fisher	11.2	11.4	9.4	8.6	6.6	6.0	6.1	6.8	5.1	6.4	6.0	5.3
Fisher days	100,866	125,898	109,788	124,305	103,985	87,617	85,849	101,699	69,920	81,690	77,209	73,327
Av. days per active fisher	8.8	8.8	8.0	7.9	6.5	6.3	6.2	7.0	6.1	6.0	6.4	5.5
Av. daily harvest (no.)	1.27	1.30	1.17	1.09	1.01	0.95	0.98	0.97	0.84	1.07	0.93	0.96
Av. daily pot-harvest (no.)	0.87	1.00	0.90	0.94	0.75	0.68	0.78	0.71	0.65	0.87	0.74	0.74
Av. daily dive-harvest (no.)	2.61	2.30	2.31	2.15	2.27	2.36	1.83	1.92	1.61	1.90	1.59	1.67
Abalone												
No. licence holders		9,272	10,133	12,514	12,976	11,972	11,157	12,084	10,509	11,035	10,797	11,127
% fished		63.5	55.8	52.3	38.8	36.3	42.0	42.4	37.9	33.5	30.7	35.9
No. active fishers		5,853	5,653	6,542	5,033	4,349	4,682	5,126	3,896	3,695	3,313	3,990
Harvest (no.)		133,711	112,571	105,515	81,021	60,943	66,438	74,769	47,113	47,522	45,142	44,740
Harvest (kg)		66,857	56,283	49,022	39,024	29,438	32,138	36,047	23,081	21,590	22,124	20,963
Av. no. per active fisher		22.8	19.9	16.1	16.1	14.0	14.2	14.6	12.1	12.9	13.6	11.2
Fisher days		25,342	18,185	23,201	14,445	12,117	11,428	15,110	9,548	9,136	10,079	10,081
Av. days per active fisher		4.3	3.2	3.5	2.9	2.8	2.4	2.9	2.5	2.5	3.0	2.5
Av. daily harvest (no.)		5.28	6.19	4.55	5.61	5.03	5.81	4.95	4.93	5.20	4.48	4.44

4.1.2 Fishing methods

Pots have consistently represented the main method used to catch Rock Lobster and apart from 2000-01, have accounted for 58-67% of the total harvest numbers in each of the years surveyed (Fig. 17). Dive methods have typically accounted for about a third of the harvest in all seasons apart from 2000-01, when divers took 44% of the total. The reason for the apparent increase in the dive harvest proportion in that year was unclear and has not been evident in subsequent seasons. Rings represent a minor component of the fishery.

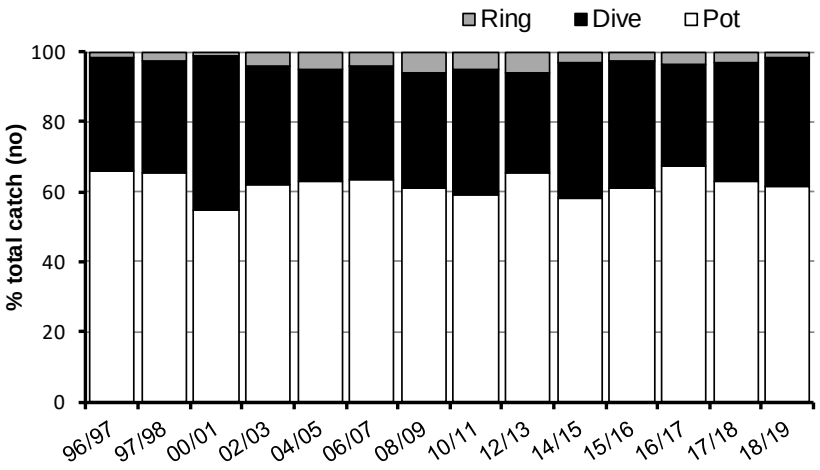

Fig. 17. Proportion of the Rock Lobster harvest by method and fishing season

4.1.3 Catch rates

The average daily harvest rate for pots (0.74 lobster) during 2018-19 remained unchanged compared to the previous season and comparable to levels experienced between 2008-09 and 2014-15 when the daily bag limit was up to five and not two, as currently applies to the main segment of the fishery (Table 15). This suggests that pot catch rates have remained largely insensitive to these bag limit changes, confirmed by two decades of survey data indicating that catches of two or more lobster per pot day are rare. Pot catch rates are, however, more likely to be responsive to trends in Rock Lobster abundance and the trend in pot catch rates over the past decade has been consistent with changes in Rock Lobster population biomass (Hartmann *et al*. 2013). Dive catch rates, by contrast, have tended to fluctuate without obvious trend, apart from the obvious step down to below 2.0 lobsters per day since 2012-13 that corresponded with the reduction in the Eastern region bag limit. Unlike pots which are dependent upon lobster availability and catchability (behaviour), divers actively search for lobster and are able to maintain catch rates by increasing search times such that a relatively high proportion of trips achieve the bag limits.

Abalone catch rates have also fluctuated without obvious trend through time, reflecting the fact that many divers regularly attain the bag limit. The average daily harvest rate for Abalone during the past two seasons (~4.5) was, however, at the lower end of the range reported for previous years (4.5-6.2).

Bag limits represent a key management strategy to constrain recreational Rock Lobster and Abalone catches in Tasmania. As discussed above, bag limits have a less obvious

impact on pot catches, with 20% of the pot effort in the Eastern region and 5% of the pot effort in the Western region resulting in the respective bag limits being achieved during 2018-19. By contrast, bag limits had a more obvious impact on dive catches, with 68% of the dive effort in the Eastern region and 15% of the dive effort in the Western region resulting in the bag limits being achieved. For divers, artificial breathing apparatus (hookah and scuba) conferred a clear advantage when targeting Rock Lobster, as reflected in catch rates and incidence of the bag limit being attained. Hookah and scuba were less of an advantage when diving for Abalone, with free-diving proving particularly successful for this species.

4.1.4 Regional patterns

The recreational Rock Lobster and Abalone fisheries are concentrated off the southeast and east coasts of Tasmania, with Areas 1-3 accounting for 78 and 60% of the harvest (by number), respectively. The remainder of the Rock Lobster harvest was split more or less evenly between the north (Areas 4 & 5) and west coasts (Areas 6-8). For Abalone the north coast was more important than the west coast, the former accounting for about 29% and the latter about 11% of the state-wide recreational harvest.

The intensity of the fishing activity off the southeast and east coasts reflects a combination of factors, including sheltered and accessible waters and proximity to major population and holiday centres. Factors such as limited availability of suitable reef habitat off the north coast (apart from the Bass Strait islands), and exposure to unfavourable sea conditions and limited access points off the west coast, contribute to the lower levels of recreational fishing pressure observed in those regions. Despite this, catch rates for Rock Lobster and Abalone tend to be higher off the west coast than elsewhere, this region representing a very significant area for both commercial Rock Lobster and Abalone fisheries (Hartmann *et al*. 2013, Mundy & Jones 2017).

There is considerable regional variability in the relative importance of the various Rock Lobster fishing methods. Pot catches clearly dominate the harvest off the southeast and east coasts, whereas dive collection is the dominant method off the north coast. Pots, dive collection, and rings are each locally important in the west coast areas. Such method-based regional differences are consistent with patterns observed in previous seasons (Lyle 2000, 2008, 2018, Forward & Lyle 2002, Lyle & Morton 2004, 2006, Lyle & Tracey 2010, 2012, 2014, 2016a,b, 2017).

4.2 Management Implications

The 2018-19 Rock Lobster harvest estimate of 74.7 tonnes represented 44% the TARC (170 tonnes) and was equivalent to 6.1% of the 2018-19 TAC[7] (1220.7 tonnes). Although this survey did not cover fishing activity that may have occurred between May and August (noting that the Eastern region was closed during that period), previous surveys have consistently indicated that recreational effort during the winter months is low and catches generally account for less than 5% of the seasonal totals. It can be concluded that the 2018-19 recreational catch did not, therefore, breach this management reference point.

The east coast (Areas 1-3) catch of 53.5 tonnes compares with 45.3 tonnes in 2017-18, 50.2 tonnes in 2016-17 and 36.7 tonnes in 2015-16; the lower catch in 2015-16 being influenced by widespread biotoxin closures. In 2018 the east coast stock rebuilding zone was amended to exclude waters south of Bruny Island, thereby focusing the

[7] TACC plus TARC

rebuilding strategy in the area where stocks are in poorest condition (DPIPWE 2018). A consequence of this reduced area has been that the target catch level for the recreational sector within the ECSRZ was set at 40 tonnes for 2018-19. When east coast recreational catches are limited to the rebuilding zone the total estimated catch was 48.6 tonnes in 2018-19 indicating that the notional catch share target was exceeded by about 20%. Significantly, this occurred despite the current season being shortened by three weeks when compared with 2017-18 when an estimated catch of 40.4 tonnes was taken. Biotoxin closures off the east coast during 2017-18 impacted on both the number of licences issued and activity of many east coast fishers in that year. By contrast, only the Maria Island biotoxin zone was affected in 2018-19 (closed for 13 days at the start of the season) and as a result higher recreational fishing effort (more so than higher catch rates) resulted in the increased catch in the current year.

Recreational ECSRZ catches have exceeded the stated notional catch share in most years since 2014-15, exceptions being an “under-catch” of 6.3 tonnes in 2015-16 while in 2017-18 the catch target was effectively equalled (refer Table 16). In both of these years, however, biotoxin closures during peak fishing periods resulted in marked reductions in recreational effort (and catch), indicating that current management settings alone have been insufficient to constrain east coast catches to within recreational catch targets.

Table 16. East Coast Stock Rebuilding Zone recreational catches relative to catch targets.

Season	2014-15	2015-16	2016-17	2017-18	2018-19
ECSRZ catch target	42 t	42 t	42 t	41 t	40 t
Catch estimate	55.6 t	35.7 t	50.2 t	40.4 t	48.6 t
Over/under catch	+13.6 t	- 6.3 t	+ 8.2 t	- 0.6 t	+ 8.6 t
Relative difference	+ 32%	- 15%	+ 19%	- 1%	+ 21%

Monitoring this fishery through time has revealed that the recreational sector is highly responsive in terms of the number of active fishers (more so than the number of licence-holders) and individual fishing activity levels in relation to changing lobster abundance (refer Table 12). As catch rates are expected to further improve under the stock rebuilding strategy it is likely that more individuals will go fishing and fish more often for lobster, representing a major challenge for management in constraining the recreational catch to within the east coast catch share.

The recreational Abalone harvest estimate of 21.0 tonnes was equivalent to 1.6% of the 2018 TACC (1333 tonnes), indicating that the recreational fishery represents a minor component of the Tasmanian Abalone fishery based on catches. While there are no management performance indicators relating to the recreational Abalone fishery, there is a need to explicitly include recreational catches into on-going stock assessment and future management of the fishery. This is particularly important since recreational fishers may continue to fish areas even when Abalone densities are reduced to below levels that are typically classed as commercially viable.

Acknowledgments

Funding for this study was provided by the Fishwise Resource Management Fund administered by the Department of Primary Industries, Parks, Water and Environment.

Our team of proficient and committed interviewers – Shirley, Josephine, Sandra, Jennie, Colleen, Sally and Frances - contributed to the success of the survey, encouraging the co-operation of fishers and maximising response rates, as well as ensuring data quality and completeness.

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

References

DPIPWE (2013). Tasmanian Rock Lobster Fishery new east coast management arrangements. Wild Fisheries Management Branch, Department of Primary Industries, Parks, Water and Environment, Hobart. 8p

DPIPWE (2018) Tasmanian Rock Lobster Fishery: East coast stock rebuilding strategy 2013-2023. Updated September 2018. Wild Fisheries Management Branch, Department of Primary Industries, Parks, Water and Environment.

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.

Haddon, M. (2001*). Modelling and Quantitative Methods in Fisheries*. Chapman and Hall/CRC, Florida, 406p.

Hartmann, K, Gardner, C., and Hobday, D. (2013). Tasmanian Rock Lobster fishery 2011/12. Institute for Marine and Antarctic Studies, Fishery Assessment Report, 61p.

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. (2018). Tasmanian recreational Rock Lobster and Abalone fisheries: 2017-18 fishing season. Institute for Marine and Antarctic Studies Report, 32p.

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.

Lyle, J.M. and Tracey, S.R. (2012). Tasmanian recreational Rock Lobster and Abalone fisheries: 2010-11 fishing season. Institute for Marine and Antarctic Studies Report, 39p.

Lyle, J.M. and Tracey, S.R. (2014). Tasmanian recreational Rock Lobster and Abalone fisheries: 2012-13 fishing season. Institute for Marine and Antarctic Studies Report, 42p.

Lyle, J.M. and Tracey, S.R. (2016a). Tasmanian recreational Rock Lobster and Abalone fisheries: 2014-15 fishing season. Institute for Marine and Antarctic Studies Report, 42p.

Lyle, J.M. and Tracey, S.R. (2016b). Tasmanian recreational Rock Lobster and Abalone fisheries: 2015-16 fishing season. Institute for Marine and Antarctic Studies Report, 37p

Lyle, J.M. and Tracey, S.R. (2017). Tasmanian recreational Rock Lobster and Abalone fisheries: 2016-17 fishing season. Institute for Marine and Antarctic Studies Report, 34p

Mundy, C. and Jones H. (2017). Tasmanian Abalone fishery assessment - 2016. Institute for Marine and Antarctic Studies Fishery Assessment Report, 147p.

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.