

TASMANIAN RECREATIONAL ROCK LOBSTER AND ABALONE FISHERIES: 2020-21 FISHING SEASON

Lyle, J.M., Ewing, F., Ewing, G., Tracey, S.

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Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 49,
Hobart TAS 7001

Enquires should be directed to:
Assoc. Prof. Sean Tracey
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 49, Hobart, Tasmania 7001, Australia
Sean.Tracey@utas.edu.au
Ph. (03) 6226 8286

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Executive Summary

This report provides an assessment of the 2020-21 recreational rock lobster and abalone fishing season and continues the time series monitoring trends in these fisheries commenced in the mid-1990s.

During 2020-21 almost 18,500 persons held at least one recreational rock lobster licence and 11,700 persons held a recreational abalone licence; an increase of almost 10% in licence numbers when compared with 2019-20.

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 2020-21 fishing season and invited to participate in a phone-diary survey to monitor their rock lobster and abalone fishing activity between November 2020 and April 2021. A total of 407 respondents (344 valid licence-holders) completed the survey (71% 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.

Rock Lobster

The 2020-21 rock lobster season for all waters outside of the East Coast Stock Rebuilding Zone (ECSRZ) opened on 1st November 2020 and closed on 30th April 2021 in the Eastern region and 31 August 2021 in the Western region. The ECSRZ opened on 5th December 2020, representing the third year 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 72,751 (95% CI: 62,049 – 84,813) rock lobster, based on 74,453 (95% CI: 62,702 – 83,410) fisher days of effort. Potting was the dominant method, representing 81% of the effort (days fished) and contributing 68% of the harvest. Dive collection accounted for 19% of the effort and 30% of the harvest, while ring usage contributed <1% of the effort and 1% of the harvest. The state-wide average catch rate was 0.98 lobster per day fished, with daily harvest rates for dive collection (1.49 lobster) almost double that for pots (0.82 lobster).

The rock lobster fishery was concentrated off the east coast with this area accounting for 75% of the harvest (by number). Catches from the north and west coasts accounted for a further 16% and 9% of the total, respectively. Conversion of lobster numbers to weight produced a state-wide harvest estimate of 81.6 tonnes for the survey period, with catches from the east coast accounting for 70%, the north coast 22%, and the west coast 8% by weight. Overall, the recreational catch represented about 48% of the total allowable recreational catch (TARC) of 170 tonnes and was equivalent to about 6.7% of the 2020-21 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 35 tonnes for the stock rebuilding zone in 2019-20. The recreational catch for the rebuilding zone in 2020-21 was, estimated at 51.1 tonnes indicating that the catch target was exceeded by about 16 tonnes or 46% and compares with “over-catches” ranging between 19-32% in three of the preceding six seasons. “Under-catches” of between 1-15% were reported in three seasons, two of which occurred in seasons impacted by biotoxin closures (2015-16 and 2017-18), whereas restrictions associated with the Covid pandemic resulted in reduced fishing effort (and catch) in the third (2019-20).

Season	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Catch target	42 t	42 t	42 t	41 t	40 t	35 t	35 t
Catch estimate	55.6 t	35.7 t	50.2 t	40.4 t	48.6 t	33.6 t	51.1
Over/under catch	+13.6 t	- 6.3 t	+ 8.2 t	- 0.6 t	+ 8.6 t	-1.4 t	+ 16.1
% over/under catch	+ 32%	- 15%	+ 19%	- 1%	+ 21%	- 4%	+ 46%

Abalone

The recreational abalone harvest up until the end of April 2021 was estimated at 36,168 (95% CI: 26,870 – 46,747) individuals, based on 11,302 (95% CI: 8,661 – 14,015) diver days of effort. Blacklip Abalone accounted for 82% and Greenlip Abalone 18% of the total numbers. In total, 64% of the abalone catch (by numbers) was taken from the east coast, with a further 29% from the north and 7% from the west coasts. The Eastern region daily bag limit of 5 abalone was achieved on about 40% of all dives targeting the species, with an overall average harvest rate of 3.3 abalone per day. By contrast, the Western region daily bag limit of 10 abalone was taken on about 30% of dives.

By converting numbers to weights, the recreational harvest was estimated at 17.2 tonnes, equivalent to just over 2% of the 2021 TACC (833 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.

Fisher's observations

Fishers were asked a range of questions about the rock lobster fishery and opinions about various approaches to monitoring and assessing the quantity of rock lobster harvested by recreational fishers. Key findings include:

- About three-quarters of respondents who fished in 2020-21 indicated that the overall quality of the fishery was about the same or better than in the previous season.
- Catch per unit effort represents an important metric in assessing fishery performance; as an indicator of stock biomass, economic performance in commercial fisheries and an indicator of recreational satisfaction against which fishery performance can be assessed.
 - In relation to satisfaction with catch rates, divers were more likely to be at least quite satisfied (83%) with the actual catch rates they achieved during the season than pot fishers (52%).
 - Based on individual catches, fishers were generally satisfied if they had achieved catch rates averaging at least one lobster per day, whereas most fishers expressed dissatisfaction with catch rates of below 0.5 lobster per day. When method is considered, divers tended to express dissatisfaction with catch rates of under about 1.0 lobster per day, this compared with 0.5 lobster per day for pot fishers.
- *Phone-diary survey approach to monitoring recreational catches*
 - When asked about reliability of the survey approach applied here to estimate the size of the recreational rock lobster catch, over 80% of respondents indicated that they thought the survey was either 'very' or 'quite' reliable, 15% rated it as either 'not' or 'not at all' reliable. This suggests that amongst survey participants most considered that their information and that of others was reliable enough to provide confidence in the quality of the survey data.

- *Catch tags to monitor recreational catches*
 - Respondents were asked for their opinions about the potential use of catch tags to estimate the size of the recreational catch. For this scenario, every recreationally caught rock lobster would need to be tagged and each tag used would need to be reported.
 - Overall, 62% of respondents believed that catch tags could represent a reliable approach to estimating the size of the recreational catch (31% did not consider it to be reliable). In relation to perceptions as to the general acceptability of tags, 52% agreed that most fishers would accept the introduction of a tag reporting system (39% disagreed). However, just over half of all respondents did accept there that there would be some major implementation issues, with non-compliance being the most cited challenge.
- *Compulsory catch reporting (phone apps) to monitor recreational catches*
 - In relation to the reliability of a compulsory catch reporting system based on smart phone apps, 54% of respondents indicated that it would be a reliable way to estimate the size of the recreational lobster catch (39% thought it would not be reliable). The approach was considered to be generally acceptable to recreational lobster fishers by 55% of respondents (38% disagreed), with 53% suggesting that there would be some major challenges to overcome, non-compliance and technical issues associated with phone reporting being the most commonly cited issues.
- *Individual season catch limits*
 - An alternative and novel approach to managing recreational catch is the concept of individual season catch limits, which would limit the total number of lobsters each licence-holder could harvest within a season. If introduced, fishers would need to report each lobster caught and the whole process would need to be traceable and enforceable.
 - Respondents were asked what they considered to be an acceptable individual season limit and while there was considerable variability in the numbers suggested, the average was 32 lobster per season, with a median of 25 lobster.
 - In terms of general acceptability, 57% of respondents indicated that the introduction of individual season limits would be acceptable (34% disagreed). Less than half (43%) indicated concern that there could be major issues associated with implementation, non-compliance was again the most cited concern.

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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 edwardsii*) 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 licence¹. 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. The decline in licence sales in 2019-20 compared with 2018-19 was partially due to the impact of the Covid-19 pandemic (Lyle et al. 2020). In the current season, however, licence numbers rose to levels comparable to the mid-2010s, with more than 18,500² persons (about 1,350 more than in 2019-20) holding at least one rock lobster licence (15,300 pot, 8,960 dive and 4,290 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 Note, the licensing system also includes gillnet, beach seine, setline and scallop licence categories.

² Based on licences issued to the end of April 2021.

1). Sales have remained relatively stable since 2010-11 but at a lower level, with about 11,740 licences issued in 2020-21 (1140 more than in 2019-20).

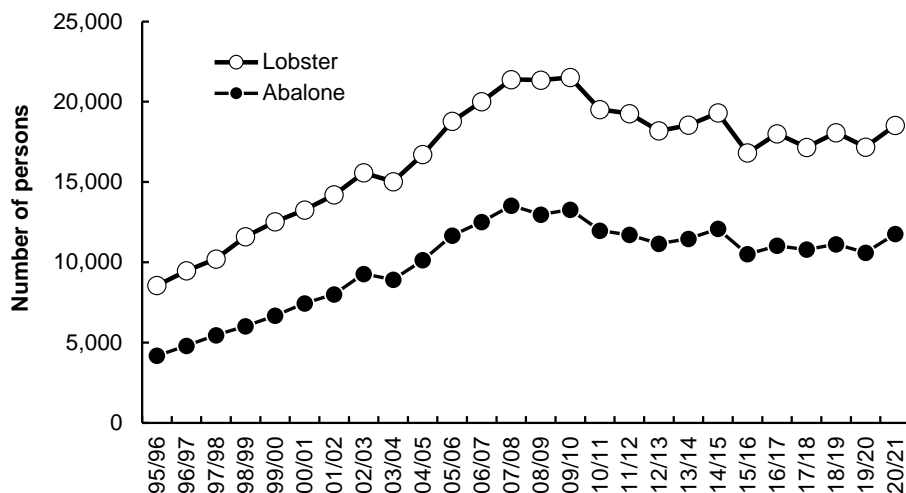


Fig. 1. Number of persons holding recreational rock lobster and abalone licences by licensing year.

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 1,502 tonnes and represented a reduction in landings which had previously averaged over 1,700 tonnes per annum for the decade prior to 1998. The TACC was increased to 1,523 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 1,050.7 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 2020-21 which, when added to the TACC, resulted in a notional TAC of 1,220.7 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, 2019).

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, 2019). 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, to maintain stock rebuilding the catch target has been gradually lowered and was set at 169 tonnes for the 2019-20 and 2020/21 quota years.

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 recreational 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 the 2017-18 quota year³ (March to February) was determined to be 134 tonnes for the commercial fishery and 41 tonnes for the recreational fishery while for 2018-19 the split was revised to 131 tonnes for the commercial fishery and 40 tonnes for the recreational fishery. In 2019-20, catch targets were further reduced, with 113 tonnes allocated to the commercial fishery and 35 tonnes for the recreational fishery.

Since 2019, a split season opening has been applied for the Eastern region, with waters outside of the ECSRZ opening on the same date as the Western region (1st November 2020) while opening of the ECSRZ was delayed by five weeks (5th December 2020) as a measure to help constrain recreational catches within the rebuilding zone.

Prior to the 2019 recreational fishing season, the daily bag and possession limits for abalone were set at 10 and 20 abalone, respectively. Rule changes implemented in November 2019 included reduction in the state-wide possession limit to 10 abalone and, for the Eastern Region (refer Fig. 2), a reduction in the daily bag limit to 5 abalone and the introduction of a boat limit of 25 abalone.

The TACC for abalone has been progressively reduced since 2010, from 2660 to 833 tonnes in 2021 (749 tonnes for Blacklip Abalone and 84 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 & McAllister 2019).

³ Note quota years (March to February) and recreational licence years (November to October) are different, in practice a quota year spans parts of two licence years which complicates catch comparison between sectors.

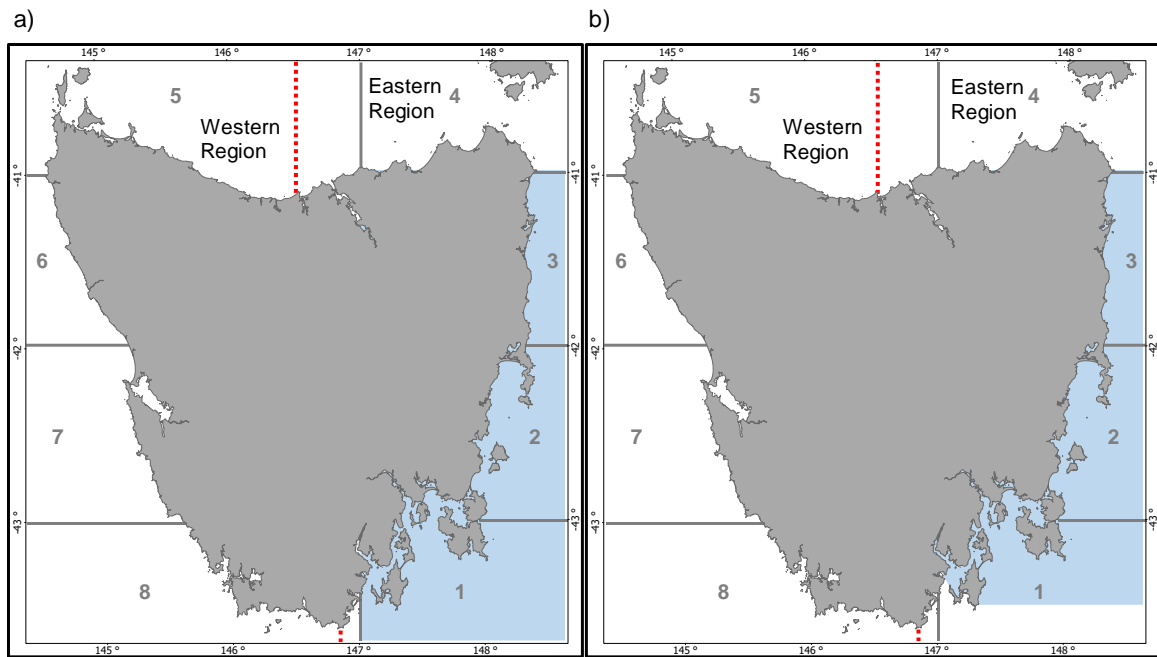


Fig 2. Map of Tasmania showing assessment areas (numbered), stock rebuilding zone (ECSRZ) (shaded) and the Eastern and Western Region boundary (red dotted line): a) ECSRZ that applied between 2013-14 and 2016-17; b) adjusted ECSRZ that applied from 2017-18.

This survey represents the sixteenth in a series for rock lobster and the fifteenth for abalone undertaken since 1996. Key objectives include characterisation of the 2020-21 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 2020-21 licensing year up until the closure of the Eastern region rock lobster fishery (i.e. between 1st November 2020 and 30th April 2021).

2.1.1 Survey sample

The survey sample was selected from the 2019-20 recreational licensing database administered by the Department of Primary Industries, Parks, Water and Environment. While most 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 2019-20 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 2020 and asked about their fishing for rock lobster and abalone during the 2019-20 season (number of days fished and estimated retained catch for either species) and whether they expected to renew their fishing licences for the 2020-21 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 rock 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 (1st November 2020 for all waters outside of the ECSRZ and 5th December 2020 for waters within ECSRZ) until closure of the Eastern region fishery (30th April 2021). The survey period was from 1st November 2020 to 30th April 2021 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 alternative management options.

2.2 Data analysis

2.2.1 Catch and effort

Although initial sample selection was based on the 2019-20 licence database, licence details for 2020-21 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 2020-21 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, 52% of licences were issued by the end of November, 83% by the end of December 2020 and 93% by the end of January 2021. 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 2019-20 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 867 licence-holders selected from the 2019-20 licence database, 92 (10.6%) either had no telephone listing or the number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 775. Contact was made with 698 licence-holders, of whom 669 fully responded, representing a screening survey response rate of 86.3%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 9.9% of the net sample and refusals or other non-response a further 3.7% (Table 1).

Amongst the respondents, 81 indicated that they were not likely to renew their licence(s) in 2020-21 and hence were not eligible for inclusion in the diary survey. The balance (589) indicated they were likely to renew their licence(s) (Table 1). Of this latter group, 82.2% were determined to have renewed their licence(s) based on the 2020-21 licence database, this compared with a renewal rate of 32.1% for those respondents who did not expect to take out a licence in 2020-21.

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

	Sample	% sample/ % eligible	Licence renewed 2019-20	Licence not renewed	% renewed
Screening survey					
Gross sample	867		650	217	75.0
Sample loss	92	10.6			
<hr/>					
Net sample	775		583	192	75.2
Full response	669	86.3	509	160	76.1
Non-response	29	3.7	21	8	72.4
Non-contact	77	9.9	53	24	68.8
<hr/>					
Eligible for diary					
Y- Likely to renew	589		484	105	82.2
N - Not likely to renew	81		26	55	32.1
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Diary Survey					
Full response	407	69.1	344	63	84.5
Partial response	74	12.6	54	20	73.0
Refuse diary	107	18.2	85	22	79.4

3.1.2 Telephone-diary survey

In total 589 respondents were deemed eligible to participate in the diary survey (i.e. likely to renew), of whom 481 initially accepted the diary with 407 completing the survey. Of the responding diarists, 63 (13.1%) did not take up a licence during 2020-21 despite rating themselves as 'quite likely' or 'very likely' to do so. Among the remaining 344 licensed respondents, all held at least one category of lobster licence and 199 were

licensed for abalone. Considering the total number of eligible respondents who renewed their licences (484) this represented an *effective* survey response rate of 71.1%. 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 55 of all 2020-21 licence holders completed the diary survey.

Table 2 Total number of 2020-21 lobster and abalone licence holders, numbers sampled (fully responding) and sample fraction by licence type.

Licence type	Licence holders	Diarists	% sampled
Rock lobster pot	15,224	296	1.9
Rock lobster dive	8,951	163	1.8
Rock lobster ring	4,292	86	2.0
Abalone	11,742	199	1.7
Total licences	40,209	744	1.8
Total persons	19,267	344	1.8

Diarists reported a total of 1,612 fishing events during the survey period, 1,553 (96%) of which were considered valid events⁴. In total, 74% of all valid fishing events were reported as being diarised, the balance was based on recalled fishing activity (typically collected by survey interviewers within a few weeks of the activity taking place).

3.2 Rock Lobster

3.2.1 2019-20 participation

Information provided in the screening survey indicated that 77.1% (SE 1.6%) of 2019-20 rock lobster licence holders fished for rock lobster during that season, with 65.4% (SE 1.8%) harvesting at least one lobster. That is, out of the 17,638 persons licensed in 2019-20, 13,591 fished for rock lobster with 11,539 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 2020-21 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 2020 and April 2021, inclusive.

An estimated 71.1% (SE 2.5%) of licence holders fished for rock lobster at least once during the fishing season with 61.8% (SE 2.7%) harvesting at least one lobster during the diary period. That is, out of the 18,520 licence-holders, 13,168 actually fished for lobster with 11,445 retaining at least one for the period.

Overall, total fishing effort was estimated to be 74,453 fisher days⁵ for the period November to April, yielding a total harvest of 72,751 lobster (Table 3). This represented

⁴ Events reported by diarists whilst unlicensed were considered out of scope and not valid.

⁵ A fisher day is defined as a day in which lobster was a nominated target species and/or lobster were caught.

an average harvest rate of 0.98 lobster per day fished. Pots were the most popular fishing method (accounting for 68% of the total harvest) followed by dive collection (30%) and rings (1%) (Table 3). More than four times as many fisher days of effort was spent using pots compared with diving, however, the total pot catch was just over double that taken by divers. This difference reflects the higher average catch rate for divers (1.49 lobster per day) compared to that for potters (0.82 lobster per day). Although ring usage is comparatively low, recreational fishers are permitted to use up to four rings at a time and the method can be very effective, with the average reported catch rate (3.39 lobster per day) higher than for dive collection.

Table 3. Rock lobster effort, harvest and harvest rates for the 2020-21 season up until 30 April

Values in parentheses represent the 95% confidence intervals. Note: since multiple methods can be used on a day, total fishing days may be less than the sum of the method totals

Method	Harvest (no.)	Effort (days)	Mean harvest rate (no. day ⁻¹)
Pot	49,860 (40,629 – 59,557)	60,671 (48,659 – 69,345)	0.82
Dive	22,014 (15,668 – 29,755)	14,773 (11,168 – 19,315)	1.49
Ring	877 (53 – 1,933)	259 (50 – 530)	3.39
Total	72,751 (62,049 – 84,813)	74,453 (62,702 – 83,410)	0.98

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 75% of the total estimated harvest (54,415 lobster) and attracted 77% of the total effort (57,073 fisher days) during the survey period. Area 1 accounted for 39% of the state-wide harvest and 45% the total effort. The north coast (Areas 4 & 5) accounted for 16% of the harvest (11,803 lobster) and 18% of effort (13,361 fisher days) while the west coast (Areas 6 - 8) contributed 9% of the total harvest (6,533 lobster) and 5% of total effort (4,020 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 - 4 (63 - 91%) and Areas 6 - 8 (68-69%), while dive collection was the primary capture method in Areas 5 (86%). Rings were most commonly used off the west coast, accounting for up to 20% of the harvest in Area 7.

Mean daily harvest rates were highly variable around the state, ranging from 0.84 lobster per day in Area 1 to 3.14 in Area 7 (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.

Table 4. Recreational rock lobster effort, harvest and harvest rates by fishing area for 2020-1

Values in parentheses represent the 95% confidence intervals

Area	Harvest (no.)	Effort (fisher-days)	Harvest rate (no. per fisher-day)
1	28,303 (21,746 – 36,426)	33,774 (25,297 – 43,617)	0.84
2	12,675 (8,559 – 16,858)	10,780 (7,644 – 14,311)	1.18
3	13,437 (8,089 – 20,548)	12,518 (8,268 – 17,320)	1.07
4	7,856 (4,533 – 11,261)	10,043 (4,622 – 12,180)	0.78
5	3,947 (1,835 – 6,456)	3,318 (1,866 – 4,993)	1.19
6	3,087 (723 – 6,851)	2,830 (1,141 – 5,139)	1.09
7	3,040 (1,094 – 5,239)	968 (369 – 1,635)	3.14
8	405 (9 – 1,095)	221 (5 – 611)	1.83

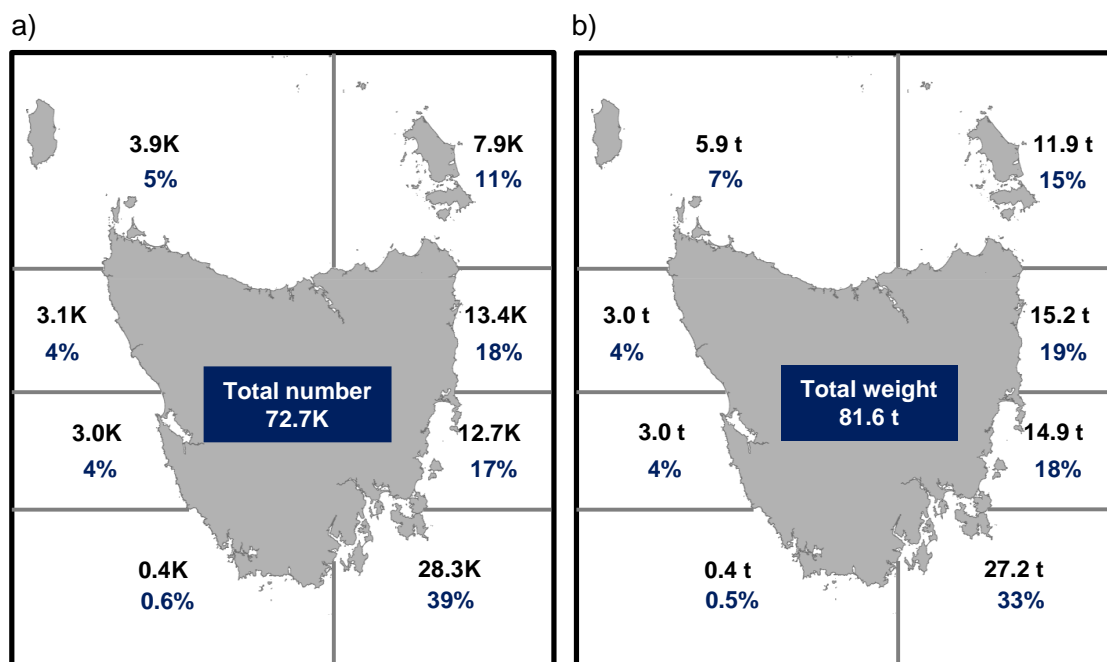


Fig. 3. Recreational harvest of rock lobster by assessment area: a) Numbers harvested (in 1000s or K) and proportion (%) of total number; b) Estimated harvest weight and proportion (%) of total weight.

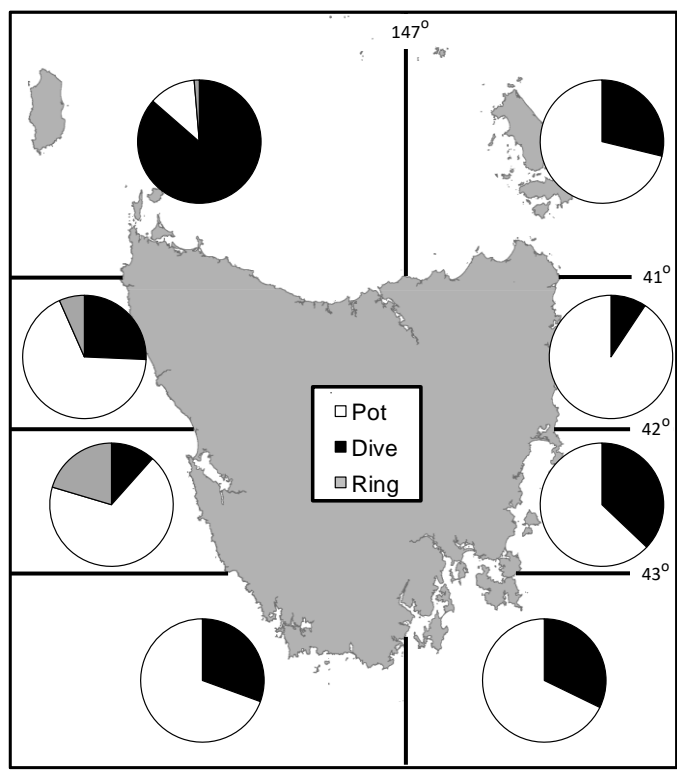


Fig. 4. Proportion of regional harvest by fishing method (pie charts).

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 51% of the harvest by number, with the area to the south of Bruny Island contributing a further 24% of the regional harvest. Norfolk-Frederick Henry Bay and the Derwent Estuary accounted 10% and 9%, respectively, while comparatively low catches (5%) were reported from the D’Entrecasteaux Channel.

Pots accounted for the majority of the catches taken from all sub-areas other than the Derwent and D’Entrecasteaux Channel, where dive catches dominated (Fig. 5).

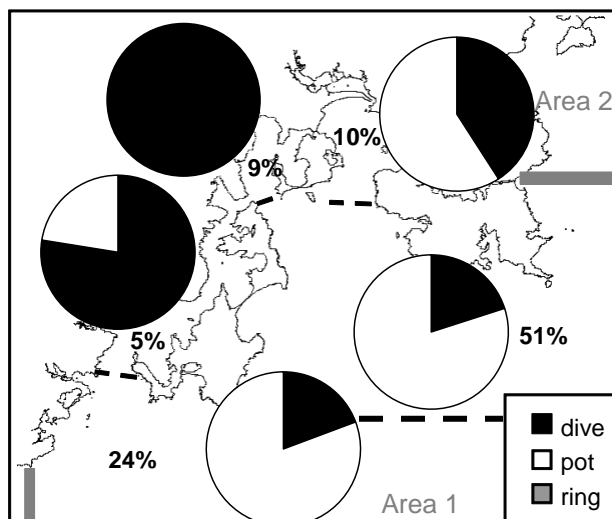


Fig. 5. Regional distribution of Area 1 harvest (%) and proportion of harvest by method (pie charts).

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. The remainder of the east coast (the East Coast Stock Rebuilding Zone) was not opened until 5th December. The delay in opening of this key area of the fishery is reflected in the peak in fishing activity occurring in December (Fig. 6). Catch and effort levels had fallen dramatically by February and continued to trend downwards to the end of the survey period.

The underlying seasonal pattern of catch and effort in the fishery was influenced most strongly by variation in pot fishing activity, with almost 75% of the pot catch and effort occurring between December and January (Fig. 6). Following a sharp decline in fishing activity in February there was a slight increase associated with Easter holiday period in April, a pattern that is typical for this fishery. Dive activity, although somewhat higher in the December-January period (54% of the catch and 56% of the effort), was more consistent throughout the season.

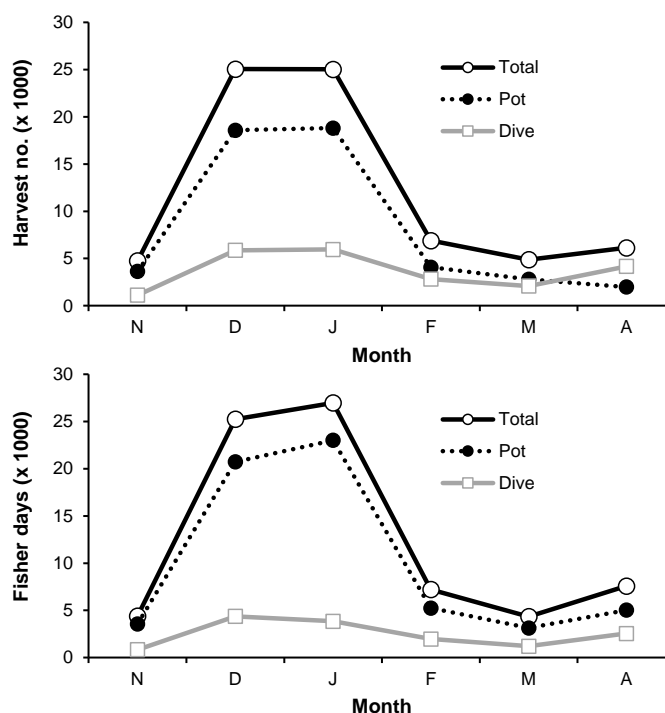


Fig. 6. Recreational rock lobster harvest (numbers) and effort (days fished) by month and method for the 2020-21 fishing season.

3.2.6 Daily harvest

Daily catch distributions differed markedly by fishing method and between management regions (Fig. 7). For instance, approximately half of the total pot effort in the Eastern (Areas 1-4) and Western (Areas 5-8) regions resulted in no retained catch. The Eastern region daily bag limit of two lobster was achieved on 26% of the days fished whereas in the Western region 29% of pot-days resulted in catches of at least two lobster, with 3% resulting in the Western region bag limit of five being taken. By contrast, divers had higher success rates, with 75% of all dives in both regions resulting in the harvest of at least one lobster. The daily bag limit of two lobster was achieved in almost 60% of the Eastern region dives whereas in the Western region divers took at least two lobster in 60% of dives and the daily bag limit of five lobster in 14% (one in seven) dives.

The actual dive method used had a strong effect on catch rates. Average daily harvest rates were highest for hookah (1.80 lobster state-wide; 1.62 and 2.43 for Eastern and Western regions, respectively), followed by scuba (1.56 lobster state-wide; 1.57 and 1.44 for Eastern and Western regions, respectively) and snorkel (0.62 lobster state-wide; 0.51 and 1.35 for Eastern and Western regions, respectively). Catches taken by hookah divers accounted for 51% of the total dive harvest; scuba contributed 41% and snorkel a further 9% to the total.

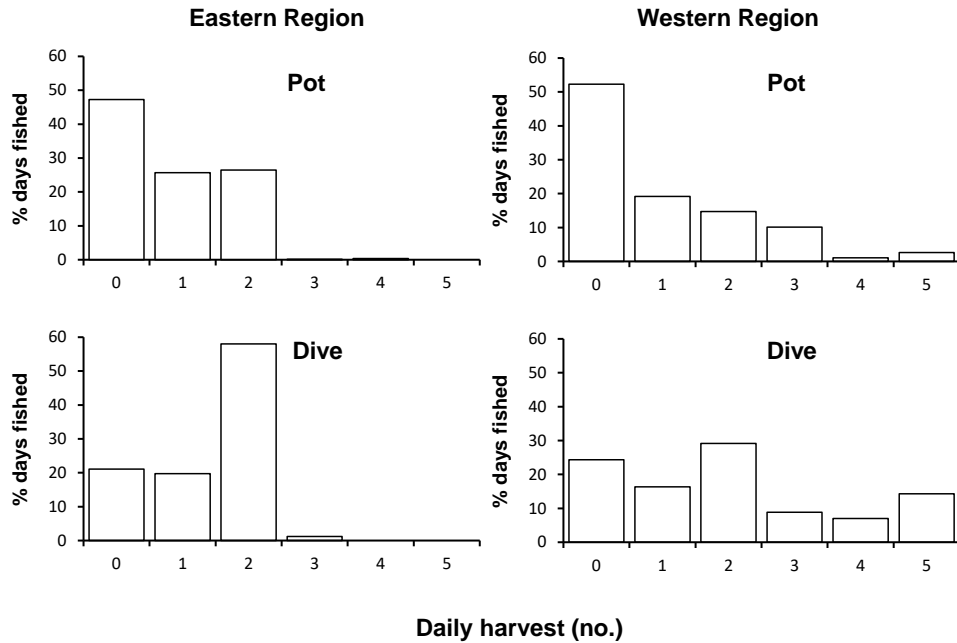


Fig. 7. Distribution of daily rock lobster harvest by fishing method and management region.

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. 8). State-wide, 13% of the active fishers harvested no legal sized lobsters, 51% harvested 5 or fewer lobsters and just 7% took 16 or more lobsters during the survey period. The proportional breakdown was similar when limited to the fishery off the east coast. In both instances, fishers taking 16 or more lobsters for the season accounted for 29% of the total harvest, highlighting the influence that a relatively small number of avid fishers can have in determining the total harvest.

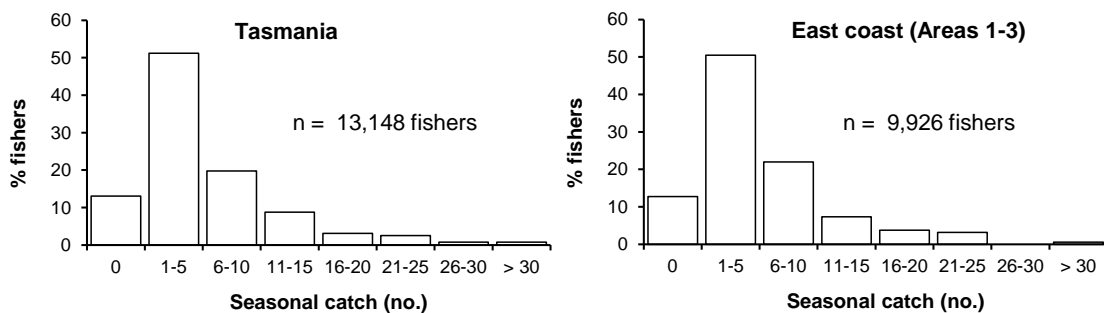


Fig. 8. Seasonal harvest of Rock Lobster for fishers who were active within the east coast (Areas 1-3) and for the whole fishery. n is estimated number of active licence-holders.

3.2.8 Released catch

A total of 46,143 rock lobster (95%CL 32,538 – 62,923) were estimated to have been released from pot catches, equivalent to 0.9 for every retained lobster. About 85% of pot releases were due the capture of undersized rock lobster, 12% of releases were due to over bag limit catches, and 3% were discarded dead or damaged or 'in berry'.

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 678 pot caught, 250 dive and 12 ring caught rock lobster from around Tasmania. Pot caught rock lobster ranged between 105-230 mm carapace length (CL), when converted to weight this equated to an overall average of 1,040 g per lobster. Dive caught rock lobster had a similar size range, 106–220 mm CL, but were larger, averaging 1,310 g. Male to female sex ratios for pot (1.0:0.70) and for dive (1.0:0.52) catches indicated that significantly more males than females were retained for both methods. Length frequency distributions by region are presented in Fig. 9. Apart from the east coast (Areas 1-3) data were limited and may not be representative.

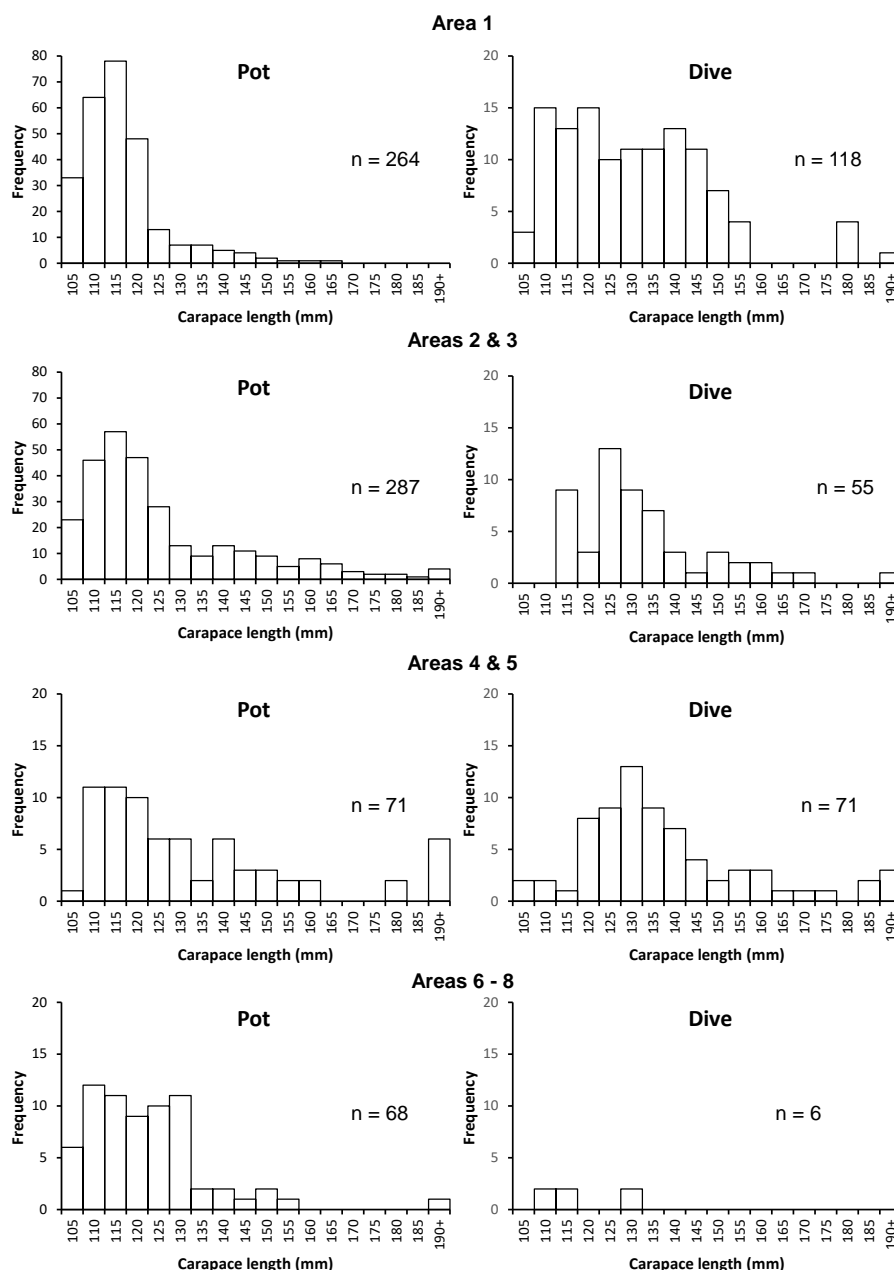


Fig. 9. Length frequency distributions by 5 mm size class for recreationally caught rock lobster taken by pot and dive fishing methods by assessment area(s). n is sample size.

3.2.10 Harvest weights

The weight of the 2020-21 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 81.6 tonnes⁶, equivalent to 48% of the TARC. Regional harvest estimates ranged from 27.2 tonnes (Area 1) to less than one tonne (Area 8) (Table 5 and Fig. 3b). As a proportion of the state-wide recreational harvest, the east coast (Areas 1-3) accounted for 70%, north coast (Areas 4&5) 22%, and west coast (Areas 6-8) 8% of the total weight. As for harvest based on numbers (refer Fig. 3a), the importance of the east coast fishery to the recreational sector is clearly evident.

Table 5. Average rock lobster weight (g) by method and estimated harvest (kg) by area

Area	Av. weight (g)		Harvest (kg)	%
	Pot/Ring	Dive		total
1	833	1234	27,229	33.4
2	1120	1273	14,914	18.3
3	1120	1273	15,241	18.7
4	1522	1503	11,913	14.6
5	1522	1503	5,943	7.3
6	999	868	2,982	3.7
7	999	868	2,993	3.7
8	999	868	389	0.5
Total			81,606	

3.3 Abalone

3.3.1 2019-20 participation

Information provided in the screening survey suggested that 57.1% (SE 2.5%) of 2019-20 licence holders fished for abalone during that season and that 53.9% (SE 2.6%) kept at least one abalone. That is, out of 11,094 persons licensed in 2019-20, an estimated 6,330 fished for abalone with 5,982 harvesting at least one abalone. However, as this information was collected retrospectively at the end of the 2019-20 season it is subject to recall bias and as such is considered indicative only.

3.3.2 2020-21 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 2020 and April 2021, inclusive.

⁶ 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.

During the survey period an estimated 37.7% (SE 3.5%) of abalone licence holders (i.e. 4,420 out of the 11,742 licence-holders) fished for abalone with 32.9% (SE 3.4%) (3,864 persons) harvesting at least one abalone.

The total estimated harvest was estimated to be 36,168 abalone (95% CI: 26,870 – 46,747), the result of 11,302 fisher days of effort⁷. This represented an average harvest rate of 3.2 abalone for each day fished. Blacklip Abalone dominated the catch, accounting for 82% of the total catch numbers (29,769) while Greenlip Abalone represented 18% of the state-wide total (6,399) (Table 6).

Table 6. Abalone harvest, effort and harvest rates by fishing area for 2020-21

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.)		Effort (fisher days)	Harvest rate (no. per fisher day)	Av. weight (g)*	Harvest (kg)
	Blacklip Abalone	Greenlip Abalone				
1	11,756 (7,787 – 16,307)	-	4,676 (3,137 – 6,491)	2.51	522	6,137
2	9,919 (4,897 – 15,854)	-	2,640 (1,428 – 4,049)	3.76	517	5,128
3	1,207 (90 – 2,616)	45 (0 – 135)	691 (176 – 1,361)	1.81	520**	651
4	2,773 (1,179 – 4,673)	2,813 (848 – 5,344)	1,654 (770 – 2,613)	3.38	391**	2,186
5	1,413 (0 – 3,198)	3,540 (677 – 7,642)	1,085 (356 – 2,007)	4.56	353**	1,747
6	2,238 (0 – 5,260)	-	391 (0 – 972)	5.73	501	1,121
7	133 (0 – 440)	-	99 (0 – 307)	1.34	501	67
8	329 (0 – 1,015)	-	66 (0 – 200)	5.00	531	175
Total	29,769 (21,681 – 38,264)	6,399 (2,741 – 11,058)	11,302 (8,661 – 14,015)	3.20		17,212

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 off eastern Tasmania, and in particular off the southeast coast (Area 1, 33% total harvest) (Fig. 10a). Blacklip Abalone were taken from all areas whereas Greenlip Abalone were restricted to the north coast. Regional harvest rates varied between 1.3 and 5.7 abalone per day, the highest catch rates were in the west (Area 6) of the state.

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

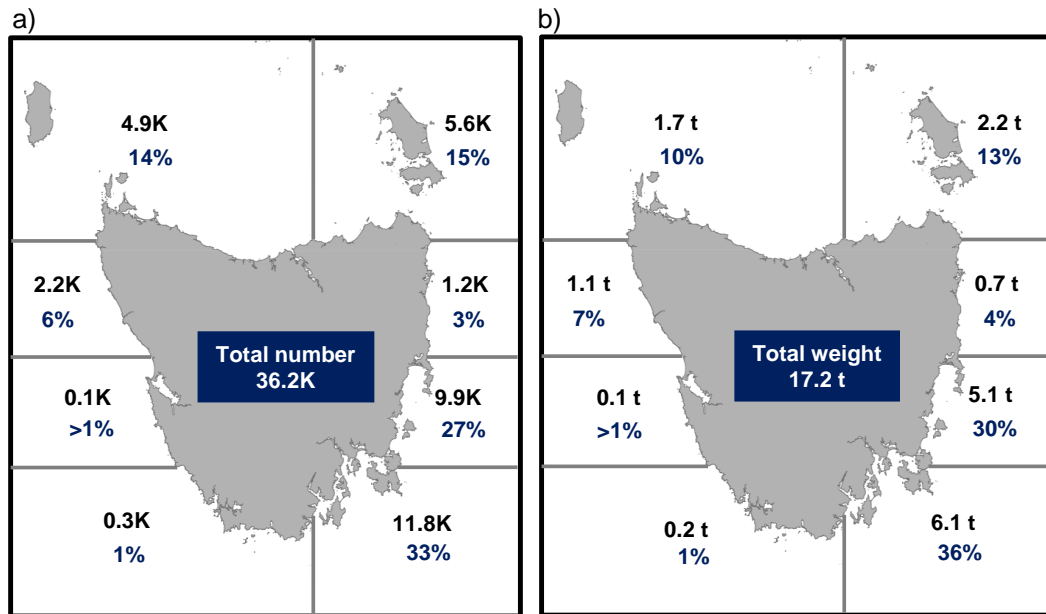


Fig. 10. Recreational harvest of abalone by assessment area: a) Numbers harvested (in 1000s or K) and proportion (%) of total number; b) Estimated harvest weight and proportion (%) of total weight.

3.3.4 Seasonal catch and effort

The fishery for abalone exhibited a strong seasonal pattern, with catch and effort peaking in January (Fig. 11). The traditional peak in catch and effort during November was not evident in 2020, highlighting the links between the rock lobster and abalone fisheries (the majority of abalone licence-holders also hold rock lobster dive licences). The increase in catch and effort in April was linked to the Easter holiday break.

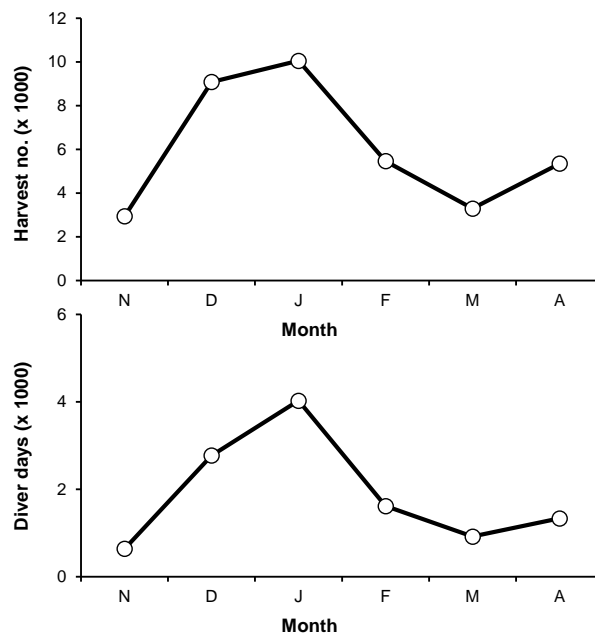


Fig. 11. Recreational abalone harvest (numbers) and effort (days fished) by month during the 2020-21 fishing season.

3.3.5 Daily harvest

The Eastern region daily bag limit of 5 abalone was achieved in about 40% all targeted dives, by contrast the Western Region bag limit of 10 abalone was achieved in just over 30% of dives (Fig. 12). However, the sampling strategy was weighted towards respondents likely to fish off the east coast of Tasmania and thus data for the Western Region was limited and thus needs to be treated with caution.

Based on the fishery in the Eastern Region, snorkel divers reported the highest average catch rate (3.3 abalone per day), took the bag limit of 5 abalone more frequently (49% of dives) than either of the other two dive method and accounted for a third of the total harvest. Average daily catch rates for hookah (3.0) were higher than for scuba divers (2.6), but the higher effort expended by hookah divers meant that the total catch taken by that method was marginally higher than that taken by snorkel divers (37%).

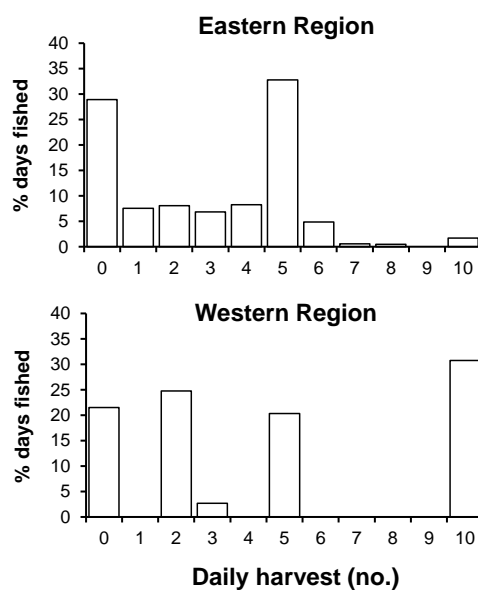


Fig. 12. Distribution of daily abalone harvest by management zone for 2020-21 licence holders

3.3.6 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 531 g off the south coast (Area 8) and 324 g off the north coast (Area 4) (Table 6). Using these values, the recreational harvest between November and April was estimated to be about 17.2 tonnes. Regionally, harvest estimates ranged from 6.1 tonnes in Area 1 to less than one tonne in Areas 3, 7 and 8 (Table 6 and Fig. 10b). The catch for the combined east coast (Areas 1-3) was 11.9 tonnes, the north coast (Areas 4&5) 3.9 tonnes, and the west coast (Areas 6-8) 1.4 tonnes.

3.4 Wash-up survey

3.4.1 General

The overall response rate to the wash-up survey was 80.6% (328 out of an eligible sample of 407)⁸.

3.4.2 Constraints to fishing

Diarists who did not report fishing for lobster 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 cited reason for licensed respondents, followed by health/age and lack of boat or equipment (Table 7). Lack of time was also the most cited reason for not renewing licences, with the lack of boat or equipment and weather being of secondary importance.

Table 7. Main reasons for not fishing for rock lobster during 2020-21.

Reasons	Not		Licensed		Combined	
	Licensed diarists	%	diarists	%		%
Lack of time/work and/or family commitments	14	46.7	28	40.0	42	42.0
Health/age	-		11	15.7	11	11.0
Lack of boat or equipment	5	16.7	10	14.3	15	15.0
Weather	4	13.3	5	7.1	9	9.0
Moved interstate, travelling did not visit Tasmania	3	10.0	3	4.3	6	6.0
Lack of interest, alternative interest	3	10.0	3	4.3	5	5.0
Lack of opportunity/fishing partner	1	3.3	2	2.9	3	3.0
Other	-		8	11.4	8	8.0
Total respondents	30		70		100	

3.4.3 Fishing quality

About 74% of respondents who fished for rock lobster during 2020-21 indicated that the overall quality of the fishery was about the same or better than in the previous year (Table 8). This is a slight increase compared to the same question posed to respondents at the end of the 2019-20 season (Lyle *et al.*, 2020b). Just over one in five respondents indicated that the current season was worse than the previous one, which compares with almost one in four respondents in 2019-20.

Table 8. Perceptions about the quality of the rock lobster fishery in 2020-21 relative to respondent's experience in 2019-20.

Response	No.	%
Better	59	27.6
Worse	47	22.0
(About the) Same	100	46.7
Unsure	8	3.7
Total respondents	214	

⁸ Eligible respondents were those who completed the diary survey.

Diarists who fished for lobster during 2020-21 were asked whether the proportion of trips in which they caught at least one legal sized lobster was higher, lower, or about the same as during the previous season (Table 9). About 70% of respondents indicated that the proportion of successful trips was about the same or better than in the previous year, 25% reported lower success rates in 2020-21.

Table 9. Proportion of rock lobster fishing trips where at least at least one legal sized lobster was caught (i.e. success rate) in 2020-21 relative to the respondent's experience in 2019-20.

Response	No.	%
Higher	35	16.4
Lower	54	25.4
(About the) Same	117	54.9
Unsure	7	3.3
Total respondents	214	

Note: 2 respondents did not fish during the 2019-20 season

3.4.4 Satisfaction with catch rates

Respondents who had reported fishing for rock lobster during the survey period were asked whether they were satisfied or not with the actual catch rates (average number of lobsters kept per day fished) they achieved during the 2020-21 season. Overall, three quarters of the respondents indicated that they were at least quite satisfied with their catch rates (Table 10). Based, on fishing method (i.e. main method used), however, it was evident that divers were more likely to be satisfied (83%) than pot fishers (52%), which is consistent with the observation that divers tend to have a lower proportion of unsuccessful trips (i.e. zero catch days) and higher daily catches than pot fishers (refer section 3.2.6).

Table 10. Fisher satisfaction with rock lobster catch rates achieved during 2020-21 season.

Response	No.	%		
		All	Pot	Dive
Very satisfied	62	28.8	29.7	26.7
Quite satisfied	100	46.5	42.6	56.7
Not very satisfied	36	16.7	16.8	16.7
Not at all satisfied	17	7.9	11.0	0.0
Total respondents	215			

Since the recreational lobster fishery is highly consumptive, that is the release of lobster that could legally be retained is extremely rare (in contrast to voluntary releases observed in many sport fisheries), fisher satisfaction is expected to be strongly correlated to harvest rate. To test this assumption, catch rates (total number of retained lobster divided by number of days fished) were calculated for each diarist who reported fishing for lobster. This analysis was restricted to those diarists who fished in the Eastern region only so as to avoid potential complications linked to differing bag limit regulations that apply in Tasmania. Overall fishers were generally satisfied (very or quite) with average catch rates of over one lobster per day, whereas fishers expressed dissatisfaction with catch rates of below 0.5 lobster per day (Fig. 13). When these data are considered in the context of the main fishing method used, it is clear most divers

expressed dissatisfaction with catch rates of under about 1.0 lobster per day compared less than 0.5 lobster per day for pot fishers (Fig. 14).

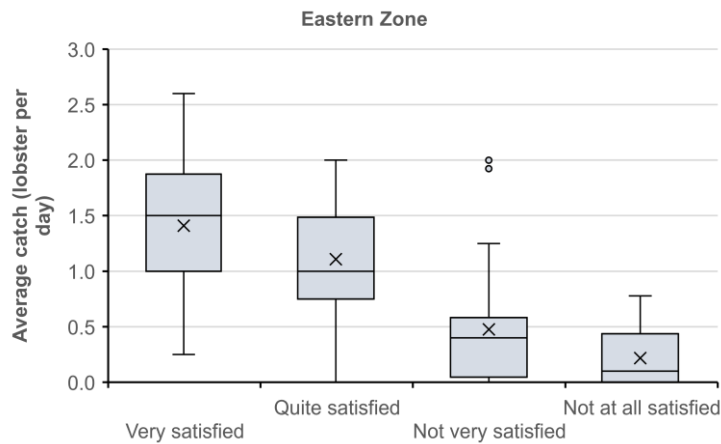


Fig. 13. Fisher satisfaction plotted against the average catch rate for the 2020-21 Eastern region fishing season. Data relate to those diarists who fished exclusively in the Eastern region. Median (horizontal line in the box) and mean (x) values are indicated. Number of respondents = 177.

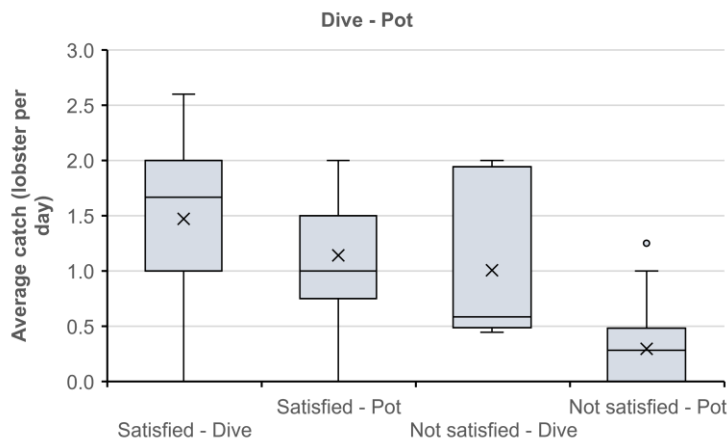


Fig. 14. Fisher satisfaction (Satisfied = 'very' or 'quite' satisfied; Not satisfied = 'not' or 'not at all' satisfied) plotted against the average catch rate they achieved for the 2020-21 Eastern region fishing season based on primary fishing method used. Data relate to those diarists who fished exclusively in the Eastern region. Median (horizontal line in the box) and mean (x) values are indicated. Number of respondents = 177.

3.4.5 Policing and enforcement

Out of 217 active fishers who responded to questions about policing, 44 (20%) indicated that they had been checked by Marine Police whilst fishing for lobster during 2020-21 (173 or 80% were not checked). On-water inspections were reported by 66% of those checked while off-water inspections (e.g. at boat ramps) were reported by 50% of fishers (note some respondents were subject to on-water and off-water checks).

Of the fishers who were checked by the Marine Police, 32 were checked once only, seven were checked on two occasions, four were checked three times and one respondent was inspected four times.

Reported inspection rates for the previous four seasons were generally comparable to the current season, ranging between 15% (2018-19) and 25% in (2017-18).

3.4.6 Options for monitoring the recreational fishery

Respondents were asked for their opinions regarding the reliability, acceptability and potential issues relating to various options for monitoring the size of the recreational rock lobster catch in Tasmania.

3.4.6.1 Diary survey approach

Respondents were advised that main purpose of the diary survey was to estimate the size of the recreational rock lobster catch, the survey being based on a statistical approach that involves selecting a random sample of fishers and then scaling up of the reported fishing activity to represent that of all lobster fishers.

When asked about their perceived reliability of the survey approach in estimating the size of the recreational rock lobster catch, over 80% of respondents indicated that they thought the survey is either 'very' or 'quite' reliable whereas 15% rated it as either "not" reliable or "not at all" reliable (Table 11). This result suggests that amongst the survey participants most considered that their information and that of others was reliable enough to provide confidence in the quality of the survey data.

Table 11. Respondent's rating of the reliability of survey methodology for estimating the size of the recreational rock lobster catch.

Response	No.	%
Very reliable	76	23.2
Quite reliable	192	58.5
Not reliable	39	11.9
Not at all reliable	11	3.4
Unsure	10	3.0
Total respondents	328	

For those respondents who indicated a reason for their concern over the survey approach, 47% suggested that the methodology was statistically flawed while 32% expressed concerns about the honesty of participants in reporting their fishing activities (Table 12).

Table 12. Reasons why survey methodology is considered unreliable by some survey respondents.

Response	No.	%
Statistically unreliable	16	47.0
Lack of honesty of participants	11	32.4
Other	7	20.6
Total respondents	34	

3.4.6.2 Catch tags

Respondents were asked for their opinions about the potential use of catch tags to estimate the size of the recreational catch. For this scenario every recreationally caught rock lobster would need to be tagged and each tag used would need to be reported to DPIPWE. Overall, 62% of respondents indicated that catch tags would represent a reliable approach to estimating the size of the recreational catch, 31% did not consider it to be a reliable approach and 7% of respondent were unsure (Table 13).

Table 13. Reliability of Tags and associated reporting requirements to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	204	62.2
No/not really	100	30.5
Unsure	24	7.3
Total respondents	328	

When asked whether a tagging and reporting system would be acceptable to most fishers, just over half (52%) of the respondents said “yes” while 39% said “no”, with 9% unsure (Table 14).

Table 14. Acceptability of tag system and associated reporting requirements to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	171	52.1
No/not really	128	39.0
Unsure	29	8.8
Total respondents	328	

Respondents were asked whether they considered there would be any major issues if such a system were to be introduced, 52% of respondents said, ‘yes’ and 41% said ‘no’, with 8.8% unsure (Table 15).

Table 15. Presence of major issues with tag system and associated reporting requirements to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	170	51.8
No/not really	135	41.2
Unsure	23	7.0
Total respondents	328	

Those respondents who indicated concerns about a tag system were asked about the types of major issues they envisaged might be faced (Table 16). Non-compliance was the most commonly cited issue (42%), followed by general resistance from fishers to the monitoring approach (19%) concerns over excessive regulation (9%), reporting requirements (7%), resistance to change (5%) and enforcement (3%).

Table 16. Major issues resulting from tag system and associated reporting requirements.

Response	No.	%
Non-compliance	68	42.0
Fisher resistance	30	18.5
Too many regulations	15	9.3
Reporting requirements	11	6.8
Resistance to change	8	4.9
Enforcement	4	2.5
Other	26	16.0
Total respondents	162	

3.4.6.3 Compulsory catch reporting

An alternative approach presented to respondents was compulsory catch reporting using smartphone apps or, for those without smart phones, reporting of catches by phone or email.

In relation to the reliability of a compulsory catch reporting system, 54% of respondents indicated that they considered that it would be a reliable way to estimate the size of the recreational lobster catch, 39% thought it would not be reliable and 6% were unsure (Table 17).

Table 17. Reliability of compulsory catch reporting to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	178	54.3
No/not really	129	39.3
Unsure	21	6.4
Total respondents	328	

When asked whether compulsory catch reporting would be acceptable to most recreational lobster fishers, 55% agreed that it would be acceptable and 38% disagreed and 7% were unsure (Table 18).

Table 18. Acceptability of compulsory catch reporting to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	179	54.6
No/not really	125	38.1
Unsure	24	7.3
Total respondents	328	

When asked whether there would be major issues associated with the introduction of compulsory catch reporting, 53% of respondents indicated that there would be major issues and 41% did not think there would be major issues (Table 19).

Table 19. Presence of major issues with compulsory catch reporting to estimate the size of the recreational rock lobster catch.

Response	No.	%
Yes	175	53.4
No/not really	135	41.2
Unsure	18	5.5
Total respondents	328	

Respondents who indicated major issues associated with the introduction of compulsory smartphone catch reporting were asked about the types of issues they perceived. Concern over non-compliance (35%) was the most common issue, followed by issues related to phone reception (22%); technology challenges (10%) and smartphone access (9%) (Table 20).

Table 20. Major issues resulting from compulsory catch reporting.

Response	No.	%
Non-compliance	61	34.9
Phone reception issues	38	21.7
Issues with technology	18	10.3
No smartphone access	15	8.6
No phone on boats	10	5.7
Reporting requirements too onerous	10	5.7
Too many regulations	5	2.9
Enforcement	4	2.3
Other	14	8.0
Total respondents	175	

3.4.6.4 Individual season catch limits

A novel approach to monitoring the recreational rock lobster catch that has been proposed is the concept introducing individual season catch limits, which would limit the total number of lobsters each licence-holder could catch within a season. If introduced, fishers would need to report each lobster caught and the whole process would need to be traceable and enforceable. To report and manage individual rock lobster catches, tags and/or smartphone apps are potential options.

When asked about what would constitute an acceptable individual season catch limit almost 75% of respondents considered limits between 11 and 50 lobsters would be acceptable to most fishers, 6% thought that the limit should be more than 50 per season (Table 21). Overall, the average suggested season limit was 32 lobster, with a median of 25 lobster. Several respondents ('Other', 2%) suggested that consideration be given to different limits for the Eastern and Western regions, or even based on fishing method. A small number of respondents indicated opposition to the setting of any limit ('No limit', 3%).

Table 21. Suggested individual season catch limits.

Number of lobsters	No.	%
1-10	28	8.5
11-25	127	39.0
26-50	115	35.1
51-100	17	5.2
>100	4	1.2
No limit	10	3.4
Other	6	1.5
Unsure	20	6.1
Total respondents	328	

Respondents were asked for their views on the acceptability of individual season limits amongst recreational lobster fishers, 57% indicated that the introduction of individual season limits would be acceptable to most fishers, 34% thought that the option would not be acceptable and 9% were unsure (Table 22).

Table 22. Respondent views on the acceptability of an individual season catch limit.

Response	No.	%
Yes	188	57.3
No/not really	112	34.1
Unsure	28	8.5
Total respondents	328	

When asked whether there would be major issues associated with the introduction of an individual season catch limit, 43% of respondents indicated concern that there could be major issues compared with 50% of respondents who believed there would be no major issues with the option (Table 23).

Table 23. Presence of major issues with implementing an individual season catch limit.

Response	No.	%
Yes	140	42.7
No/not really	164	50.0
Unsure	24	7.3
Total respondents	328	

Respondents who indicated concern about major issues associated with the implementation of a seasonal catch limit highlighted potential issues related to non-compliance (23%), followed by concerns about over regulation (11%) and that what constitutes acceptable limits will differ between fishers (9%) (Table 24). A small number of respondents (3%) recognised that the proposed measure would disadvantage avid fishers who typically catch more rock lobster.

Table 24. Major issues with implementing an individual season catch limit.

Response	No.	%
Non-compliance	32	22.9
Too many regulations	15	10.7
People's acceptable annual limit differs	12	8.6
Fishers won't like it	11	7.9
Enforcement	8	5.7
Resistance to change	8	5.7
Avid fishers are disadvantaged	4	2.9
Too onerous	4	2.9
Other	34	24.3
No response	12	8.6
Total respondents	140	

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 (refer Fig. 1) and corresponded with a general decline in overall stock abundance (Hartmann et al. 2019) and subsequent changes to 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 been equivalent to half or less of the TARC.

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 the second lowest since surveys commenced but about one third higher than the previous season (Table 25). Lower catches in the past two seasons are linked to a marked fall in the average catch rate to less than 4 per day, itself associated with halving of the Eastern region bag limit (from 10 to 5 abalone per day) in 2019.

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 25). In the seasons especially impacted by biotoxin closures (2015-16 and 2017-18) and the previous season (2019-20) which was impacted by coronavirus restrictions about 30% of rock lobster licence-holders did not fish for lobster. Lack of time (due work and/or family commitments), lack of a boat/gear and health/age were the most cited reasons for not fishing for lobster (and not renewing licences) during 2020-21.

Coupled with this trend has been a general decline in the average number of days fished per season by active fishers for both lobster (about 9 down to 5 days) and abalone (4 down to about 2.5 days), contributing to declines in average seasonal harvest per fisher (from greater than 11 to 4-6 for lobster, and from 23 to 8-14 for abalone) (Table 14). Furthermore, daily harvest rates for lobster have declined since the early 2000s (1.3 to less than 1.0 per day); this decline being particularly influenced by pot catch rates which fell from 1.0 in 2002-03 to below 0.7 lobster per day in 2015-16 and 2019-20 (Table 25). Pot catch rates did, however, recover in the current season, to an average of just over 0.8 lobster per pot-day, up from about 0.6 per day in the previous season.

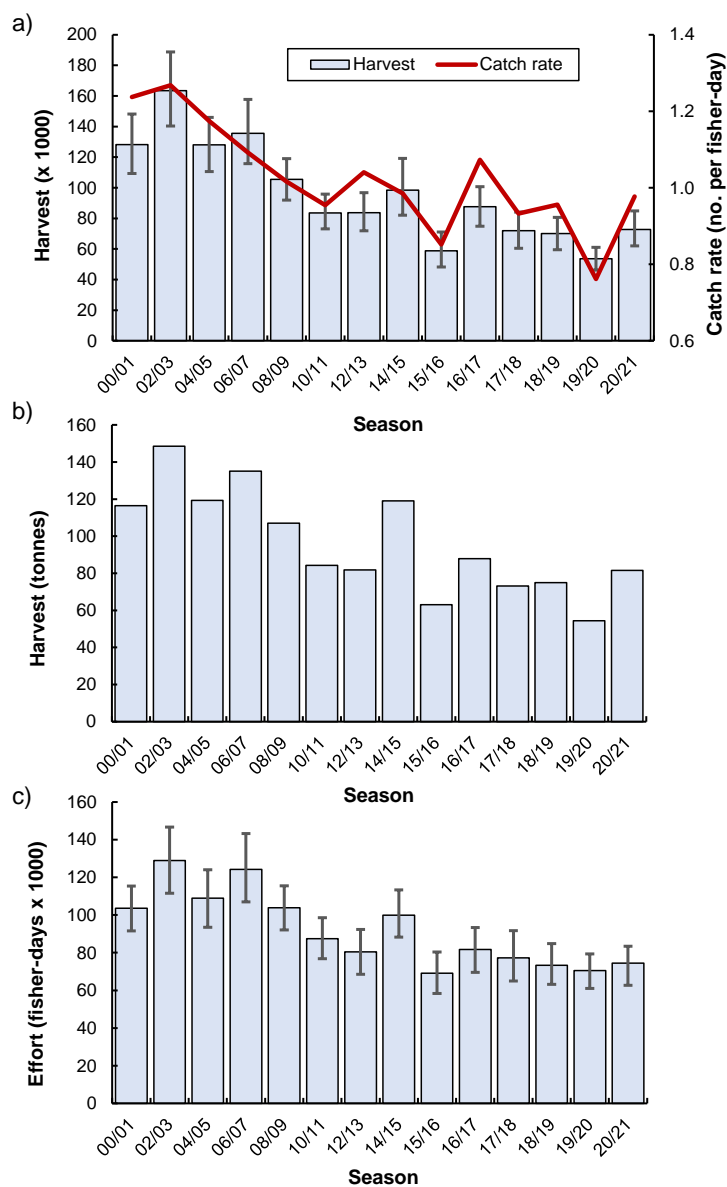


Fig. 15. Tasmanian recreational rock lobster fishery: a) estimated state-wide harvest (numbers) and average catch rate (number per fisher-day); b) effort (fisher days) by fishing season; c) estimated state-wide harvest (tonnes). Error bars indicate 95% confidence intervals.

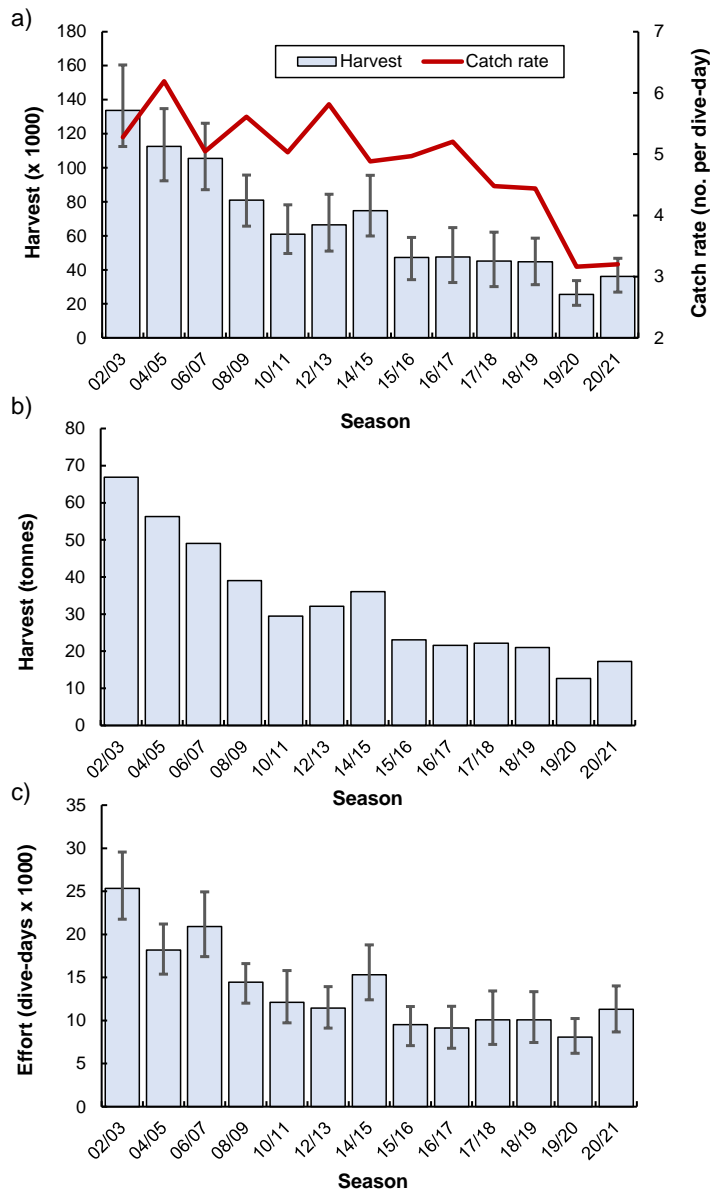


Fig. 16. Recreational abalone fishery: a) estimated state-wide harvest (numbers) and average catch rate (number per dive-day); b) estimated state-wide harvest (tonnes); and c) effort (dive-days) by fishing season. Error bars indicate 95% confidence interval on estimates.

Table 25. 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*	2019-20*	2020-21*
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	17,182	18,520
% 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	70.4	71.1
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	12,090	13,168
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	53,655	72,751
Harvest (kg)	116,509	148,526	119,354	135,067	107,027	84,261	81,849	118,996	63,022	87,941	73,187	74,982	54,345	81,606
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	4.4	5.5
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	70,473	74,453
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	5.8	5.7
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	0.76	0.98
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	0.62	0.82
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	1.27	1.49
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	10,600	11,742
% fished		63.5	55.8	52.3	38.8	36.3	42.0	42.4	37.9	33.5	30.7	35.9	31.5	37.7
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	3,341	4,420
Harvest (no.)		133,711	112,571	105,515	81,021	60,943	66,438	74,769	47,113	47,522	45,142	44,740	28,150	36,168
Harvest (kg)		66,857	56,283	49,022	39,024	29,438	32,138	36,047	23,081	21,590	22,124	20,963	12,642	17,212
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	8.4	8.2
Fisher days		25,342	18,185	23,201	14,445	12,117	11,428	15,110	9,548	9,136	10,079	10,081	8,064	11,302
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	2.4	2.6
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	3.49	3.20

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 were estimated to have taken 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.

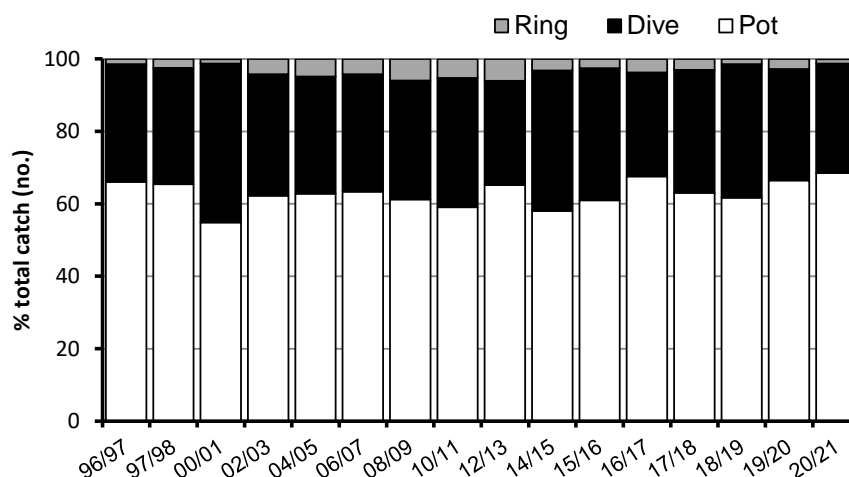


Fig. 17. Proportion of the rock lobster harvest by method and fishing season

4.1.3 Catch rates

The average daily harvest rate during 2020-21 for pots (0.82 lobster) was, with the exception of 2016-17, higher than levels experienced in all years since 2008-09, despite the fact that higher daily bag limits applied in seasons prior the 2015-16 season (Table 25). 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 relatively 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.* 2019). 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.

Catch per unit effort represents an important metric in assessing fishery performance; as an indicator of stock biomass, economic performance in commercial fisheries and, as suggested by this study, an indicator of recreational satisfaction against which fishery performance could be assessed.

Apart from the last two seasons, abalone catch rates have fluctuated without obvious trend through time, reflecting the fact that many divers regularly attain the bag limit. The average daily harvest rate for 2020-21 was the lowest on record (3.2), impacted by the

bag limit reduction that applied to the main region of the fishery (noting that the reduced bag limit was attained in less than half of all dives).

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 26% of the pot effort in the Eastern region and 3% of the pot effort in the Western region resulting in the respective bag limits being achieved during 2019-20. By contrast, bag limits had a more obvious impact on dive catches, with 60% of the dive effort in the Eastern region and 14% 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 75 and 64% of the harvest (by number), respectively. Catches from the north coast (Areas 4 & 5) were higher than off the west coast (Areas 6-8) for both species (16% compared with 9% for lobster and 29% compared with 7% for abalone).

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 accessibility 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.* 2019, 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 west 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, Lyle *et al.* 2019a; 2020b).

4.2 Management Implications

The 2020-21 rock lobster harvest estimate of 81.6 tonnes represented 48% the TARC (170 tonnes) and was equivalent to 6.7% of the 2020-21 TAC⁹ (1,220.7 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 2020-21 recreational catch did not, therefore, breach this management reference point.

⁹ TACC plus TARC

The east coast (Areas 1-3) catch of 57.4 tonnes compares with 39.3 tonnes in 2019-20, 53.5 tonnes in 2018-19, with 45.3 tonnes in 2017-18, 50.2 tonnes in 2016-17 and 36.7 tonnes in 2015-16; the substantially lower catches in 2015-16 and 2019-20 being influenced by widespread biotoxin closures and COVID-19 travel restrictions.

In 2018 the east coast stock rebuilding zone was amended to exclude waters south of Bruny Island, thereby focusing the rebuilding strategy in the area where stocks are in poor 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 35 tonnes for 2019-20 and 2020-21. When east coast recreational catches are limited to the rebuilding zone the total estimated catch was 33.6 tonnes in 2019-20 indicating that the notional catch share target was not exceeded. Significantly, however, many fishers reported that the COVID-19 restrictions had impacted the amount of fishing they did and therefore higher catches might be expected under more normal conditions (Lyle *et al.* 2020b). This appears to be the case in 2020-21, with an estimated 51.1 tonnes taken from within the ECSRZ. In practice, recreational ECSRZ catches have exceeded the notional catch shares in most years since 2014-15, exceptions being under-catches in 2015-16, 2017-18 and 2019-20. (Table 26). In each of these years, however, external factors (biotoxin closures during peak fishing periods and COVID restrictions) resulted in marked reductions in recreational effort (and catch), suggesting that management settings alone have been insufficient to constrain east coast catches to within recreational catch targets.

Table 26. East Coast Stock Rebuilding Zone recreational catches relative to catch targets.

Season	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Catch target	42 t	42 t	42 t	41 t	40 t	35 t	35 t
Catch estimate	55.6 t	35.7 t	50.2 t	40.4 t	48.6 t	33.6 t	51.1
Over/under catch	+13.6 t	- 6.3 t	+ 8.2 t	- 0.6 t	+ 8.6 t	-1.4 t	+ 16.1
% over/under catch	+ 32%	- 15%	+ 19%	- 1%	+ 21%	- 4%	+ 46%

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 25). As catch rates are expected to 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 17.2 tonnes was equivalent to 2.1% of the 2021 TACC (833 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 low, risking localised depletion.

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