

MRFC FINAL REPORT

LICENSED RECREATIONAL FISHING AND AN EVALUATION OF RECALL BIASES IN THE ESTIMATION OF RECREATIONAL CATCH AND EFFORT

J.M. Lyle

December 1999



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SUMMARY

The pattern and intensity of licensed recreational fishing activity was strongly linked with the commencement of the licensing year (in particular the opening of the rock lobster season) and the summer holiday period. That is, effort levels for all methods rose sharply in November and peaked during December and January. They then fell to an intermediate level between February and April, which was followed by a further drop in fishing activity during the winter months.

The significance of the East Coast in terms of recreational fishing activity has been clearly demonstrated, the region accounting for the majority of the recreational effort and harvest for each of the licensed fisheries. The proximity of the major population and holiday centres, accessibility (including placement of boat ramps) and its generally protected coastal waters are contributing factors. Although a productive region, the West Coast is more remote, less populated and exposed to the prevailing sea conditions. Levels of harvest and effort for rock lobster and abalone were generally lower off the north coast compared with the West Coast, despite the presence of several large population centres. Low effort levels off the north coast presumably reflect the limited availability of suitable reef habitat. Levels of gillnet effort were low but comparable for the north and west coasts.

This study presented a unique opportunity to compare retrospective (recall survey) and 'prospective' (diary survey) data collection and thereby assess the utility of recall surveys as a means of providing reliable catch and effort information. Recall estimates of gillnet effort, rock lobster pot harvest and effort and dive harvest of rock lobster and abalone, were consistently higher than diary estimates, often by a factor of around two. This indicates a significant overestimation of effort and harvest for the recall surveys. Adjustment for recall bias is not a simple matter since it is influenced by a complex range of factors and, as determined in this study, differed between individual recall surveys, between different fishing methods and through the fishing season.

As a means of providing estimates of effort and harvest, the telephone recall survey approach proved unreliable in absolute terms but may be justified in situations where little is known about a fishery and information about indicative levels of effort and harvest are acceptable. The present findings confirmed that, in terms of an assessment of the relative distribution of effort and harvest by method, season and region, recall surveys could be very informative. The utility of recall surveys to detect variability between years was unclear but there may be potential to use such an approach to monitor trends over time rather than providing absolute estimates of effort or harvest

Attitudinal surveys indicated that the majority of licence-holders were satisfied with the state of recreational fishing in Tasmania. There was high general awareness of size limits for rock lobster among licence-holders; awareness of finfish size limits was lower. Licence-holders demonstrated strong awareness of rock lobster bag and possession limits and a moderate awareness of abalone bag and possession limits. By contrast, awareness of recently introduced regulations relating to the possession of these species by non-licensed fishers was poor.

For information and education programs to be effective it is important to access the main sources of information used by recreational fishers. This study demonstrated that departmental publications were an important and effective means of providing information about fisheries regulations. There was relatively high general awareness of the management planning process suggesting that media coverage (newspaper and television) had been relatively effective at informing fishers of developments.

Attitudinal and awareness findings apply only to licence-holders and may not be representative of recreational fishers in general but they do represent an important first step towards assisting resource managers in the evaluation and development of information programs aimed at promoting responsible community attitudes and behaviour for sustainable resource use.

1 INTRODUCTION

1.2 Background

Little is known about the recreational fishery in Tasmania, though participation levels are believed to be high and many of the species targeted by recreational anglers have commercial significance. The Australian Bureau of Statistics (ABS) Household Survey in 1983 provides the best general statistics on recreational fishing in Tasmania but figures are out of date and provide no estimate of harvest. In 1983, about 25% of all Tasmanians were engaged in some form of salt water fishing activity, of whom one fifth fished at least once a month (ABS 1984).

A more recent ABS survey of home food production in Tasmania, estimated home seafood 'production' for the year ending April 1992 at over 1,000 tonnes for finfish (including trout), 60 tonnes for rock lobster and 25 tonnes for abalone (ABS 1994). Although the survey was relatively large (with low sampling error), the figures were subject to the ability of householders to accurately recall harvest over the previous twelve months. Notwithstanding this, it was apparent that the recreational harvest was significant, especially in relation to the commercial finfish catch which has ranged between 1,600 - 2,500 tonnes per annum in recent years (figures exclude blue eye trevalla, ling, tuna and school and gummy shark).

Tasmania has had a recreational licensing system in place since the late 1970s. Prior to 1995 there were three categories of sea fishing licence; non-commercial rock lobster pot, non-commercial dive and non-commercial scallop. The rock lobster pot licence entitled recreational fishers to take rock lobster using pots, the diving licence permitted the taking of rock lobster, abalone and scallops by diving and the scallop licence permitted the use of dredges to take scallops.

The licensing system was revised for the 1995/96 licensing year with the introduction of licences for recreational nets (gillnet and beach seine) and the splitting of the non-commercial dive licence into rock lobster, abalone and scallop dive licences. Since 1995/96 the number of licence-holders has increased steadily from around 10,000 to 12,000 in 1998/99 (Table 1). The number of licensed recreational gillnets (graball and mullet nets) rose from around 9,000 in 1995/96 to over 10,000 in 1997/98, dropping slightly in 1998/99 to around 9,500. There have also been significant increases in the numbers of rock lobster pot, rock lobster dive and abalone dive licenses issued.

In Tasmania, unlike most other Australian states, recreational fishers are permitted to use gillnets. Individuals are currently allowed to license up to two 'graball' nets, these are gillnets with mesh size of 100-140 mm and maximum length of 50 m, and one 'mullet' net, a gillnet with mesh size of 60-70 mm and maximum length of 25 m (previously 50 m). In addition, recreational fishers can license one beach seine, a net with minimum mesh size of 30 mm and maximum length of 50 m. A complex suite of regulations applies to their use, including area closures.

Table 1 Numbers of Tasmanian recreational sea fishing licences issued since 1995/96.

Graball net (1) refers to the first graball net and Graball net (2) refers to the second graball net licensed.

* Data incomplete ** Licence type first introduced in 1998/99.

Licence type	Licensing year			
	1995/96	1996/97	1997/98	1998/99*
Graball net (1)	5665	6303	6638	6421
Graball net (2)	2663	2655	2651	2328
Mullet net	678	683	733	702
Beach seine	494	541	660	668
Rock lobster pot	6200	7067	7798	7950
Rock lobster ring**	-	-	-	2028
Rock lobster dive	3468	3839	4173	4285
Abalone dive	4179	4798	5464	5793
Scallop dive	180	209	221	373
Scallop dredge	22	59	76	165
Licence-holders	10094	11103	11874	12092

In late 1996 a major study funded by the Fisheries Research and Development Corporation (FRDC) and the State government (FRDC Project 1996/161), was implemented to provide an assessment of the licensed recreational fishery of Tasmania. The main objectives of this study were to estimate catch and effort for recreational rock lobster, abalone and net fisheries. Detailed information about fishing activity was monitored using a specially developed telephone/fishing diary survey (Lyle 1999). In addition to the collection of diary data, telephone surveys were used to collect information about previous fishing activity.

1.2 Current study

Funding was provided through the Marine Recreational Fishing Trust Fund to undertake an additional telephone survey of licensed recreational fishers at the completion of the FRDC study. This telephone survey was designed to provide catch and effort data based on recall and to assess awareness and attitudes of licence-holders. In this respect it supplemented the more detailed assessment of the licensed recreational fishery and when combined, provided continuous data sets based on recall and diary survey techniques for the period December 1996 to April 1998.

The primary objectives of the current study were

- to estimate recreational catch and effort based on recall for the period November 1997 – April 1998,
- to evaluate the extent of recall biases in the estimation of recreational catch and effort,
- to assess suitability of telephone surveys for the future assessment of the licensed recreational fishery, and
- to assess key attitudinal information (e.g. awareness of regulations, perceptions on resource status, attitudes to change in management) relevant to the management of recreational fishing.

2 METHODS

2.1 Survey design

Lyle (1999) has described the survey methodology developed for FRDC Project 1996/161 in detail. This methodology is described in brief here.

Effectively a three stage interviewing approach was adopted, comprising a recall survey, a diary survey and an attitudinal survey. Survey interviewers collected data from respondents by telephone interview.

2.1.1 Recall survey

The recall survey represented the initial contact with licence-holders and was designed to collect fishing information for the previous six months (based on respondent recall), confirm licensing status and invite eligible respondents to participate in the diary survey, if applicable. Respondents were asked to estimate the number of days that they had fished, by month and by broad regions, using fishing methods for which they held licences. Numbers of rock lobster and abalone caught and retained were also estimated. This aspect of the questionnaire was based on the approach reported by Lyle and Smith (1998).

2.1.2 Diary survey

The diary survey involved a follow up period of up to six months during which fishing activity was monitored in detail, using a combination of a fishing diary and frequent telephone contact. Respondents were encouraged to "only record things that they might forget". Survey data were collected by a brief telephone interview soon after each fishing trip.

Diarists provided the following information for each fishing event:

- date,
- location (recorded by interviewers as fishing region),
- fishing method (and, where appropriate, amount of gear used),
- fishing platform (boat, shore or both),
- target species (up to two species),
- start and finish times of fishing, with any significant breaks,
- retained catch (harvest) numbers by species, and
- number of rock lobster released (for rock lobster pots only).

For passive fishing methods, such as gillnets and rock lobster pots, the start of fishing was taken as the time the gear was set and the finish as the last time on a given day that it was checked or hauled. Harvest, therefore, related to the combined harvest on a given day and not what was removed from the gear each time it was checked, if checked more than once in a day. Gillnets and rock lobster pots were commonly left set overnight and in such instances the start of the event (set) and end (last check or haul) occurred on different days. In situations where gear was left in the water more

or less continuously over a period of several days, the last check on a given day also represented the start of the next event for that piece of fishing gear.

Although the vast majority of licence-holders were Tasmanian residents, there were a small number of interstate/overseas residents who took out licences, 1.7% and 2.2% of licence-holders in 1996/97 and 1997/98, respectively. It should be noted that non-residents were excluded from the diary survey. Since most took out licences when visiting Tasmania on holiday, it was likely that by the time they were registered on the licensing database most would have left the State.

2.1.3 Attitudinal survey

Attitudinal surveys comprised an interview in which respondents 16 years of age and older were asked a range of questions aimed at assessing awareness and attitudes relating to resource and management issues.

2.2 Sampling

2.2.1 Sampling frame

The recreational sea fishing licence database provided the sampling frame used in this study. The licensing year spans the period 1st November to 31st October in the following year and a licence is valid from the date of issue and expires at the end of the licensing year. In this respect licences are valid for a maximum of 12 months.

2.2.2 Stratification

A stratified random sample was drawn from the licence database. Information provided on the licensing database included name, address, phone number, licences held and number of days fished in the previous twelve months. Stratification was based on the combination of licence(s) held, home address and avidity (ie. days fished in the previous twelve months) (Lyle 1999).

The primary rationale for this stratification was to enable a greater sample-take of gillnet fishing methods and the more avid fishers. The latter point seeks to address the issue of non-normal distribution of catch (ie where a large proportion of the catch is taken by a small group of avid anglers). It follows that greater statistical power will be obtained though a higher than usual sample-take of these avid anglers.

2.3 Survey Implementation

2.3.1 Wave design

For several reasons but principally concerned with minimising respondent burden, the diary survey was administered as three consecutive 'waves' of enumeration for the survey period, which ran from November 1996 to April 1998. In each wave, a new

sample of licence holders was randomly selected from the recreational sea fishing licence database as outlined above. The wave design is represented in Table 2.

Table 2 Sample design showing timing of recall surveys and system of diary waves.

X Recall survey, shading represents corresponding recall period and bold horizontal line the diary period. *Wave 1 recall covered the period June to November 1996, data have been reported in Lyle and Smith (1998).

	1996		1997												1998					
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	
Wave 1*	X	██████████																		
Wave 2					X	██████████														
Wave 3												X	██████████							
Supplementary recall																			X	

Note – Waves 1-3 were part of FRDC project 1996/161. Supplementary recall survey was funded by the Marine Recreational Fishing Trust fund.

The supplementary recall survey was conducted in May 1998 primarily to collect retrospective information about fishing activity for the period November 1997 - April 1998. Diary coverage was complete for the period December 1996 - April 1998 and, with this supplementary recall survey, recall data were available for the corresponding period (ie. recall data from Waves 2 and 3 and the supplementary recall survey). This enabled comparisons between harvest and effort estimates based on ‘prospective’ (diary) and retrospective (recall) data collections to be made and the utility of recall data to be appraised.

An attitudinal survey was also administered as part of the supplementary recall survey and, therefore, responses relate to 1997/98 licence-holders.

2.3.2 Survey scope

Marine and estuarine waters of Tasmania, including the offshore Bass Strait islands (ie. King and Flinders Island) were defined as in-scope. Seven fishing regions were defined for the purpose of diary analysis (Fig. 1). For recall surveys, regional data were collected for the North Coast (NW and NE Tas regions combined), East Coast (E and SE Tas regions combined) West Coast (W Tas) and Bass Strait Islands (Flinders Island and King Island regions combined).

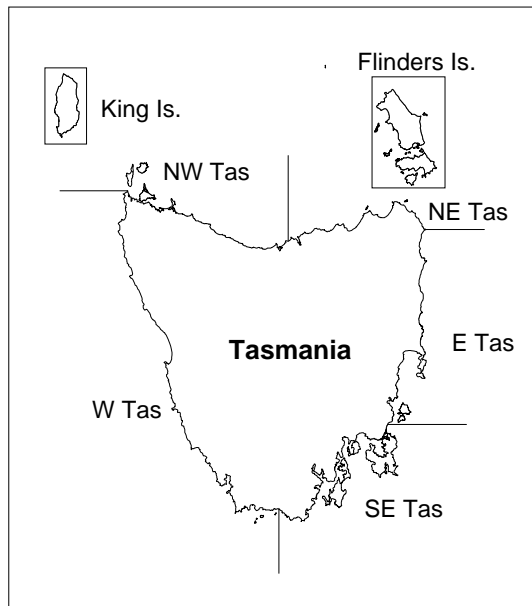


Fig. 1 Map of Tasmania, showing fishing regions (from Lyle 1999).

The survey encompassed marine/estuarine fishing activity of holders of Tasmanian recreational sea fishing licences. The survey covered the (attempted) capture of any form of aquatic organism in estuarine/marine waters adjacent to Tasmania by recreational sea fishing licence-holders.

2.4 Data Analysis

In this study the licensed fisher was the sample unit and holders of Tasmanian recreational sea fishing licences constituted the population. Given that there was a progressive increase in the number of recreational licence-holders during the licensing year, the sizes of both the sample and population changed within each enumeration period.

The number of licence-holders registered at the end of each month on the licence database and the number of respondents who were licensed within the sample provided the basis for expansion. The base unit for catch and effort analysis was the effort and catch per respondent per month.

Standard errors on estimates of catch and effort were calculated using the stratified random survey estimator (Pollock *et al.* 1994). When summing catch or effort across months, standard errors were approximated as the square root of the sum of the individual monthly variances.

Standard errors for proportional responses were calculated based on Cochran (1977).

3 RESULTS

3.1 Response rates

3.1.1 Recall surveys

Response profiles for recall surveys are presented in Table 3 and include results from FRDC project 1996/161 (Lyle 1999). Full response rates were consistently high, around 88% overall. Refusals accounted for less than 2%, non-contacts 3% and sample loss 8% of the combined sample. Sample loss occurred for several reasons but was primarily due to selected licence-holders not having a telephone listing or having a silent listing. If sample loss is discounted, the full response rate was about 96%.

Table 3 Response profiles for recall surveys.
Figures in parentheses represent percentage of total sample.

	Wave 2	Wave 3	Supplementary survey	Combined
Full response	612 (91.2%)	626 (86.1%)	638 (86.0%)	1876 (87.7%)
Refusal	5 (0.7%)	8 (1.1%)	21 (2.8%)	34 (1.6%)
Non-contact	12 (1.8%)	19 (2.6%)	22 (3.0%)	53 (2.5%)
Sample loss	42 (6.3%)	74 (10.2%)	61 (8.2%)	177 (8.3%)
Total sample	671	727	742	2140

3.1.2 Diary surveys

Diary uptake rates for eligible anglers and diary survey response rates for FRDC project 1996/161 (Lyle 1999) are presented in Table 4. Full diary response refers to respondents who participated in the diary survey for their entire diary period. Respondents who went out of scope during the diary period (e.g. moved interstate/overseas or went on an interstate/overseas holiday that extended beyond the end of the diary period) were treated as full respondents if complete information was collected up until the time they left the State.

Diary refusal rates were low (around 3%) and full response rates for eligible diarists were consistently higher than 90%. Overall, almost 97% of respondents who accepted a diary fully participated in the survey.

Data for diarists who partially responded (e.g. declined to participate for the full period or with whom contact was lost, generally through telephone disconnection) has been excluded from all subsequent analyses.

Table 4 Response profiles for diary waves.
 Figures in parentheses represent percentage of eligible respondents.

	Wave 1	Wave 2	Wave 3	Combined
No. eligible	667	363	661	1691
Refused diary	25 (3.7%)	9 (2.5%)	15 (2.3%)	49 (2.9%)
Accepted diary	642 (96.3)	354 (97.5%)	646 (97.7%)	1642 (97.1%)
Full diary response	612 (91.7%)	350 (96.4%)	624 (94.4%)	1586 (93.8%)

Given the very high response rates, possible biases arising from non-response were not considered to be a significant problem in this study.

3.2 Diary and recall effort and harvest

Information contained in this section is presented as expanded estimates for resident Tasmanian holders of recreational sea fishing licences. Reference should be made to Lyle (1999) for a more detailed analysis of diary results.

In order to compare diary and recall effort estimates, it has been assumed that each 'recall day' fished equated to an event as determined in the diary survey. In practice, however, many diary events based on passive fishing gear types spanned more than one day (ie. gillnets or rock lobster pots set one day and then hauled the next day). It is unclear whether respondents would interpret such instances as one or two fishing days for the purpose of the recall surveys. In such cases, recall based effort (days fished) would tend to be over-estimated if the latter applied, regardless of any problems relating to recall bias. No such interpretation problems should apply to harvest estimation.

3.2.1 Recreational gillnet effort

Monthly graball and mullet net effort for diary and recall surveys produced the same trend, with effort peaking during summer, especially January, and declining to a low level between May and October (Fig. 2). Recall estimates were, however, consistently higher than those for the diary survey, with total effort for the survey period (December 1996 - April 1998) based on recall at least double that derived from the diary survey. That is, gillnet effort was estimated at 158,915 net days based on recall compared with just 79,018 net days for the diary survey. Mullet net effort was 6921 net days for recall while the diary estimate was 2353 net days.

The relative significance of graball nets to the total recreational gillnet (graball and mullet net combined) effort was very similar for the two survey approaches, accounting 95% of the recall compared with 97% of the diary survey effort estimates.

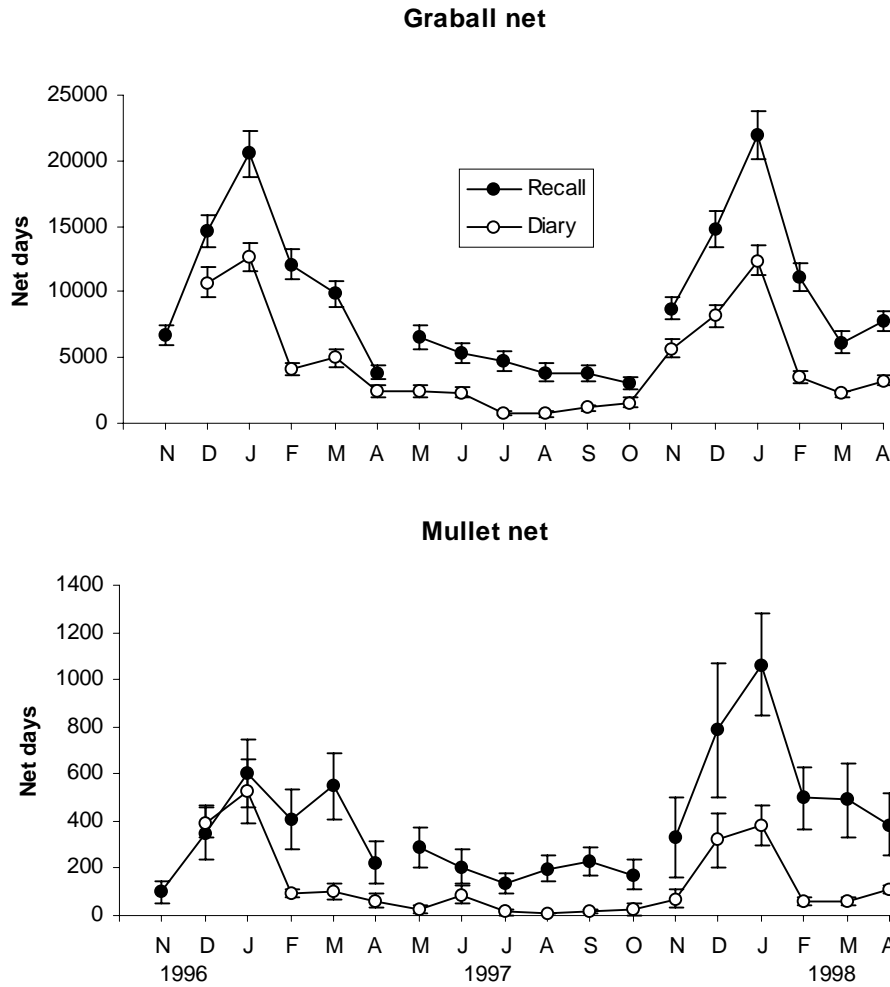


Fig. 2 Estimated monthly gillnet effort (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

When effort was summed for each recall survey and compared with diary estimates for corresponding periods, it was apparent that the magnitude by which recall overestimated diary effort was variable. During the peak fishing period (November/December - April), recall estimates were higher by a factor of at least 1.7 and up to 3.6 times, while during the low activity winter period recall estimates were over 3 times higher (Table 5 and Fig. 2). These findings indicate that the application of a simple scaling or adjustment factor for recall bias is not appropriate.

Table 5 Graball and mullet net effort based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

Period	Graball net			Mullet net		
	Recall	Diary	Ratio	Recall	Diary	Ratio
Dec 96-Apr 97	60982 (2652)	34924 (1811)	1.7	2131 (281)	1176 (157)	1.8
May-Oct 97	27308 (1703)	8909 (792)	3.1	1235 (159)	182 (53)	6.8
Nov 97-Apr 98	70625 (2927)	35185 (1666)	2.0	3555 (465)	995 (151)	3.6

Although recall based effort was consistently higher than diary estimates, by region the relative (expressed as percentage) distribution of effort for the two survey approaches was comparable (Fig. 3). The vast majority (80%) of the graball net effort was centred off the East Coast, with relatively low levels (<10%) off the north and west coasts. By contrast, over half of the mullet net effort was directed off the East Coast, with a further 40% off the north coast.

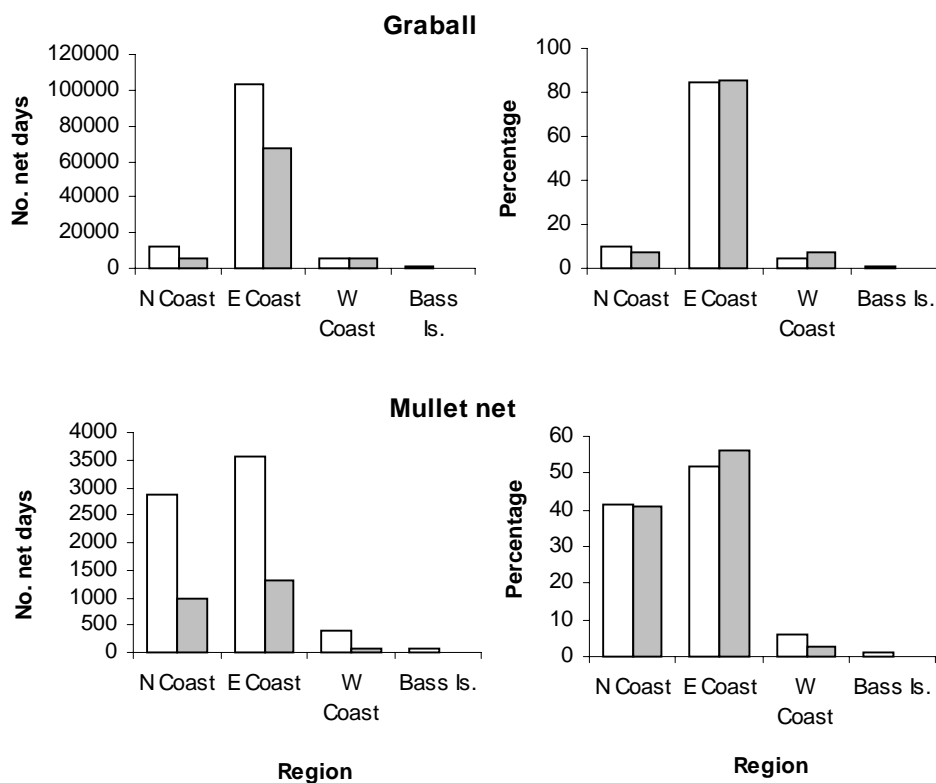


Fig. 3 Regional gillnet effort based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

3.2.2 Rock lobster

Pot effort and harvest

Rock lobster pot effort and harvest derived from recall and diary surveys are presented in Fig. 4. Seasonal trends for both effort and harvest were similar for the two survey approaches, although recall estimates were consistently higher. Effort and harvest levels were greatest during summer, especially December and January. Despite potting effort being highest in January, the diary survey indicated that harvest peaked in December whereas the recall survey indicated a January peak. On average, diarists reported higher catch rates (number of rock lobster per pot set) in December compared with January and as a consequence the December yield was actually higher (Lyle 1999).

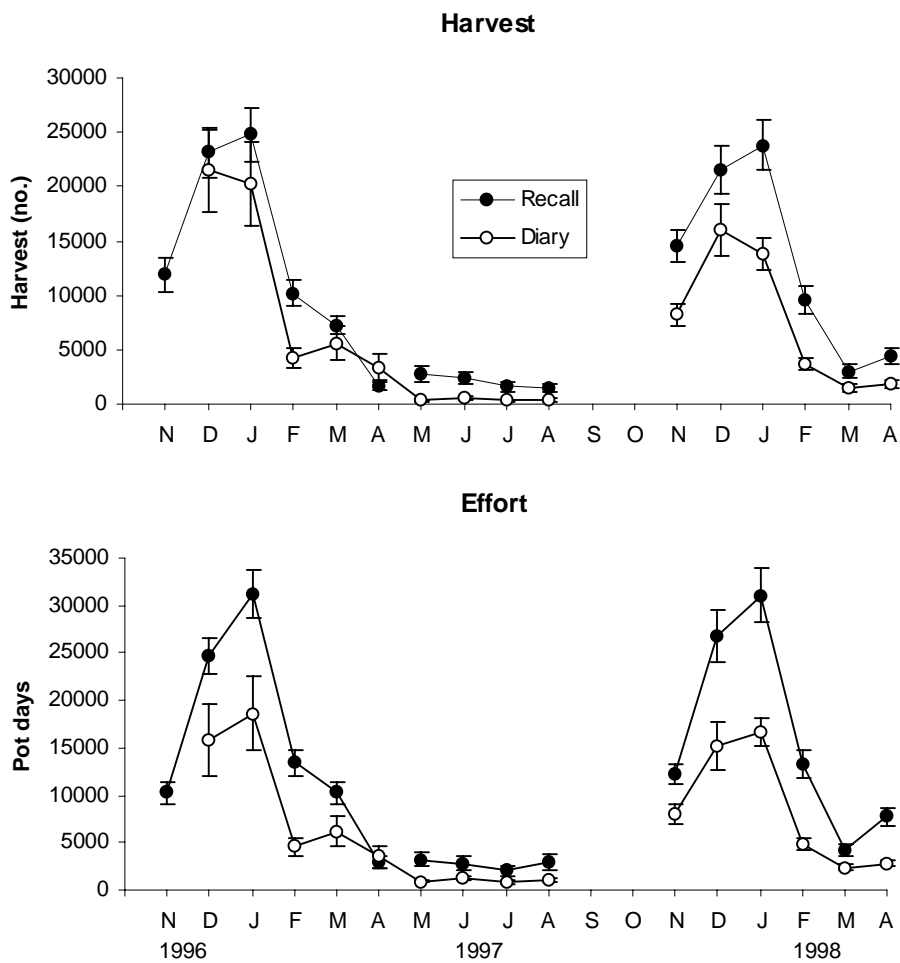


Fig. 4 Estimated monthly rock lobster pot effort and harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

Over the entire survey period, recall estimates exceeded diary totals by a factor of 1.8 and 1.5 times for effort and harvest, respectively. Recall based effort for the period was 189,048 pot days compared with 102,478 pot days for the diary survey while harvest was estimated at 152,191 and 101,645 rock lobster for the recall and diary

surveys, respectively. An unexpected finding was that the overall harvest rate for the diary survey (approximately one lobster per pot day) was in fact higher than that for the recall survey (about 0.8 rock lobster per pot day).

With the exception of the December 1996 - April 1997 recall survey; recall harvest estimates exceeded diary estimates by a factor of at least 1.7 times (Table 6). For the December 1996 - April 1997 period, effort was substantially overestimated (1.7 times) by recall but the harvest estimates were relatively close, the recall harvest estimate being only about 20% higher than the diary estimate. In the second year, the recall harvest for the peak period (November-April) was higher than the diary estimate by a factor of 1.7 times. There was greater consistency in the extent by which effort was over-estimated during the peak period in each of the two years (ie. 1.7 - 1.9 times).

Table 6 Recreational rock lobster pot effort and harvest based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

Standard errors are in parentheses

Period	Effort			Harvest		
	Recall	Diary	Ratio Recall:Diary	Recall	Diary	Ratio Recall:Diary
Dec 96-Apr 97	82622 (3685)	48618 (3548)	1.7	66907 (3679)	55012 (5800)	1.2
May-Oct 97	10981 (1470)	4012 (695)	2.7	8388 (1084)	1683 (313)	5.0
Nov 97-Apr 98	95445 (4400)	49848 (2660)	1.9	76896 (3809)	44950 (3111)	1.7

In absolute terms, effort and harvest estimates by fishing region were substantially higher for recall-based surveys but the relative distribution of effort and harvest between regions was comparable for the two survey methods (Fig. 5). The importance of the East Coast is clearly evident, with around 80% of the harvest and effort concentrated in that region. The north and west coasts were of relatively minor importance in terms of pot effort and harvest (<10%).

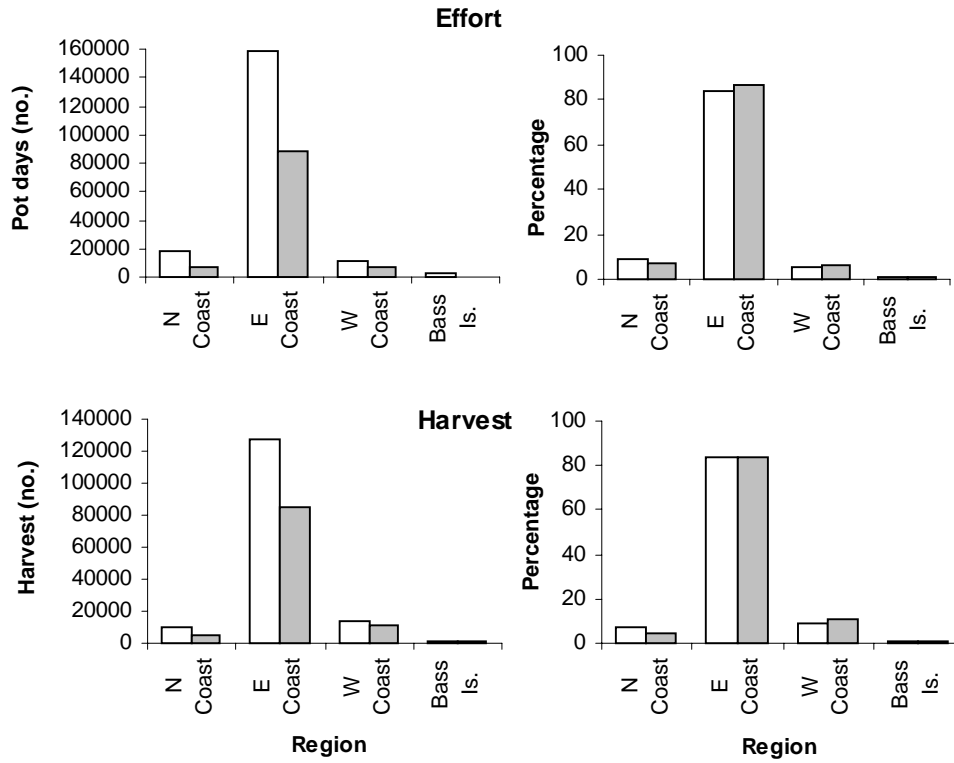


Fig. 5 Regional rock lobster pot effort and harvest based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

Dive harvest

The seasonal trend in rock lobster dive harvest estimates derived from recall and diary surveys was similar for the two approaches, with a marked peak in December and January (Fig. 6). In general, monthly recall based harvest estimates exceeded diary estimates and the overall harvest based on recall was about 1.5 times greater than that for the diary survey (ie. 81,308 and 53,147 rock lobster for recall and diary surveys, respectively).

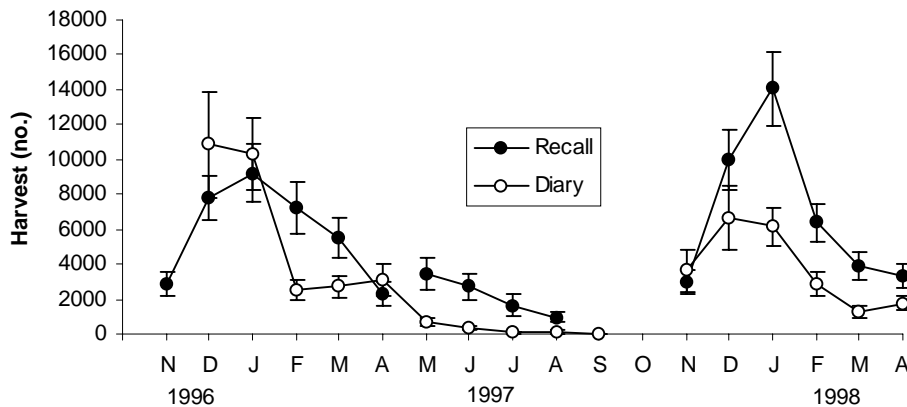


Fig. 6 Estimated monthly rock lobster dive harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

In the first recall/diary period (December 1996 - April 1997), the recall survey produced a harvest estimate only 10% greater than that for the diary survey (Table 7). This result was strongly influenced by the apparent underestimation of recall harvest in December and January (Fig. 6). In the second peak period (November 1997 - April 1998) the recall estimate was substantially inflated, by a factor of 1.8 times, while during the winter period (May - August 1997) the recall estimate was 6.8 times higher than the diary harvest.

Table 7 Recreational rock lobster dive harvest based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

Standard errors are in parentheses

Period	Recall	Diary	Ratio Recall:Diary
Dec 96-Apr 97	32019 (2882)	29505 (3900)	1.1
May-Oct 97	8743 (1409)	1275 (169)	6.8
Nov 97-Apr 98	40546 (3203)	22367 (2603)	1.8

While differing in absolute terms, there was general consistency in the relative proportions of the dive harvest taken by fishing region for recall and diary surveys (Fig. 7). Over 60% of the rock lobster dive harvest was taken from the East Coast, with around 15% from the north coast and around 10% from the West Coast and Bass Strait islands.

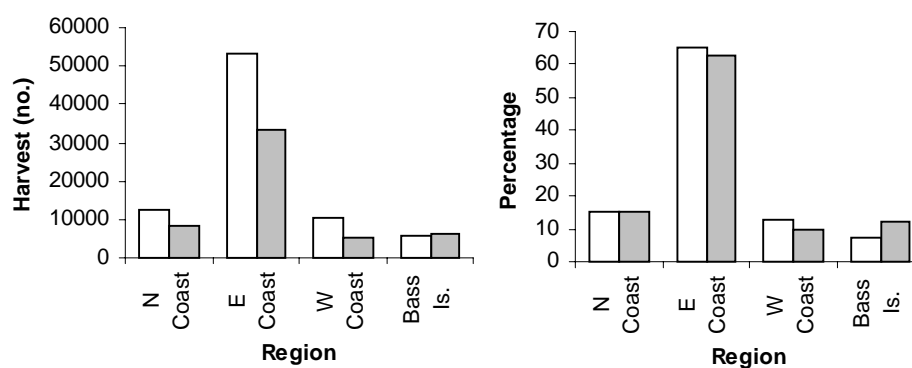


Fig. 7 Regional dive harvest of rock lobster based on recall (clear) and diary (shaded) survey for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

Total harvest

There was virtually no difference in the relative proportions of the total rock lobster harvest taken by rock lobster pot and dive collection, ie pots accounted for 65% and dive methods 35% of the combined harvest for recall and diary surveys.

3.2.3 Abalone

The seasonal pattern of the abalone harvest was very similar for recall and diary surveys, with recall estimates generally higher (Fig. 8). For the entire survey period the recall harvest estimate (309,245 abalone) was almost 2.3 times greater than that for the diary survey (135,334 abalone).

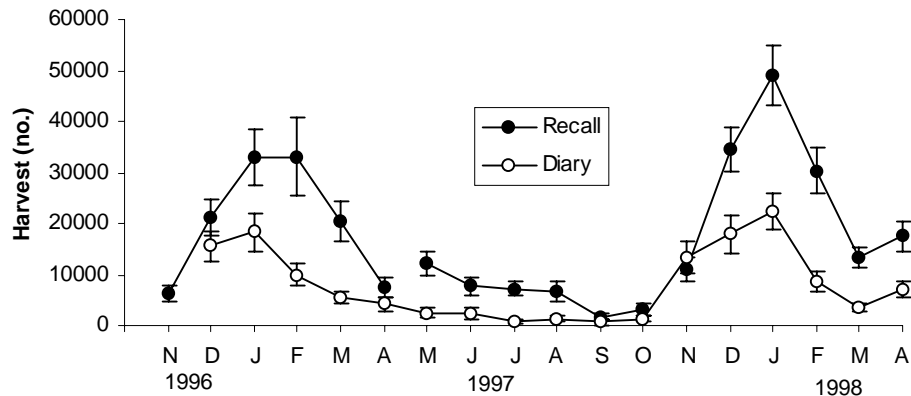


Fig. 8 Estimated monthly abalone dive harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

For those surveys covering the peak fishing periods (ie. December 1996 - April 1997 and November 1997 - April 1998), recall harvest exceeded diary harvest estimates by 2.1 times (Table 8). During the winter (May - October 1997), when harvest levels were low, the recall harvest was 4.3 times greater than the diary estimate.

Table 8 Recreational rock lobster and abalone dive harvest based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders.

Standard errors are in parentheses

Period	Recall	Diary	Ratio Recall:Diary
Dec 96-Apr 97	114931 (10974)	53469 (5483)	2.1
May-Oct 97	38603 (4016)	8940 (1524)	4.3
Nov 97-Apr 98	155711 (9627)	72925 (6513)	2.1

Regionally, the relative distribution of the abalone harvest was comparable for both recall and diary surveys despite substantial differences in absolute harvest estimates (Fig. 9). Over 60% of the harvest was taken off the East Coast, with the north and west coasts of secondary importance.

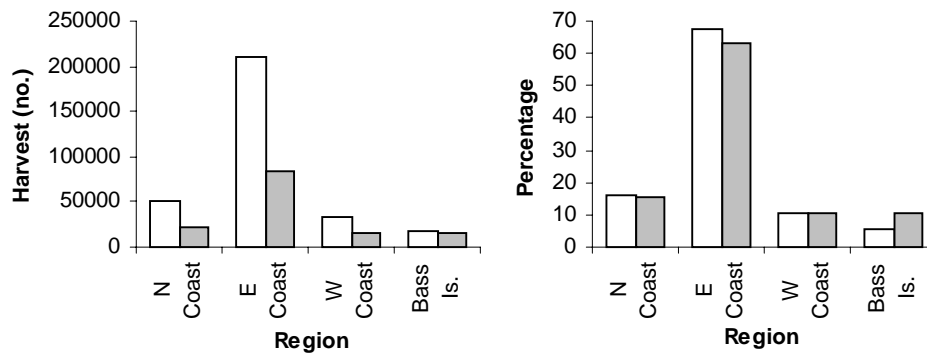


Fig. 9 Regional dive harvest of abalone based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

3.3 Awareness and attitudes of holders of recreational sea fishing licences

Information contained in this section was collected as part of the supplementary recall survey conducted in May 1998. Responses apply to 1997/98 licence-holders and results are presented as expanded estimates for resident Tasmanian holders of recreational sea fishing licences aged 16 years and older.

3.3.1 General fishing issues

In response to a question relating to satisfaction with sea fishing in general over the past few years, about 70% of licence-holders indicated that they were at least quite satisfied while 25% were less than satisfied (Table 9). Holders of rock lobster pot and rock lobster dive licences were asked about satisfaction with rock lobster fishing. Slightly more than 60% were satisfied while 30% were not satisfied.

Respondents were then asked whether the quality of fishing they had done in the previous twelve months was better, worse or about the same as that for the year prior. Such questioning allowed inferences to be made about perceived inter-annual variability for the two years prior to the attitudinal survey. Slightly less than 60% of licence-holders indicated that they considered fishing in general was about the same, less than 15% considered fishing was better while over 20% considered fishing was worse in the previous twelve months compared to the year prior (Table 9). By comparison, rock lobster fishing in the previous twelve months was considered better by less than 10%, less than half considered it to be about the same and over one third of all rock lobster fishers considered it to be worse.

About 10% of licence-holders considered that they had spent more time sea fishing in general during the previous twelve months compared with the year prior, over one third indicated that they had fished less and about half considered that they had fished about the same (Table 9). With regards to rock lobster fishing, about 10% of licence-holders considered that they had spent more time rock lobster fishing, about 40% spent less time and about 40% had spent about the same amount of time.

Table 9: General satisfaction, quality and time spent fishing, resident Tasmanian recreational sea fishing licence-holders 16 years and older.

Response	Fishing in general		Rock lobster fishing	
	%	SE	%	SE
<i>SE standard error</i>				
<i>Satisfaction with sea fishing</i>				
Very satisfied	8.9	1.4	9.4	1.3
Quite satisfied	60.9	2.7	53.8	2.3
Not very satisfied	24.7	2.4	25.0	2.0
Not at all satisfied	1.5	0.4	4.7	1.0
Unsure	4.0	1.2	7.0	1.3
<i>Quality of sea fishing in the previous 12 months compared to the year prior</i>				
Better	13.6	1.8	8.2	1.3
same	56.1	2.7	43.6	2.3
worse	21.6	2.2	34.6	2.3
unsure	8.7	1.8	13.7	1.7
<i>Amount of time sea fishing during the previous 12 months compared to the year prior</i>				
More	11.3	1.7	10.6	1.5
Same	49.2	2.7	41.8	2.3
Less	37.3	2.6	41.4	2.4
unsure	2.2	1.0	6.3	1.3

3.3.2 Awareness of fisheries legislation

Awareness of fisheries legislation relating to size, bag and possession limits for key species and selected regulations relating to Shark Nursery Areas was assessed through a series of questions directed to respondents. Respondents who, unaided, provided correct answers were considered to be fully aware of the regulation, those who indicated that they had heard of the regulation once prompted by the interviewer were considered to have some general awareness. Respondents who could not recall having heard of the regulation were considered to have no awareness.

Awareness of size limit regulations was highest for rock lobster, with over 90% of licence-holders being at least generally aware of the regulation (Table 10). General awareness of the size limit for flathead was also relatively high (80%). Awareness of size limits for trumpeter¹ and flounder were lower, with around 40% of the licence-holders having no awareness of these regulations. In all cases less than half of the licence-holders were fully aware of size limits, with full awareness being very poor for trumpeter and flounder (<10%).

¹ The same minimum size limit applies for both bastard and striped trumpeter.

Table 10 Awareness of size limits for key species by resident Tasmanian sea fishing licence-holders, 16 years and older.

SE is standard error

Species	Awareness	%	SE
<i>Flathead - 300 mm</i>			
	Full	28.2	1.9
	General	51.0	2.1
	None	20.8	1.9
<i>Trumpeter - 330 mm²</i>			
	Full	7.2	0.9
	General	53.6	2.1
	None	39.2	2.1
<i>Flounder - 250 mm</i>			
	Full	9.1	1.0
	General	50.9	2.1
	None	40.0	2.1
<i>Rock lobster - 110 mm for males, 105 mm for females</i>			
	Full	48.9	2.1
	General	42.0	2.1
	None	9.1	1.3

In terms of awareness of bag and possession limit regulations for rock lobster and abalone, awareness was higher for rock lobster, with over 85% of licence-holders having at least general awareness of the bag and possession limits for rock lobster pot/dive licence-holders (Table 11). Over 70% of licence-holders indicated awareness of the abalone bag limit but just 60% were aware of the possession limit for abalone dive licence-holders. There was poor awareness of rock lobster and abalone possession limits for non-rock lobster/abalone licensed fishers, with over 60% of licence-holders unaware of these regulations.

² Subsequently revised to 350 mm.

Table 11 Awareness of recreational bag and possession limits for rock lobster and abalone by resident Tasmanian recreational sea fishing licence-holders, 16 years and older.

SE is standard error		
Awareness	%	SE
<i>Rock lobster daily bag limit - 5 per person</i>		
Full	74.9	1.9
General	15.3	1.6
None	9.8	1.2
<i>Rock lobster possession limit (rock lobster pot/dive licence-holders) - 10 per person</i>		
Full	68.0	2.0
General	17.9	1.7
None	14.1	1.5
<i>Rock lobster possession limit (non-rock lobster pot/dive licence-holders) - 5 per person</i>		
Full	14.4	1.4
General	22.9	1.9
None	62.7	2.1
<i>Abalone daily bag limit - 10 per person</i>		
Full	55.0	2.1
General	14.9	1.5
None	30.1	1.9
<i>Abalone possession limit (abalone dive licence -holders) - 20 per person</i>		
Full	39.4	2.1
General	18.8	1.8
None	41.8	2.1
<i>Abalone possession limit (non-abalone dive licence-holders) - 5 per person</i>		
Full	12.0	1.4
General	17.1	1.7
None	70.9	2.0

Respondents were asked whether they had heard anything about Shark Nursery Areas and those who had were asked about net usage and restrictions that apply to catching shark in these areas. Around 70% of licence-holders had heard about Shark Nursery Areas, with about 60% of these at least generally aware of the restrictions that apply to net usage. Less than half were aware of restrictions that apply to the capture of school and gummy shark in SNAs (Table 12).

Table 12 Awareness of Shark Nursery Areas (SNAs), restrictions relating to net usage and catches of sharks in SNAs by resident Tasmanian recreational sea fishing licence-holders, 16 years and older. SE is standard error

Awareness	%	SE
<i>Shark Nursery Areas (SNAs)</i>		
General	72.7	2.0
None	27.3	2.0
<i>Net usage in SNAs - max. of one graball net, no mullet nets permitted</i>		
Full	33.9	2.1
General	27.3	2.2
None	38.9	2.3
<i>Sharks catch in SNAs - no school or gummy shark may be kept, taken by any method</i>		
Full	15.7	1.7
General	32.9	2.3
None	51.3	2.5

3.3.3 Sources of information

Respondents were asked how they had learnt about sea fishing regulations in Tasmania, identifying their main and second main sources of information (Table 13). Department of Primary Industries, Water and Environment (DPIWE) publications were the main source of information for over 70% of licence-holders, with around 85% mentioning this source. Of secondary importance were other fishers and print media (e.g. newspapers but not fishing magazines), each mentioned by over 30% of licence-holders. Television, radio, fishing magazines and fishing clubs/associations were of minor importance as sources of information regarding fishing regulations.

Table 13 Main sources of information about fisheries legislation for resident Tasmanian recreational sea fishing licence-holders, 16 years and older.

Information source	Any mention	Main	Secondary
DPIWE publications	85.5	72.8	12.7
Other fishers	34.1	10.6	23.5
Other print media	31.1	10.1	20.9
DPIWE other	6.4	2.0	4.4
Clubs/associations	4.3	1.1	3.2
Radio	3.2	0.6	2.6
TV	2.6	1.0	1.6
Other	1.9	1.0	0.9
Fishing magazine	1.3	0	1.3
Tackle shop	0.8	0.5	0.3
None	0.1	0.1	

Each year, corresponding to the start of the licensing year, DPIWE produces a series of brochures for the recreational finfish, rock lobster and abalone fisheries; these brochures provide general information about each fishery and a summary of relevant regulations. These brochures are available free of charge at the point of sale of recreational licences (selected government offices and post offices). Respondents were asked whether they had seen these brochures and if so whether they still retained a copy. Over half (56%) of the 1997/98 licence-holders recalled having seen the brochures, 40% had not seen the brochures and 4% were unsure. Of those licence-holders that had seen the brochures, 79% still retained a copy, 12% did not have a copy and the remainder were unsure.

3.3.4 Management planning process

During 1996 and 1997 DPIWE undertook reviews of the major wild fisheries, including the recreational fishery, with the intention of developing management plans for the scalefish, rock lobster and abalone fisheries. Respondents were asked whether they could recall hearing about the process and, if so, how they had heard about it.

The majority (60%) of licence-holders indicated they were aware of the management review process (Table 14). Other print media (mainly newspapers) was the main source of information, being mentioned by around 60% of those licence-holders that were aware of the reviews. Other fishers were also identified as important sources of

information (35% of mentions), followed by television (20%) and radio (14%). By contrast to information about fisheries regulations, DPIWE publications were of minor significance (<10% of mentions). Fishing clubs/associations, fishing magazines and tackle shops were not rated highly as sources of information.

Table 14 Awareness of management planning process and main information sources for resident Tasmanian recreational sea fishing licence-holders, 16 years and older.

Aware of management planning process			
Yes	59.9		
No	36.6		
Unsure	3.9		
Sources of information			
	Mentioned	Main	Secondary
Other print media	58.8	44.4	14.4
Other fishers	34.1	17.9	16.3
TV	19.2	10.8	8.4
Radio	13.6	10.6	3.3
DPIWE publications	8.7	6.2	2.4
DPIWE other	6.0	3.8	2.2
Other	2.3	1.9	0.3
Clubs/associations	6.0	3.5	2.5
Fishing magazines	1.1	0.6	0.5
Tackle shop	0.5	0.3	0.2

4 DISCUSSION

4.1 General

The overall success of this survey can be assessed in a number of ways, one of which relates to response rates. Non-response, either through non-contact, refusals or partial response (e.g. dropping out during the course of the survey) can introduce significant biases when non-respondents behave differently to those who respond (Pollock *et al.* 1994). In this study, response rates were consistently very high, around 90% or greater and, significantly, refusals were less than 2% for recall surveys and less than 3% for the diary surveys. In the diary survey around 97% of respondents who accepted the diary fully responded. Careful questionnaire design, thorough training of interviewers and a comprehensive approach to respondent management were all contributing factors to this outcome.

Using similar design philosophy, comparable response rates have been attained for a broad scale survey of recreational fishing in the Northern Territory (Coleman 1998) and for a survey of recreational rock lobster fishing in South Australia (McGlennon 1999).

4.2 Fishing effort and harvest

For a detailed discussion of fishing effort and harvest results reference should be made to Lyle (1999).

The pattern and intensity of licensed fishing activity was strongly linked with the commencement of the licensing year (and in particular the opening of the rock lobster season) and the summer holiday period. That is, effort/harvest levels for all methods rose sharply in November and peaked during December and January. They then fell to an intermediate level between February and April, followed by a further drop in fishing activity during the winter months.

The significance of the East Coast and the summer months in terms of recreational fishing activity has been clearly demonstrated by this survey. The proximity of the major population and holiday centres, accessibility (including placement of boat ramps) and its generally protected coastal waters are contributing factors. Although productive, the West Coast is more remote, less populated and exposed to the prevailing sea conditions. Levels of harvest and effort for rock lobster and abalone were generally lower off the north coast compared with the West Coast, despite the presence of several large population centres. Low effort levels off the north coast presumably reflect the limited availability of suitable reef habitat. Gillnet effort was comparable between the north and west coasts but catch compositions differed markedly (Lyle 1999).

4.3 Recall and diary surveys

Telephone surveys have been applied widely to collect basic information about recreational fishing, such as participation, types of fishing, socio-demographic profiles, awareness and attitudes, etc (e.g. Cierpicki *et al.* 1997, Roy Morgan Research 1999). Telephone surveys have several advantages, they are cost effective to administer, response rates are generally high and results are available within a very short time frame (Pollock *et al.* 1994). However, because telephone surveys occur after fishing has occurred, information about fishing activity is collected retrospectively. Several studies have demonstrated that recall bias can lead to significant overestimates of both harvest and effort. The extent of the bias is influenced not only by the length of the recall period but also by the frequency of participation (Fisher *et al.* 1991, Tarrant *et al.* 1993, Connelly and Brown 1995).

This study presented a unique opportunity to compare retrospective and diary data collection and thereby assess the utility of telephone surveys as a means of providing reliable catch and effort information. Compared with many surveys, which involve recall periods of up to 12 months, the maximum period of recall here was six months. Nevertheless, recall estimates were consistently higher than diary estimates, often by a factor of around two, suggesting significant overestimation of effort and harvest based on recall. Adjustment for recall bias is not a simple matter since it is influenced by a complex range of factors and, as determined in this study, differed between individual recall surveys and by fishing method.

Therefore, as a means of providing estimates of effort and harvest, the telephone recall survey approach has proven unreliable in absolute terms but may be justified in situations where little is known about a fishery and information about indicative levels of effort and harvest are acceptable. The present findings confirm that, in terms of an assessment of the relative distribution of effort and harvest by method, season and region, recall surveys can be very informative.

The utility of recall surveys to detect variability between years is unclear but there may be potential to use such an approach to monitor trends over time rather than providing absolute estimates of effort or harvest. The present survey provided for a limited comparison based on the December - April period for 1996/97 and 1997/98. Diary estimates indicated that the magnitude of 1997/98 rock lobster pot and dive harvests were 0.69 and 0.63 times the 1996/97 harvests, respectively. The comparable ratios based on recall estimates were 0.93 and 1.17, respectively. Comparable diary and recall ratios for the two years were 1.01 and 1.02 for rock lobster pot effort, 1.11 and 1.17 for abalone harvest and 0.84 and 1.01 for graball effort. With the exceptions of rock lobster dive harvest and graball net effort, trends were consistent between survey methods, though recall surveys tended to be less sensitive in detecting the magnitude of change.

Nonetheless, in the absence of other information, the telephone survey approach may be useful in assessing recreational fishing activity for key fisheries provided that the limitations in the data are fully acknowledged.

4.4 Awareness and attitudes

The survey has highlighted that the majority of licence-holders were generally satisfied with the state of recreational fishing in Tasmania, a conclusion consistent with findings reported by Lyle and Smith (1998). There was, however, evidence that over a third of the fishers perceived that the 1997/98 rock lobster season was poorer than the 1996/97 season, an observation supported by lower harvest and harvest rates (for pots) in 1997/98.

There was very high (90%) general awareness of size limits for rock lobster amongst licence-holders; awareness of finfish size limits was variable but lower. Flathead is the most frequently caught salt water angling species in Tasmania (Lyle 1999) and, although general awareness of the size limit was high (80%), about 20% of licence-holders remained unaware of the regulation. Creel surveys have identified that retention of undersized flathead by anglers was a major problem (Lyle and Campbell 1999), emphasising the need for targeted education programs relating to size limits. There was only moderate awareness of size limits for trumpeter and flounder ($\approx 60\%$), which was not unexpected since these species have greatest relevance to fishers who use gillnets and, in the case of flounder, fishers who spearfish.

Licence-holders demonstrated strong awareness ($>85\%$) of rock lobster bag and possession limits and a moderate awareness ($>60\%$) of abalone bag and possession limits. By contrast, regulations introduced in November 1997 that relate to the possession of these species by non-licensed fishers was poor ($<40\%$) and will need to be addressed in future education programs.

For information and education programs to be effective it is important to access the main sources of information used by recreational fishers. This study demonstrated that DPIWE publications were important and a potentially effective means of providing information about regulations. However, by comparison with 1995/96, fewer licence-holders had seen the recreational fishing brochures in 1997/98 (84% in 1995/96 compared with 56% in 1997/98) (refer Lyle and Smith 1998). This highlighted a suspected problem that some issue points for licences did not make brochures readily available to licence applicants.

Newspaper and television reports along with other fishers were perceived to be important sources of information about the management planning process. The relatively high general awareness of the planning process (60%) suggested that media coverage (newspaper and television) had been relatively effective at informing fishers of developments.

Evaluation of awareness and attitudes of recreational fishers through surveys such as this provides a valuable means of identifying issues that require particular attention as well as enabling managers to assess the success and impact of existing education and awareness programs. Although the present findings applied only to licence-holders and may not be representative of recreational fishers in general, they do represent an important first step towards assisting resource managers in the evaluation and development of information programs aimed at promoting responsible community attitudes and behaviour for sustainable resource use.

4.5 Conclusions

The telephone (recall) survey approach developed for this project represents a cost-effective means of surveying licence holders, response rates were very high and basic harvest and effort information was readily collected. However, the accuracy of the information provided is subject to ability of anglers to accurately recall fishing activity and there was evidence that effort and harvest levels were substantially overestimated. Recall bias was not consistent over time or by method and appeared to be affected by the level of fishing activity. This study demonstrated that application of a simple correction factor would not be appropriate and that the recall-based approach was less sensitive at identifying variations in effort and harvest levels than the alternative diary approach.

Logically, the accuracy of recall surveys would be improved with shorter periods of recall. In this study, a six month recall period was used whereas in the United States of America, the Marine Recreational Fishery Statistics Survey uses telephone surveys to collect information about fishing effort for the previous 2-month period (Anon. 1996). In that case, extensive testing was undertaken to determine an appropriate recall period, taking into account the issue of recall bias (Essig and Holliday 1991). The relationship between the length of recall period and recall bias was not investigated in this study. If an on-going program of monitoring the licensed recreational fishery is to be developed this relationship should be investigated with a view to establishing/quantifying the trade-offs between cost and accuracy.

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