FRDC FINAL REPORT

ASSESSMENT OF THE LICENSED RECREATIONAL FISHERY OF TASMANIA (PHASE 2)

J.M. Lyle

February 2000

FRDC Project No.1996/161

FISHERIES RESEARCH & DEVELOPMENT CORPORATION

National Library of Australia Cataloguing-in-Publication Entry

Lyle, J.M.

Assessment of the licensed recreational fishery of Tasmania (Phase 2)

Bibliography.
ISBN 0-7246-7237-0.

1. Fishing – Tasmania. 2. Gillnetting – Tasmania
3. Fish and game licences – Tasmania. I. Title

597.09946

Published by the Tasmanian Aquaculture and Fisheries Institute
University of Tasmania 2000

Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Taroona, Tasmania 7053

Telephone: (03) 6227 7277 Fax: (03) 6227 8035

ASSESSMENT OF THE LICENSED RECREATIONAL FISHERY OF TASMANIA (PHASE 2)

J.M. Lyle

February 2000

FRDC Project No. 1996/161

Table of Contents

1 NON-TECHNICAL SUMMARY

1996/161 Assessment of the licensed recreational fishery of Tasmania (Phase 2)

Principal Investigator: Jeremy Lyle

Address: University of Tasmania
Tasmanian Aquaculture and Fisheries Institute
Marine Research Laboratories
Nubeena Crescent
Taroona, TAS 7053
jeremy.lyle@utas.edu.au

Objectives:

1. To estimate catch and effort for scalefish by recreational netting in Tasmania.
2. To estimate recreational catch and effort for rock lobster and abalone in Tasmania.
3. To provide reliable disaggregations of catch and effort data by key species, region and season.
4. To compare, in terms of catch and effort, the recreational and commercial fisheries (as appropriate).
5. To evaluate the impacts of management initiatives on catch and effort in the licensed recreational fishery, with particular emphasis on the net fishery.
6. 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 and avoidance and resolution of conflicts between commercial and recreational sectors.

Non Technical Summary

There have been very few attempts to study the recreational fishery in Tasmania and there are no recent estimates of participation, or reliable estimates of harvest and effort. In Tasmania, recreational gillnet usage is permitted, though nets must be licensed. Other fishing activities/gear requiring recreational sea fishing licences, include rock lobster pots and dive collection of rock lobster and abalone. In 1997/98 there were almost 12,000 recreational licence-holders, with around 10,000 gillnet, 7,800 rock lobster pot, 4,200 rock lobster dive and 5,500 abalone dive licences issued.

The present study provides the first comprehensive assessment of the fishing activity of licensed recreational fishers. The survey instrument developed for this study involved a multi-stage approach comprised of:

- an initial screening interview, designed to collect fishing information for the previous six months (based on recall) and to invite eligible respondents to participate in a diary survey;
- a diary survey, whereby fishing activity was monitored in detail, for a period of up to six months; and
- an attitudinal survey designed to assess awareness and attitudes.

Respondents were managed by survey interviewers who used frequent telephone contact to collect and record fishing information. This approach resulted in response rates which were consistently in excess of 90%, and therefore problems with non-response were minimised and data quality maximised.

The study was administered in three consecutive 'waves' which spanned the period December 1996 - April 1998. The recreational sea fishing licence database provided the sample frame, with a stratified random sample of licence-holders selected for the survey. Around 2,500 fishers provided information about previous fishing activity and over 1,500 participated in the diary survey. Diary information was provided on over 5,000 rock lobster pot, 3,800 gillnet, 3,700 line fishing and 1,200 dive fishing events.

During the 17-month diary survey, resident licence-holders undertook an estimated 81,000 gillnet sets, equivalent to 1,245,000 hours of net effort, producing a harvest of 513,000 fish. Recreational netting was a highly seasonal activity, which reached a peak during summer, especially in December and January, falling to low levels by late autumn. The vast majority of the gillnet effort (97%) and harvest (92%) was attributable to graball nets.

Regionally, the main area of graball net usage was the east coast, principally south-eastern Tasmania, where approximately 70% of the total effort was directed. Levels of graball effort on the north and west coasts were comparatively low (<10%).

Numerically, blue warehou and bastard trumpeter dominated the gillnet harvest, together comprising 40% of the total numbers. Flounder, mullet, jack mackerel and cod were of secondary importance, each contributing around 5% to the total harvest. Graballs were primarily used to target species such as blue warehou, bastard trumpeter and flounder, whereas mullet comprised the bulk of the harvest from mullet nets.

During the survey, the estimated recreational gillnet harvest of blue warehou was over 190 tonnes, which compared with about 240 tonnes for the commercial sector. Species with harvests exceeding 20 tonnes included bastard trumpeter, Australian salmon, silver trevally and striped trumpeter. Among these, the recreational share of the total harvest exceeded 35% for bastard trumpeter and silver trevally.

The overnight setting of gillnets was a very common practice, with over 75% of all net sets being fished overnight. At least one quarter of all gillnet sets had effective soak times of around 24 hours or greater. Excessively long soak times such as these have considerable potential for wastage. Proposed restrictions on night netting will have a significant impact on current fishing practices and, as demonstrated from attitudinal surveys, are likely to meet strong opposition from net fishers.

Resident licence-holders harvested approximately160,000 lobsters during the survey. Regionally, about three quarters of the total harvest was taken from the east coast, mainly from the south-east. The west coast contributed just over 10% of the harvest. Harvests for the north coast and Bass Strait islands were relatively minor. Rock lobster pots dominated (63%) the harvest, with dive collection of secondary

importance (33%) and a small component (4%) of the harvest taken by other methods, principally rock lobster rings.

Effort and harvest rose sharply at the opening of the rock lobster season (late November) and peaked in December/January, followed by sharp falls in February. Low levels of activity were maintained after April through to the end of the fishing season (August). The combined harvest for December 1997 – April 1998 was just two-thirds the size of that for the corresponding period in 1996/97. This decline was influenced by a combination of lower harvest rates for pots and a decline in targeted dive effort (and consequent harvest) in 1997/98.

The recreational share of the total rock lobster harvest was relatively low (5%). It was assumed that the recreational harvest was largely limited to shallow water because of the need to hand haul pots and also depth restrictions on diving. By contrast the bulk of the commercial harvest was taken from depths greater than 18 m. If the shallow water harvest (<18 m) is considered, then the recreational share was more significant, representing around 15% of the total. Regionally, the recreational share in south-eastern Tasmania was over 20% or, if restricted to shallow waters, in excess of 38%, while off eastern Tasmania the recreational harvest accounted for about 10% of the total and over 20% of the shallow water harvest.

Approximately 135,000 abalone were taken by divers during the survey period, over 60% from the east coast (mainly the south-east) with a further 10% each from the north west coast, west coast and King Island regions. Concentration of dive activity during summer was apparent, with almost half of the 1997 harvest of 78,000 abalone taken in the months of January and December. The recreational harvest for the survey period was equivalent to 65 tonnes of abalone and constituted a very minor component (2%) of the total Tasmanian harvest.

This study presented a unique opportunity to compare retrospective (recall survey) and 'prospective' (diary survey) data collection. Recall estimates of gillnet effort, rock lobster pot harvest and effort, 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, the bias being 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 has proven unreliable in absolute terms. However, this survey-type 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.

The attitudinal survey indicated that the majority of licence-holders were satisfied with the state of recreational fishing and the management of the fishery in Tasmania. In relation to the management of recreational gillnetting, the majority of licence-holders supported limiting the number of gillnets per boat to a maximum of three, but there was strong opposition to proposed bans on night netting and requirements to be in attendance of nets.

There was high general awareness of size limits for rock lobster, with awareness of finfish size limits lower. Licence-holders also demonstrated strong awareness of rock lobster bag and possession limits and a moderate awareness of abalone bag and possession limits.

Departmental publications were identified as 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 had been relatively effective at informing fishers of developments.

Keywords

Recreational fishery assessment, recreational fishing licences, gillnet, rock lobster, abalone, finfish, telephone/diary survey, recall bias, angler awareness and attitudes.

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, and of those, 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 1000 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 is apparent that the recreational harvest was significant, especially in relation to the commercial finfish catch, which has ranged between 1600 - 2500 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 number of rock lobster pot, rock lobster dive and abalone dive licences 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 (gillnet with mesh size of 100-140 mm and maximum length of 50 m) and one 'mullet' net (gillnet with mesh size of 60-70 mm and maximum length of 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.

	Licensing year			
Licence type	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

Prior to the present study, very little was known about recreational net usage in Tasmania. The 1983 ABS survey found that 6.6% of Tasmanian households (excluding those occupied by commercial fishers) owned a graball and an estimated 15,000 persons used a graball at least once a year (ABS 1984). At that time, fifteen percent of anglers who owned graballs used them at least once a fortnight. A more recent assessment of net usage, based on a telephone survey of licensed anglers, has indicated that between November 1995 and October 1996, recreational gillnet fishing effort was of the order of 110,000 net days for graballs and 4,700 net days for mullet nets (Lyle and Smith 1998). The survey also demonstrated that approximately 45% of the net fishers 'mostly' left their nets in the water overnight and a further 25% 'occasionally' did overnight sets. Although the survey provided no estimates of harvest, the impact of recreational netting is likely to be significant, particularly on the principal target species which include blue warehou, bastard trumpeter, striped trumpeter, flathead, flounder, mullet and Australian salmon. These are species that also have commercial importance and, as a consequence, there is a clear (but unquantified) relationship between the recreational and commercial fisheries. Not surprisingly, there have been long-standing conflicts over access and resource sharing in some areas.

In terms of the recreational harvest of rock lobster, a voluntary recall-based survey produced an estimated total harvest of around 250,000 rock lobsters in 1986/87, about 11% of the commercial catch (A. Schaap, unpubl. data). While this estimate was substantially higher than the 1992 ABS figure of 60 tonnes (equivalent to about 76,000 rock lobster), the survey was subject to self-reporting and non-response biases. The more recent telephone-based survey of licensed fishers estimated a recreational harvest of around 111,000 rock lobster in 1995/96, representing about 5% of the commercial harvest (Lyle and Smith 1998). The same survey also produced an estimate of harvest of 133,000 abalone, roughly equivalent to about 3% of the commercial production.

The current project seeks to build on the preliminary survey of licensed fishing (Phase 1) (Lyle and Smith 1998) and provide a detailed assessment of the licensed recreational fishery in terms of effort and harvest. Although non-licensed fishers have been excluded, the study provides a comprehensive assessment of the recreational gillnet, rock lobster and abalone fisheries and enables the impact of proposed management changes in relation to net usage to be evaluated. Findings will also assist in the development of awareness and education programs aimed at promoting responsible community attitudes and behaviour for sustainable resource use.

3 NEED

Estimates of participation rates, catch and effort are essential for effective fisheries management. Such data are usually collected from the commercial sector through mandatory logbook programs but are generally unavailable or difficult to obtain from the recreational sector. As many of Tasmania's fisheries resources are believed to be either fully or over-exploited and as resource sharing and other management issues become increasingly important, so too does the need for total fishery data.

The size of the recreational catch is a major uncertainty in stock assessments of the main Tasmanian fisheries, ie. scalefish, rock lobster and abalone. There are presently over 9,500 licensed recreational gillnets in Tasmania, with an estimated effort for the 1995/96 licensing year, of around 110,000 net days. The impact on inshore scalefish stocks is unknown but is likely to be significant.

The move to quota management in the Tasmanian rock lobster fishery has increased the need for accurate stock assessments on which to set catch limits. The stock assessment model of the Tasmanian rock lobster fishery uses an estimate of recreational catch as an important input parameter.

The Tasmanian Government is developing management plans for all fisheries, including the recreational fishery. The general lack of data for the recreational sector has made decision making difficult and uncertain. A number of important management changes have been proposed especially in relation to recreational gillnet usage. The Scalefish Fishery Management Plan, which took effect in July 1998, included provisions to limit the number of gillnets that can be used from a boat and a prohibition on leaving gillnets set overnight. The night netting provisions have, however, been disallowed and are subject to a ministerial review. Collection of detailed catch and effort information prior to implementation of management changes provides a unique opportunity to assess their potential impact on fishing practices.

4 OBJECTIVES

1. To estimate catch and effort for scalefish by recreational netting in Tasmania.
2. To estimate recreational catch and effort for rock lobster and abalone in Tasmania.
3. To provide reliable disaggregations of catch and effort data by key species, region and season.
4. To compare, in terms of catch and effort, the recreational and commercial fisheries (as appropriate).
5. To evaluate the impacts of management initiatives on catch and effort in the licensed recreational fishery, with particular emphasis on the net fishery.
6. 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 and avoidance and resolution of conflicts between commercial and recreational sectors.

5 METHODS

5.1 Survey design philosophy

The underlying design philosophy is based on the 'Fishcount' survey of recreational fishing in the Northern Territory (Coleman 1998). The survey instrument comprises several modules, with the primary source of data collection being a longitudinal diary survey.

While broad-scale diary surveys have been applied elsewhere, for example New Zealand (Bradford 1998) and Queensland (Higgs 1999), the approach adopted in this study differs. The diary was employed more as a 'memory jogger' than a logbook and, significantly, responsibility for data collection rested with the survey interviewers, not the respondents. In the more traditional diary survey approach, diaries or logbooks are issued to respondents who are expected to maintain a record of their fishing activities. Information is often general in nature, usually providing more a summary of a day's fishing rather than detail about the various activities undertaken, including changes in targeting. Since the burden of maintaining the logbook rests with the respondent, instructions may be misinterpreted and data may be incomplete or ambiguous. The need to periodically remind respondents to submit documentation creates a further problem, whereby information that has not been diarised and thus must be collected on the basis of recall, if at all. Partial or full non-response in self-administered diary surveys can also be a major issue and an important source of bias or uncertainty (Pollock *et al.* 1994).

The approach developed for this study effectively transferred the burden of data collection from the respondent to the survey interviewer. Data collection was undertaken by brief telephone interviews in which trained interviewers recorded details of any fishing that had occurred since the last contact. The level of fishing activity determined the frequency of such interviews and, as a general rule, respondents were contacted at least once a month even if no fishing was planned.

Respondents were encouraged to record basic information in their diaries, such as date, location, start and finish times (and any significant breaks from fishing) and catch by species for each fishing activity undertaken. By maintaining regular contact, usually within a couple of weeks of any fishing event, details of any non-diarised fishing were obtained with minimal concern in relation to recall bias. In practice, however, non-diarised fishing proved to be a minor issue, with almost 95% of all fishing events recorded in the diaries.

By maintaining regular contact, interviewers were able to immediately clarify ambiguities, obtain greater detail than could be achieved in a self-administered diary and also ensure completeness of data. This approach to respondent management and data collection, by necessity, required highly trained and proficient interviewers, which was achieved through careful interviewer recruitment, training and management.

5.2 Survey scope

5.2.1 Geographic scope

Marine and estuarine waters of Tasmania, including the offshore Bass Strait islands (ie. King and Flinders Island), extending offshore to the extent of the Exclusive Economic Zone, were defined as in-scope. Seven fishing regions were defined for the purpose of analysis (Fig. 1).

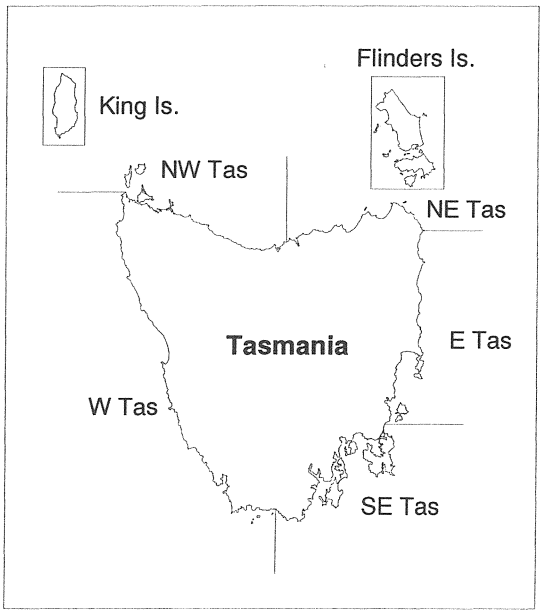

Fig. 1 Map of Tasmania, showing fishing regions.

5.2.2 Persons in-scope

The survey encompassed marine/estuarine fishing activity of Tasmanian recreational sea fishing licensees. While the vast majority of licence-holders are Tasmanian residents, there are usually a small number of interstate/overseas residents who take out licences (e.g. 1.7% and 2.2% of licence-holders in 1996/97 and 1997/98, respectively). Commercial fishers are also eligible to take out recreational fishing licences, although some restrictions, based on the type of commercial fishing licence(s) held, do exist. There are no age restrictions on the issue of licences.

5.2.3 Fishing activities in-scope

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. As well as licensed fishing activities, namely the use of gillnets, beach seines, rock lobster pots, diving for rock lobster, abalone and scallops and the use of scallop dredges, information was also obtained about other fishing activities, e.g. line fishing, use of bait nets, 'rock lobster rings'[1], and spearing of fish.

Commercial fishing/gathering activities were excluded from the study. However, commercial fishermen were eligible for inclusion in the study if they were involved in recreational fishing in some way (as defined).

5.3 Sampling

5.3.1 Sampling frame

The recreational sea fishing licence database provided the sampling frame used in this study. This licensing system is structured around a base licence (effectively comprised of a registration fee and one nominated licence category) to which additional licences may be added at a marginal cost. Many fishers take out more than one licence and are able to add licences to their 'package' at any time throughout the licensing year, which spans the period 1st November to 31st October in the following year. 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.

Typically, licence uptake is high early in the season, with 48-50% of licence-holders registered by the end of November in each of the two years covered by this survey (ie. 1996/97 and 1997/98). In both of these years, 90-91% of licence-holders had taken up licences by the end of January.

As indicated below, many diary respondents held licences for only part of their diary period (ie. took up licences some time after 1st November) and in other instances,

[1] A rock lobster ring is a single ring or hoop to which mesh of string or twine is attached. Rings are baited in the centre of the hoop to attract rock lobster. Rings have no top and are attended regularly.

some respondents did not take up a licence at all. Although all marine recreational fishing activities by respondents were recorded, only those activities undertaken whilst holding a current recreational sea fishing licence were used in subsequent analyses.

5.3.2 Stratification

Information provided on the licensing database included name, address, phone number, date of birth and date and type of licences issued. As part of the licence application form, applicants were asked to estimate the number of days fished in the previous twelve months. Although not a compulsory requirement, approximately 42% of applicants in each of the licensing years provided this information.

Stratification of the sample was on the combination of licence(s) held, home address and avidity (ie. days fished in the previous twelve months). Three classes or groupings of licences were identified:

- holders of a mullet net plus any other licence type(s),
- holders of a graball (but not mullet net) net licence, plus any other licence type(s), and
- holders of any licence type(s) other than mullet or graball nets.

Home address was grouped according to the following classes:

- south, east and north-east Tasmania, including Flinders and King Island (post codes 7000 - 7315),
- north-west Tasmania (post codes 7316 - 7470), or
- interstate or overseas.

Avidity classes were defined as:

- fished 0-20 days in previous twelve months,
- fished > 20 days in previous twelve months, and
- no details provided in relation to fishing in the previous twelve months.

Based on the above criteria each licence-holder was assigned to one of 27 strata. However, avidity sub-strata had to be collapsed for north-west Tasmania and for non-residents due to small numbers of licence-holders, reducing the total number of strata to fifteen. If only resident Tasmanian licence-holders are considered there were twelve strata.

The primary rationale for this stratification was to enable greater sampling of gillnet fishing methods and the more avid fishers. The latter aspect 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 through a higher than usual sample-take of these avid anglers.

5.3.3 Sampling procedure

A stratified random sample was drawn from the licence database, the actual sampling fraction being higher for strata that included gillnet licence-holders and the more avid (> 20 days) class.

5.4 Survey Design

The survey design involved a three-stage interviewing approach, comprising an initial recall/screening survey, a diary survey and an attitudinal survey.

5.4.1 Recall/screening survey

This 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 (or 'longitudinal') survey. In the recall component, 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 estimated and the main species (up to two) targeted and caught were recorded for net fishing. This aspect of the questionnaire was based on the approach reported by Lyle and Smith (1998).

Eligibility criteria, with regard to diary survey participation, are discussed in Section 5.5.

5.4.2 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". As described above, survey data were collected by a brief telephone interview soon after each fishing trip.

Respondents 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, including any significant breaks,
- retained catch (harvest) numbers by species, and
- numbers of rock lobster released (for rock lobster pots only).

By definition, a fishing event was described in terms of fishing region, method and target species. If one or more of these factors changed on a given day, a separate event was recorded. In this way, catch and effort could be correctly attributed to actual fishing behaviour.

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.

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 already left the State. In any case, until non-residents returned to their place of residence, they would not be readily contactable. It was, however, possible to assess the *relative* impacts of non-resident fishing through their inclusion in the recall survey of fishing activity.

5.4.3 Attitudinal survey

The attitudinal survey was conducted at the end of the diary period and comprised a telephone interview in which respondents 16 years of age or more were asked a range of questions aimed at assessing awareness and attitudes in relation to resource and management issues.

5.5 Survey Implementation

5.5.1 Wave design

For several reasons, but principally concerned with minimising respondent burden, the study was administered in three consecutive 'waves'. In each wave, a new sample of licences 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/screening surveys and system of diary waves. X recall/screening 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). ** Refer to section 5.5.4 for details.

	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

5.5.2 Waves 1 and 3

Since the licensing year commenced in November, the primary sampling frame used for Waves 1 and 3 was, by necessity, based on the database of licence-holders for the previous year, that is 1995/96 for Wave 1 and 1996/97 for Wave 3. While not a problem for the recall component of the survey (which collated information about fishing in the previous licensing year), for purposes of the subsequent diary survey it was necessary to determine the likelihood that respondents were going to renew licences. Those respondents who considered that they were at least "quite likely" to renew were eligible for inclusion in the diary survey.

The fact that respondents were selected on the basis of licences held in the previous year necessitated, in some instances, *post hoc* allocation to particular strata to reflect the correct stratum for expansion of diary information. *Post hoc* stratification was required for a total of 18% of Wave 1 and 3 diarists, the majority due to changes in reported avidity class (just 5% were also due to changes in licence class groupings).

In sampling from the previous year's licence database, it was assumed that the majority of licences issued each year would be renewals (licensees from the previous year). Based on actual turnover in 1996/97 and 1997/98, approximately 64% and 71% of licence-holders respectively, represented renewals. In an attempt to include 'new' licensees in the survey, some additional sampling of new licence-holders was undertaken according to the protocol described above. Sampling rates were designed to be consistent with those applied to the primary sample and once in the diary survey, these 'new' licence-holders were treated as if they had been part of the primary selection process.

5.5.3 Wave 2

Wave 2 recall/screening was conducted in the middle of the licensing year and the sample was, therefore, based on the current year's licensing data. However, as fishing activity is highly seasonal in Tasmania, falling to low levels during winter and early spring (Lyle and Smith 1998), only those respondents who indicated that they were at least "quite likely" to fish in the period May - October 1997 were invited to participate in the diary. Respondents who considered themselves unlikely to fish were treated as expending zero activity and therefore producing zero harvest.

5.5.4 Supplementary survey

A supplementary survey was conducted in May 1998 primarily to collect retrospective information about fishing activity for the period November 1997 - April 1998.

Diary coverage included 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.

5.6 Data Analysis

5.6.1 Catch and effort

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 (refer section 5.3.1), coupled with supplementary sampling for 'new' licensees (refer section 5.5.1), 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 licensed respondents 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), where:

L number of distinct strata;

h denotes the stratum being considered (h=1, ..., L);

i is the sample unit within the stratum in the sample (i= 1,..., n_h);

N_{hk} is population size in stratum h in the kth month;

n_{hk} is sample size in stratum h in the kth month;

$N_k = \sum_{h=1}^{L} N_{hk}$ is the total number of licensed fishers in the kth month;

$W_{hk} = \frac{N_{hk}}{N_k}$ is the fraction of the licensed population in stratum h in the kth month;

y_{hki} is the value (catch or effort) of the ith unit of stratum h in the kth month;

$\bar{y}_{hk} = \left[\sum_{i=1}^{n_{hk}} y_{hki} \right] / n_{hk}$ is the sample mean for stratum h in the kth month;

$\hat{Y}_{hk} = N_{hk} \bar{y}_{hk}$ is the estimated population total for stratum h in the kth month;

$\hat{Y}_k = \sum_{h=1}^{L} \hat{Y}_{hk}$ is the estimated population total in the kth month;

$s_{hk}^2 = \left[\sum_{i=1}^{n_{hk}} (y_{hki} - \bar{y}_{hk})^2 \right] / (n_{hk} - 1)$ is sample variance for stratum h in the kth month;

$Var(\bar{y}_k) = \sum_{h=1}^{L} W_{hk}^2 \frac{s_{hk}^2}{n_{hk}} \left(\frac{N_{hk} - n_{hk}}{N_{hk}} \right)$ is the stratified variance estimator for the mean in the kth month;

$Var(\hat{Y}_k) = N_k^2 Var(\bar{y}_k)$ is the variance of the estimator of the population total in the kth month; and

$SE(\hat{Y}_k) = \sqrt{Var(\hat{Y}_k)}$ is its standard error.

When summing catch or effort across months, standard errors were approximated as the square root of the sum of the individual monthly variances, i.e.

$$SE(\hat{Y}) \approx \sqrt{\sum_{k=1}^{K} Var(\hat{Y}_k)}$$

where K is the number of months being combined.

5.6.2 Proportional responses

Standard errors for proportional responses were calculated based on Cochran (1977) as follows:

$$p_{st} = \sum_{h=1}^{L} p_h W_h$$

$$Var(p_{st}) = \sum_{h=1}^{L} \frac{W_h^2 (N_h - n_h)}{N_h - 1} \frac{p_h (1 - p_h)}{n_h}$$

$$SE(p_{st}) = \sqrt{Var(p_{st})}$$

where

p_{st} is the proportion of 'yes' responses in the population;

p_h denotes the proportion of 'yes' responses for stratum h;

$W_h = \frac{N_h}{N}$ is the fraction of the licensed population in stratum h;

N_h is the population size in stratum h;

N is the total population;

n_h is the sample size in stratum h.

5.7 On-site surveys

A series of access point creel surveys was undertaken to collect size composition information for the major recreational finfish species and to assess fish identification skills of recreational anglers. Representative size composition information was required to convert numbers (as reported in the diary survey) into weights, thereby allowing comparisons to be made between levels of commercial and recreational harvest. Although diarists were provided with a show-card of common finfish species

to assist in identification, a general assessment of fish identification skills by anglers was useful in identifying potential problems.

A team of creel survey interviewers located at Stanley (NW Tas), Bridport (NE Tas), St Helens (E Tas), Tasman Peninsula and Southport (SE Tas), was recruited and trained in fish identification and interview techniques. Research personnel conducted additional interviews, expanding the area of coverage on the east coast. In this way, broad spatial coverage of the east and north coasts was achieved. On-site surveys were conducted between December 1997 and April 1998.

A non-random design was adopted in order to maximise the number of interviews and the types of fishing activities surveyed. Interviewers were encouraged to survey boat ramps in their local areas at times when fishers were likely to be returning from a fishing trip and/or checking gear. Sampling effort, therefore, was concentrated on weekends, public holidays and in the early mornings and evenings. In addition, greater sampling intensity was directed during the peak fishing months of December - February and also during the Easter holiday period.

Where feasible, interviews were conducted with all fishing parties, or otherwise, were selected at random. Therefore, when method, fishing region, time of year and targeting were taken into account, systematic biases, in terms of catch and size composition, were minimised.

Interviews were generally conducted with one angler, on behalf of the entire fishing party. A small number of interviews (<2%) were conducted with beach or jetty anglers, the remainder involved boat fishing.

The following information was collected:

- number of anglers in the fishing party;
- post code of primary respondent;
- type of waters fished (estuary, coastal and/or offshore);
- fishing method/gear (and units of gear where appropriate);
- fishing platform;
- estimated start time, end time and any breaks from fishing;
- species targeted (up to two); and
- species and number of fish caught and kept.

Where more than one fishing method was used, every effort was made to collect information pertaining to each gear type. In a small number of instances, anglers were unable to attribute their catch to each of the different methods employed (ie. at the event level). These data have not been used in subsequent analyses.

Interviewers measured the catch and in doing so, were able to assess the ability of anglers to correctly identify the catch to the species level. Lengths were based on the measurement of snout to the medial caudal ray[2], with the exception of sharks and

[2] For species with emarginate or forked caudal fins this measurement represents fork length, whereas species with truncate or rounded caudal fin this measurement is total length.

squid, which were measured for total length or mantle length, respectively. Measurements were reported to the centimetre rounded down. Rock lobster and abalone were not measured for size. In situations where the catch had been filleted at sea, it was not feasible to confirm species identification or count and measure the catch.

Lyle and Campbell (1999) provide a detailed report of the on-site surveys, only summary information is provided in this report. Lengths were converted into weights using length-weight relationships (Appendix 1) and mean weights by fishing method was calculated (Appendix 2).

6 DETAILED RESULTS

6.1 Response rates

6.1.1 Recall/screening surveys

Response rates were consistently high, with almost 88% of respondents fully responding (Table 3). Refusals accounted for just 1%, 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 1	Wave 2	Wave 3	Supplementary survey	Combined
Full response	561	612	626	638	2437
	(87.7%)	(91.2%)	(86.1%)	(86.0%)	(87.7%)
Refusal	2	5	8	21	36
	(0.3%)	(0.7%)	(1.1%)	(2.8%)	(1.3%)
Non-contact	20	12	19	22	73
	(3.1%)	(1.8%)	(2.6%)	(3.0%)	(2.6%)
Sample loss	57	42	74	61	234
	(8.9%)	(6.3%)	(10.2%)	(8.2%)	(8.4%)
Total sample	**640**	**671**	**727**	**742**	**2780**

The numbers and types of licences held by respondents who provided full recall data for Waves 2, 3 and the Supplementary survey are presented in Table 4. Recall information derived from the Wave 1 survey has been reported by Lyle and Smith (1998) and relates to the 1995/96 licensing year.

Table 4 Numbers and types of licences held by respondents who participated (full response) in the recall surveys.

Licence	Wave 2	Wave 3	Supplementary survey
Graball net (1)	433	463	459
Graball net (2)	202	212	178
Mullet net	82	85	75
Beach seine	35	34	33
Rock lobster pot	428	416	438
Rock lobster dive	194	200	212
Abalone dive	232	264	275
Total	1606	1674	1670
No. respondents	612	626	638

Waves 1-3 recall surveys also represented screening surveys for potential diarists. However, as noted in Section 5.5, some additional sampling of 'new' licensees was undertaken to supplement the number of diarists in Waves 1 and 3. In practice, these were simple screening surveys, which produced full responses from 257 out of 286 potential respondents, that is a response rate of 90%, comparable to that for the recall surveys.

6.1.2 Diary surveys

Diary uptake rates for eligible anglers and diary survey response rates are presented in Table 5. Full diary response refers to respondents who participated in the diary survey for the 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 fully responding if complete information was collected up until the time they went out of scope.

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 5 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	9	15	49
	(3.7%)	(2.5%)	(2.3%)	(2.9%)
Accepted diary	642	354	646	1642
	(96.3)	(97.5%)	(97.7%)	(97.1%)
Full diary response	612	350	624	1586
	(91.7%)	(96.4%)	(94.4%)	(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.

A breakdown of licence types held by respondents who fully responded in each of the diary waves is presented in Table 6. As is evident from the data, not all Wave 1 and Wave 3 diarists actually took up licences during their diary period (ie. 81 diarists in Wave 1 and 80 in Wave 3). Data from non-licensed respondents has been excluded in all subsequent analyses.

Table 6 Numbers and types of licences held by respondents who participated (full response) in the diary surveys.

Licence type	Wave 1	Wave 2	Wave 3
Graball net (1)	385	262	403
Graball net (2)	164	126	185
Mullet net	75	45	74
Beach seine	33	24	47
Rock lobster pot	372	248	379
Rock lobster dive	152	103	177
Abalone dive	200	134	243
Total licences	1381	942	1511
No. licensed diarists	531	350	544
No. diarists	612	350	624

Diarists reported a total of 14,845 fishing events for the entire survey period, 14,174 of which were within the survey scope. A breakdown of events by method and diary wave indicates the dominance of rock lobster pot usage, followed by line fishing and graball netting by diarists (Table 7).

Table 7 Number of fishing events by method/gear and diary wave reported by licensed diarists.
* Includes events in which either one or two licensed graball nets were used, total number of graball net 'sets' was 4667.

Method/gear	Wave 1	Wave 2	Wave 3	Total
Rock lobster pot	2240	251	2586	5077
Line fishing	1301	645	1730	3676
Graball net*	1541	451	1623	3615
Dive	565	95	595	1255
Mullet net	109	24	93	226
Flounder spear	65	32	93	190
Rock lobster ring	42	5	36	83
Beach seine	18	7	20	45
Bait net	2	1	0	3
Other	4	0	0	4
Total	5887	1511	6776	14174

6.2 Net fishing

Information reported in this section relates to analyses based on diary data provided by fully responding resident Tasmanian holders of recreational sea fishing licences.

6.2.1 Effort and harvest

Graball net

Expanded effort and harvest[3] estimates for recreational graball net usage is presented in Table 8. Effort has been expressed in two ways, viz number of graball 'net sets' or 'net days', and as net hours. In those instances where respondents reported using two graball nets, effort (not harvest) was treated as if two separate net events had occurred. By doing so, it was possible to expand effort data on the basis of net *sets* rather than *events*.

In 1997, resident Tasmanian recreational sea fishing licence-holders conducted an estimated 46,973 (SE 1916) graball net sets, representing 718,948 (SE 36,480) net hours of effort, for a total harvest of 280,474 (SE 13,969) fish. Over the 17 month survey period (December 1996 - April 1998), an estimated 79,020 (SE 2584) net sets or 1,219,263 (SE 51,141) net hours of effort was expended for a total harvest of 470,704 (SE 18,332) fish.

Graball net effort (and harvest) was highly seasonal, increasing sharply at the beginning of the licensing year in November and reaching a peak during summer and especially during January, before declining to low levels in the winter months (Table 8, Fig. 2). January fishing alone accounted for almost 30% of the total effort and harvest in 1997.

The influence of Easter fishing was also evident in both years, with a slight increase in effort and harvest in March 1996 (Easter occurred at the end of March in that year) and in April 1998.

Monthly harvest rates, harvest per unit effort (HPUE), did not indicate a clear seasonal pattern, although it tended to peak in December/January and then declined slightly during the autumn months (Fig. 2). The overall mean harvest rate was just under 6 fish per net set or 0.4 fish per net hour.

[3] Rock lobster bycatch is excluded from this analysis.

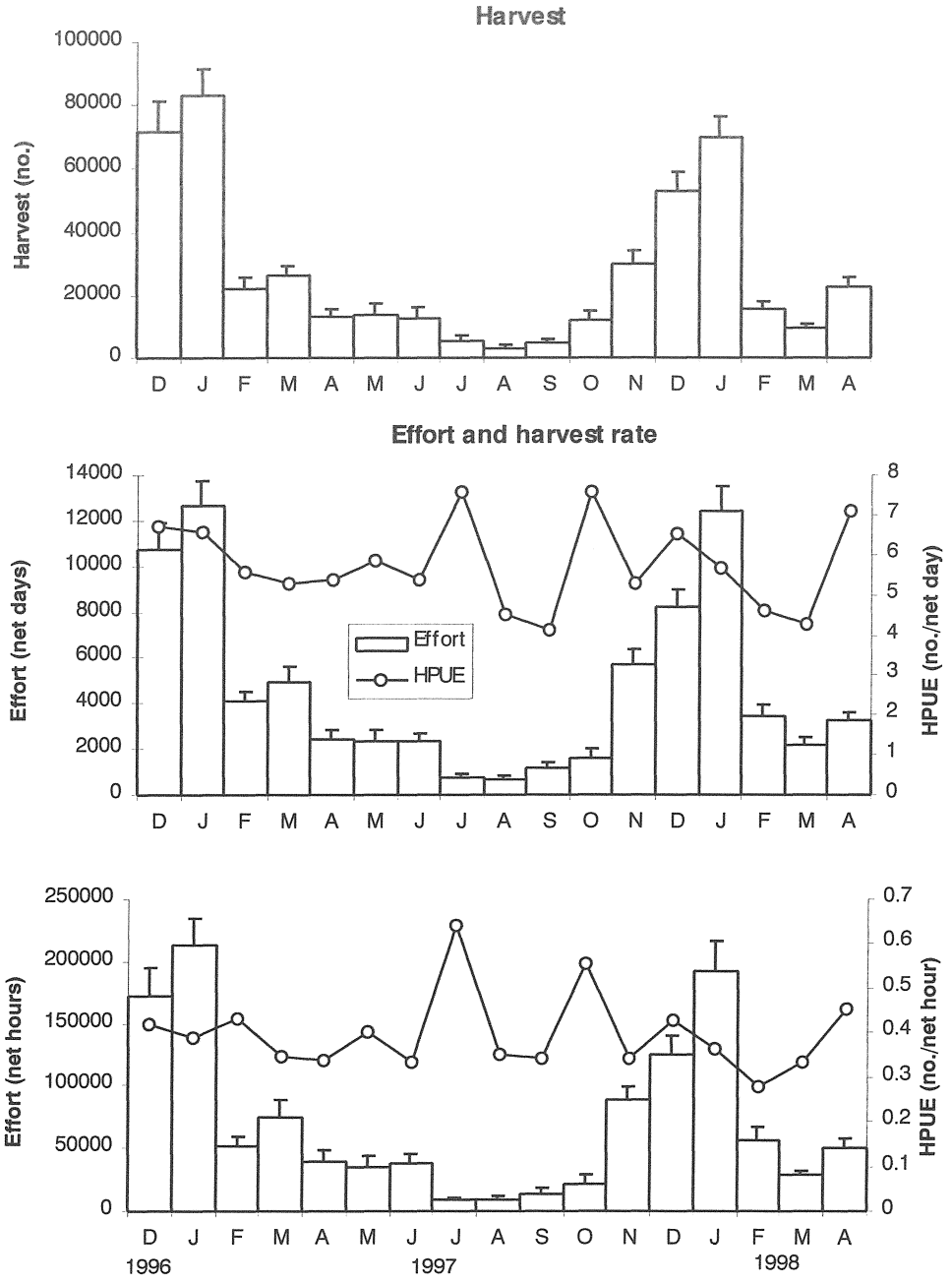

Fig. 2 Recreational graball net effort, harvest and harvest per unit effort (HPUE) by month for resident Tasmanian recreational sea fishing licence-holders. Error bars represent standard error.

Table 8 Graball net effort and harvest (excluding rock lobster) by month for resident Tasmanian recreational sea fishing licence-holders.
No. is number; SE is standard error

	Effort					
	Net sets		Net hours		Harvest (fish)	
Month	No.	SE	No.	SE	No.	SE
December 1996	10740	1159	172048	23785	71811	9347
January 1997	12689	1050	213776	21566	83339	8454
February	4070	476	52048	6708	22524	3121
March	4967	646	75456	12212	26244	3467
April	2458	434	38922	9145	13192	2659
May	2383	453	34730	9228	13885	3815
June	2340	367	37808	7388	12541	3463
July	733	177	8665	1942	5556	1897
August	699	179	8986	3182	3160	805
September	1163	269	14095	4831	4817	1120
October	1591	390	21622	7313	12025	2936
November	5704	666	87800	11888	29928	4323
December	8174	814	125041	14704	53263	5957
January 1998	12381	1125	192238	23578	70084	6187
February	3449	458	56592	9843	15794	2232
March	2221	261	28742	3564	9522	1437
April	3256	351	50695	7306	23019	2868
1997	46973	1916	718948	36480	280474	13969
Dec 96 - Apr 98	79020	2584	1219263	51141	470704	18332

Mullet net

The monthly distribution of mullet net effort and harvest followed a similar pattern to that for graball nets, with effort and harvest concentrated during December and January (Table 9, Fig. 3). Mullet net effort, 1350 (SE 196) net sets in 1997 and 2351 (SE 224) net sets for the survey period, represents a very minor component (< 3%) of the overall recreational gillnet effort in Tasmania.

Mullet net harvests for 1997 and the survey period were 24,968 (SE 4364) and 42,554 (SE 4818) fish, respectively. These figures indicate that mullet nets accounted for about 8% of the total recreational gillnet harvest by number. Harvest rates for mullet nets (around 18 fish per set or 1.7 fish per net hour) were over three times higher than for graball nets.

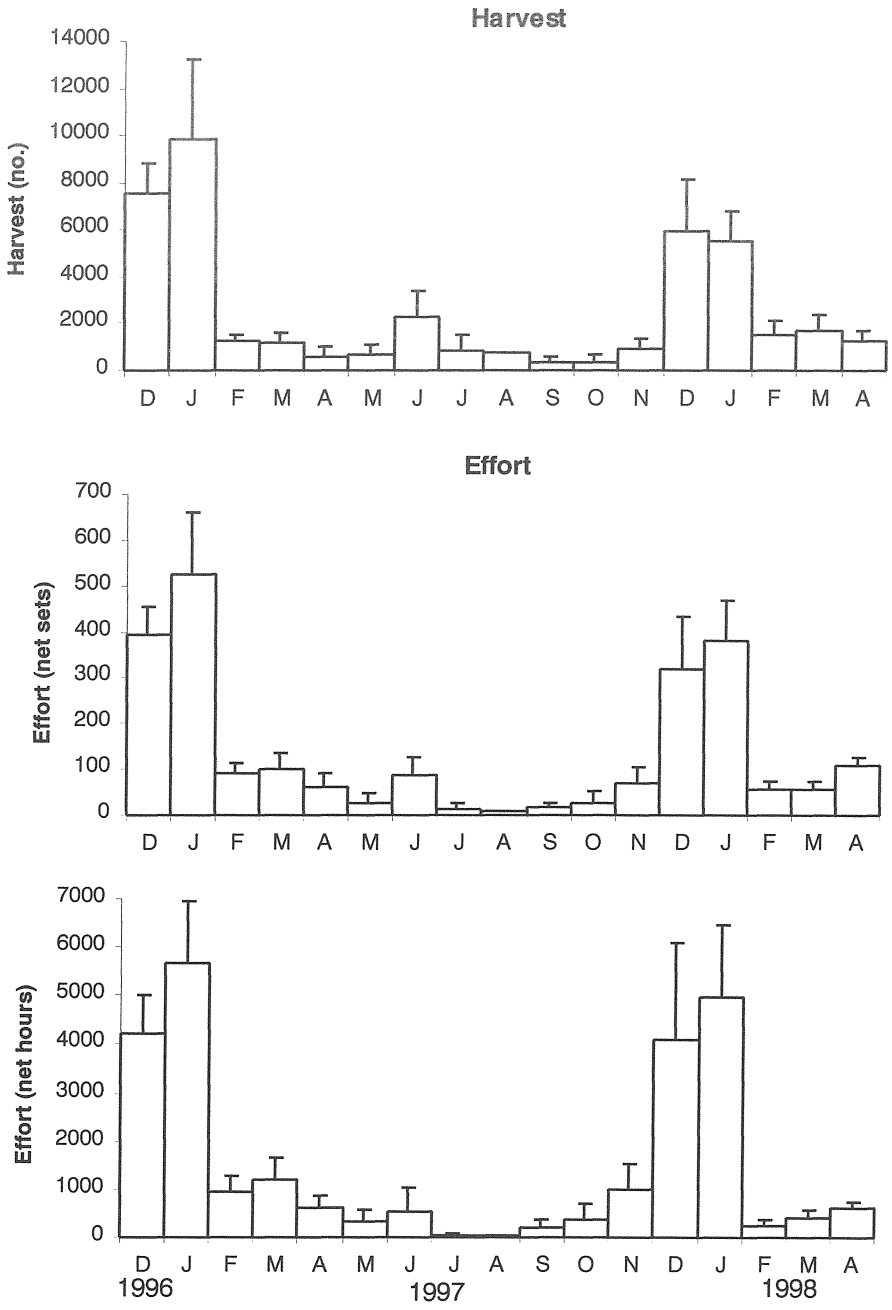

Fig. 3 Recreational mullet net effort and harvest by month for resident Tasmanian recreational sea fishing licence-holders. Error bars represent one standard error.

Table 9 Mullet net effort and harvest by month for resident Tasmanian recreational sea fishing licence-holders.

No. is number SE is standard error

	Effort					
	Net sets		Net hours		Harvest (fish)	
Month	No.	SE	No.	SE	No.	SE
December 1996	394	62	4237	766	7586	1269
January 1997	525	136	5657	1287	9848	3362
February	93	20	960	333	1264	234
March	101	35	1213	441	1148	475
April	63	28	606	284	622	360
May	27	19	316	280	649	428
June	89	39	558	466	2313	1055
July	13	12	44	40	809	746
August	9	0	28	0	790	0
September	17	11	219	141	368	255
October	27	25	375	345	341	315
November	69	38	976	574	913	420
December	319	115	4093	1992	5903	2267
January 1998	381	86	4974	1498	5519	1263
February	59	14	243	127	1518	566
March	58	17	425	171	1693	677
April	109	18	608	136	1270	431
1997	1350	196	15044	2603	24968	4364
Dec 96 - Apr 98	2351	224	25531	3110	42554	4818

6.2.2 Effort and harvest by region

Graball net

Graball net effort and harvest was concentrated in SE Tas (70% effort and over 55% harvest), with E Tas of secondary importance (15% effort and 25% harvest) (Table 10). Levels of effort and harvest from the north (NW and NE Tas) and west coasts (W Tas) were of similar magnitude (around 10%). Very limited graball net fishing activity was reported for the Bass Strait islands (Flinders Island and King Island) compared to the rest of the State.

Table 10 Graball net effort and harvest by fishing region for resident Tasmanian recreational sea fishing licence-holders.

Figures in parentheses represent percentage of total effort or harvest. No. is number.

Region	Effort				Harvest (No.)	
	No. net sets		Net hours			
	1997	Dec 96 - Apr 98	1997	Dec 96 - Apr 98	1997	Dec 96 - Apr 98
NW Tas	2132	3477	24644	44468	11388	18819
	(4.5)	(4.4)	(3.4)	(3.6)	(4.1)	(4.0)
NE Tas	1259	2081	19099	28722	11956	18328
	(2.7)	(2.6)	(2.7)	(2.4)	(4.3)	(3.9)
E Tas	7715	11999	112744	182611	73214	107209
	(16.4)	(15.2)	(15.7)	(15.0)	(26.1)	(22.8)
SE Tas	32123	55560	509312	880336	156072	286572
	(68.4)	(70.3)	(70.8)	(72.2)	(55.6)	(60.9)
W Tas	3541	5619	51007	80136	26810	38049
	(7.5)	(7.1)	(7.1)	(6.6)	(9.6)	(8.1)
King Is.	86	148	815	1573	564	1171
	(0.2)	(0.2)	(0.1)	(0.1)	(0.2)	(0.2)
Flinders Is.	116	137	1327	1417	471	555
	(0.2)	(0.2)	(0.2)	(0.1)	(0.2)	(0.1)
Total	46973	79020	718948	1219263	280474	470704
	(100)	(100)	(100)	(100)	(100)	(100)

Mullet net

Mullet net effort tended to be concentrated in the NE, E and SE Tas regions (Table 11). In terms of harvest, however, around 40% of the total was taken from NE Tas, with the E and SE Tas regions each accounting for around 20%. Mullet net usage off the west coast and Bass Strait islands was low.

Table 11 Mullet net effort and harvest by fishing region for resident Tasmanian recreational sea fishing licence-holders.

Figures in parentheses represent percentage of total effort or harvest.

Region	Effort				Harvest	
	No. net sets		Net hours		No.	
	1997	Dec 96 - Apr 98	1997	Dec 96 - Apr 98	1997	Dec 96 - Apr 98
NW Tas	122	204	950	1256	3073	5534
	(9.1)	(8.7)	(6.3)	(4.9)	(12.3)	(13.0)
NE Tas	486	764	4633	6647	10470	16452
	(36.0)	(32.5)	(30.8)	(26.0)	(41.9)	(38.7)
E Tas	305	502	3528	5183	4394	9375
	(22.6)	(21.4)	(23.4)	(20.3)	(17.6)	(22.0)
SE Tas	387	819	5696	12068	5342	9269
	(28.7)	(34.8)	(37.9)	(47.3)	(21.4)	(21.8)
W Tas	49	62	237	377	1688	1923
	(3.7)	(2.6)	(1.6)	(1.5)	(6.8)	(4.5)
Total	1350	2351	15044	25531	24968	42554
	(100)	(100)	(100)	(100)	(100)	(100)

6.2.3 Catch composition

Graball net

In total 67 taxa were reported by diarists in graball net catches, full details of which are provided in Appendix 3. Blue warehou dominated the catch (28% by number) followed by bastard trumpeter (15%), flounder (6%), cod (6%), jackass morwong (5%) and jack mackerel (5%) (Table 12). A range of other species, including leatherjackets, silver trevally, flathead, Australian salmon, striped trumpeter, gurnard and Atlantic salmon were of minor importance (> 1%). In addition to fish, there was a bycatch of rock lobster, a species known to entangle in gillnets, especially when set overnight (refer section 6.2.7).

Table 12 Graball net harvest by species for resident Tasmanian recreational sea fishing licence-holders.

	1997		Dec 96 - Apr 98	
Species	No.	%	No.	%
Blue warehou	81264	28.9	133802	28.4
Bastard trumpeter	41767	14.8	73677	15.6
Flounder	18644	6.6	30371	6.4
Cod	16159	5.7	25902	5.5
Jack mackerel	10041	3.6	23356	5.0
Jackass morwong	16679	5.9	22437	4.8
Leatherjacket	12850	4.6	22131	4.7
Silver trevally	10213	3.6	18283	3.9
Flathead	11795	4.2	16565	3.5
Australian salmon	11745	4.2	16531	3.5
Wrasse	7572	2.7	15669	3.3
Striped trumpeter	7016	2.5	12969	2.8
Gurnard	5866	2.1	9639	2.0
Atlantic salmon	3812	1.4	7899	1.7
Mullet	2716	1.0	3689	0.8
Gummy shark	1905	0.7	3687	0.8
Bream	1859	0.7	2897	0.6
Marblefish	2111	0.8	2714	0.6
Trout	2355	0.8	2690	0.6
Shark, unspecified	1755	0.6	2416	0.5
Barracouta	1229	0.4	2271	0.5
Boarfish	1542	0.6	2005	0.4
Skate/rays	776	0.3	1792	0.4
Ling	1177	0.4	1738	0.4
Banded morwong	748	0.3	1464	0.3
Other fish species	6879	2.4	14111	2.6
Rock lobster	950	0.3	1250	0.3
Total	281424	100.0	471954	100.0

From the composition of the catch it can be inferred that graball nets were set in a variety of habitats, with typically reef-dwelling species (e.g. blue warehou, trumpeter, and wrasse) as well as species associated with soft bottom habitats (e.g. flounder, flathead, Australian salmon) harvested.

Information about targeting was collected routinely, with up to two target species nominated for each event. Almost half (48%) of all graball net sets had no specific target attributed, with respondents generally reporting that they were either fishing for "a feed" or for "nothing in particular". Blue warehou was targeted in about 27% of all graball net sets, bastard trumpeter in 24%, Atlantic salmon in 5% and flounder in 4%. Of the remaining species, only silver trevally (5%) and striped trumpeter (4%) were reported as target species in greater than about 1% of graball net sets.

Catch composition by targeted and non-targeted effort is summarised in Table 13. This analysis reveals that there was only limited bycatch (17% by number) when flounder were targeted and that bycatch levels became progressively higher for effort targeted at blue warehou (48%), Atlantic salmon (62%) and bastard trumpeter (72%). It is also apparent that bastard trumpeter was a relatively common bycatch of fishing for blue warehou and *vice versa*. Cod and leatherjacket were a relatively important bycatch of targeting Atlantic salmon. Interestingly, the relative catch composition for non-targeted effort was similar to that for the overall catch (refer Table 12).

The extent of targeting can also be evaluated in terms of the proportion of the total harvest of a given species that was taken in effort targeted at that species. For instance, 66% of the flounder, 57% of the Atlantic salmon, 50% of the blue warehou and 40% of the bastard trumpeter harvests were taken in effort targeted at each of these species, respectively.

Table 13 Graball net harvest (numbers) by targeted effort for resident Tasmanian sea fishing licence-holders, December 1996 - April 1998.

	Blue warehou		Bastard trumpeter		Flounder		Atlantic salmon		No target	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
Blue warehou	66747	52.0	30387	28.8	169	0.7	178	1.5	59730	26.2
Bastard trumpeter	21235	16.6	29962	28.4	89	0.4	254	2.2	34085	14.9
Flounder	1723	1.3	1215	1.2	20002	83.1	790	6.8	6974	3.1
Cod	6014	4.7	6409	6.1	399	1.7	1113	9.5	14210	6.2
Jack mackerel	4062	3.2	4579	4.3	0	-	0	-	11978	5.3
Jackass morwong	2921	2.3	5242	5.0	40	0.2	347	3.0	12429	5.5
Leatherjacket	3872	3.0	5070	4.8	192	0.8	1169	10.0	11731	5.1
Silver trevally	1464	1.1	2755	2.6	0	-	236	2.0	11385	5.0
Flathead	1868	1.5	2072	2.0	515	2.1	162	1.4	9549	4.2
Australian salmon	1525	1.2	1608	1.5	1216	5.1	126	1.1	10377	4.6
Wrasse	3820	3.0	4588	4.3	138	0.6	257	2.2	8050	3.5
Striped trumpeter	3812	3.0	2539	2.4	34	0.1	106	0.9	5513	2.4
Gurnard	2316	1.8	1602	1.5	14	0.1	442	3.8	5358	2.3
Atlantic salmon	1275	1.0	1012	1.0	354	1.5	4468	38.2	1642	0.7
Other	5601	4.4	6550	6.2	905	3.8	2044	17.5	25005	11.0
Total	128255	100	105589	100	24067	100	11692	100	228016	100

Mullet net

In total 27 taxa were recorded in mullet net catches (Appendix 3), with mullet dominating the catch (around 60% by number) (Table 14). Jack mackerel and Australian salmon were of secondary importance (around 10%).

Table 14 Mullet net harvest by species for resident Tasmanian recreational sea fishing licence-holders.

	1997		Dec96 - Apr98	
Species	No.	%	No.	%
Mullet	15867	63.5	25149	59.1
Jack mackerel	3425	13.7	4634	10.9
Australian salmon	2139	8.6	4016	9.4
Species unknown	125	0.5	3189	7.5
Flathead	719	2.9	1247	2.9
Wrasse	584	2.3	695	1.6
Pike	374	1.5	541	1.3
Cod	262	1.0	512	1.2
Leatherjacket	384	1.5	465	1.1
Other fish species	1090	4.4	2108	5.0
Total	24968	100.0	42554	100.0

The majority of the mullet net effort (71%) was targeted at mullet and the bulk of the remainder (22%) was non-targeted effort. The vast majority of the mullet harvest (87%) was taken in effort targeted at the species and there were relatively low levels of bycatch (33%) (Table 15).

Catch composition for non-targeted effort indicates a higher representation of species such as wrasse and leatherjacket and a lower representation of mullet than for the overall catch composition (refer Table 14).

Table 15 Mullet net harvest by nominated target species for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	Target species			
	Mullet		No target	
Species	No.	%	No.	%
Mullet	21805	66.5	3080	38.8
Jack mackerel	3058	9.3	1197	15.1
Australian salmon	2369	7.2	662	8.4
Species unknown	2338	7.1	851	10.7
Flathead	864	2.6	299	3.8
Pike	455	1.4	72	0.9
Cod	342	1.0	170	2.1
Wrasse	127	0.4	497	6.3
Leatherjacket	88	0.3	367	4.6
Other fish species	1326	4.0	732	9.2
Total	32770	100.0	7927	100.0

6.2.4 Catch composition by region

Graball net catch composition by fishing region is summarised in Table 16. Catch compositions for the east coast regions (E and SE Tas) were generally similar, with blue warehou and bastard trumpeter together dominating the harvest (>43% of numbers). The relative significance of these species was lower off the north coast (<28%), being replaced in importance by species such as silver trevally (25%) and Australian salmon (17%) in NW Tas and leatherjacket (8%) and wrasse (8%) in NE Tas. Bastard trumpeter (24%) and flounder (27%) dominated west coast catches while blue warehou represented only a minor component (<5%) of the harvest in this region.

Although Atlantic salmon and trout were minor species in terms of harvest, data suggest that catches of Atlantic salmon were largely restricted to SE Tas and trout to W Tas. Regional differences in species composition no doubt reflect a combination of distribution and abundance patterns for the key species, as well as the influence of targeting practices.

Table 16 Total estimated graball net harvest by species and fishing region for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	Region									
	NW Tas		NE Tas		E Tas		SE Tas		W Tas	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
Blue warehou	2681	14.2	3452	18.8	29609	27.6	96301	33.6	1730	4.5
Bastard trumpeter	1633	8.7	1576	8.6	16785	15.7	44265	15.4	9293	24.4
Flounder	346	1.8	968	5.3	4191	3.9	14451	5.0	10415	27.4
Cod	365	1.9	288	1.6	3991	3.7	18709	6.5	2508	6.6
Jack mackerel	146	0.8	751	4.1	7539	7.0	14921	5.2	0	0
Jackass morwong	571	3.0	305	1.7	8608	8.0	12803	4.5	128	0.3
Leatherjacket	908	4.8	1472	8.0	5771	5.4	13463	4.7	517	1.4
Silver trevally	4677	24.9	853	4.7	5630	5.3	6328	2.2	783	2.1
Flathead	496	2.6	684	3.7	3739	3.5	10909	3.8	261	0.7
Australian salmon	3248	17.3	784	4.3	4184	3.9	4744	1.7	3089	8.1
Wrasse	555	2.9	1469	8.0	4665	4.4	7988	2.8	966	2.5
Striped trumpeter	420	2.2	58	0.3	1766	1.6	9336	3.3	1259	3.3
Gurnard	293	1.6	955	5.2	3385	3.2	4813	1.7	191	0.5
Atlantic salmon	39	0.2	132	0.7	0	0.0	7281	2.5	447	1.2
Mullet	253	1.3	951	5.2	444	0.4	1206	0.4	572	1.5
Trout	0	-	102	0.6	0	-	430	0.1	2158	5.7
Other fish species	2189	11.6	3530	19.3	6903	6.3	18624	6.5	3731	9.9
Total	18819	100	18328	100	107209	100	286572	100	38049	100

6.2.5 Harvest of key species

There was strong seasonality in the harvest of blue warehou, bastard trumpeter and mullet, with highest levels of harvest in December and January (Fig. 4). The monthly pattern of flounder harvest was less influenced by high summer catches and was relatively consistent in all but the winter months.

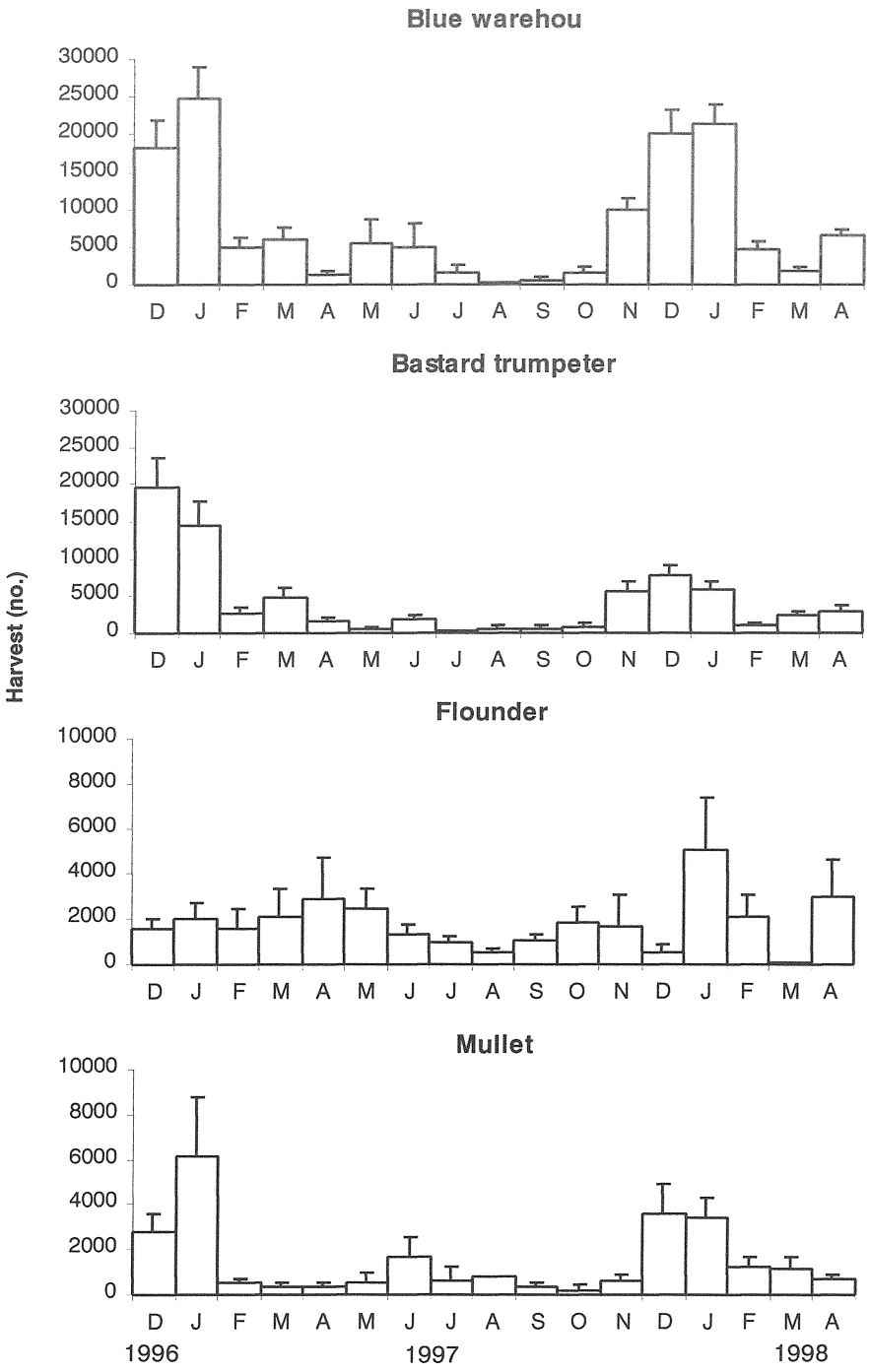

Fig.4 Monthly gillnet harvest estimates for key species, based on resident Tasmanian recreational sea fishing licence-holders. Error bars represent one standard error.

6.2.6 Inter-annual variability in effort and harvest

Inter-annual variability can be assessed by comparing gillnet effort and harvest for December - April in each of the two years covered by the diary survey. Total effort and harvest in 1997/98 was about 80% of that in 1996/97 for both graball and mullet nets (Table 17), despite a greater number of licensed gillnets in the second year (refer

Table 1). Harvest levels for several of the key gillnet species, namely blue warehou, flounder and mullet, however, varied little between years. By contrast, the harvest of bastard trumpeter in 1997/98 was less than half of that in 1996/97, a reduction that exerted a major influence on the overall graball harvest. Given that the mullet harvest was very similar between years, it can be inferred that the decline in overall harvest in the second was due to lower levels of bycatch.

Table 17 Recreational gillnet effort and harvest comparison for 1996/97 and 1997/98 for resident Tasmanian recreational sea fishing licence-holders.
No. is number SE is standard error

	Dec 96 - Apr 97 (Y1)		Dec 97 - Apr 98 (Y2)		Ratio
	No.	SE	No.	SE	(Y2/Y1)
Graball net					
Net sets	34925	1811	29481	1526	0.84
Net hours	552250	36174	453308	30579	0.82
Total harvest	217110	13700	171682	9436	0.79
Blue warehou	55259	6119	54319	4385	0.98
Bastard trumpeter	43151	5300	20111	2029	0.47
Flounder	9999	2535	10718	3001	1.07
Mullet net					
Net sets	1175	157	926	146	0.79
Net hours	12673	1622	10343	2505	0.82
Total harvest	20469	3650	15902	2775	0.78
Mullet	10252	2693	10103	1689	0.99

6.2.7 Recreational gillnet fishing practices

Information in relation to the time of day that gillnets were set and hauled and harvest per event, enables a number of observations to be made about recreational gillnet fishing practices, in particular the prevalence and potential impacts of night netting.

In practice, detailed information about effective soak times (ie. how long gillnets were left unattended) can not be inferred directly from this survey. Set duration was taken as the time between when gear was set and the last time on a given day that it was checked or hauled. In instances where a net was set on one day, but not checked/hauled until sometime the following day (ie. set overnight), the event effectively ran over two days. Information about when and how many times nets were checked on a given day was not recorded.

Overnight netting and set duration

Survey data demonstrate that approximately 77% of all graball net sets and 53% of all mullet net sets were fished overnight. Based on set duration (as defined) for graball, three modes were apparent (Fig. 5). Day sets comprised the first, and smallest, mode at around 3-6 hours. The second mode at 9-15 hours was primarily due to overnight sets; generally those nets set in the evening and hauled the following morning. The third mode at 21-24 hours was largely due to nets left in the water over periods of several days. In such instances fishers generally reported their last check of the net at

about the same time each day. In a minority of instances (>4%) nets were left unchecked for periods exceeding 24 hours. Such excessively long sets were invariably due to unfavourable sea conditions preventing the safe retrieval of the gear. A similar pattern existed for mullet nets, with the greater proportion of day sets being clearly evident (Fig 5).

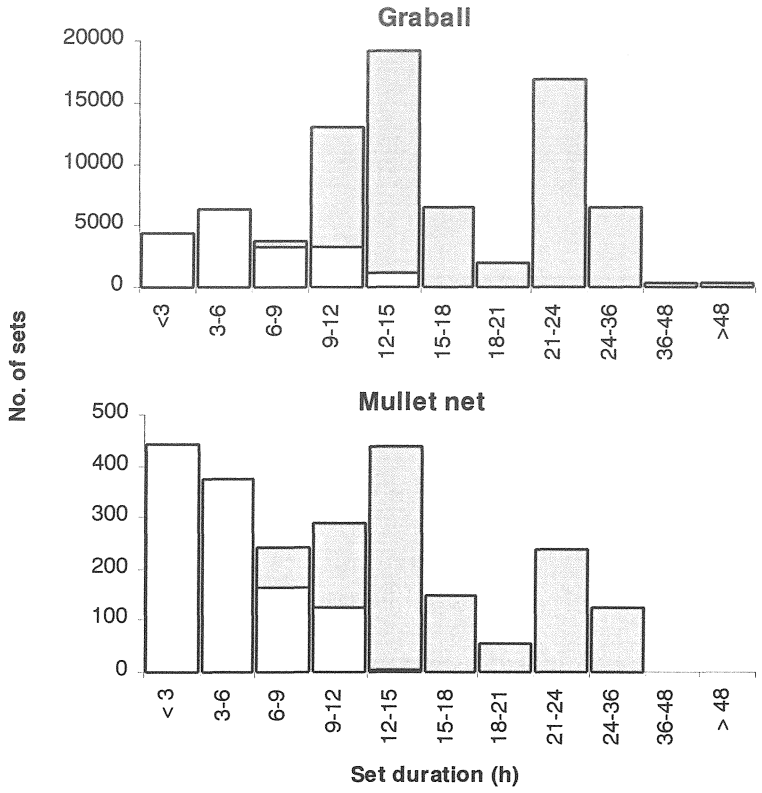

Fig. 5 Set duration distribution for recreational gillnets, with day (clear) and overnight (shaded) sets indicated, for resident Tasmanian recreational sea fishing licence-holders based on the period December 1996 - April 1998.

While direct inferences about soak time can not be made because nets may be checked more than once a day, the time of day that gillnets were set can provide some insight into fishing practices. For instance, if gillnets were set in the morning but not checked again until sometime the following day, the effective soak time must be in the order of 24 hours. By contrast, gillnets set in the afternoon/evening but not checked/hauled until the following day, will have soak times in the order of 12-15 hours if checked in the morning. Soak times will be even longer if not checked until later in the day. There were very few instances where day sets had soak times exceeding 12 hours (Fig. 5).

For the overnight sets, 34% of all graball and 28% of mullet nets were set in the morning (prior to 1000 h), while 58% of graball and 66% of mullet nets were set in the afternoon/evening (after 1600 h). Effectively then, at least one quarter of all recreational gillnet effort (net sets) involved nets set in the morning and not checked until sometime the following day and as such, would have had excessively long soak times.

Day and overnight set harvest rates

Nets that were set overnight usually fished through the dusk and dawn periods, times when many species are believed to be active, as well as including some day-time fishing (the extent dependent on when they were set and hauled). Harvest rates (number of fish per set) indicated little, if any, advantage in overnight compared with day only sets for both graball and mullet nets (Tables 18 and 19). This finding is even more significant when set duration is taken into account, the mean duration of an overnight set (17.7 h) being over 2.5 times greater than that for day sets (6.8 h).

Although the more popular fishing practice, the overall harvest rate (numbers per set) for overnight sets was slightly lower than that for day sets (Tables 18 and 19). Catch rates for species such as bastard and striped trumpeter, Australian salmon, Atlantic salmon, mullet, flathead, jackass morwong and leatherjackets were higher in day sets. Harvest rates for day and overnight sets were roughly equal for blue warehou and silver trevally, slightly higher in overnight sets for wrasse, cod and jack mackerel and substantially higher for gummy shark, flounder and rock lobster.

Higher overall harvest rates for daytime sets may be linked to more effective targeting as well as to increased daytime activity levels (vulnerability) of many species. The quality of the catch may also be a contributing factor. With the longer soak times of the overnight sets, the potential for wastage arising from poor quality and damage to the catch would be increased when compared with shorter set times. That is to say, the proportion of the catch that was retained would be lower and this would be reflected in lower harvest rates. However, since diarists only reported what they retained, it has not been possible to test this hypothesis.

Table 18 Graball net harvest and harvest per unit effort (HPUE) for daytime and overnight net sets for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	Harvest (no.)		HPUE (No. per set)		Harvest rate ratio
Species	Day set	Overnight set	Day set	Overnight set	Day/ Overnight
Striped trumpeter	6057	6913	0.33	0.11	2.92
Atlantic salmon	2979	4919	0.16	0.08	2.02
Australian salmon	6056	10474	0.33	0.17	1.93
Flathead	5588	10977	0.31	0.18	1.70
Jackass morwong	7393	15044	0.41	0.25	1.64
Bastard trumpeter	23541	50136	1.29	0.82	1.56
Leatherjacket	6631	15500	0.36	0.26	1.43
Blue warehou	34428	99374	1.89	1.63	1.15
Silver trevally	3958	14325	0.22	0.24	0.92
Wrasse	2918	12752	0.16	0.21	0.76
Cod	4617	21284	0.25	0.35	0.72
Jack mackerel	4112	19244	0.23	0.32	0.71
Shark, school & gummy	371	4153	0.02	0.07	0.30
Flounder	2287	28084	0.13	0.46	0.27
Rock lobster	39	1211	0.00	0.02	0.11
Total harvest	121081	350896	6.64	5.77	1.15
No. net sets	18241	60779			

Table 19 Mullet net harvest and harvest per unit effort (HPUE) for daytime and overnight net sets for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	Harvest (no.)		HPUE (No. per set)		Harvest rate ratio
Species	Day set	Overnight set	Day set	Overnight set	Day/ Overnight
Australian salmon	2928	1087	2.63	0.88	3.00
Mullet	16770	8379	15.08	6.76	2.23
Total harvest	24286	18268	21.83	14.74	1.48
No. net sets	1112	1239			

Harvest by event

The distribution of harvest per event for both single and two graball net sets were characterised by modes at 1-5 fish and were skewed to the right with a very small proportion (<3%) of large harvests (>40 fish) (Fig. 6). Around 23% of single graball and 20% of two graball net events yielded no harvest, while almost 64% of single graball but only 48% of two net sets, produced 5 or fewer fish. The primary advantage of using two nets would appear to be not so much in reducing the chance of nil catches, but rather increasing the likelihood of moderate (> 5 fish) harvests. The situation for mullet nets was quite different, with only a small proportion of nil catches (7%) but with over 60% of sets yielding between 1 and 20 fish (Fig. 6).

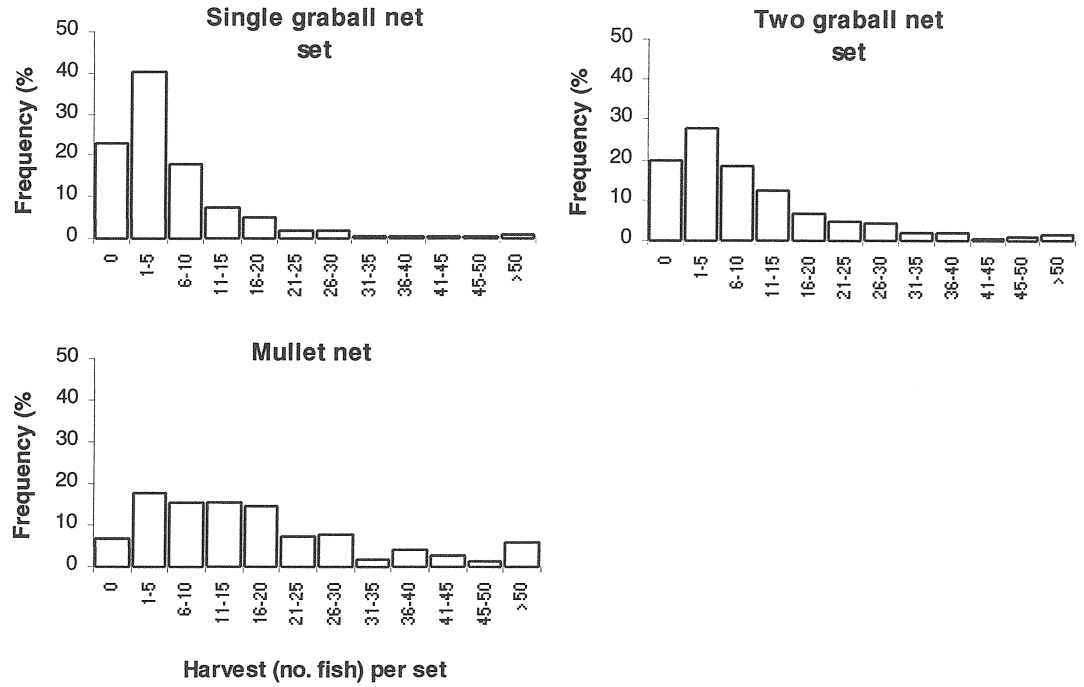

Fig. 6 Distribution of harvest per event (set) for recreational gillnets for resident Tasmanian recreational sea fishing licence-holders, based on the period December 1996 - April 1998.

6.2.8 Beach seine

Very limited information was available for beach seining (refer Table 7), so expanded estimates of effort and harvest are subject to considerable uncertainty. The survey provided an estimate of 982 beach seine fishing days for the entire survey period, representing a harvest of 34,845 fish. Mullet was the dominant species caught, accounting for over half of the harvest (Table 20). Garfish, flounder and jack mackerel were of secondary importance. In all, 15 taxa were reported in beach seine catches (refer Appendix 3).

Table 20 Beach seine catch composition for resident Tasmanian sea fishing licence-holders.

	1997		Dec 96 - Apr 98	
Species	No.	%	No.	%
Mullet	8561	55.7	22437	64.4
Garfish	1831	11.9	3865	11.1
Flounder	1474	9.6	3829	11.0
Jack mackerel	2599	16.9	2599	7.5
Australian salmon	519	3.4	816	2.3
Other	389	2.5	1297	3.6
Total	15373	100	34845	100

6.3 Rock lobster pot

Information reported in this section relates to analyses based on diary data provided by fully responding resident Tasmanian holders of recreational sea fishing licences.

The survey encompassed two rock lobster seasons, namely the 1996/97 and 1997/98 seasons. The 1996/97 season commenced on 18 November 1996 and closed on 30 April 1997 for female lobster and 31 August 1997 for male lobster but also included a mid-season closure from 15-28 February. In 1997/98 the rock lobster season opened on 22 November 1997 and closed on the 30 April 1998 for females and the 31 August 1998 for males.

Diarists reporting rock lobster pot activity provided details about the numbers of rock lobster released, in addition to the numbers caught and kept. The reason(s) for release were not established but as minimum size limits apply, it is likely that most rock lobster which were released were undersized. Other reasons for release include catches in excess of the daily bag limit of 5 rock lobster (although this study demonstrated that few fishers achieve their bag limit using pots, refer Fig. 8), damaged lobster and out of season and/or 'berried' females.

6.3.1 Catch and effort

Monthly estimates of rock lobster pot effort and catch (harvested and released) are presented in Table 21 and effort, harvest and harvest rates are shown in Fig. 7. Pot effort has been expressed as 'pot days' or more precisely 'pot events'. In practice, just 5% of pot sets were set and hauled on the same day, about 92% of events involved pots set overnight, while a further 3% were set for periods in excess of 24 hours.

For that part of the 1996/97 rock lobster season covered by the survey (December 1996 - August 1997), a total of 52,630 (SE 3616) pot days of effort yielded a harvest of 56,695 (SE 5808) rock lobster, with 67,477 (SE 9637) rock lobster released. In 1997/98 (November 1997 - April 1998), 49,848 (SE 2660) pot days produced a harvest of 44,950 (SE 3111) rock lobster with 60,327 (SE 4968) released. Overall, about 1.3 rock lobster were released for every one retained. This ratio tended to be higher than average between May and August but was no doubt influenced by the closure of the fishery to the taking of female rock lobster from May onwards.

Pot effort was particularly concentrated in December and January, and although January effort levels were slightly higher, peak harvest occurred in December, reflecting a slightly higher HPUE in that month (Fig. 7). As the season progressed there was a gradual decline in HPUE up until April, which was followed by a sharp fall in May, to a level that was generally maintained through to the end of the season in August. HPUE peaked at over one rock lobster per pot day in each of the two seasons.

Harvest rates were generally higher in 1996/97, the impact of which was particularly evident when December - April data were compared. There was little difference in effort between years, 48,618 (SE 3549) pot days in 1996/97 compared with 49,847 (SE 2507) 1997/98. The 1997/98 harvest of 37,705 (SE 2955) rock lobster was, however, just two thirds the size of the 1996/97 harvest of 55,012 (SE 5800) rock lobster.

Table 21 Rock lobster pot effort and harvest by month for resident Tasmanian recreational sea fishing licence-holders.

No. is number SE is standard error

	Effort (pot days)		Harvest		Released		Ratio
Month	No.	SE	No.	SE	No.	SE	Released: retained
December 1996	15791	1977	21498	3746	29817	7715	1.39
January 1997	18610	2477	20316	3867	22329	4943	1.10
February	4548	841	4206	907	2865	819	0.68
March	6153	1009	5594	1609	6313	2524	1.13
April	3516	907	3398	1118	2546	1173	0.75
May	895	279	286	98	850	378	2.98
June	1282	350	620	204	974	335	1.57
July	847	334	342	116	974	368	2.85
August	988	416	435	184	809	347	1.86
September	-		-		-		
October	-		-		-		
November	7986	891	8244	976	13402	2193	1.63
December	15212	1830	16003	2467	20344	3020	1.27
January 1998	16685	1455	13764	1421	16096	2148	1.17
February	4786	667	3680	626	6425	2167	1.75
March	2344	428	1477	303	2892	1178	1.96
April	2835	434	1782	376	1168	249	0.66
Total	102477	4489	101643	6589	127804	10842	1.26

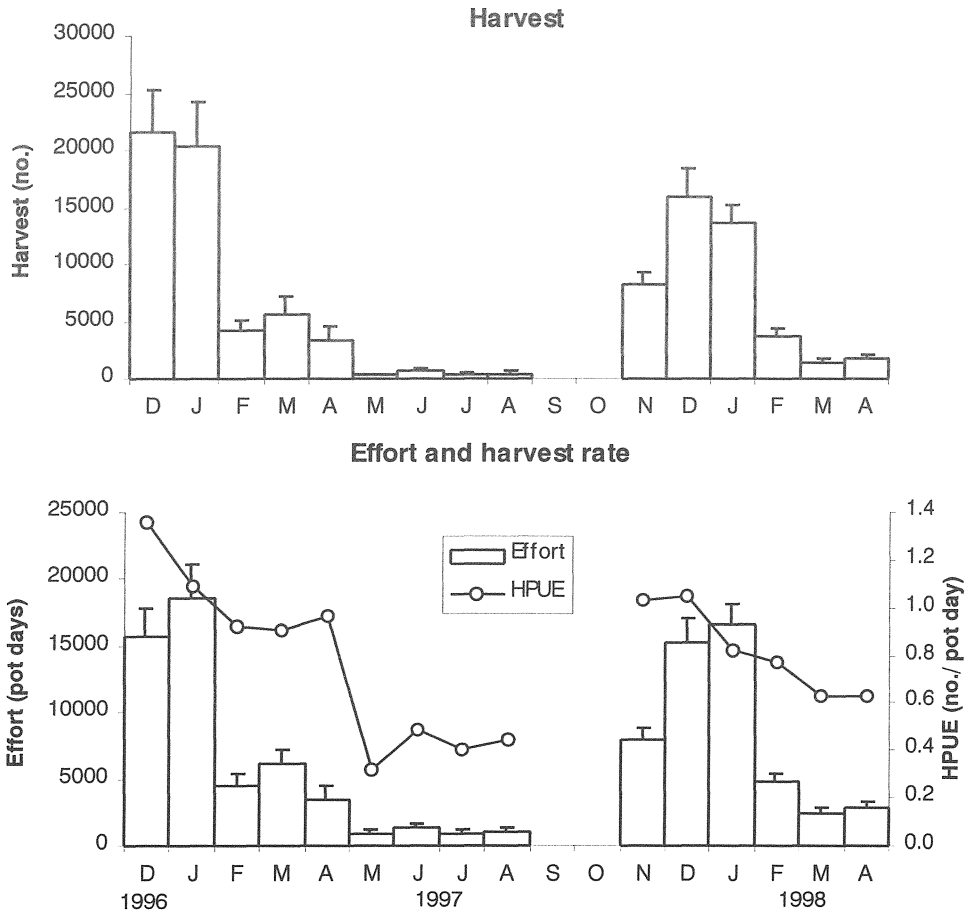

Fig. 7 Monthly estimates of rock lobster harvest, effort and harvest per unit effort (HPUE) for recreational rock lobster pots, resident Tasmanian recreational sea fishing licence-holders. Error bars represent one standard error.

6.3.2 Effort and harvest by region

The recreational pot fishery was primarily centred off the east coast of Tasmania and in particular SE Tas. This region alone produced over 50% of the harvest in each of the two seasons surveyed (Table 22). E Tas represented between 23 and 33% of the harvest depending on season. Of the remaining regions, W Tas contributed around 10% of the harvest, while harvest levels for the north coast and Bass Strait island regions were relatively small.

Table 22 Rock lobster pot effort and rock lobster harvest by fishing region for resident Tasmanian recreational sea fishing licence-holders.
Figures in parentheses represent percentage of total effort or harvest.

	Effort (pot days)		Harvest (no.)	
Region	Dec 96 - Aug 97	Nov 97 - Apr 98	Dec 96 - Aug 97	Nov 97 - Apr 98
NW Tas	663	2504	939	1111
	(1.3)	(5.0)	(1.7)	(2.5)
NE Tas	1679	2125	900	1662
	(3.2)	(4.3)	(1.6)	(3.7)
E Tas	22539	15024	19113	10496
	(42.8)	(30.1)	(33.7)	(23.4)
SE Tas	23743	26997	28722	26606
	(45.1)	(54.2)	(50.7)	(59.2)
W Tas	3685	2834	6368	4511
	(7.0)	(5.7)	(11.2)	(10.0)
King Is.	295	213	574	495
	(0.6)	(0.4)	(1.0)	(1.1)
Flinders Is.	26	149	77	68
	(0.0)	(0.3	(0.1)	(0.2)
Total	52630	49847	56694	44949
	(100)	(100)	(100)	(100)

6.3.3 Harvest per pot day

Almost half of all pot sets yielded no harvest, around 25% produced only one rock lobster, while just 3% caught 5 or more rock lobster (Fig. 8). Harvest levels exceeding the daily bag limit of 5 rock lobster were reported in a very small percentage (0.5%) of pot sets.

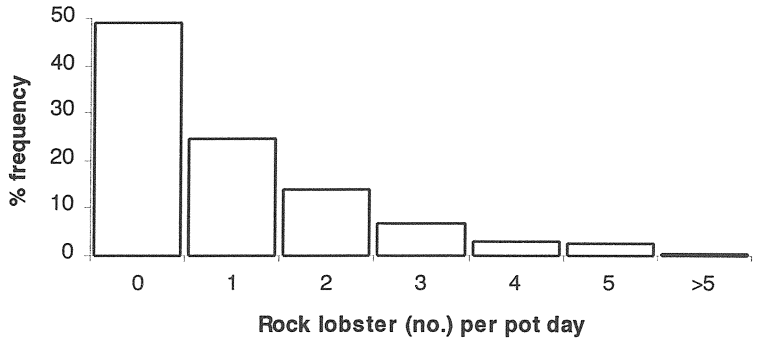

Fig. 8 Distribution of rock lobster harvest (no.) per pot day for resident Tasmanian recreational sea fishing licence-holders, based on the period December 1996 - April 1998

6.4 Dive methods

Information reported in this section relates to analyses based on diary data provided by fully responding resident Tasmanian holders of recreational sea fishing licences.

In reporting dive activity, respondents indicated whether they were snorkelling, SCUBA diving or diving on surface air supply (hookah).

6.4.1 Catch composition

By number, abalone accounted for 67% of the dive harvest, with rock lobster of secondary importance, representing 26% of the total (Table 23). These species are essentially taken by hand collection, whereas scalefish, which made up less than 7% of the total harvest, are generally taken using spears. Bastard trumpeter, flounder, sweep and leatherjacket were the main species taken by divers. The significance of the low harvest of scalefish indicates that underwater spearfishing was not a common activity among licence-holders.

Table 23 Dive harvest species composition for resident Tasmanian recreational sea fishing licence-holders, December 96 - April 98

No. is number

Species	No.	%
Abalone	135335	67.1
Rock lobster	53165	26.4
Bastard trumpeter	3233	1.6
Flounder	2652	1.3
Sweep	1344	0.7
Leatherjacket	1248	0.6
Striped trumpeter	631	0.3
Flathead	620	0.3
Other fish	3389	1.7
Total	201617	100

6.4.2 Effort and harvest

Dive effort (number of dives and hours dived) and harvest of rock lobster and abalone are presented in Table 24, with monthly harvest shown in Fig. 9. Effort and harvest for both species peaked during December and January, dropping to low levels during the winter months.

Rock lobster

For the entire survey the total recreational dive harvest for resident licence-holders was 53,165 (SE 13,277) rock lobster (Table 24). By fishing season, the harvest was 30,780 (SE 3909) in 1996/97 and 22,367 (SE 2603) in 1997/98.

Based on the combined December - April harvest, it was apparent that the 1997/98 harvest of 18,709 (SE 2310) rock lobster was just 63% of the size of the harvest taken in the previous year, that is 29,505 (SE 3900) rock lobster.

Abalone

Over the survey period, resident licence-holders harvested an estimated 135,335 (SE 8715) abalone by recreational diving activity (Table 24). In 1997 an estimated 78,177 (SE 6962) abalone were harvested, almost half (46%) of which were caught in January and December.

The combined harvest for December - April of 59,610 (SE 5270) abalone in 1997/98 was only slightly higher than that for the same period in 1996/97, namely 53,469 (SE 5483) abalone.

Table 24 Dive effort and rock lobster and abalone harvest for resident Tasmanian recreational sea fishing licence-holders.

No. is number SE is standard error

	Effort				Harvest			
	Dives		Dive hours		Rock lobster		Abalone	
Month	No.	SE	No.	SE	No.	SE	No.	SE
December 1996	4796	1006	9588	2567	10853	3065	15506	2943
January 1997	5105	1031	8116	1598	10277	2062	18298	3609
February	1783	322	2377	412	2560	589	9994	2309
March	1722	309	2660	525	2705	645	5441	1087
April	1127	286	1877	535	3110	895	4230	1366
May	801	259	1322	566	715	217	2530	1071
June	564	217	859	394	358	148	2295	1065
July	251	108	228	85	85	50	878	427
August	231	85	227	82	117	62	1289	559
September	119	64	152	101	18	17	683	487
October	323	161	386	240	0	-	1265	677
November	2463	464	4435	739	3658	1200	13315	3116
December	3875	625	6125	933	6662	1856	17958	3726
January 1998	4710	560	7136	847	6139	1098	22230	3456
February	2060	374	3318	683	2885	657	8750	1922
March	1065	180	2015	363	1261	344	3689	775
April	1527	264	2021	339	1762	372	6983	1609
Total	32522	6314	52842	11009	53165	13277	135335	8715

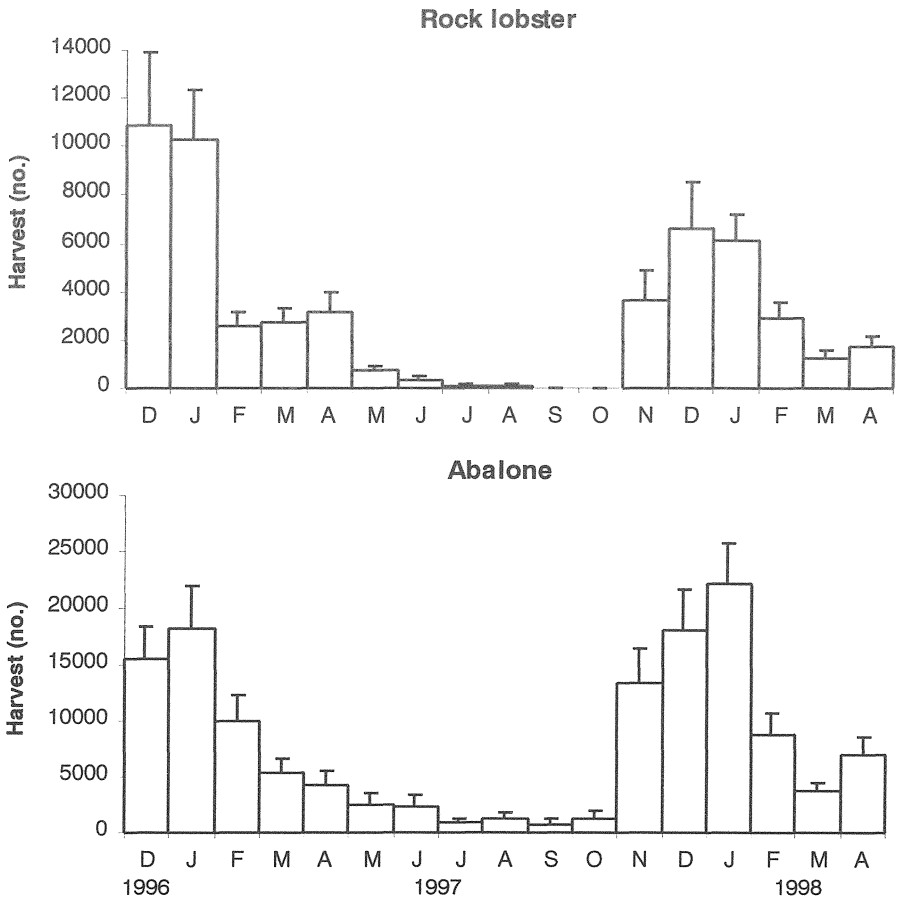

Fig. 9 Recreational dive harvest for rock lobster and abalone by resident Tasmanian recreational sea fishing licence-holders. Error bars represent one standard error.

6.4.3 Harvest by method and region

Rock lobster

Regionally, almost half of the dive harvest of rock lobster was taken from SE Tas, with a further 10% from each of the E Tas, NW Tas, W Tas and King Island regions (Table 25). NE Tas and Flinders Island accounted for less than 5% of the harvest.

When dive method was considered the importance of diving on surface air supply as a means of catching rock lobster was evident (Table 25). Overall, greater than half of the total harvest was taken using surface air, SCUBA diving accounted for just over one third and snorkel diving the remainder. Collection on surface air supply generally accounted for at least half of the harvest in each of the regions. The relative importance of SCUBA and snorkel harvests was variable, with SCUBA relatively important (>40%) in the NE, E and SE Tas regions and snorkel accounting for over 20% of the harvest in the W Tas and King Island regions.

Table 25 Rock lobster dive harvest by region and method for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.
Values in parentheses represent percentage of regional total

Dive method	NW Tas	NE Tas	E Tas	SE Tas	W Tas	King Is.	Flinders Is.	Tasmania
Snorkel	243	159	488	2362	1265	1420	200	6138
	(4.2)	(6.5)	(7.0)	(8.9)	(24.0)	(31.8)	(10.9)	(11.5)
SCUBA	1146	1131	2903	11409	1127	427	524	18667
	(19.8)	(46.3)	(41.9)	(43.2)	(21.4)	(9.6)	(28.4)	(35.1)
Surface	4396	1152	3545	12646	2877	2625	1119	28360
	(76.0)	(47.2)	(51.1)	(47.9)	(54.6)	(58.7)	(60.7)	(53.3)
Total	5784	2442	6936	26417	5269	4472	1843	53165
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Abalone

The relative distribution of the abalone harvest around Tasmania was similar to that for rock lobster, with about half taken from SE Tas and each of E Tas, NW Tas, W Tas and King Island regions contributing around 10% (Table 26).

The harvest of abalone was taken more or less equally between the three dive methods (Table 26). Between regions, however, differences in relative contributions by method were apparent. For instance snorkelling accounted for over half of the harvest in the NW, NE and E Tas regions, just under half in the Bass Strait islands, but only about one quarter of the SE and W Tas harvests. In NE and SE Tas, over 35% of the harvest was taken on SCUBA, compared to less than 25% elsewhere. Surface air was particularly important for W Tas and King Island, where around half of the harvest was taken using that method.

Table 26 Abalone harvest by region and method for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.
Values in parentheses represent percentage of regional total

Dive method	NW Tas	NE Tas	E Tas	SE Tas	W Tas	King Is.	Flinders Is.	Tasmania
Snorkel	7386	4462	9453	17725	3760	5199	1334	49319
	(58.2)	(53.4)	(54.8)	(26.1)	(25.9)	(44.8)	(44.5)	(36.4)
SCUBA	2523	3557	4059	24290	3481	989	731	39630
	(19.9)	(42.6)	(23.5)	(35.8)	(24.0)	(8.5)	(24.4)	(29.3)
Surface air	2788	341	3749	25882	7272	5419	935	46386
	(22.0)	(4.1)	(21.7)	(38.1)	(50.1)	(46.7)	(31.2)	(34.3)
Total	12697	8360	17260	67897	14514	11608	2999	135335
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

6.4.4 Targeted effort and harvest

Targeting is an important consideration when examining dive effort and harvest and exerted a strong influence on catch composition and catch rates. Almost 73% of all dives were targeted at rock lobster, producing just over 99% of the dive harvest for the species, 63% of the total dive effort was directed at abalone, producing 96% of the

total abalone harvest. Recreational divers tended to target either rock lobster or abalone individually or both species together on a dive.

Rock lobster

Dive effort targeted at rock lobster (and harvest), peaked strongly during December and January then declined to particularly low levels by May (Table 27). Monthly harvest rates were high and generally consistent between November and April, averaging around two rock lobster per dive, or over one per dive hour. Harvest rates during the second half of the season were about half this level, no doubt influenced by the closure of the fishery on female rock lobster in May.

Table 27 Targeted dive effort for rock lobster, rock lobster harvest and harvest per unit effort (HPUE) by month for resident Tasmanian recreational sea fishing licence-holders.

Month	Effort		Harvest	HPUE	
	No. of dives	Dive hours	No.	No. per dive	No. per dive hour
December 1996	4027	8681	10843	2.69	1.25
January 1997	4292	6926	10071	2.35	1.45
February	1085	1686	2505	2.31	1.49
March	1090	1994	2628	2.41	1.32
April	1092	1856	3110	2.85	1.68
May	653	1150	715	1.09	0.62
June	472	741	349	0.74	0.47
July	202	186	85	0.42	0.46
August	125	123	117	0.93	0.95
September	-	-	-	-	-
October	-	-	-	-	-
November	1574	3091	3658	2.32	1.18
December	2954	4825	6662	2.26	1.38
January 1998	2924	4964	6074	2.08	1.22
February	1525	2687	2885	1.89	1.07
March	700	1438	1261	1.80	0.88
April	930	1354	1762	1.89	1.30
Total	23645	41702	52725	2.23	1.26

Approximately one quarter of all dives targeted at rock lobster resulted in no harvest; around 20% yielded one rock lobster and a further 20% two lobsters (Fig. 10). In almost 20% of dives five or more lobsters were taken. Harvest distributions for the different dive methods were slightly different, with surface air the most effective with one or more rock lobster taken in around 85% of dives compared with 70% for SCUBA and 65% for snorkel. The proportion of dives that produced 4 or more rock lobster was 40% for surface air, 22% for SCUBA and just 11% for snorkel.

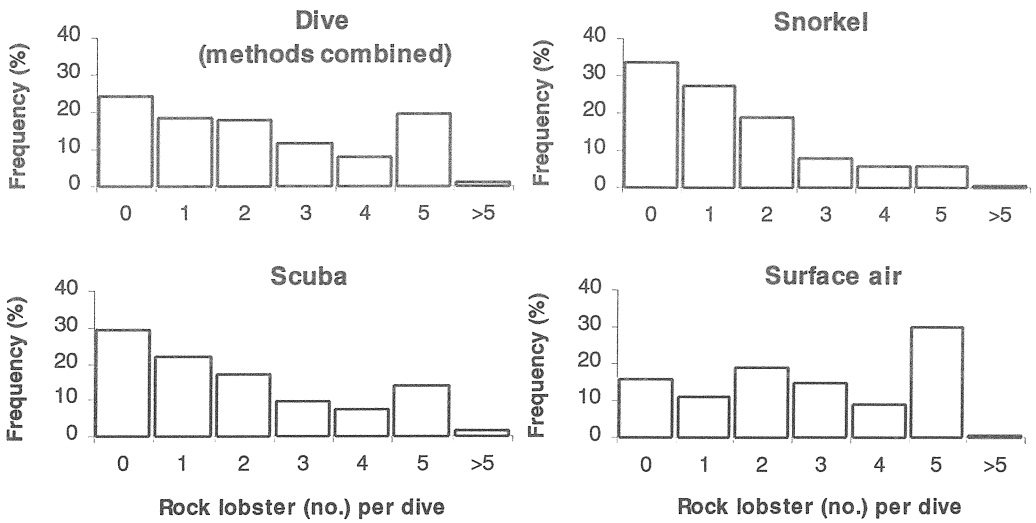

Fig. 10 Distribution by method of rock lobster harvest (no.) per dive for resident Tasmanian recreational sea fishing licence-holders, based on the period December 1996 - April 1998.

Abalone

Targeted effort, harvest and HPUE for abalone are presented in Table 28. Effort and harvest was relatively high between November and January, with a strong peak in December and January. These two months alone accounted for around 45% of the annual effort and harvest in 1997. From March to October, effort and harvest was maintained at low levels. Harvest rates varied slightly between months but without an obvious trend, fluctuating around six abalone per dive, which was equivalent to about four per dive hour.

Table 28 Targeted dive effort for abalone, abalone harvest and harvest per unit effort (HPUE) by month for resident Tasmanian recreational sea fishing licence-holders.

Month	Effort		Harvest	HPUE	
	No. of dives	Dive hours	No.	No. per dive	No. per dive hour
December 1996	2456	4797	14883	6.06	3.10
January 1997	2894	4438	17186	5.94	3.87
February	1262	1682	9166	7.27	5.45
March	951	1402	5330	5.61	3.80
April	667	951	4101	6.15	4.31
May	474	591	2530	5.34	4.28
June	421	695	2089	4.96	3.00
July	231	201	878	3.81	4.36
August	204	196	1289	6.31	6.58
September	68	109	683	10.00	6.28
October	281	355	1265	4.50	3.56
November	1806	3215	13012	7.21	4.05
December	2617	3867	17649	6.74	4.56
January 1998	3236	4660	21027	6.50	4.51
February	1302	1852	8724	6.70	4.71
March	548	943	3374	6.16	3.58
April	1100	1352	6850	6.23	5.07
Total	20516	31307	130037	6.34	4.15

Only 10% of dives targeted at abalone resulted in a nil harvest and, significantly, around 40% yielded the daily bag limit of 10 abalone (Fig. 11). Almost half of the dives involving surface air supply resulted in a harvest of at least 10 abalone, which compares with 40% for snorkel and just 25% for SCUBA.

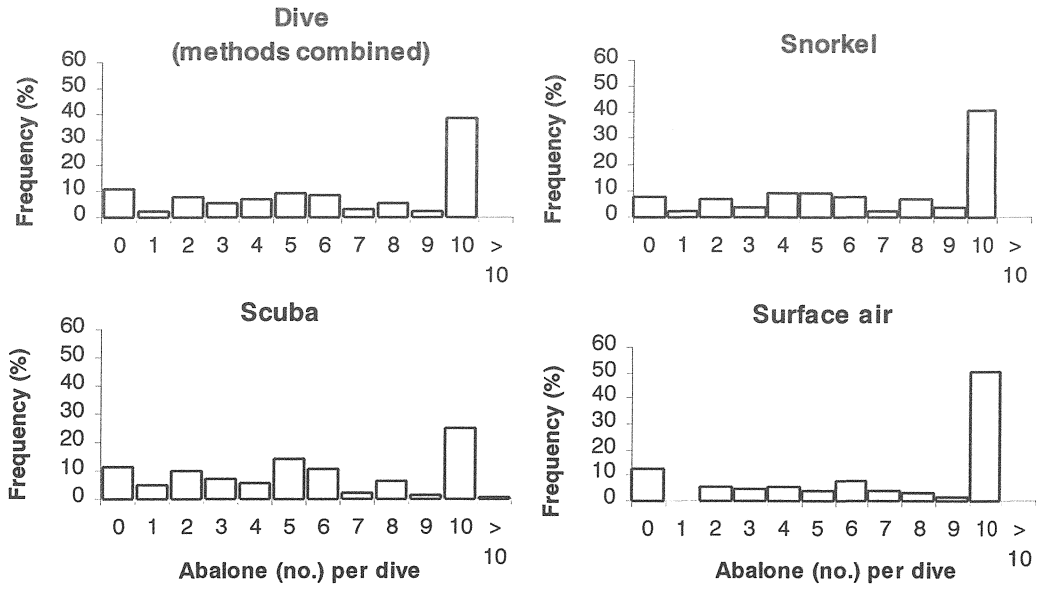

Fig. 11 Distribution by method of abalone harvest (no.) per dive for resident Tasmanian recreational sea fishing licence-holders, based on the period December 1996 - April 1998.

6.5 Total rock lobster harvest

Information reported in this section relates to analyses based on diary data provided by fully responding resident Tasmanian holders of recreational sea fishing licences.

As indicated above, rock lobster were captured using a variety of methods, including pots, dive collection and as an incidental bycatch in gillnets. Rock lobster were also taken using rock lobster rings. Total harvest, regardless of fishing method, for resident licence-holders was 160,130 (SE 7835) for the survey period. An estimated 89,851 (SE 6721) rock lobster were harvested in the 1996/97 and 70,262 (SE 4027) in the 1997/98 fishing seasons. Temporal coverage of the two fishing seasons differed but inter-seasonal differences can be assessed by comparing December - April harvest levels. On this basis, the 1997/98 harvest of 57,736 (SE 3710) rock lobster was just two-thirds the size of the 1996/97 harvest of 86,638 (SE 6707).

Harvest was relatively high immediately following the opening of the season in November and reached a strong peak in December and January (Fig. 12). Harvest levels fell sharply in February then declined further until May, after which, they remained at a low level through to the end of the season. Slight increases in the

harvest in March 1997 and, to a lesser extent in April 1998, were influenced by increased fishing activity associated with Easter.

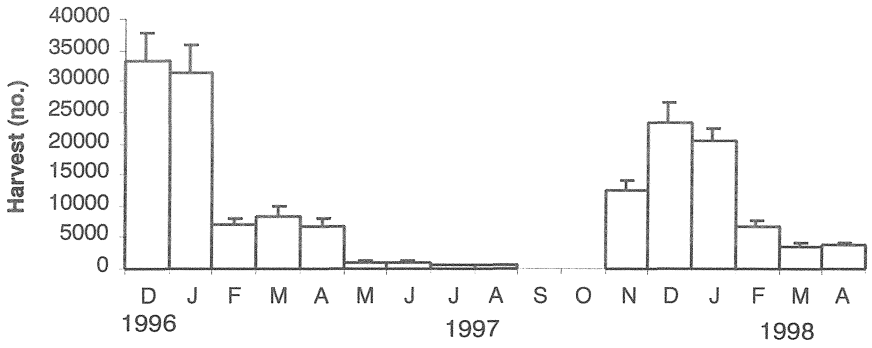

Fig 12 Rock lobster harvest by resident Tasmanian recreational sea fishing licence-holders. Error bars represent one standard error.

Rock lobster pot and dive collection were the primary methods used to take rock lobster, pots accounted for 63% and dive collection 33% of the total harvest (Table 25). Rock lobster rings contributed almost 3% and gillnets less than 1% to the total harvest. The significance of rock lobster rings is, however, underestimated. At the time of the survey their usage was not a licensed activity and estimates do not account for fishing by non-licensed anglers.

Regionally, just over half of the total harvest was taken from SE Tas, with the E Tas and W Tas regions contributing 23% and 12%, respectively (Table 29). Levels of harvest for the north coast and Bass Strait islands were relatively low.

By method, rock lobster pots accounted for the majority of the harvest in all but NW Tas and the Bass Strait islands (Table 29). In these regions, over 70% of the harvest was taken by diving. Rock lobster ring harvest was highest in W Tas, where the method was responsible for just under 20% of the regional harvest.

Table 29 Rock lobster harvest by fishing method and region for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.
Figures in parentheses represent percentage of regional totals.

	Region							
Method/gear	NW Tas	NE Tas	E Tas	SE Tas	W Tas	King Is.	Flinders Is.	Tasmania
Rock lobster	2049	2562	29609	55329	10879	1070	144	101643
pot	(25.9)	(51.2)	(80.7)	(66.5)	(54.9)	(19.3)	(7.3)	(63.5)
Dive	5784	2442	6936	26417	5269	4472	1843	53165
	(73.2)	(48.8)	(18.9)	(31.8)	(26.6)	(80.7)	(92.7)	(33.2)
Rock lobster	65	0	100	264	3644	0	0	4072
ring	(0.8)		(0.3)	(0.3)	(18.4)			(2.5)
Gillnet	0	0	66	1169	15	0	0	1250
			(0.2)	(1.4)	(0.1)			(0.8)
Total	7898	5004	36711	83179	19808	5542	1988	160130
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

6.6 Non-licensed fishing activities

Information reported in this section relates to analyses based on diary data provided by fully responding resident Tasmanian holders of recreational sea fishing licences.

In addition to fishing activities that required licences, respondents reported a range of other fishing activity, principally line fishing, 'flounder spearing' and use of rock lobster rings (refer section 6.5). Expanded effort and harvest estimates for line and spear methods are reported below. In analysing these data, however, it needs to be emphasised that activity was based only on that undertaken by resident Tasmanians and only if the fishers were in possession of a recreational sea fishing licence at the time of the activity. Thus, any fishing activity undertaken prior to taking up a licence, has been excluded[4].

The main value of this analysis is to set lower bounds for recreational effort and harvest, provide indicative information on spatial and temporal patterns of fishing activity and define catch composition. It is not valid to extrapolate these analyses to represent the activity of non-licensed anglers.

6.6.1 Line fishing

During the survey period, licence-holders undertook 68,947 (SE 1960) line fishing events, representing 192,196 (SE 6160) fishing hours, for a total harvest of 927,516 (SE 33,548) fish (Table 30). Line fishing was concentrated between December and April, peaking in January, the pattern of harvest following a similar trend. Underlying this, however, is the pattern of licence up-take which will effectively produce underestimates of activity early in the licensing year (refer to section 5.3).

Flathead were the dominant line caught species, alone accounting for two thirds of the total harvest (Table 31). Species of secondary importance include barracouta, Australian salmon, cod, gurnard, squid, whiting, jackass morwong and albacore tuna.

Over 50 taxa were recorded by diarists (Appendix 3), indicating a range of fishing activity that included inshore fishing for species such as flathead, Australian salmon, squid and whiting, game fishing for tuna and deepwater reef fishing for striped trumpeter and blue eye trevalla (not shown in Table 31).

The vast majority of line fishing effort was targeted, with just 17% of line fishing events with no target species nominated. Over half (54%) of all line fishing events were directed at flathead, with 8% targeted at Australian salmon and at barracouta and just over 6% at tuna. The actual harvest of these key species taken by targeted effort represented 86% of the total harvest for flathead, 74% for Australian salmon, 70% for barracouta and 98% for tuna.

[4] This condition is necessary in order to provide a frame (licence-holders) against which the data can be expanded..

There was only minor bycatch (<16% numbers) associated with targeting flathead and barracouta, a moderate level (30%) for Australian salmon and a relatively high level for tuna (approximately 50%) (Table 32). Flathead were a relatively common bycatch of fishing for Australian salmon, while barracouta were an important bycatch when fishing for tuna.

Table 30 Line fishing effort and harvest by month for resident Tasmanian recreational sea fishing licence-holders.

No. is number SE is standard error

	Effort					
	Line fishing events		Line hours		Harvest	
Month	No.	SE	No.	SE	No.	SE
December 1996	5287	775	11472	1771	68298	9641
January 1997	8044	795	18584	1936	110406	14766
February	3386	349	9777	1246	50759	7218
March	5042	478	15995	1801	67730	10627
April	2813	361	8957	1496	46670	7605
May	2280	352	6978	1070	32712	6975
June	2898	402	7677	1115	33625	7694
July	837	180	2368	632	10411	3065
August	1181	223	3078	609	9091	2066
September	1772	292	5557	1042	19664	3696
October	1732	250	5985	1089	29912	5811
November	3061	351	7273	956	37613	5409
December	5600	560	13449	1427	74201	8043
January 1998	10176	745	27506	2513	146106	13266
February	4855	455	14694	1703	60908	7677
March	4447	440	15055	1687	51193	5692
April	5535	469	17791	1892	78216	7841
1997	38646	1438	105679	4378	522795	26529
Dec 96 - Apr 98	68947	1960	192196	6160	927516	33548

Table 31 Line harvest by species for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	1997		Dec 96 - Apr 98	
Species	No.	%	No.	%
Flathead	346832	66.3	617939	66.6
Barracouta	50460	9.7	90326	9.7
Australian salmon	22278	4.3	45704	4.9
Cod	18530	3.5	26556	2.9
Gurnard	18625	3.6	25744	2.8
Squid	11783	2.3	19492	2.1
Whiting	3704	0.7	15072	1.6
Jack ass morwong	8492	1.6	11521	1.2
Albacore tuna	4356	0.8	10667	1.2
Pike	4489	0.9	8193	0.9
Flounder	4650	0.9	7567	0.8
Wrasse	5119	1	7289	0.8
Striped trumpeter	4307	0.8	5612	0.6
Bream	2557	0.5	5293	0.6
Silver trevally	2294	0.4	3768	0.4
Gummy shark	1492	0.3	2966	0.3
Mullet	2052	0.4	2812	0.3
Bastard trumpeter	1141	0.2	2547	0.3
Leatherjacket	1885	0.4	2504	0.3
Southern bluefin tuna	81	0	1786	0.2
Stripey tuna	347	0.1	1571	0.2
Garfish	52	0	1519	0.2
Blue warehou	1368	0.3	1412	0.2
Jack mackerel	353	0.1	1180	0.1
Tuna, unspecified	526	0.1	1031	0.1
Atlantic salmon	612	0.1	997	0.1
Other	4408	0.8	6447	0.7
Total	522795	100	927516	100

Table 32 Line fishing harvest (numbers) by nominated target species for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

Figures in parentheses represent percentage of total harvest.

	Flathead		Barracouta		Australian salmon		Tuna		None targeted	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
Flathead	530161	88.0	6599	8.7	7433	15.4	2894	9.4	76034	58.0
Barracouta	15401	2.6	63637	83.9	1578	3.3	6566	21.2	10424	7.9
Australian salmon	4219	0.7	356	0.5	33897	70.4	0	-	8240	6.3
Tuna	17	0.0	187	0.2	0	-	14853	48.0	89	0.1
Cod	11706	1.9	906	1.2	426	0.9	12	0.0	5263	4.0
Gurnard	9574	1.6	407	0.5	1044	2.2	3369	10.9	5513	4.2
Jackass morwong	3894	0.6	295	0.4	50	0.1	708	2.3	2241	1.7
Pike	842	0.1	1828	2.4	1224	2.5	136	0.4	2109	1.6
Squid	9410	1.6	623	0.8	83	0.2	614	2.0	3448	2.6
Whiting	5391	0.9	129	0.2	96	0.2	0	-	4367	3.3
Other	12006	2.0	838	1.1	2336	4.9	1798	5.8	13395	10.2
Total	602621	100.0	75806	100.0	48168	100.0	30950	100.0	131122	100.0

Line effort and harvest was concentrated off the east coast, with around 50% in SE Tas and 30% in E Tas (Table 33). A further 15% of the statewide effort and harvest was attributed to the north coast regions.

The vast majority (almost 90%) of flathead harvest was taken from the east coast, mainly SE Tas. The harvest of Australian salmon was concentrated in the NW (40%) and E Tas (30%) regions, while SE Tas (57%) was the main region for barracouta (Table 33). Tuna fishing was almost exclusively restricted to the east coast, with around 80% of the harvest from E Tas.

Table 33 Line effort and harvest by fishing region for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.
Figures in parentheses represent percentage of total effort or harvest

	Effort		Harvest				
	Events	Hours	Total	Flathead	Australian salmon	Barracouta	Tuna
NW Tas	7864	22465	84422	31834	18409	16864	187
	(11.4)	(11.7)	(9.1)	(5.2)	(40.3)	(18.7)	(1.2)
NE Tas	4014	10613	58549	39151	1536	4940	0
	(5.8)	(5.5)	(6.3)	(6.3)	(3.4)	(5.5)	(-)
E Tas	18926	57404	265287	192305	13629	11526	11898
	(27.5)	(29.9)	(28.6)	(31.1)	(29.8)	(12.8)	(78.6)
SE Tas	33593	90233	489379	350355	4666	52259	3057
	(48.7)	(46.9)	(52.8)	(56.7)	(10.2)	(57.9)	(20.2)
W Tas	2552	7308	20544	2274	4458	4039	0
	(3.7)	(3.8)	(2.2)	(0.4)	(9.7)	(4.5)	(-)
King Is.	1287	2631	5740	487	2963	368	0
	(1.9)	(1.4)	(0.6)	(0.1)	(6.5)	(0.4)	(-)
Flinders Is.	711	1542	3595	1532	41	331	0
	(1.0)	(0.8)	(0.4)	(0.2)	(0.1)	(0.4)	(-)
Total	68947	192196	927516	617939	45704	90326	15142
	(100)	(100)	(100)	(100)	(100)	(100)	(100)

6.6.2 Flounder spear fishing

Flounder spear fishing is distinguished from underwater spear fishing in that it is conducted either whilst wading or from a boat in shallow waters. As a general rule, spearing was conducted at night (using a light source to locate fish).

During the survey, licence-holders undertook 3271 (SE 320) spear fishing events, representing 6773 (SE 754) hours of effort. The resultant harvest of 54,101 (SE 7791) fish was dominated (91%) by flounder (49,384 with SE 7288). A variety of other species were taken (refer Appendix 3), but only flathead were of significance (5% of harvest).

Effort and harvest in SE Tas accounted for about half of the total, a further quarter came from the north coast and 10% from Flinders Island (Table 34).

Table 34 Flounder spear effort and harvest by fishing region for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

	Effort				Harvest			
	Events		Hours		Total		Flounder	
Region	No.	%	No.	%	No.	%	No.	%
NW Tas	523	16.3	937	13.8	10194	18.8	9132	18.5
NE Tas	345	10.7	789	11.6	6388	11.8	5939	12.0
E Tas	285	8.8	408	6.0	2700	5.0	2649	5.4
SE Tas	1630	50.7	3790	56.0	28097	51.9	25000	50.6
W Tas	293	9.1	420	6.2	2009	3.7	2009	4.1
Flinders Is.	141	4.4	430	6.3	4713	8.7	4655	9.4
Total	3217	100	6773	100	54101	100	49384	100

6.7 Comparison of recreational and commercial fisheries

6.7.1 Scalefish

Gillnet

Recreational harvest estimates for the major species may be converted into weights by applying a weight conversion factor determined from creel survey catch sampling (Appendix 2). Average weights specific to particular fishing methods have been used where appropriate.

Recreational gillnet harvest by weight for key species in 1997 and for the entire survey are presented in Tables 35 and 36, respectively. In 1997 an estimated 116 tonnes of blue warehou was taken by recreational gillnets, while over the entire period, the harvest was almost 192 tonnes. Bastard trumpeter accounted for 24 tonnes in 1997 and 42 tonnes for the survey period. Species of secondary importance, with annual harvests in the range of 5-20 tonnes included Australian salmon, silver trevally, striped trumpeter, cod, leatherjacket, jackass morwong, mullet, flounder and wrasse.

By comparison with the commercial harvest (both gillnet and all commercial methods), the recreational fishery was significant for several species (Table 35 and 36). In terms of gillnets, the recreational component represented over 40% of the combined recreational and commercial gillnet harvest for blue warehou, Australian salmon, silver trevally, striped trumpeter, cod, leatherjacket, flathead, jack mackerel, barracouta (1997 only) and mullet. The recreational harvests of the remaining key species, with the exception of banded morwong, were equivalent to at least 20% of the total gillnet harvest.

As many of the species were also taken using other fishing methods, the relative importance of the recreational gillnet harvest was lower when compared to the 'all methods' commercial harvest. In fact, apart from blue warehou, silver trevally, mullet and leatherjacket, the recreational share was generally below 40%. It is worth noting that the particularly high value for the recreational share for silver trevally (>80%)

was more a reflection of the small commercial harvest, than a particularly large recreational harvest.

Table 35 Tasmanian recreational gillnet and commercial harvest estimates (tonnes) for key scalefish species for 1997. Commercial catch data are based on General Fishing returns.
Commercial gillnet refers to graball and small mesh nets only.

Species	Harvest (tonnes)					Rec. catch % of total	
	Recreational			Commercial			
	Graball	Mullet net	Combined	Gillnet	All methods	Gillnet only	All methods
Blue warehou	116.2	0.1	116.3	119.3	126.6	49.3	47.9
Bastard trumpeter	23.8	0	23.8	50.6	51.8	32.0	31.5
Australian salmon	20.1	0	20.1	18.0	522.0	52.7	3.7
Silver trevally	16.9	0	16.9	1.5	3.7	92.1	82.0
Striped trumpeter	12.1	0	12.1	17.7	83.6	40.7	12.7
Cod	9.0	0.1	9.1	5.9	34.2	60.9	21.1
Leatherjacket	7.1	0.2	7.3	2.8	12.0	71.9	37.8
Jackass morwong	7.0	0	7.0	13.7	31.4	34.0	18.3
Mullet	1.0	5.6	6.5	4.1	9.3	61.1	41.2
Flounder	5.2	0	5.2	13.1	28.1	28.6	15.7
Wrasse	4.6	0.4	5.0	19.4	110.6	20.4	4.3
Flathead	4.4	0.2	4.6	3.2	61.8	58.5	6.9
Jack mackerel	2.4	1.1	3.5	2.6	18.6	57.2	16.0
Barracouta	1.3	0.4	1.7	1.7	63.1	51.1	2.7
Banded morwong	0.9	0	0.9	76.8	78.2	1.2	1.2

Table 36 Tasmanian recreational gillnet and commercial harvest estimates (tonnes) for key scalefish species for December 1996 - April 1998.
Commercial catch data are based on General Fishing returns. Commercial gillnet refers to graball and small mesh nets only.

Species	Harvest (tonnes)					Rec. catch % of total	
	Recreational			Commercial			
	Graball	Mullet net	Combined	Gillnet	All methods	Gillnet only	All methods
Blue warehou	191.3	0.2	191.6	230.9	241.7	45.3	44.2
Bastard trumpeter	42.0	0.0	42.0	73.3	75.3	36.5	35.8
Australian salmon	28.3	0.0	28.3	27.5	653.0	50.7	4.1
Silver trevally	30.2	0.1	30.3	3.6	6.8	89.3	81.7
Striped trumpeter	22.4	0.0	22.4	28.6	117.9	43.9	16.0
Cod	14.5	0.2	14.7	7.9	38.8	65.0	27.4
Leatherjacket	12.2	0.3	12.4	4.7	18.3	72.4	40.4
Mullet	1.3	8.8	10.1	6.3	17.9	61.7	36.0
Wrasse	9.6	0.4	10.0	28.0	153.1	26.3	6.1
Jackass morwong	9.4	0.1	9.5	20.1	42.3	32.1	18.3
Flounder	8.5	0.0	8.5	18.7	41.3	31.3	17.1
Jack mackerel	5.6	1.5	7.1	5.4	31.9	56.8	18.3
Flathead	6.1	0.3	6.5	4.5	97.5	58.9	6.2
Barracouta	2.5	0.6	3.1	5.2	104.7	37.2	2.9
Banded morwong	1.8	0.0	1.8	105.8	107.3	1.7	1.7

Inferences about the relative levels of gillnet effort expended by recreational and commercial sectors can be made based on comparisons of survey and commercial logbook data. Commercial gillnet effort is reported in terms of kilometre-net hours (km-net h), whereas in this study, recreational effort was recorded as total net hours. Recreational gillnets are restricted to a maximum length of 50 m. On average recreational gillnets will be shorter, say 45 m, since previous findings have indicated that around 25% of recreational gillnets were less than 50 m in length (Lyle and Smith 1998). Based on this assumption, it was possible to express recreational gillnet effort in similar units to that for commercial netting effort.

The total gillnet effort in 1997 was estimated at 33,030 km-net h (32,353 and 677 km-net h for graball and mullet net, respectively) for the recreational sector, compared with 20,579 km-net h for the commercial sector. Comparable figures for the entire survey were 56,016 (54,867 for graball and 1149 for mullet net) for the recreational and 31,417 km-net h for the commercial sectors. As a proportion of total effective gillnet effort, the recreational component accounted for 62% in 1997 or 64% for the entire survey period.

Regional breakdowns of gillnet harvest for blue warehou and bastard trumpeter are shown in Fig. 13. Commercially, SE Tas was the most important fishing region in terms of harvest. It is particularly significant, therefore, that in this region the recreational harvest for both species exceeded the commercial harvest. E Tas and NE Tas (the latter due mainly to low harvest levels for both sectors) also represented regions where the recreational harvest share was significant.

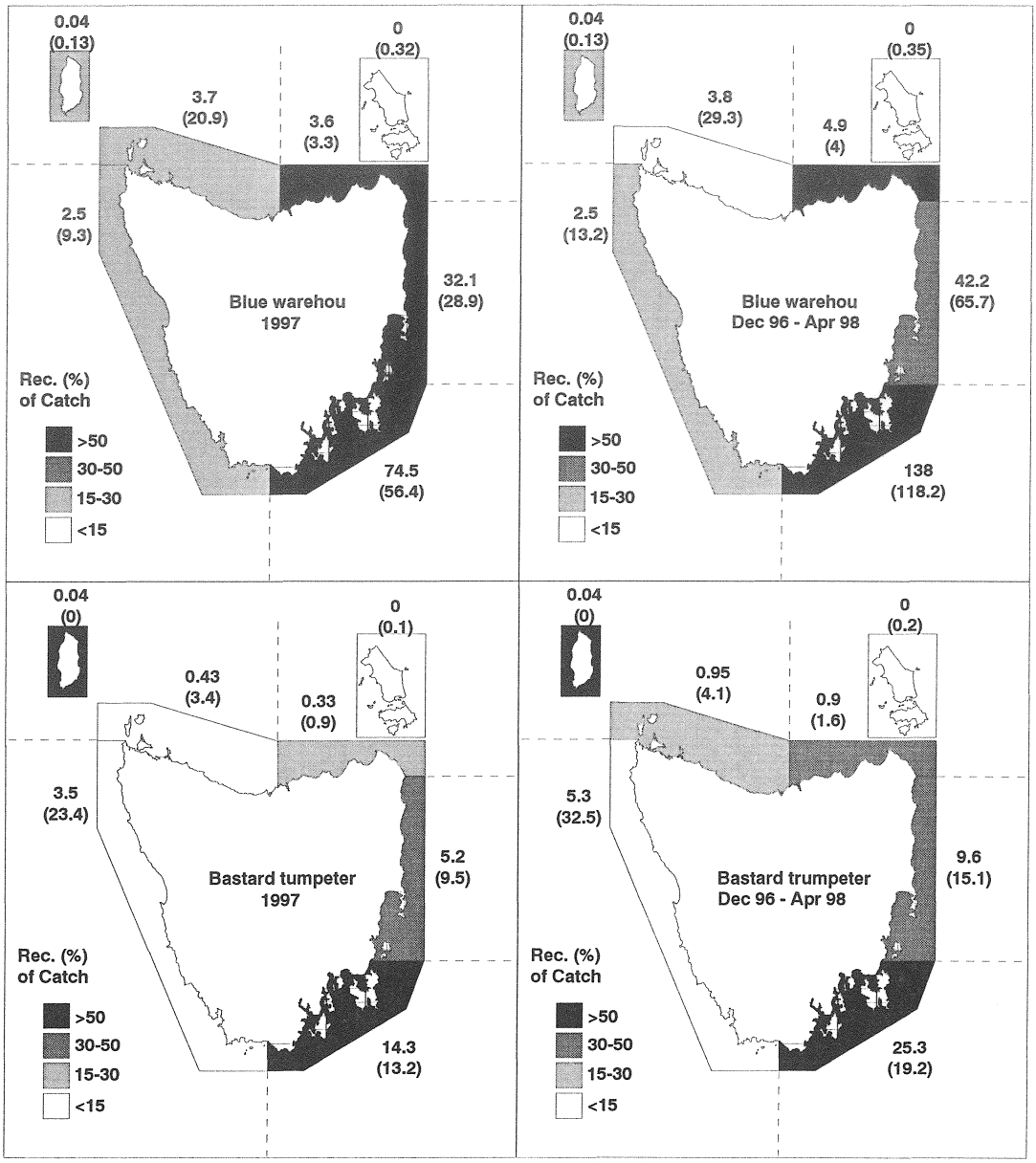

Fig. 13 Regional breakdown of gillnet harvest by recreational and commercial sectors for blue warehou and bastard trumpeter. Values represent recreational and commercial harvest in tonnes, the commercial harvest being shown in parentheses. Shading indicates the recreational share as a proportion of total harvest.

Other methods

Line and spear fishing harvest levels for resident Tasmanian sea fishing licence-holders are presented in Table 37. Flathead and barracouta clearly dominated (> 100 tonnes for the survey period), followed by Australian salmon, cod, striped trumpeter and jackass morwong (10-30 tonnes). Even though these represent minimum estimates of recreational harvest (refer section 6.6), they do highlight several important points. Firstly, even based on this subset of the recreational fishery, the harvest of flathead and barracouta was comparable or exceeded the total commercial catch of these species (refer Tables 35 and 36). Secondly, the combined line and spear harvest of flounder was about double that taken by recreational gillnets and

thirdly, line and recreational gillnet harvests of Australian salmon, cod and jackass morwong line were roughly equivalent.

Since only a small proportion of recreational fishers take out recreational sea fishing licences, it is reasonable to assume that the total recreational harvest will be substantially larger than indicated.

Table 37 Line and spear fishing harvest estimates (tonnes) for resident Tasmanian recreational sea fishing licence-holders.

	1997			Dec 96 - Apr 98		
	Line	Spear	Total	Line	Spear	Total
Flathead	86.7	0.6	87.3	154.5	1.6	156.1
Barracouta	60.0		60.0	107.5		107.5
Australian salmon	14.7		14.7	30.2		30.2
Cod	11.9		11.9	17.0		17.0
Flounder	1.9	6.9	8.8	3.0	15.3	18.3
Striped trumpeter	9.5		9.5	12.3		12.3
Jackass morwong	5.9		5.9	8.1		8.1
Wrasse	3.0		3.0	4.3		4.3
Whiting	0.6		0.6	2.4		2.4
Trumpeter, bastard	1.0		1.0	2.2		2.2
Leatherjacket	0.9		0.9	1.2		1.2
Mullet	0.4		0.4	0.6		0.6

6.7.2 Rock lobster

In Tasmania, commercial rock lobster catches are reported in terms of numbers and weight, enabling direct comparison between sectors on the basis of numbers. Data have been summarised separately for the two fishing seasons encompassed in this survey. Recreational harvest estimates of around 90,000 and 70,000 rock lobsters for 1996/97 and 1997/98 respectively, represented about 5% of the total catch for the State (Table 38).

The need to pull pots by hand and depth restrictions on divers would suggest that the bulk of the recreational catch was taken in relatively shallow waters (say less than 20 m). Commercial fishers use hydraulic pot haulers and, having larger vessels, operate over a wider area including deeper offshore reefs. Comparisons with commercial catches from shallow waters (<18 m) indicate that, state-wide, the recreational harvest share was about 13% in 1996/97 and 16% in 1997/98 of the total (Table 38).

Table 38 Recreational and commercial rock lobster harvest estimates (number x 1000) for Tasmania, indicating recreational component of the total harvest.
Shallow refers to commercial catches from < 18m and it has been assumed that all of the recreational harvest was taken from this depth range.

	Dec 96 - Aug 97		Nov 97 - Apr 98	
Fishery	All depths	Shallow	All depths	Shallow
Recreational	89.9	89.9	70.3	70.3
Commercial	1654.3	614.1	1406.6	357.5
Total	1744.2	703.9	1476.9	427.7
% recreational	5.2	12.8	4.8	16.4

The distribution and magnitude of the rock lobster harvest is presented by fishing year in Fig. 14. In terms of the commercial fishery, the west coast was the most important region, accounting for over half of the commercial production. By contrast, this region was of relatively minor significance to the recreational fishery and therefore the recreational share of the harvest was small, around 1% of the 'all depths' and less than 4% of the shallow harvest. Although of particular importance to the recreational fishery, the east coast (E and SE Tas) accounted for just 20% of the commercial harvest. In SE Tas the recreational harvest share was comparatively high, around 22% of the 'all depths' and over 38% of the shallow harvest. The recreational harvest from E Tas was lower, but still represented around 10% of the 'all depths' and over 23% of the shallow harvest for the region. The recreational share was also high for NW Tas, especially from the shallow water, but this was more a consequence of a small commercial, rather than high, recreational harvest.

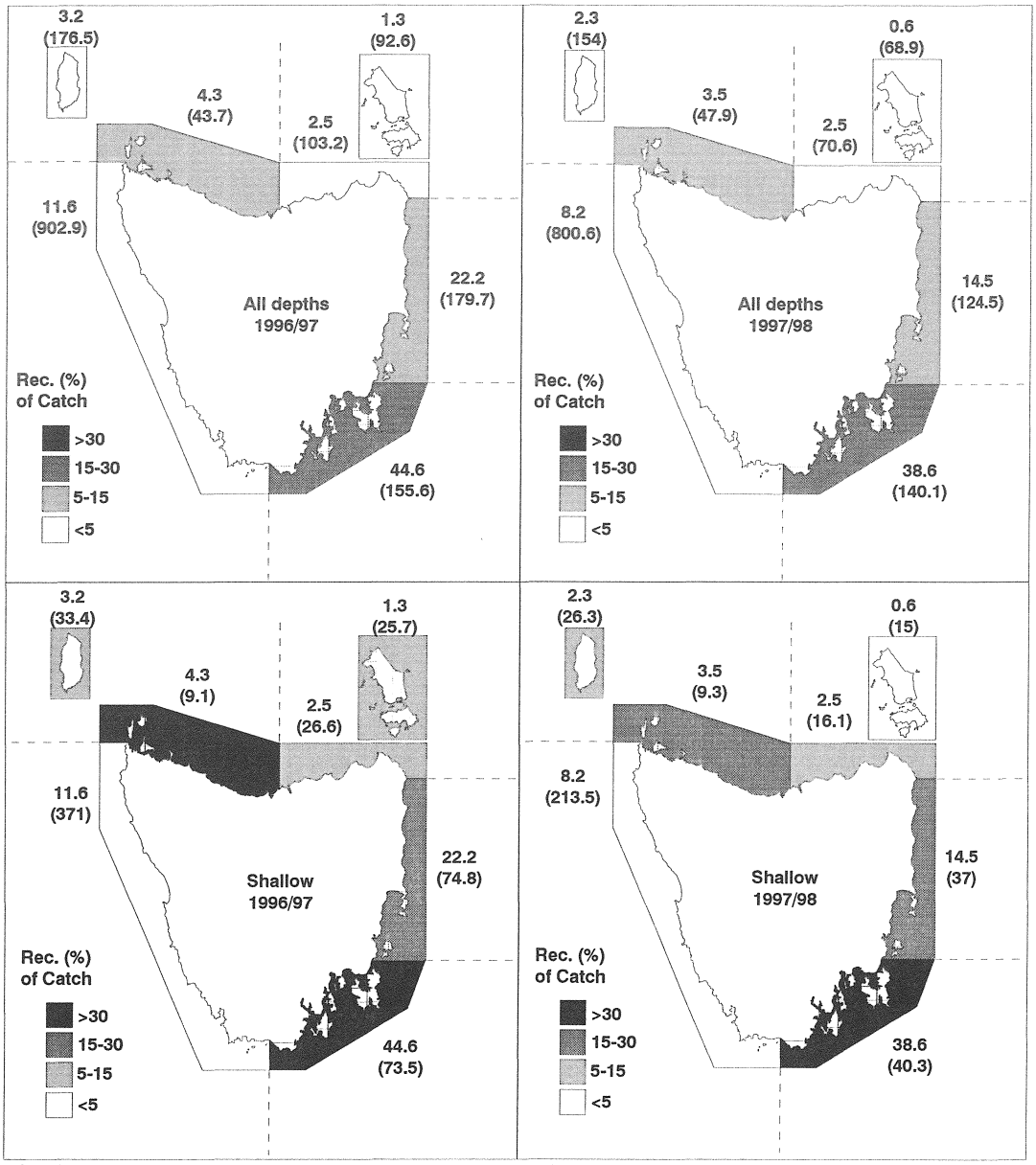

Fig. 14 Regional breakdown of rock lobster harvest by recreational and commercial sectors. Values represent recreational and commercial harvest in number (x1000), the commercial harvest being shown in parentheses. Shading indicates the recreational share as a proportion of total harvest.

6.7.3 Abalone

The recreational harvest of abalone has been converted from numbers to weight by applying a conversion factor of 0.48, equivalent to the average weight in kilograms of abalone taken by commercial operators. As identical size limits are applied to both commercial and recreational fisheries, it was assumed that this was a reasonable approximation of mean size.

The 1997 recreational harvest of about 37.5 tonnes was equivalent to about 1.5% of the combined recreational and commercial harvest (Table 39). For the entire survey period the recreational harvest of 65 tonnes was equivalent to just 2% of the total harvest.

Table 39 Recreational and commercial abalone harvest estimates (tonnes) for Tasmania, indicating recreational component of the total harvest.

Fishery	1997	Dec 96 - Apr 98
Recreational	37.5	65.0
Commercial	2500.2	3229.1
Combined	2537.7	3294.1
% recreational	1.5	2.0

The distribution and magnitude of the abalone catch in 1997 and for the entire survey period is shown in Fig. 15. These data indicate that even though the recreational harvest was concentrated in SE Tas, the relative impact of the recreational fishery in this region was low, accounting for less than 3% of total harvest. The low recreational share was due to the importance of this region to the commercial fishery. Comparable levels of commercial harvest were also taken from the west coast; a region of relatively limited recreational activity. The recreational share of the harvest for W Tas was consequently insignificant (< 1%).

The highest relative catch levels (>3%) occurred in the north coast regions and in particular, NW Tas in 1997, when the recreational component represented almost 10% of the total harvest. The apparent importance of this region was, however, more a function of a relatively low commercial harvest than a large recreational fishery.

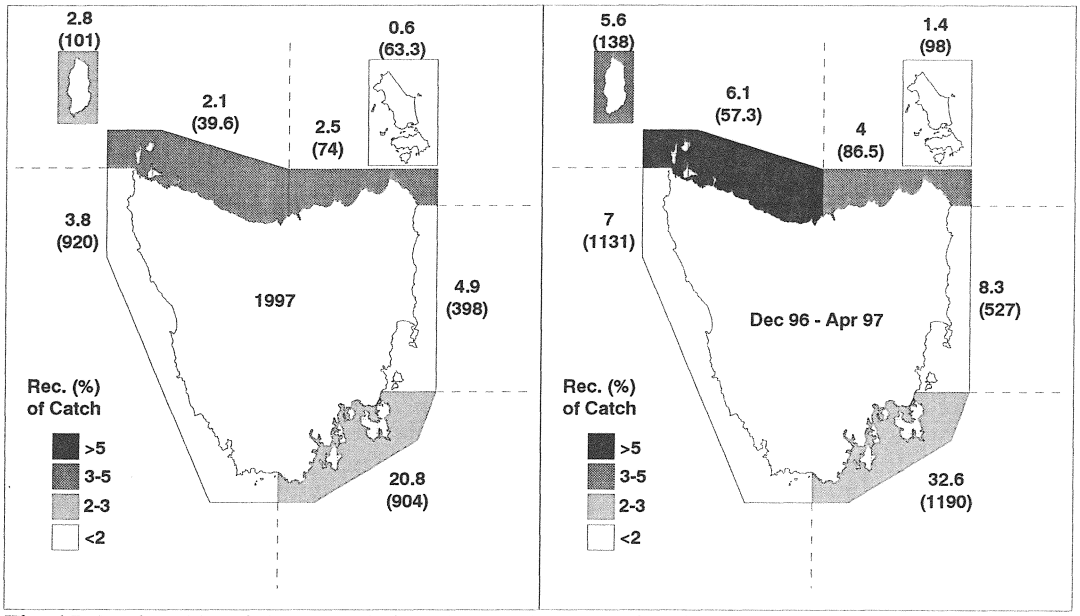

Fig. 15 Regional breakdown of abalone harvest by recreational and commercial sectors. Values represent recreational and commercial harvest in tonnes, the commercial harvest being shown in parentheses. Shading indicates the recreational share as a proportion of total harvest.

6.8 Recall surveys

Information contained in this section is based on recall surveys conducted as part of the screening surveys for Wave 2 (April 1997) and Wave 3 (October 1997) and as part of the Supplementary survey (May 1998). Unless otherwise specified, results are presented as expanded estimates for resident Tasmanian holders of recreational sea fishing licences.

Respondents were asked to estimate the number of days fished using a given licence type for the six months prior to the survey. Information was broken down by month and into broad fishing regions, viz: North Coast (incorporating NW and NE Tas), East Coast (incorporating E and SE Tas), West Coast (W Tas) and Bass Strait islands (King Island and Flinders Island). Recall-based effort was collected for graball and mullet net usage, rock lobster pots, rock lobster and abalone dive methods. Harvest estimates (numbers) were also collected for rock lobster (pot and dive) and abalone.

In order to compare diary and recall estimates, it has been assumed that each 'recall day' fished equated to an 'event', as determined in the diary survey. Since there were virtually no instances where diary respondents reported more than one event for a given method on a given day (that is either target species or region did not change), this would appear to be a valid assumption. 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.

6.8.1 Recreational gillnet effort

Graball and mullet net effort estimated from the recall surveys is presented in Table 39 and is compared with diary survey effort in Fig. 16. Both data sources produced the same trend, with effort peaking during summer, especially January, and declining to low levels between May and October. Recall estimates were, however, consistently higher than those from the diary survey, with summed recall estimates (December 1996 - April 1998) double those for graball and almost three times higher for mullet net (refer Tables 8, 9 and 40).

When effort was summed for each recall survey, it is apparent that the magnitude by which recall overestimated diary effort was variable, by a factor of at least 1.7 and up to 3.6 times, during the peak fishing periods and over 3 times for the winter period (Fig. 16). These findings indicate that the application of a simple scaling or adjustment factor for recall effort is not appropriate.

Although recall-based effort was consistently higher than diary estimates, by region the relative (expressed as percentage) distribution of effort for recall and diary surveys were comparable (Fig. 17). In addition, the relative contributions of graball and

mullet net effort to the total recreational gillnet effort were very similar, with graballs representing 94.6% of the recall compared with 97.1% of diary-based gillnet effort.

Table 40 Graball and mullet net effort by month based on recall for resident Tasmanian recreational sea fishing licence-holders.

SE is standard error

		Graball net		Mullet net	
Recall survey	Period	Effort (net days)	SE	Effort (net days)	SE
Wave 2	November 1996	6749	781	101	47
	December	14650	1219	351	117
	January 1997	20529	1720	600	145
	February	12088	1152	407	131
	March	9890	987	550	139
	April	3825	541	222	89
	Nov96 - Apr97	67731	2765	2232	285
Wave 3	May	6562	853	291	85
	June	5335	758	208	75
	July	4693	735	134	43
	August	3847	669	199	58
	September	3861	612	233	60
	October	3010	486	172	62
	May - Oct 97	27308	1703	1235	159
Supplementary recall survey	November	8745	882	332	172
	December	14790	1419	788	285
	January 1998	21960	1832	1065	214
	February	11169	1046	497	134
	March	6172	844	488	158
	April	7788	784	385	130
	Nov97 - Apr98	70625	2927	3555	465

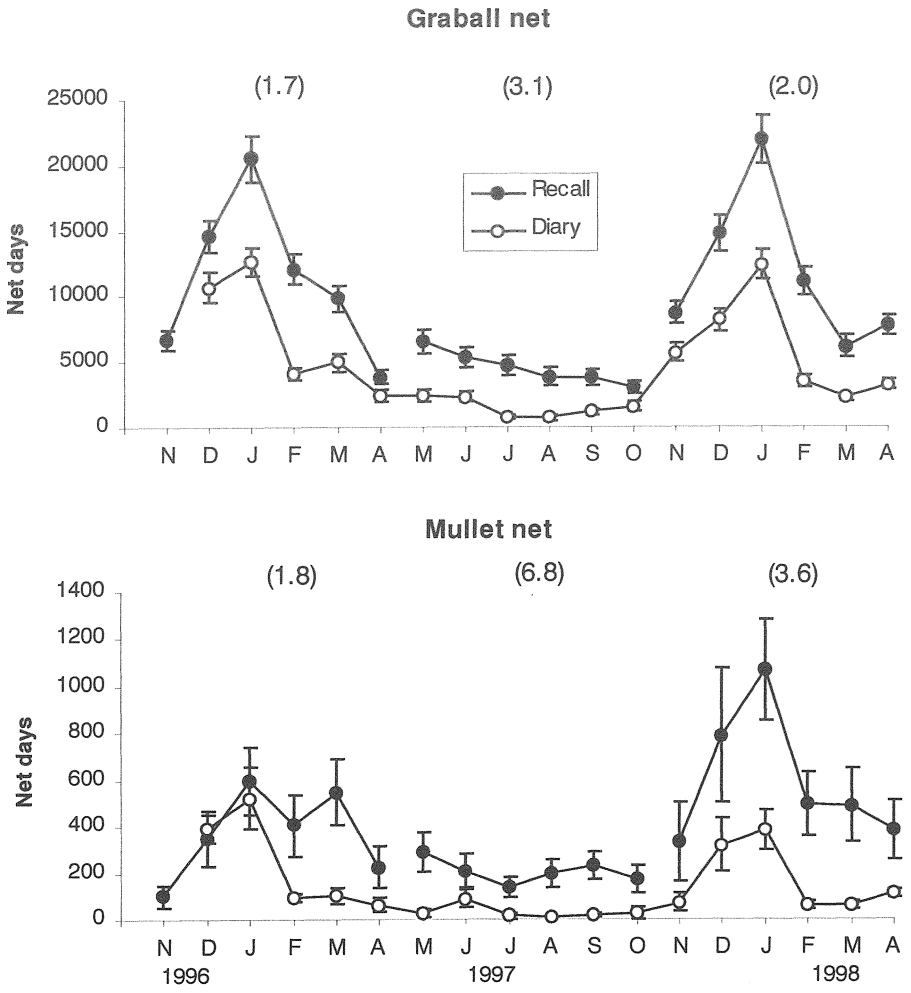

Fig. 16 Estimated monthly gillnet effort (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders. Values in parentheses indicate the ratio of recall to diary survey estimates for each overlapping period.

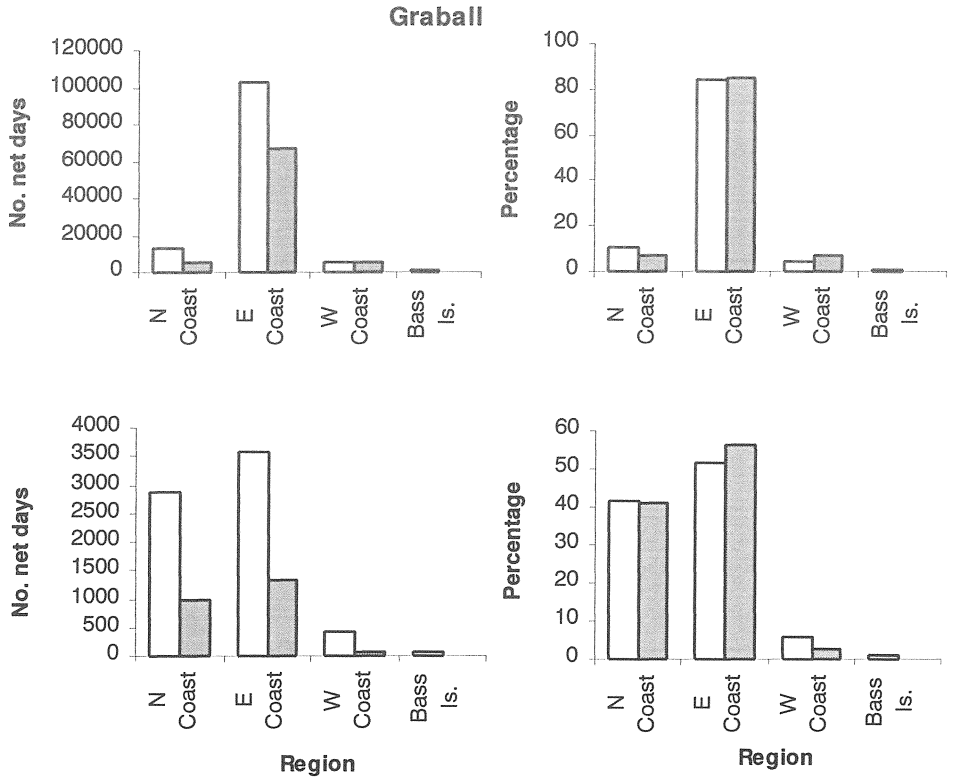

Fig. 17 Regional gillnet effort based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

6.8.2 Rock lobster

Rock lobster pot effort and harvest derived from recall surveys are presented in Table 41 and compared with diary estimates in Fig. 18. Seasonal trends for both effort and harvest were similar for the two surveys, although recall estimates were consistently higher. For the entire survey period, recall estimates exceeded the diary totals by a factor of 1.8 and 1.5 times for effort and harvest, respectively (refer Tables 21 and 41).

With the exception of the December 1996 - April 1997 harvest; recall estimates were higher, by a factor of at least 1.7 times in each of the recall surveys (Fig. 18). Although effort was substantially overestimated (1.7 times) by recall for December 1996 - April 1997, harvest estimates were relatively close for the two methods, 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).

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. 19).

Table 41 Recreational rock lobster pot effort, harvest and harvest rate (HPUE) by month based on recall for resident Tasmanian recreational sea fishing licence-holders.

SE is standard error

		Effort		Harvest		HPUE
Recall survey	Month	Pot days	SE	No.	SE	No./day
Wave 2	November 1996	10262	1104	11952	1557	1.16
	December	24676	1891	23121	2270	0.94
	January 1997	31173	2504	24792	2503	0.80
	February	13447	1404	10199	1126	0.76
	March	10328	1163	7215	841	0.70
	April	2999	640	1580	381	0.53
	Nov96 - Apr97	92884	3847	78859	3995	
Wave 3	May	3186	753	2816	725	0.88
	June	2826	695	2428	542	0.86
	July	2013	605	1644	471	0.82
	August	2955	864	1501	367	0.51
	September					
	October					
	May - Oct 97	10981	1470	8388	1084	
Supplementary	November	12272	1043	14513	1457	1.18
recall survey	December	26769	2673	21534	2210	0.80
	January 1998	31071	2777	23792	2256	0.77
	February	13347	1464	9619	1245	0.72
	March	4249	639	3027	607	0.71
	April	7737	933	4411	702	0.57
	Nov97 - Apr98	95445	4400	76896	3809	

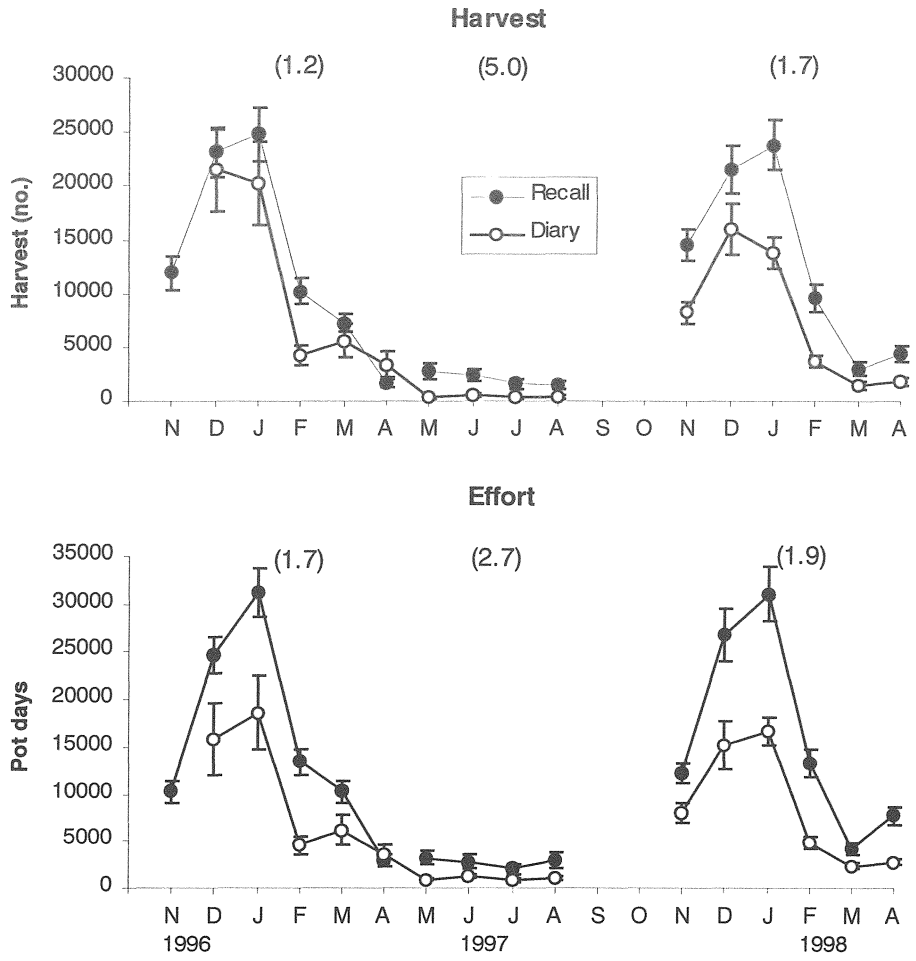

Fig. 18 Estimated monthly rock lobster pot effort and harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders. Values in parentheses indicate the ratio of recall to diary survey estimates for each overlapping period.

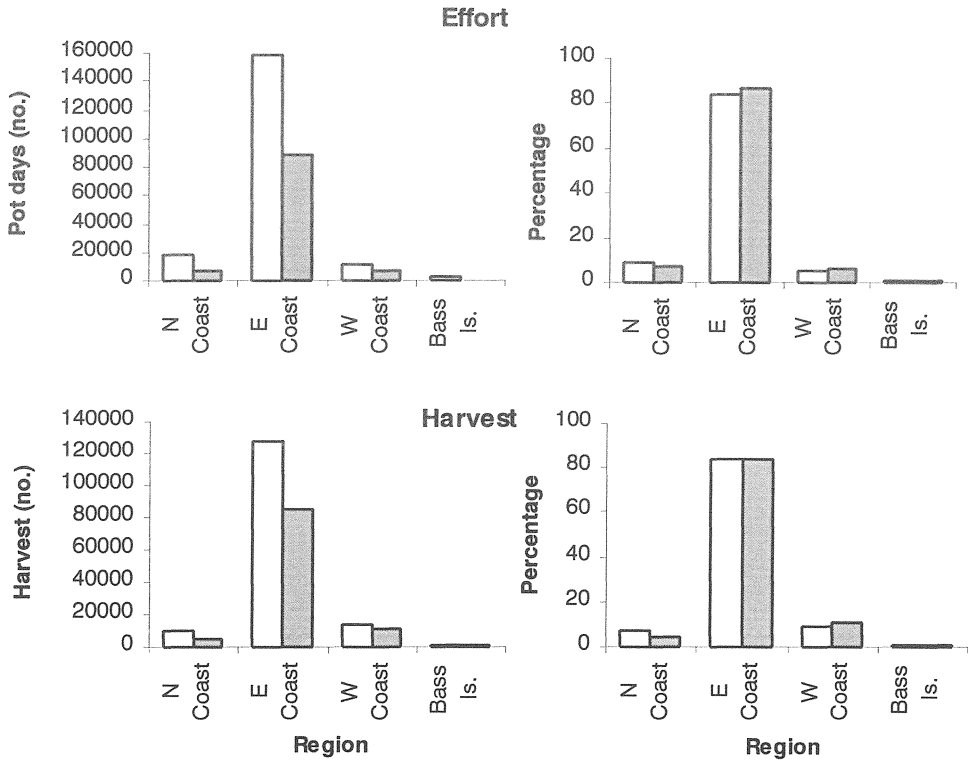

Fig. 19 Regional rock lobster pot effort and harvest based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

Table 42 summarises recall-derived dive harvest estimates, which are compared with diary estimates in Fig 20. The trend in harvest was similar for the two approaches, with recall estimates generally higher. In fact, overall harvest based on recall was about 1.5 times higher than that based on the diary survey (refer Tables 24 and 42). In the first recall/diary period (December 1996 - April 1997), the recall survey produced a harvest estimate only 10% higher than that for the diary. This result was strongly influenced by apparent underestimation of recall harvest in December 1996. 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 42 Recreational dive harvest of rock lobster by month based on recall for resident Tasmanian recreational sea fishing licence-holders.
SE is standard error

Recall survey	Month	Harvest (no.)	SE
Wave 2	November 1996	2851	695
	December	7764	1267
	January 1997	9229	1631
	February	7212	1534
	March	5510	1113
	April	2304	671
	Nov96 - Apr97	34870	2965
Wave 3	May	3444	917
	June	2697	774
	July	1647	667
	August	956	318
	September	-	-
	October	-	-
	May - Oct 97	8743	1409
Supplementary recall survey	November	2965	660
	December	9977	1694
	January 1998	14056	2143
	February	6373	1104
	March	3849	806
	April	3325	705
	Nov97 - Apr98	40546	3203

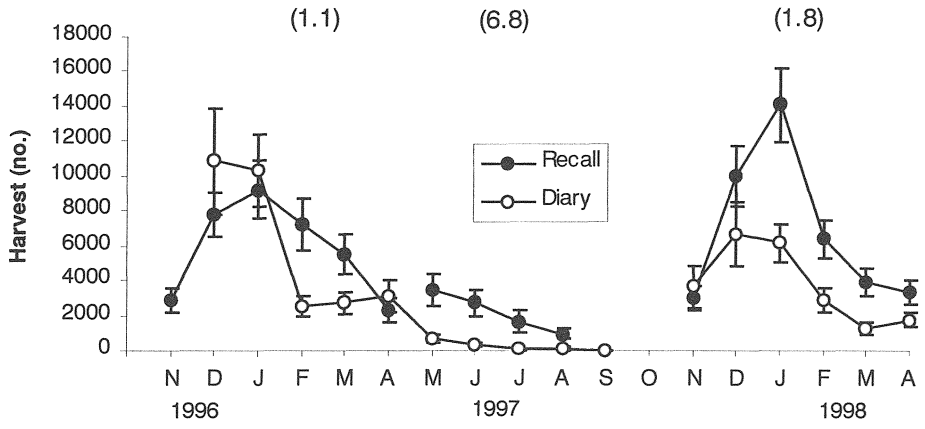

Fig. 20 Estimated monthly rock lobster dive harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders. Values in parentheses indicate the ratio of recall to diary survey estimates for each overlapping period.

While differing in absolute terms, there was consistency in the relative proportions of the dive harvest by fishing region for the recall and diary surveys (Fig. 21).

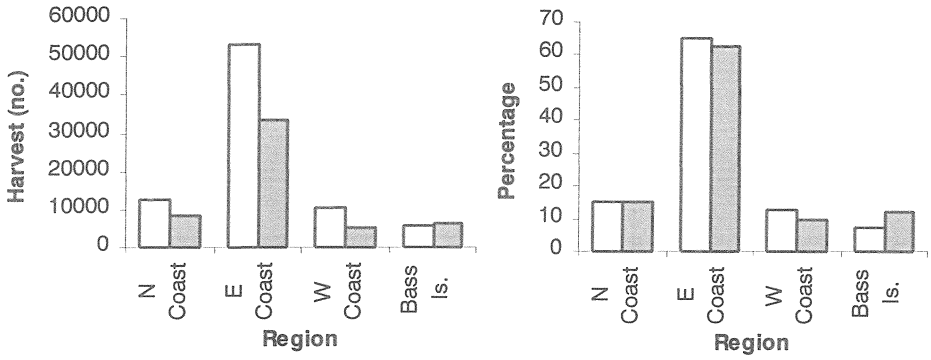

Fig. 21 Regional dive harvest of rock lobster based on recall (clear) and diary (shaded) survey for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

Recall and diary surveys produced more or less the same result in terms of the relative contributions of rock lobster pot and dive collection to the harvest. That is, pots accounted for 65% and dive methods 35% of the combined harvest.

6.8.3 Abalone

Abalone dive harvest based on recall is represented in Table 43 and compared with diary estimates in Fig. 22. The seasonal pattern of the abalone harvest was very similar for the recall and diary surveys, with recall estimates generally higher. The total recall estimate for December 1996 - April 1998 was almost 2.3 times higher than the diary estimate (refer Tables 24 and 43). For the 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. During the winter (May - October 1997) when harvest levels were low, the recall harvest was 4.3 times greater than the diary estimate.

Table 43 Recreational dive harvest of abalone by month based on recall for resident Tasmanian recreational sea fishing licence-holders.
SE is standard error

Recall survey	Month	Harvest (no.)	SE
Wave 2	November 1996	6297	1467
	December	21106	3561
	January 1997	32801	5452
	February	33086	7625
	March	20368	4030
	April	7569	1907
	Nov96 - Apr97	121228	11071
Wave 3	May	12311	2313
	June	7742	1836
	July	7168	1472
	August	6583	1937
	September	1719	597
	October	3080	1061
	May - Oct 97	38603	4016
Supplementary recall survey	November	10919	2420
	December	34551	4256
	January 1998	48935	5949
	February	30297	4528
	March	13460	2024
	April	17550	2955
	Nov97 - Apr98	155711	9627

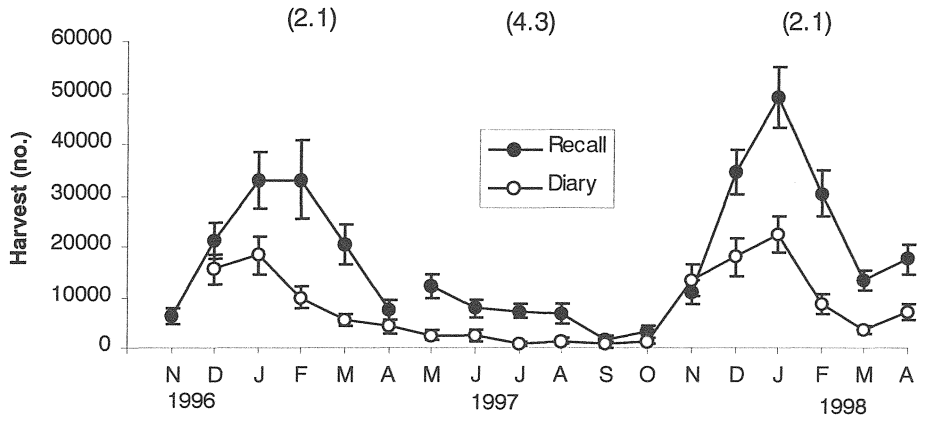

Fig. 22 Estimated monthly abalone dive harvest (with standard errors) based on recall and diary surveys for resident Tasmanian recreational sea fishing licence-holders. Values in parentheses indicate the ratio of recall to diary survey estimates for each overlapping period.

Regionally, the relative distribution of the abalone harvest was comparable for recall and diary surveys, despite substantial differences in absolute harvest estimates (Fig. 23).

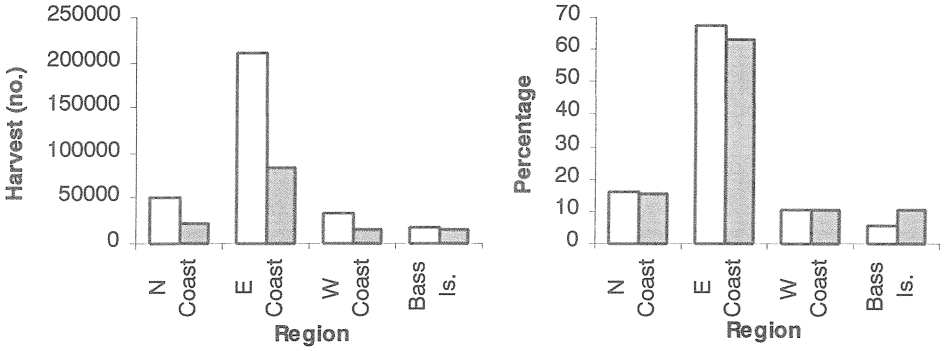

Fig. 23 Regional dive harvest of abalone based on recall (clear) and diary (shaded) surveys for resident Tasmanian recreational sea fishing licence-holders, December 1996 - April 1998.

6.8.4 Non-resident licence-holders

Recall surveys sampled non-resident (interstate and overseas) as well as resident Tasmanian licence-holders in order to assess, in relative terms, the impact of fishing by non-resident licence-holders.

When compared with fishing by resident licence-holders, non-resident fishing activity accounted for just 0.1% of the graball net effort, 0.5% of the rock lobster pot effort, 0.2% of the rock lobster pot harvest, 1.1% of the rock lobster dive harvest and 1.1% of the abalone harvest. The relative impact of fishing by non-resident licence-holders was, therefore, minimal.

6.9 Awareness and attitudes of holders of recreational sea fishing licences

Information contained in this section was collected at the end of each diary phase for respondents' aged 16 years or more. In practice, three attitudinal surveys were administered, surveys occurring at the end of diary Waves 1 and 2 applied to 1996/97 licence-holders, while an attitudinal survey conducted at the end of Wave 3 applied to 1997/98 licence-holders.

Results are presented as expanded estimates for resident Tasmanian holders of recreational sea fishing licences aged 16 years or more.

6.9.1 General fishing issues

In each of the attitudinal surveys, respondents were asked questions relating to general satisfaction with sea fishing in Tasmania.

In response to a question relating to satisfaction with sea fishing over the past few years, over 70% of licence-holders indicated that they were at least quite satisfied while 20-25% were less than satisfied (Table 44).

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. Around 60% of licence-holders indicated that they considered fishing was about the same, slightly less than 20% considered fishing was better, while a similar proportion considered fishing was worse in the previous twelve months compared to the year prior (Table 44).

Just over 10% of licence-holders considered that they had spent more time sea fishing in general during the pervious twelve months compared with the year prior. Over half of the 1996/97 licence-holders (Wave 2) and around 40% of 1997/98 licence-holders (Wave 3) indicated that they had fished less than in the year prior (Table 44). Over 40% of 1997/98 licence-holders considered that they had fished about the same, compared with around 35% of 1996/97 licence-holders.

Table 44: General satisfaction and time spent fishing, resident Tasmanian recreational sea fishing licence-holders 16 years and older.

Responses to Wave 1 and Wave 2 surveys relate to 1996/97 licence holders, Wave 3 survey relates to 1997/98 licence-holders. SE standard error *NA* question not asked.

	Wave1		Wave 2		Wave 3	
Response	%	SE	%	SE	%	SE
Satisfaction with sea fishing in general						
Very satisfied	9.8	1.4	9.6	2.4	18.2	2.2
Quite satisfied	68.0	2.2	61.9	4.0	59.2	2.7
Not very satisfied	18.5	1.8	22.2	3.1	18.6	2.0
Not at all satisfied	1.7	0.7	2.5	1.7	1.1	0.4
Unsure	2.0	0.8	3.9	1.9	2.8	1.0
Quality of sea fishing in the previous 12 months compared to the year prior						
Better	*NA*	*NA*	15.4	2.5	21.9	2.3
same	*NA*	*NA*	61.5	3.9	57.4	2.7
worse	*NA*	*NA*	18.5	3.3	15.3	1.8
unsure	*NA*	*NA*	4.6	1.5	5.4	1.5
Amount of time sea fishing during the previous 12 months compared to the year prior						
More	*NA*	*NA*	11.1	2.5	13.1	1.9
Same	*NA*	*NA*	35.3	3.1	42.6	2.7
Less	*NA*	*NA*	52.2	3.7	43.7	2.7
unsure	*NA*	*NA*	1.5	1.0	0.6	0.5

Respondents who held rock lobster pot and/or dive licences were questioned about rock lobster fishing in Tasmania. Between 64-73% of licence-holders were at least quite satisfied with rock lobster fishing. The level of satisfaction was slightly higher for 1996/97 licence-holders (Table 45). Conversely, a slightly greater proportion of 1997/98 licence-holders (33%) expressed some dissatisfaction with rock lobster fishing compared with 1996/97 licence-holders (24-29%).

In terms of the quality of rock lobster fishing, only 15% of 1996/97 and just 8% of 1997/98 licence-holders considered it to be better in the previous 12 months compared with the year prior. Just over half believed it to be about the same for each of the two previous years (Table 45). Significantly, around one third of 1997/98 licence holders,

about double the rate for 1996/97 licence-holders, believed the quality of fishing to be worse in the previous twelve months.

About one third of the licence-holders considered that they had spent about the same amount of time fishing for rock lobster in each of the two previous years (Table 45). Half considered that they had fished less in the previous twelve months and only a small proportion (around 10%) considered that they had spent more time fishing for rock lobster in the twelve months prior to interview than in the year before.

Table 45: General satisfaction and time spent rock lobster fishing, resident Tasmanian recreational rock lobster pot/dive licence-holders, 16 years and older.
Responses to Wave 1 and Wave 2 surveys relate to 1996/97 licence holders, Wave 3 and Supplementary surveys relate to 1997/98 licence-holders. SE standard error *NA* question not asked.

	Wave1		Wave 2		Wave 3	
Response	%	SE	%	SE	%	SE
Satisfaction with rock lobster fishing in general						
Very satisfied	8.2	1.5	12.7	2.7	9.1	1.6
Quite satisfied	65.1	2.4	52.3	3.8	55.1	2.7
Not very satisfied	19.4	1.9	25.2	3.1	30.2	2.5
Not at all satisfied	4.3	1.0	4.0	1.2	3.2	0.9
Unsure	3.0	0.9	5.8	1.9	2.4	0.7
Quality of rock lobster fishing in the previous 12 months compared to the year prior						
Better	*NA*	*NA*	15.1	2.7	8.4	1.4
same	*NA*	*NA*	57.5	3.8	52.7	2.7
worse	*NA*	*NA*	15.7	2.7	32.7	2.6
unsure	*NA*	*NA*	11.8	2.5	6.2	1.3
Amount of time spent rock lobster fishing during the previous 12 months compared to the year prior						
More	*NA*	*NA*	10.0	2.3	12.2	1.9
same	*NA*	*NA*	34.4	3.6	38.1	2.7
less	*NA*	*NA*	54.2	3.8	48.6	2.7
unsure	*NA*	*NA*	1.5	0.9	1.1	0.6

In the Wave 1 attitudinal survey, respondents were asked how satisfied (in general) they had been with the overall management of sea fishing in Tasmania. The majority of licence-holders (almost 80%) reported being at least quite satisfied and only a small minority (16%) was less than satisfied (Table 46).

Table 46 Satisfaction with the management of sea fishing, 1996/97 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.
SE is standard error

Response	%	SE
Very satisfied	7.1	1.2
Quite satisfied	71.2	2.1
Not very satisfied	14.4	1.6
Not at all satisfied	2.0	0.6
Unsure	5.4	1.1

6.9.2 Attitudes to selected management proposals

Wave 1 respondents (1996/97 licence-holders) were asked whether they agreed or disagreed with a series of suggestions concerning the management of recreational gillnet fishing in Tasmania. Results are presented in Table 47.

Nearly 80% of licence-holders agreed with the suggestion to restrict the number of gillnets used per boat to a maximum of three. The level of disagreement, although relatively low, was slightly higher amongst those licence-holders with gillnet licences (18%) compared with all licence-holders (13%).

The majority of licence-holders (60%) opposed a proposal to limit the use of recreational gillnets to daylight hours, with two thirds of net licence-holders not supporting the proposal. Support for this proposal was only 28% overall and just 24% among net licence-holders.

There was strong opposition (over 80%) to a proposal to require nets to be checked and cleared every hour, with fishers in attendance of nets at all times. Support for this proposal was very low, with less than 10% of licence-holders in favour.

Table 47 Responses to suggestion relating to the management of gillnet fishing in Tasmania, 1996/97 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.
SE is standard error

	%	SE	Net licence holders only %
Restrict the number of gillnets used per boat to a maximum of three			
Agree	78.6	1.9	75.6
Disagree	12.9	1.5	17.7
Unsure	8.4	1.4	6.7
Restrict the use of gillnets to daylight hours, from one hour before sunrise to one hour after sunset			
Agree	27.7	2.1	24.2
Disagree	60.6	2.3	65.8
Unsure	11.7	1.6	10.0
Require nets to be checked and cleared every hour and fishers to be in attendance of nets at all times			
Agree	9.6	1.5	7.3
Disagree	80.3	1.9	84.8
Unsure	10.1	1.3	1.5

6.9.3 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 Wave 3 respondents (1997/98 licence-holders). 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 80% of licence-holders being at least generally aware of the regulation (Table 48). General awareness of the size limit for flathead was also relatively high (70%). Awareness of size limits for trumpeter[5] and flounder were generally low, with over half of the licence-holders having no awareness of these regulations.

Table 48 Awareness of size limits for key species by 1997/98 resident Tasmanian sea fishing licence-holders, 16 years and older.
SE is standard error

Species	Awareness	%	SE
Flathead - 300 mm			
	Full	35.2	2.1
	General	35.2	2.3
	None	29.6	2.2
Trumpeter - 330 mm[6]			
	Full	10.9	1.3
	General	32.1	2.1
	None	57.1	2.2
Flounder - 250 mm			
	Full	14.1	1.6
	General	33.0	2.1
	None	52.9	2.3
Rock lobster - 110 mm for males, 105 mm for females			
	Full	46.6	2.4
	General	37.3	2.3
	None	16.1	1.9

In terms of awareness of bag and possession limit regulations for rock lobster and abalone, awareness was higher for rock lobster, with over 80% of licence-holders having at least general awareness of the bag and possession limits (Table 49). Around two thirds of licence-holders indicated awareness of the abalone bag limit, but just over half 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 the regulations.

[5] The same minimum size limit applies for both bastard and striped trumpeter.
[6] Subsequently revised to 350 mm.

Table 49 Awareness of recreational bag and possession limits for rock lobster and abalone by 1997/98 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.
SE is standard error

Awareness	%	SE
Rock lobster daily bag limit - 5 per person		
Full	71.9	2.2
General	13.9	1.7
None	14.1	1.8
Rock lobster possession limit (rock lobster pot/dive licence-holders) - 10 per person		
Full	61.0	2.4
General	19.4	2.0
None	19.6	2.0
Rock lobster possession limit (non-rock lobster pot/dive licence-holders) - 5 per person		
Full	17.2	1.7
General	20.8	2.0
None	61.9	2.4
Abalone daily bag limit - 10 per person		
Full	53.3	2.4
General	11.6	1.6
None	35.1	2.2
Abalone possession limit (abalone dive licence -holders) - 20 per person		
Full	38.7	2.4
General	13.6	1.7
None	47.7	2.4
Abalone possession limit (non-abalone dive licence-holders) - 5 per person		
Full	15.3	1.7
General	13.8	1.7
None	70.9	2.2

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 (Table 50).

Table 50 Awareness of Shark Nursery Areas (SNAs), restrictions relating to net usage and catches of sharks in SNAs by 1997/98 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.
SE is standard error

Awareness	%	SE
Shark Nursery Areas (SNAs)		
General	71.5	2.2
None	28.5	2.2
Net usage in SNAs - max. of one graball net, no mullet nets permitted		
Full	28.4	2.2
General	31.6	2.5
None	40.0	2.5
Sharks catch in SNAs - no school or gummy shark may be kept, taken by any method		
Full	13.7	1.8
General	30.0	2.4
None	56.3	2.6

6.9.4 Sources of information

Wave 3 respondents (1997/98 licence-holders) were asked how they had learnt about sea fishing regulations in Tasmania, identifying their main and second main sources of information (Table 51). Department of Primary Industries, Water and Environment (DPIWE) publications were the main source of information for over two thirds of licence-holders, with around 80% mentioning this source. Of secondary importance were other print media (e.g. newspapers, but not fishing magazines) and other fishers, each mentioned by around 30% of licence-holders. Television, radio, fishing magazines and fishing clubs/associations were of minor importance as sources of information regarding fishing regulations.

Table 51 Main sources of information about fisheries legislation for 1997/98 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.

Information source	Any mention	Main	Secondary
DPIWE publications	78.9	66.8	12.0
Other print media	37.7	13.8	23.9
Other fishers	31.4	11.1	20.3
DPIWE other	8.1	2.4	5.7
TV	4.2	0.8	3.3
Radio	2.6	1.0	1.7
Clubs/associations	2.1	1.1	1.0
Fishing magazine	1.2	0.2	1.0
Tackle shop	0.1	0.0	0.1
Other	3.2	1.7	1.5
None	1.0	1.0	

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 the fishery and a summary of relevant

regulations. The 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. Half of the 1997/98 licence-holders recalled having seen the brochures, 46% 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.

6.9.5 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. Wave 3 respondents (1997/98 licence-holders) were asked whether they could recall hearing about the process, and if so, how they had heard about it.

The majority (almost 60%) of licence-holders indicated they were aware of the management review process (Table 52). 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 review. Other fishers and television were also identified as important sources of information (20-30% of mentions). 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 52 Awareness of management planning process and main information sources for 1997/98 resident Tasmanian recreational sea fishing licence-holders, 16 years and older.

Aware of management planning process			
Yes	58.8		
No	33.9		
Unsure	7.2		
Sources of information			
	Mentioned	Main	Secondary
Other print media	59.9	44.6	15.3
Other fishers	33.8	20.6	13.2
TV	22.3	11.5	10.8
Radio	9.6	5.6	4.0
DPIWE publications	7.9	6.0	1.8
DPIWE other	6.6	4.1	2.5
Other	4.2	3.6	0.6
Clubs/associations	3.3	2.7	0.6
Fishing magazines	1.4	1.1	0.3
Tackle shop	0.3	0.3	0.0
None	-	-	50.4

7 DISCUSSION AND CONCLUSIONS

7.1 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 just 1% for the recall/screening 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 a similar design philosophy, comparable response rates have been achieved in 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). By comparison, self-administered diary surveys conducted in New Zealand (Bradford 1998) and Queensland (Higgs 1999) produced response rates of just 70% and 40%, respectively, over a twelve month diary period. Bradford (1998) and Higgs (1999) both attempted to correct for non-response, generally by categorising respondents and non-respondents on the basis of previous fishing activity. Activity of non-respondents was imputed based on the reported activity of 'similar' respondents. In both cases, imputation of missing data introduces unknown biases and uncertainty about the accuracy of population estimates. The exceptionally high response rates in the present study effectively eliminated any necessity to impute for missing data.

7.2 Recreational effort and harvest

Each year a small percentage of licence-holders (about 2%) are interstate or overseas residents. Although the diary survey was limited to resident Tasmanians and, therefore, effort and harvest estimates did not take account of fishing by non-resident licence-holders, recall survey data suggest that the relative impacts of fishing by non-residents was negligible (<1% of total).

7.2.1 Gillnets

A telephone survey of 1995/96 licence-holders provided preliminary information about recreational gillnet fishing in Tasmania (Lyle and Smith 1998). The survey found that effort was highest during December and January and was concentrated off the east coast. Blue warehou and bastard trumpeter were the primary species targeted using graball nets, while the smaller meshed mullet nets were used mainly to catch mullet. Being based on recall, however, Lyle and Smith (1998) acknowledged the limitations of the findings, which did not include estimates of harvest.

The present study generally confirmed these key findings but, being based on 'prospective' rather than retrospective data collection, provides greater detail about fishing practices, targeting, effort and harvest levels and was not subject to problems associated with respondent recall.

Recreational gillnet fishing is a significant activity in Tasmania with over 9,500 gillnets licensed in recent years. During the 17 month survey period (December 1996 - April 1998) resident licence-holders undertook approximately 81,000 net sets, equivalent to 1,245,000 net hours of effort, producing a harvest of 513,000 fish. Recreational netting was a highly seasonal activity, which reached a peak during summer, especially in December and January and fell to low levels by late autumn. In 1997, about 45% of the annual effort and harvest occurred in the months of January and December, whereas the six months May - October contributed less than 20% to the total. The vast majority of the total effort (97%) and harvest (92%) was attributable to graball nets.

Regionally, the main area of graball net usage was the east coast, principally south-eastern Tasmania where about 70% of the total effort was directed. Levels of graball effort in the north and west coasts were comparatively low (<10%). By contrast, mullet net usage was relatively high in north-eastern Tasmania as well as off the east coast.

A wide range of species was caught by recreational gillnets, including species typically associated with reef and soft bottom habitats for graballs and primarily soft bottom habitats for mullet nets. Reflecting this and linked with mesh selectivity and targeting, there were marked differences in the composition of the catch for graball and mullet nets. Graball nets were primarily used to catch species such as blue warehou, bastard trumpeter and flounder whereas mullet comprised the bulk of the mullet net harvest.

Numerically, blue warehou and bastard trumpeter dominated the gillnet harvest, together comprising 40% of the total numbers. Flounder, mullet, jack mackerel and cod were of secondary importance, each contributing around 5% to the total harvest. It is significant that the two main gillnet species, blue warehou and bastard trumpeter, were only occasionally taken by other recreational fishing methods, such as line and spear-fishing. Flounder, on the other hand, were also commonly taken by spear, the spear harvest for resident licence-holders exceeding that for gillnets.

In practice, fishers reported targeting a variety of species, the main ones being blue warehou, bastard trumpeter, flounder and Atlantic salmon using graballs and mullet using mullet nets. Although blue warehou and bastard trumpeter were the most frequently targeted species; almost half of the harvest of both species was taken in non-targeted effort. Levels of incidental harvest of non-target species, were also moderately high (around 50% or greater by number) for effort targeted at these two species. Gillnet fishing for flounder and mullet appeared more selective, with the majority of the harvest (>66%) of either species taken in targeted effort and with relatively low levels of incidental harvest (< 33%). Graball net effort directed at Atlantic salmon also accounted for the majority of the harvest of this species but included a high incidental harvest (>60%) of other species.

The pattern of harvest for blue warehou, bastard trumpeter and mullet largely mirrored the seasonal distribution of effort. By contrast, flounder harvest was relatively consistent throughout the year. Clearly, both availability/vulnerability of the species and the level of (targeted) effort expended influence the seasonal pattern of harvest.

As well as indicating seasonality in harvest, the survey provided evidence for inter-annual variability in the abundance of bastard trumpeter, the 1997/98 harvest was less than half of that for 1996/97, despite only a moderate (20%) decline in effort between years. A decline in commercial harvest also occurred over the same period, falling from over 50 tonnes in 1996/97 to under 40 tonnes in 1997/98 (Lyle and Jordan 1999). Recruitment variability is a feature of the species and a particularly strong cohort spawned in 1993 influenced inshore catches up until at least 1996/97 (Murphy and Lyle 1999). The lower 1997/98 harvest may be due to movement of these fish offshore (adults of the species tend to move offshore into deeper water) and/or depletion resulting from fishing. Harvest levels for blue warehou, flounder and mullet provided little indication of inter-annual variability within the survey timeframe.

7.2.2 Rock lobster

Lyle and Smith (1998) determined that about two thirds of the 1995/96 recreational harvest of rock lobster was taken by pots, dive capture accounting for the bulk of the remainder. They also indicated that the fishery was seasonal, with effort and harvest peaking during summer, and centred largely off the east coast of Tasmania. Although effort and harvest levels were estimated, they were recall-based and considered indicative.

The current study generally confirmed these earlier conclusions, demonstrating that rock lobster pots dominated (63%) the harvest, with dive collection of secondary importance (33%) and a small component (4%) of the harvest taken by other methods, principally rock lobster rings. The impact of rock lobster rings was, however, underestimated since fishing by non-licence holders was not taken into account. A specific licence for rock lobster rings, entitling fishers to use up to four rings, was not introduced until November 1998, after the survey had been completed. Just over 2000 rock lobster ring licences have been issued in 1998/99 (refer Table 1).

Resident Tasmanian licence-holders harvested an estimated 160,000 lobsters during the survey, 90,000 and 70,000 in the 1996/97 and 1997/98 fishing seasons, respectively. Effort (and harvest) rose sharply at the opening of the season (late November) and peaked in December and January, followed by a rapid fall in February and then a further decline in May to low levels of activity which were maintained through to the end of the season (August). The combined December - April harvest in 1997/98 was just two thirds of that for the same period in 1996/97. This decline was influenced by a combination of factors; lower harvest rates for pots (pot effort was comparable between years) and a decline in targeted dive effort (and consequent harvest) in 1997/98 (dive harvest rates were comparable between years).

Monthly harvest rates for pots generally declined as the season progressed. Harvest rate in 1996/97 peaked at around 1.4 but fell to around 0.9 rock lobster per pot day by April 1997. From May until the end of the season the harvest rate was below 0.5 rock lobster per pot day. Harvest rates in 1997/98 were generally lower, peaking at 1.1 in November/December 1997 and falling to 0.6 rock lobster per pot day by April 1998. Harvest rates for dive collection tended to be more consistent, averaging over two per dive during the first half of the season in both years. They then declined to less than one per dive in the second half of the season. Markedly lower harvest rates in the latter part of the season coincide with the closure of the fishery for female rock lobster from May until the end of the season.

By comparison with the South Australian recreational rock lobster pot fishery, harvest rates tended to be higher in Tasmania. Monthly harvest rates for 1998/99 peaked at just 0.8 rock lobster per pot day in South Australia (McGlennon 1999). Recreational fishers in that State are, however, permitted to use up to two pots and, since the vast majority of fishers actually used two pots, their *daily* harvest was likely to be comparable to that for Tasmania.

Only a very small proportion of pot effort (3%) resulted in the bag limit (5 rock lobster) being taken, whereas around 20% of the targeted dive effort resulted in a harvest of at least five rock lobster. As a management measure, the bag limit is more effective in limiting catches for divers than for fishers using pots.

Divers using surface air appeared to be more successful in capturing rock lobster than those using either SCUBA or snorkel methods. In practice, it is to be expected that using surface air or SCUBA will confer an advantage to divers in their ability to locate and capture rock lobster, but it is unlikely that dive method alone will determine success. Rather, skill and motivation (e.g. whether primarily diving to catch rock lobster or to experience the marine environment) will also be important factors.

Regionally, about three quarters of the total harvest was taken from the east coast, mainly from south-eastern Tasmania. The west coast was also relatively important, contributing just over 10% of the harvest, the north coast and Bass Strait islands were of minor significance. There were regional differences in the relative importance of the different fishing methods. Rock lobster pots accounted for over two thirds of the east coast harvest, around half of the west and north-east coast harvests and less than one quarter of the harvest from elsewhere. Dive collection dominated in the north west and Bass Strait islands while rock lobster rings were also relatively important off the west coast.

7.2.3 Abalone

The only previous assessment of the recreational abalone fishery in Tasmania is based on recall information and applies to the 1995/96 licensing year (Lyle and Smith 1998). While harvest and effort estimates were subject to recall bias, the survey indicated that around three-quarters of the annual harvest was taken from the east coast and about 60% of the harvest was taken during the summer months.

The present findings support the regional and seasonal nature of the fishery. During the 17-month survey, an estimated 135,000 abalone were taken by divers, over 60% from the east coast, mainly the south-east, with a further 10% from each of the north west and west coasts and King Island. The concentration of dive activity during summer was apparent, with almost half of the 1997 harvest of 78,000 abalone taken in the months of January and December.

Monthly harvest rates were relatively high (generally over 6 abalone per dive) and consistent throughout the year. In fact approximately 40% of dives targeted at abalone achieved the daily bag limit of ten abalone, indicating that the bag limit is effective in constraining the harvest. As noted with rock lobster, success (measured in terms of proportion of bag limit catches and harvest rate) was highest for divers using surface air supply. Unlike rock lobster, however, harvest rates were higher for snorkel diving compared with SCUBA, an observation noted previously by Lyle and Smith (1998). The shallow distribution of abalone and the relative ease of locating and extracting them from the rocks, no doubt contribute to the general success of snorkelling.

Regionally, snorkelling was the main method used on the north coast, but was less important on the south east and west coasts. The harvest share derived from diving on surface air supply was relatively high for the south-east and west coasts and the Bass Strait islands.

7.2.4 General

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 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, particularly the south-east 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.

7.3 Gillnet fishing practices and implications for management

When this project was proposed it had been anticipated that the Scalefish Fishery Management Plan would be implemented in time for the commencement of the 1997/98 licensing year, enabling impacts of management initiatives on fishing practices, especially net fishing, to be evaluated. However, the management plan was not released until mid-1998, after the survey had been completed. Nevertheless, several observations can be made about gillnet fishing practices and their implications for management.

During the development of the Scalefish Fishery Management Plan concern was expressed regarding the impact of recreational net fishing on fish stocks and, in particular, levels of wastage arising from poor fishing practices, principally overnight netting. Reflecting these concerns, the plan included provisions to prohibit gillnetting overnight with the exception of a small area off the west coast and gillnetting for flounder[7] (DPIF 1998). However, the Minister for Fisheries disallowed the night netting provisions because of concerns over the safety of fishers who, in order to comply with these regulations, might have been required to retrieve nets in unfavourable sea conditions. The issue of night netting is now the subject of a review which has also given consideration to addressing poor fishing practices, though limiting maximum soak times for gillnets. A final decision on this matter had not been made at the time of writing.

This study clearly demonstrated that fishing of gillnets overnight was a very common practice among recreational fishers in Tasmania, with over 75% of all net sets being fished overnight. Any restrictions on night netting will, therefore, have a significant impact on current fishing practices and, as demonstrated from attitudinal surveys in this and previous surveys (Lyle and Smith 1998), are likely to meet strong opposition from net fishers.

Motivations for overnight netting include:

- convenience - gillnets fish through the periods when many species are thought to be most active (dusk and dawn) without requiring fishers to be on the water;
- gillnetting is often linked with fishing with rock lobster pots - pots tend to be checked once a day (usually morning) and gillnets are checked at the same time, some or all of the catch being used to bait pots; and/or
- belief that certain species are best caught at night and/or catches and catch rates are higher in night sets.

Recreational gillnet fishers frequently leave nets set more or less continuously for periods of several days, checking and clearing the nets once or several times each day. Unfortunately the survey methodology did not permit direct estimation of soak time where nets were checked more than once on a given day. However, where gillnets were set in the morning and not checked or hauled until some time the following day,

[7] Under the Plan a flounder net is defined as a graball net with mesh size of 125 -140 mm with height not exceeding 12 meshes.

it was inferred that effective soak times were in the order of 24 hours or greater. At least one quarter of all gillnet sets fell into this category and there were, no doubt, additional instances where gillnets were set in the afternoon/evening but not hauled until late the following day. Regardless of the outcome of the night netting review, there is an urgent need to address such fishing practices. Excessively long soak times have considerable potential for wastage arising from deterioration and damage due to other predators (e.g. fish and lice) and reduced likelihood of survival of any unwanted catch.

Subsequent gillnet fishing trials have demonstrated that the quality of the catch deteriorates with increasing soak time and that the likelihood of damage (due to predators and lice) increases when nets are set overnight (Lyle and Patterson, unpublished data).

With regard to the relationship between night netting and harvest, a significant finding of this study was that harvest rates (number fish per set) were in fact higher for many species in day time sets compared with overnight sets, despite the longer soak times of overnight sets. For key species, such as bastard trumpeter and mullet, along with striped trumpeter, Atlantic salmon, Australian salmon and jackass morwong, harvest rates were higher in day sets. The harvest rate for blue warehou was basically the same for day and overnight sets and only school and gummy shark, flounder and rock lobster (an incidental bycatch) were taken at higher rates in overnight sets. As respondents were only required to report retained catch, the impact and magnitude of wastage from recreational gillnetting could not be assessed directly. Had discarding (including damaged fish) been reported, then the actual catch in overnight sets would have been higher than suggested by these analyses.

7.4 Recreational harvest share

In many respects, recreational graball nets are very similar to gillnets used by commercial operators. Probably the main differences are that recreational nets are limited to a maximum length of 50 m and most tend to have mesh sizes of 100-110 mm (ie. 4-4¼ inch), although some fishers do use larger mesh sizes (Lyle and Smith 1998). Commercial operators tend to use a range of mesh sizes depending upon the target species, for instance 125 mm (5 inch) and 133-140 mm (5¼-5½ inch) are favoured when targeting blue warehou (Tilzey 1999) and banded morwong (Murphy and Lyle 1999), respectively. In terms of small meshed gear, recreational fishers are permitted to use nets with mesh sizes between 60-70 mm (mullet nets), whereas the minimum mesh size available to commercial operators is 70 mm (special small mesh). It was expected, therefore, that there would be similarity in the species targeted and caught by recreational and commercial fishers.

By weight, blue warehou represented the major species taken by both the recreational and commercial gillnet sectors and, significantly, the recreational share was roughly equivalent to the commercial harvest taken in Tasmanian waters. Blue warehou supports a major fishery off south-eastern Australia, comprised of trawl and non-trawl (primarily gillnet) components. In 1997, catches in Commonwealth waters were 790 tonnes for trawl and 270 tonnes for non-trawl (Tilzey 1999). The Tasmanian inshore

fishery produced commercial landings of almost 130 tonnes which, when combined with the recreational harvest of almost 120 tonnes, was comparable in magnitude to the Commonwealth non-trawl harvest. The need to factor recreational harvest in future stock assessments has been recognised by the Blue Warehou Fishery Assessment Group.

Apart from blue warehou, other species with annual recreational gillnet harvests exceeding 10 tonnes included bastard trumpeter, Australian salmon, silver trevally and striped trumpeter. Among these, the recreational share of the total harvest exceeded 35% for bastard trumpeter and silver trevally. Several of the species taken by gillnets are also harvested using other methods, they include Australian salmon (beach seine), striped trumpeter (hook methods), wrasse (hook and traps), flathead (trawl) and barracouta (hook) (Lyle and Jordan 1999). As a consequence, the recreational gillnet share of the total harvest of these species was relatively low (around 5%). Banded morwong were an exception. Despite being taken almost exclusively by gillnet, the recreational harvest was very small and represented less than 2% of the total. This can be explained since banded morwong are targeted by commercial gillnet fishers for the Asian restaurant (live fish) market, but have little appeal as a table fish for recreational fishers.

As fishing by non-licensed fishers was not covered by this study, line and spear fishing harvests were underestimated. Nevertheless several important observations can be made. For instance, the recreational harvest of flathead and barracouta exceeded the commercial harvest, while the harvest of flounder, Australian salmon, cod and jackass morwong taken on lines and by spear, exceeded the recreational gillnet harvest. Overall, the magnitude of the recreational harvest of many finfish species will be significant when compared with the commercial fishery and should not be ignored when conducting resource assessments.

The recreational share of the total rock lobster harvest was relatively low (5%). The bulk of the commercial harvest was, however, taken from depths greater than 18 m (Frusher and Gardner 1999) whereas it has been assumed that the recreational harvest was largely limited to shallow water because of the need to hand haul pots and depth restrictions applying to diving. When the harvest from shallow waters (<18 m) was considered, the recreational share was more significant and represented around 15% of the total. Regionally, the recreational share in south-eastern Tasmania was over 20% or, if restricted to shallow waters, in excess of 38%, while off eastern Tasmania the recreational harvest accounted for about 10% of the total or over 20% of the shallow water harvest. Clearly, there is potential for significant interactions between fishing sectors at the regional level and there is a need for ongoing assessment of the recreational harvest. In fact, the rock lobster management plan contains a trigger point relating to the relative size of the recreational harvest. In the event of the recreational harvest exceeding 10% of the commercial harvest in a given season, management arrangements for the recreational fishery will be reviewed (DPIF 1997).

The recreational harvest of 65 tonnes of abalone for the survey period represents a very minor proportion (2%) of the total harvest. While relatively small, the recreational share was more significant in certain regions, such as the north-west

coast, and importantly, recreational divers were more likely to continue taking abalone from reefs where abundances would be insufficient to maintain commercially viable harvest rates. For these reasons Officer (1999) recommended that monitoring of the recreational fishery should be ongoing.

7.5 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 prospective data collection and thereby assess the utility of telephone surveys as a means of providing reliable catch and effort information. Compared with many surveys that 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 harvest, respectively. The comparable ratios based on recall estimates were 0.93 and 1.17, respectively. Comparable diary and recall ratios 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 the 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.

7.6 Awareness and attitudes

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

In relation to the management of recreational gillnetting, the majority of licence-holders supported limiting the number of gillnets per boat to a maximum of three. This option has, in fact, been implemented as part of the fisheries regulations introduced in 1998 (DPIF 1998). By contrast, there was strong opposition to proposed bans on night netting and possible requirements to be in attendance of nets. Opposition to these proposals was not unexpected since they would require substantial changes to the way in which the majority of recreational gillnet fishers currently operate.

There was high (85%) general awareness of size limits for rock lobster amongst licence-holders, while 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 (<50%), 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 (>80%) of rock lobster bag and possession limits and a moderate awareness (>50%) 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 50% in 1997/98) (refer Lyle and Smith 1998). This highlighted a suspected problem that some instances brochures were not readily available when applicants applied for licences.

Newspaper and television reports, along with other fishers, were perceived as 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 in the evaluation and development of information programs aimed at promoting responsible community attitudes and behaviour for sustainable resource use.

8 BENEFITS

Information derived from this study has been used widely by resource managers and has been incorporated in fishery assessments for the scalefish (Lyle and Jordan 1999), rock lobster (Frusher and Gardner 1999) and abalone (Officer 1999) fisheries of Tasmania. Information regarding recreational harvest of blue warehou has also been input in the 1999 blue warehou assessment (Blue Warehou Assessment Group).

Information relating to gillnet fishing practices and implications for the management of net fishing, in particular night netting, has been provided to resource managers and considered by the Scalefish Fishery Advisory Committee and the Marine Recreational Fishing Council in providing recommendations to the Minister of Fisheries on gillnetting. At the time of writing, the outcome of the night netting review had not been finalised.

Although not a licensed fishing method whilst the survey was under-way, survey findings did identify the effectiveness of rock lobster rings as a means of catching rock lobster. Indirectly, this has provided impetus to incorporate this method into the recreational licensing system and close a 'loophole' in the management of the rock lobster fishery. The requirement to license rock lobster rings took effect in November 1998, with just over 2000 ring licences issued in 1998/99.

From attitudinal and awareness surveys, resource managers have been able to gauge fisher reaction to a number of possible management options, several of which have now been implemented. The project has provided fisher feedback regarding the effectiveness of education and information campaigns conducted by the Department and highlighted issues that require particular attention in terms of raising fisher awareness.

9 INTELLECTUAL PROPERTY

As per the original project application, attribution of intellectual property derived from this project was 47.71% to the Fisheries Research and Development Corporation and 52.29% to the University of Tasmania.

Kewagama Research retains certain specific and continuing rights in terms of design related issues (as opposed to data) for specific methodologies and interviewing techniques (in particular, the 'memory jogger' diary system). These rights entitle the client bodies to full usage of survey materials in conducting the survey, including repeat surveys, but restricts clients in terms of any "on-selling" or provision of the instrument to a third party, including any "unnecessary" publication of methodological details.

10 FURTHER DEVELOPMENT

The efficacy of the survey design philosophy, as an instrument to undertake broad-scale recreational fishing assessment, has been clearly demonstrated. The logical next step for further development is the implementation of a state-wide survey of recreational fishing in general and not limited to licensed fishers. In practice, this will occur as part of a national survey of recreational and indigenous fishing, scheduled for 2000/01. Experience gained in this study, coupled with that of the Northern Territory recreational fishing survey (Coleman 1998), has contributed significantly to the development of the National Survey.

The issue of ongoing monitoring of the rock lobster fishery, in particular, has been raised and the development of a regular telephone/diary-based survey of rock lobster licence-holders is being considered by resource managers and industry.

11 STAFF

Tasmanian Aquaculture and Fisheries Institute

Jeremy Lyle
Fiona Ewing*
David Campbell

* Externally funded

Consultant

Laurie West (Kewagama Research)

Contract telephone interviewers

Lyn Barwick
Malcolm Campbell
Wendy Chopping
Maureen Gyles
Rachel Hyland
Janice MacClean
Daryn Payne
Janine Bird
Allan Chapman
Denis Golden
Janet Hill
Judy Kingston
Peter McKenna
Helen Sinclair

12 ACKNOWLEDGMENTS

Sincere thanks are extended to Laurie West (Kewagama Research) for developing the survey instrument, preparation of questionnaires, assistance in the recruitment and training of interviewers and invaluable advice throughout all phases of the project.

Fiona Ewing provided excellent support including management of interviewers, monitoring of workflow, data editing and entry and preliminary analyses. David Campbell also provided invaluable help with mail-outs and allocation of workloads, on-site surveys, implementation of the office management system and data analysis.

The professionalism and commitment of the survey interviewers - Lyn Barwick, Janine Bird, Malcolm Campbell, Allan Chapman, Wendy Chopping, Denis Golden, Maureen Gyles, Janet Hill, Rachel Hyland, Judy Kingston, Janice MacClean, Peter McKenna, Daryn Payne and Helen Sinclair - contributed significantly to the success of the project, encouraging cooperation of fishers and maximising response rates.

I am also grateful to Dennis Reid (NSW Fisheries Research Institute) for statistical advice regarding the estimation of errors and to John Smith (DPIWE) for his continued support and encouragement with the project. Colin Buxton, Malcolm Haddon, Cheryl Munro and Laurie West reviewed the report and provided many helpful comments.

Sincere thanks are also extended to the recreational fishers who so willingly participated in the study.

Additional funding assistance was provided by the Marine Recreational Fishing Trust Fund to undertake creel survey work and conduct the Supplementary recall survey.

13 REFERENCES

ABS (1984). Household fish consumption and non-commercial fishing activities, Tasmania. Australian Bureau of Statistics, Hobart.

ABS (1994). Australian Bureau of Statistics Home Production of Selected Food Stuffs Year ended April 1992. Australian Bureau of Statistics.

Annala, J.H. and Sullivan, K.J. (1997). Report from the Fishery assessment Plenary, May 1997: stock assessments and yield estimates 381p. (Unpublished report held in NIWA library, Wellington) NZ Ministry of Fisheries.

Blackburn, M (1960). A study of condition (weight for length) of Australian barracouta, *Thrysites atun* (Euphrasen), in Australian waters. *Australian Journal of Marine and Freshwater Research* **11**:14-41.

Bradford, E. (1998) National marine recreational fishing survey 1996: scaling the diary survey results to give the total recreational harvest. *NIWA Technical Report* **17**, 33p.

Cierpicki, S. Riquier, C. and Kennedy, R. (1997). South Australian fishing survey 1997. *South Australian Fisheries Management Series Paper No.* **25**, 58p.

Cochran, W.G. (1977). *Sampling Techniques* (Third Edition) John Wiley & Sons, New York, 428p.

Coleman, A.P.M (1998). Fishcount: A survey of recreational fishing in the Northern Territory. NT Department of Primary Industry and Fisheries. *Fishery Report No.* **43**, 135p.

Connelly, N.A. and Brown, T.L. (1995). Use of angler diaries to examine biases associated with 12-month recall on mail questionnaires. *Transactions of the American Fisheries Society* **124**: 413-422.

DPIF (1997). Rock lobster fishery policy document. Tasmanian Department of Primary Industry and Fisheries, 83p.

DPIF (1998) Scalefish fishery policy document. Tasmanian Department of Primary Industry and Fisheries, 91p.

Fisher, W.L., Grambsch, A.E., Eisenhower, D.L. and Morganstein, D.R. (1991). Length of recall and accuracy of estimates from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. *American Fisheries Society Symposium* **12:** 367-374.

Frusher, S.D. and Gardner, C. (1999) Tasmanian rock lobster fishery 1998. TAFI Fishery Assessment Report, 43p.

Higgs, J. (1999). Experimental recreational catch estimates for Queensland residents. Queensland Fisheries Management Authority, *RFISH Technical Report* **2**, 55p.

Jordan, A. (1997). Demersal trawl surveys of the continental shelf of southern and eastern Tasmania 1993-95. *Marine Research Laboratories Technical Report* **50**, 148p.

Lyle, J.M. and Campbell, D.A. (1999). Species and size composition of recreational catches with particular reference to licensed fishing methods. TAFI Final Report to Marine Recreational Fishery Advisory Committee, 46p.

Lyle, J. M. and Ford, W. B. (1993). Review of trawl research 1979-1987, with summaries of biological information for the major species. *Marine Research Laboratories Technical Report* **46**, 169p.

Lyle, J.M. and Jordan, A.R. (1999). Tasmanian scalefish fishery assessment 1998. TAFI Fishery Assessment Report, 88p

Lyle, J.M. and Smith, J.T. (1998). Pilot survey of licensed recreational sea fishing in Tasmania - 1995/96. *Marine Research Laboratories Technical Report* **51**, 55p.

McGlennon, D. (1999). Survey of the licensed recreational rock lobster fishery in South Australia 1998/99. SARDI Final Report, 20p.

McGlennon, D. and Kinloch, M. (1997). Resource allocation in the South Australian marine scalefish fishery. Final report to Fisheries Research and Development Corporation, Project 93/249.

Murphy, R. and J.M. Lyle (1999). Impact of gillnet fishing on inshore temperate reef fishes, with particular reference to banded morwong. Final report to Fisheries Research and Development Corporation, Project 95/145, 136p.

Officer, R. (1999). Tasmanian abalone fishery 1997/1998. TAFI Fishery Assessment Report, 68p.

Pollock, K.H., Jones, C.M. and Brown, T.L. (1994). *Angler survey methods and their applications in fisheries management.* American Fisheries Society Special Publication 25, Bethesda, Maryland.

Roy Morgan Research (1999). Recreational fishing in Queensland - A survey of Queensland residents. Report prepared for Queensland Fisheries Management Authority. 51p.

Steffe, A.S., Murphy, J.J., Chapman, D.J., Tarlinton, B.E., Gordon, G.N.G., and A. Grinberg (1996). An assessment of the impact of offshore recreational fishing in New South Wales waters on the management of commercial fisheries. Final report to Fisheries Research and Development Corporation Project 94/053.

Tarrant, M.A., Manfredo, M.J.., Bayley, P.B. and Hess, R. (1993). Effects of recall bias and nonresponse bias on self-reported estimates of angling participation. *North American Journal of Fisheries Management* **13**: 217-222.

Tilzey, R.D.J. (ed.) (1999). The South East Fishery 1998. Fishery Assessment Report complied by the South East Fishery Assessment Group. Australian Fisheries Management Authority, Canberra, 199p.

Williams, H., Kirkwood, R., Pullen, G., and G. Kucerans (1986). The jack mackerel purse seine fishery in Tasmania, 1985-86. *Department of Sea Fisheries Technical Report* **13**, 43p.

14 APPENDICES

Appendix 1

Length-weight relationships used to convert size composition data into weights for key finfish species.

Lengths are fork lengths.

Species	Length-weight relationship	Source
Australian salmon (*Arripis trutta*)	$W(g) = 1.17x10^{-2}*L\ (cm)^{3.09}$	MRL, unpub. data
Barracouta (*Thyrsites atun*)	$W(g) = 1.06x10^{-1}*L(cm)^{2.238}$	Blackburn.(1960).
Cod (*Pseudophycis bachus*)	$W(g) = 7.4x10^{-3}*L(cm)^{3.06}$	Annala and Sullivan (1997)
Sand flathead (*Platycephalus bassensis)*	$W(g) = 1.89x10^{-3}*L(cm)^{3.381}$	Jordan (1997)
Tiger flathead (*Neoplatycephalus richardsoni*)	$W(g) = 4.1x10^{-3}*L(cm)^{3.163}$	Jordan (1997)
Greenback flounder (*Rhomosolea tapirina*)	$W(g) = 8.75x10^{-3}*L(cm)^{3.147}$	MRL, unpub. data
Jack mackerel (*Trachurus declivis*)	$W(g) = 1.15x10^{-2}*L(cm)^{3.061}$	Williams *et al.* (1986)
Leatherjacket (Fam. Monocanthidae)	$W(g) = 1.65x10^{-2}*\ L(cm)^{3.014}$	Steffe *et al.* (1996)
Banded morwong (*Nemadactylus spectabilis*)	$W(g) = 3.49x10^{-2}*L(cm)^{2.881}$	Murphy and Lyle (1998)
Jackass morwong (*Nemadactylus macropterus*)	$W(g) = 1.4x10^{-2}*L(cm)^{3.086}$	Jordan (1997)
Yellow eye mullet (*Aldrichetta foresteri*)	$W(g) = 3.78x10^{-3}*\ L(cm)^{3.34}$	MRL, unpub. data
Silver trevally (*Pseudocaranx dentax*)	$W(g) = 3.35x10^{-2}*\ L(cm)^{2.846}$	Steffe *et al.* (1996)
Bastard trumpeter (*Latridopsis forsteri*)	$W(g) = 1.12x10^{-2}*L(cm)^{3.14}$	Murphy and Lyle (1998)
Stirped trumpeter (*Latris lineata*)	$W(g) = 3.41x10^{-2}*L(cm)^{2.77}$	Murphy and Lyle (1998)
Blue warehou (*Seriolella brama*)	$W(g) = 1.7x10^{-2}*L(cm)^{3.037}$	Lyle and Ford (1993)
Wrasse (fam. Labridae)	$W(g) = 5.35\ x10^{-2}*\ L(cm)^{2.71}$	MRL, unpub. data

Appendix 2

Sample size, size range and mean length and weight by fishing method for key finfish species based on recreational catches.

nd not determined

	Fishing method					
	Dive	Graball net	Mullet net	Beach seine	Line	Spear
Australian salmon						
Min. length (cm)		37			19	
Max. length (cm)		57			52	
Av. length (cm)		46.3			32.2	
Av. weight (kg)		1.71			0.66	
No. of fish		97			403	
Barracouta						
Min. length (cm)		34	54		23	
Max. length (cm)		71	93		102	
Av. length (cm)		60.1	75.0		62.6	
Av. weight (kg)		1.09	1.81		1.19	
No. of fish		16	3		752	
Cod						
Min. length (cm)		29	24		30	
Max. length (cm)		48	40		49	
Av. length (cm)		38.5	31.6		39.8	
Av. weight (kg)		0.56	0.35		0.64	
No. of fish		77	5		36	
Sand flathead						
Min. length (cm)		26			16	33
Max. length (cm)		44			55	49
Av. length (cm)		33.2	51.0		31.4	41.6
Av. weight (kg)		0.28			0.25	0.61
No. of fish		28	1		4225	25
Tiger flathead						
Min. length (cm)		30			22	
Max. length (cm)		44			66	
Av. length (cm)		39.0			41.9	
Av. weight (kg)		0.46			0.65	
No. of fish		18			462	
Greenback flounder						
Min. length (cm)		22			25	20
Max. length (cm)		37			34	35
Av. length (cm)		26.9			30.1	27.7
Av. weight (kg)		0.28			0.40	0.31
No. of fish		191			30	144
Jack mackerel						
Min. length (cm)		26	20		20	
Max. length (cm)		29	38		39	
Av. length (cm)		25.7	28.7		29.4	
Av. weight (kg)		0.24	0.33		0.39	
No. of fish		97	13		7	

Appendix 2 (continued)

	Fishing method					
	Dive	Graball net	Mullet net	Beach seine	Line	Spear
Leatherjacket						
Min. length (cm)		22			19	
Max. length (cm)		46			39	
Av. length (cm)	21.5	31.6			29.0	
Av. weight (kg)	0.17	0.55			0.46	
No. of fish	1	67			18	
Banded morwong						
Min. length (cm)	33	22			31	
Max. length (cm)	48	47			51	
Av. length (cm)	40.5	35.7			40.6	
Av. weight (kg)	1.67	1.23			1.73	
No. of fish	2	11			3	
Jackass morwong						
Min. length (cm)		18			15	
Max. length (cm)		46			57	
Av. length (cm)		26.7			29.6	
Av. weight (kg)		0.42			0.70	
No. of fish		272			238	
Mullet						
Min. length (cm)			25	24	14	
Max. length (cm)			38	36	33	
Av. length (cm)		18	30.4	30.1	24.7	
Av. weight (kg)		nd	0.35	0.35	0.20	
No. of fish		1	166	24	59	
Silver trevally						
Min. length (cm)		20	28			
Max. length (cm)		58	28			
Av. length (cm)		41.2	28			
Av. weight (kg)		1.65	0.46			
No. of fish		24	2			
Bastard trumpeter						
Min. length (cm)	24	21			23	
Max. length (cm)	46	52			43	
Av. length (cm)	33.5	30.0			34.0	
Av. weight (kg)	0.88	0.57			0.85	
No. of fish	10	183			10	
Striped trumpeter						
Min. length (cm)		34			33	
Max. length (cm)		62			82	
Av. length (cm)		48.0			52.1	
Av. weight (kg)		1.73			2.20	
No. of fish		51			137	

Appendix 2 (Continued)

	Fishing method					
	Dive	Graball net	Mullet net	Beach seine	Line	Spear
Blue warehou						
Min. length (cm)	38	23	35		16	
Max. length (cm)	38	56	38		43	
Av. length (cm)	38.0	40.9	37.5		34.1	
Av. weight (kg)	1.15	1.43	1.06		0.86	
No. of fish	1	765	2		96	
Wrasse						
Min. length (cm)		20	18		22	
Max. length (cm)		23	48		42	
Av. length (cm)	37.5	21.3	29.5		29.9	
Av. weight (kg)	0.98	0.23	0.61		0.59	
No. of fish	1	4	102		73	

Appendix 3

List of taxa reported by diarists and capture methods.

Fishing methods - GN graball net, MN mullet net, BS beach seine, LN line, SP spear, DV dive, RP rock lobster pot, RR rock lobster ring. Y indicates taxa was caught by the fishing method

			Fishing method							
Common name	Alternative common names	Scientific name	GN	MN	BS	LN	SP	DV	RP	RR
Rock lobster		*Jasus edwardsii*	Y					Y	Y	Y
Abalone	Blacklip & greenlip abalone	*Haliotis ruba & H. laevigata*						Y		
Altantic salmon		*Salmo salar*	Y	Y		Y		Y		
Australian salmon	Cockie or black-back salmon	*Arripis trutta & A. truttaceus*	Y	Y	Y	Y	Y	Y		
Barracouta	Couta	*Thyrsites atun*	Y	Y		Y		Y		
Bream		*Acanthopagrus butcheri*	Y	Y	Y	Y				
Blue eye trevalla	Deep sea trevalla	*Hyperoglyphe antartica*				Y				
Blue grenadier		*Macruronus novaezelandiae*	Y							
Blue mackerel		*Scomber australasicus*	Y							
Blue warehou	Snotty or black trevally	*Seriolella brama*	Y	Y	Y	Y		Y		
Boarfish	Duck fish	*Pentaceropsis recurvirostris*	Y			Y		Y		
Bullseye		fam. Pempheridae	Y							
Cod	Red cod or rock cod	fam. Moridae	Y	Y		Y		Y	Y	
Dory		fam. Zeidae	Y	Y		Y			Y	
Eel		various	Y			Y			Y	
Flathead	esp sand flathead, some tiger flathead	fam. Platycephalidae	Y	Y	Y	Y	Y	Y		
Flounder		fam. Pleuronectidae esp *Rhomosolea tapirina*	Y	Y	Y	Y	Y	Y		
Garfish		*Hyporhamphus melanochir*	Y		Y	Y	Y			
Gemfish		*Rexea solandri*	Y							
Gurnard	Gurnard perch	fam. Scorpaenidae & Triglidae	Y	Y	Y	Y		Y		
Hapuka		*Polprion oxygeneios*				Y				
Herring cale		*Odax cyanomelas*	Y							
Jack mackerel		*Trachurus declivis*	Y	Y	Y	Y	Y			
Knifejaw		*Oplengnathus woodwardi*	Y							
Latchet		*Pterygotrigla polyommata*	Y			Y				
Leatherjacket	Triggerfish	fam. Monacanthidae	Y	Y	Y	Y	Y	Y		
Ling		*Genypterus* spp.	Y	Y		Y	Y	Y	Y	
Luderick	Blackfish	*Girella tricuspidata*	Y	Y		Y		Y		
Magpie perch	Magpie morwong	*Cheilodactylus nigripes*	Y							
Marblefish	Grouper	*Dactylosargus arctiden*	Y							
Marlin		fam. Istiophoridae				Y				
Banded morwong	Carp	*Cheilodactylus spectabilis*	Y	Y		Y		Y		
Jackass morwong	Perch	*Nemadactylus macropterus*	Y	Y		Y		Y	Y	

Appendix 3 (continued)

Common name	Alternative common names	Scientific name	Fishing method							
			GN	MN	BS	LN	SP	DV	RP	RR
Mullet		fam. Mugilidae, esp *Aldrichetta forsteri*	Y	Y	Y	Y	Y	Y		
Old wife		*Enoplosus armatus*	Y							
Pike	Two species long-finned and short-finned pike	*Dinolestes lewini* and *Sphyraena novaehollandiae*	Y	Y		Y		Y		
Pilchards		fam. Clupeidae	Y							
Red mullet		*Upeneichthys* sp.	Y							
Redfish		fam. Berycidae	Y	Y						
Shark ,bull		*Hexanchus griseus*	Y							
Shark, elephant	Ghost shark	*Callorhynchus milii*	Y					Y		
Shark, gummy		*Mustelus antarcticus*	Y			Y			Y	
Shark, mako	Blue shark	*Isurus oxyrinchus*	Y			Y				
Shark, Port Jackson		*Heterodontus portusjacksoni*	Y			Y				
Shark, saw		*Pristiophorus* spp	Y			Y				
Shark, school	Snapper shark	*Galeorhinus galeus*	Y			Y				
Shark, spurdog	Dogfish	*Squalus* spp.				Y				
Shark, thresher		*Alopias vulpinus*	Y							
Silver trevally	Silver bream	*Pseudocaranx dentex*	Y	Y	Y	Y		Y		
Skates/rays		Rajiformes	Y	Y		Y				
Snapper	Cockney or red bream	*Pagrus auratus*	Y	Y		Y				
Stargazer		fam. Uranoscopidae	Y				Y			
Sweep		*Scorpis* spp.	Y			Y		Y		
Trout	Sea-run trout	fam. Salmonidae	Y	Y	Y	Y				
Bastard trumpeter	Silver trumpeter	*Latridopsis forsteri*	Y	Y		Y		Y		
Striped trumpeter	Stripey trumpeter	*Latris lineata*	Y			Y	Y	Y	Y	
Albacore tuna		*Thunnus alalunga*				Y				
Southern bluefin tuna		*Thunnus maccoyii*				Y				
Stripey tuna	Skipjack tuna	*Katsuwonus pelamis*	Y			Y				
Whiting		fam. Sillaginidae, esp *Sillago flindersi*	Y	Y	Y	Y		Y	Y	
Wrasse	Kelpie or parrot fish	fam. Labridae	Y	Y		Y	Y			Y
Yellowtail kingfish		*Seriola lalandi*	Y			Y				
Zebrafish		*Maelambaphes zebra*	Y							
King trevally		Species uncertain	Y							
Soldierfish		Species uncertain				Y				
Sergeant baker		Species uncertain				Y				
Arrow squid		*Nototodarus gouldi*	Y	Y	Y	Y	Y			
Southern calamary		*Sepioteuthis australis*				Y	Y			
Octopus		*Octopus* spp.	Y		Y	Y			Y	
Crab									Y	