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# RECREATIONAL GILLNETTING IN TASMANIA – AN EVALUATION OF FISHING PRACTICES AND CATCH AND EFFORT

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*February 2012*

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# Recreational gillnetting in Tasmania – an evaluation of fishing practices and catch and effort

## Executive Summary

Recreational fishers have a long history of gillnet usage in Tasmania, targeting species that have traditionally been difficult to catch using angling methods, species such as bastard trumpeter, blue warehou, flounder and mullet. The recent development of the salmonid aquaculture industry has also provided further opportunities for gillnet fishers, with escapee Atlantic salmon and ocean trout (farmed rainbow trout) readily taken by gillnets.

The present study provides a comprehensive assessment of the status of recreational gillnetting in Tasmania, including the influence of recently introduced management measures designed to improve fishing practices. A total of 610 persons, 573 of whom held a recreational gillnet licence during 2010, fully participated in the 12 month telephone-diary survey, providing detailed information about their gillnet fishing activities. These data have been expanded to represent the entire population of gillnet licence holders.

*Catch and effort*

Although approximately 9,000 persons were issued recreational gillnet licences during 2010, only 6,600 licence-holders set a gillnet at least once during the year. These fishers accounted for an estimated 25,720 net-days (95% confidence interval 22,142-28,901) or 26,088 net set-days (recognising that some fishers utilise graball and mullet nets on a given day) of fishing effort. Graball nets accounted for 97% and mullet nets 3% of the total number of gillnet sets. Gillnets captured 173,922 organisms (95% CI 147,165-202,905), almost 65% (112,521; 95% CI 93,026-133,486) were kept and the remainder released or discarded (61,401; 95% CI 50,582-73,312). Overall, catch rates averaged 4.4 organisms retained and 2.5 released or discarded per gillnet set.

More than 70 taxa were caught by gillnets, including a diverse range of scalefish, sharks, rays, squid and crustaceans. Bastard trumpeter, blue warehou and wrasse dominated catches, collectively accounting for 45% of total numbers. In descending order, other species of significance included Atlantic salmon, leatherjackets, various species of sharks and marblefish. Bastard trumpeter and blue warehou together represented 45% of the total retained catch, Atlantic salmon contributed a further 10%, with Australian salmon, jackass morwong, mullet and wrasse of secondary importance. Wrasse dominated the released/discarded (by-catch) component of the catch (26%), with marblefish, various species of sharks, leatherjackets, bastard trumpeter and banded morwong accounting for a further 43% of the by-catch.

Recreational gillnet activity was focussed in the south-east, with the D'Entrecasteaux Channel and the south-east coast regions collectively accounting for around half of the

state-wide catch and effort. Catch and effort levels were comparable (around 20%) between the east and west coast regions while the north coast accounted for around 10% of the gillnet activity.

Bastard trumpeter featured prominently in catches taken from all regions apart from the north coast whereas blue warehou was more restricted, being a dominant component of catches from the D'Entrecasteaux Channel, south-east and east coast regions. Wrasse represented a significant by-catch in all regions while Atlantic salmon were restricted to the west coast (almost exclusively in Macquarie Harbour) and the D'Entrecasteaux Channel, areas of significant salmonid aquaculture activity. Australian salmon and mullet dominated gillnet catches from the north coast, reflecting the comparatively high levels of mullet net usage in that region.

In terms of catch weights, bastard trumpeter and blue warehou dominated, each accounting for around 30 tonnes in 2010. By comparison with commercial production, the recreational catch of bastard trumpeter was about three times greater than the commercial take whereas blue warehou catches were similar between sectors. Other species for which the 2010 recreational gillnet catch was significant when compared with the commercial catch included mullet, jackass morwong, leatherjacket and cod. Recreational gillnets also represent an important source of fishing pressure on escapee salmonids, playing a role in removing what are in effect introduced species.

*Fishing practices*

The peak time of day for setting gillnets was between about 07:00-09:00, with three-quarters of all nets set before midday. Conversely, over two-thirds of all nets were hauled during the afternoon. The median soak time was 3.5 hours, with 12% of day-set soak times being less than 2 hours and 78% less than 6 hours. Soak times exceeding 11 hours for daytime sets accounted for 1% of the total effort. Overnight sets, which accounted for 8% of the total effort, were typically fished for periods of over 10 hours.

Almost 30% of the graball net effort was reported as not directed towards any particular species. Bastard trumpeter and blue warehou were the most commonly cited target species with salmonids, mainly Atlantic salmon, of secondary importance as a target species for graball nets. By contrast, mullet nets were primarily used to target mullet, with only a small proportion of non-targeted effort.

*Comparison with previous surveys*

Several surveys have been conducted since 1995 and provide information on recreational gillnetting, encompassing a period of significant management change in relation to gillnetting practices. For instance, the prohibition on night netting in most areas implemented in late 2004 appears to have had a significant and dual impact on netting effort, not only has the ban achieved a marked reduction in the proportion of night sets (from 75% in 1997 to 8% in 2010) but there has been a concomitant and substantial reduction in recreational netting effort overall. For instance, recreational gillnet effort (based on net sets) in 2010 was about 60% of the level in 1997, this has occurred despite 40% more gillnet licence-holders in 2010.

Linked to the decline in effort in recent years has been a more than halving of the retained catch, this decline being accentuated by a fall in catch rates, from an average over 6 fish retained per net set in 1997 to just over 4 fish per set throughout the past decade. While variability in the abundance of target species has contributed to this trend (especially blue warehou), changes in fishing practices (no night netting, shorter average set durations, reduction in the length of mullet nets, larger minimum size limits for some species influencing release/discarding rates, etc) have also been contributing factors.

Several characteristics of the recreational gillnet fishery have, however, remained consistent through time, including the relative distribution of effort around the state, the relativity between graball and mullet net effort, and the overall composition of the catch. Gillnet effort has been typically concentrated off the south-east of the state, including the D'Entrecasteaux Channel, followed by the east and west coast regions in importance. While the north coast has consistently attracted the lowest gillnet effort, the region represents the most important area of mullet net usage. Historically, bastard trumpeter and blue warehou have been the main species targeted and caught by graball whereas mullet is the main species targeted using mullet nets. Flounder, on the other hand, have tended to decline in importance as a gillnet species since the late 1990s, partly influenced by the ban on night netting. The other conspicuous change through time has been the increased importance of Atlantic salmon escapees as a target species for recreational gillnetters, reflecting the growth of the salmon farming industry in Tasmania.

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# 1 INTRODUCTION

## 1.1 Background

Recreational as well as commercial fishers are permitted to use gillnets in Tasmania. The gear is used to target a diverse range of finfish in a variety of habitats, including inshore reefs and sheltered coastal waters. The main scalefish species taken include banded morwong, blue warehou, bastard trumpeter, wrasse, flounder, Australian salmon, mullet, and escapee salmonids. In addition, school and gummy shark, along with several other elasmobranch species, are occasionally captured, though there is a specialised commercial fishery for shark employing large mesh gillnets and managed by the Commonwealth (Southern and Eastern Scalefish and Shark Fishery).

The Tasmanian gillnet fishery is comprised of several sub-fisheries defined by gear characteristics (mesh size, mesh gauge, hanging ratios, etc), fishing practices (set duration, orientation of nets, etc), habitat fished and target species. Excluding shark nets, there are three classes of gillnet that are distinguished by mesh size, viz. 'graball' (105-140 mm), 'small mesh' (75 – 100 mm) and 'mullet' (60-70 mm) nets. Commercial operators are permitted to use graball and small mesh nets whereas recreational fishers have access to graball and mullet nets.

A major management review undertaken in 1998 resulted in the establishment of three categories of commercial scalefish licence, each with limits on the quantity of graball net that can be used; namely 1000 m for scalefish A, 500 m for scalefish B, and 150 m for scalefish C licences. Holders of commercial rock lobster licences are also entitled to use up to 150 m graball net. There are currently around 320 scalefish and over 200 rock lobster licence packages endorsed to use gillnets in Tasmania. In addition, there are 10 small mesh net entitlements which are restricted to the north coast of Tasmania. Since the mid 1990s there has been a marked reduction in commercial gillnet production, down from around 400 to 150 tonnes per annum by 2009/10, coupled with a more than halving of effort, down from over 5722 fisher-days to around 2100 fisher-days (Hartmann and Lyle 2011). Management changes, changing market preferences as well as reduced availability of some key species (e.g. blue warehou) have contributed to these declines.

## 1.2 Recreational licensing

Recreational gillnetting has had a long history in Tasmania with bastard trumpeter representing a major target species since European settlement (Harries and Lake 1985; Harries and Croome 1989). Historical information on recreational gillnetting is limited, the earliest reliable information being provided by an Australian Bureau of Statistics (ABS) survey in 1983 which estimated that about 7% of Tasmanian households (excluding those occupied by commercial fishers) owned a graball net and that nearly 15,000 persons used a graball net at least once a year, 30% of whom used the nets at least once a month (ABS 1984).

Recreational gillnet licences were first introduced in 1995, with licences issued annually and valid for the period 1st November to the following 31st October. Initially individuals could licence and use up to two 50 m graball nets and one 50 m mullet net,

however, since November 2002 the number of graball nets permitted per licence-holder has been reduced to one and the maximum length of mullet nets reduced to 25 m.

Gillnet licence numbers rose steadily from around 8,900 in 1995/96 to over 11,000 in 1999/2000 and then fell to around 8,000 in 2003/04, partly in response to the removal of the second graball net entitlement (Fig. 1). Licence numbers then increased progressively to just over 10,000 by 2007/08 and 2008/09, but have subsequently declined to just over 9,000 in 2010/11. However, as indicated by the number of 'Graball 1' licences, the number of persons holding gillnet licences actually increased up until 2007/08. Overall, mullet net licence numbers have increased only marginally through time, accounting for 7-10% of the gillnet licences issued each year.

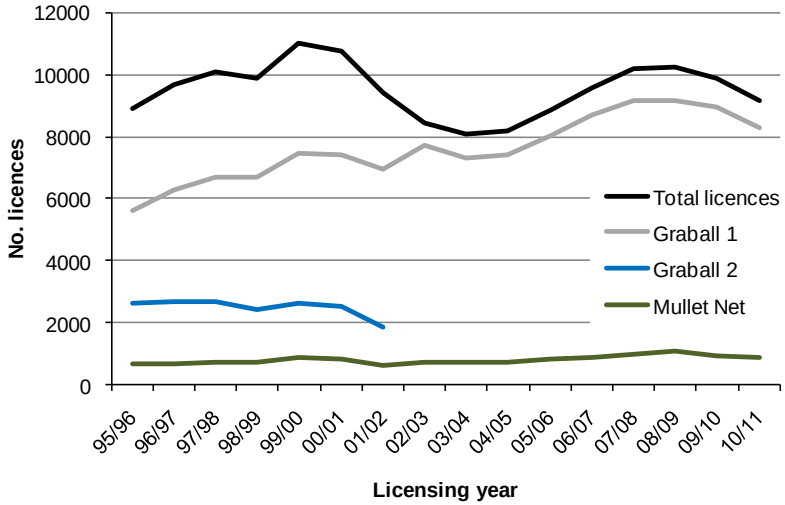


**Fig. 1** Number of recreational gillnet licences issued since 1995/96 by licence type and licensing year.

The licensing database provides some basic demographic information about licence holders, including age and residence. The average age of gillnet licence-holders in 2010 was 47 years, with a median age of 49 years, and over one third of licence-holders were aged between 45 and 59 years of age (Fig. 2). By contrast with the general fishing population of Tasmania (Lyle *et al*. 2009, Fig. 2), there were disproportionately more gillnet licence holders in the 45 years and older age groups and disproportionately fewer in the less than 30 year age groups. Not unexpectedly and in contrast to the general fisher population, children (<15 years) were not well represented amongst persons with gillnet licences.

Based on residence, defined using ABS Statistical Sub-Divisions (SSD), gillnet licence-holders are concentrated in the Greater Hobart (43% of licence-holders) and the surrounding Southern (20%) SSDs (Fig. 3). The Burnie-Devonport SSD in the north accounted for 12% of licence-holders, with the remaining regions of relatively minor importance in terms of licence numbers. Although area of residence does not necessarily define areas fished, the heavy concentration of licence-holders in the south-east is likely to be an important factor in determining the distribution of gillnet effort around the state.

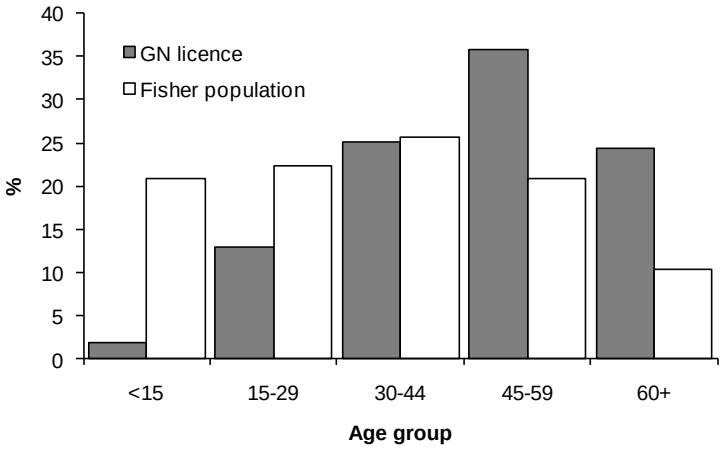


**Fig. 2** Demographic profile (%) of recreational gillnet licence-holders (2009/10 licensing year) and resident Tasmanian recreational fishers (during 2007 - Lyle *et al*. 2009) by age group.

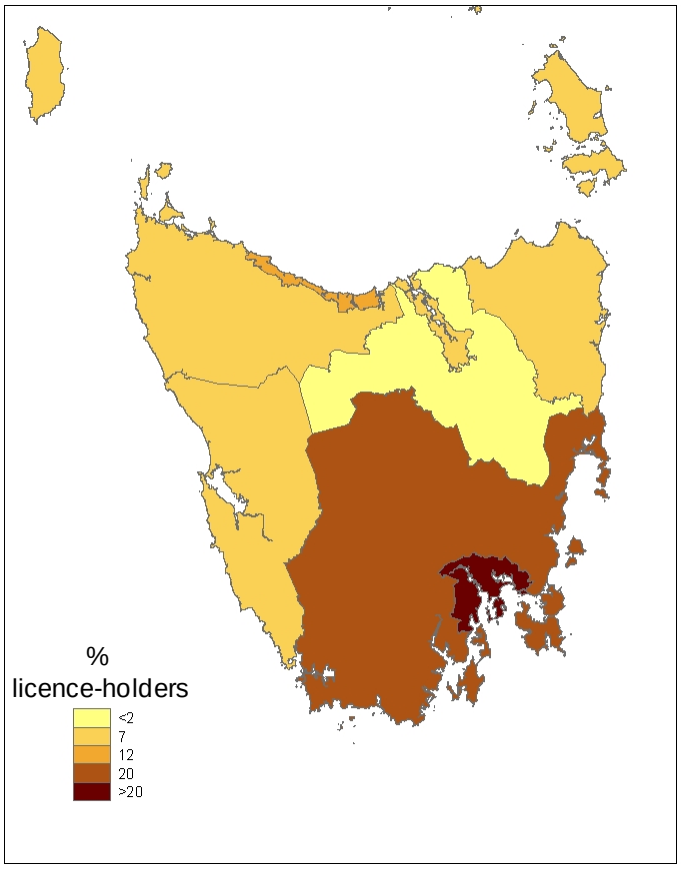


**Fig. 3** Map showing the relative numbers of recreational gillnet licence-holders by area of residence (ABS Statistical Sub-division) and based on the 2009/10 licensing year. A further 1.5% of licence-holders reside interstate.

## 1.3 Management of recreational gillnetting

Over the past decade there have been a number of major management changes in relation to gillnet usage, largely designed to improve fishing practices and reduce wastage and impacts on non-target species. From November 1998 recreational gillnets

were required to be marked as day or night sets to address the common practice of leaving gillnets unattended for excessively long periods (> 12 h). Overnight netting was prohibited in all regions apart from Macquarie Harbour on the west coast in November 2004; current regulations specify that recreational gillnets must not be set between one hour after sunset and one hour before sunrise. Although night netting was a common and popular practice amongst recreational fishers (Lyle and Smith 1998; Lyle 2000), it is significant that the ban has had little discernable impact on licence numbers (Fig. 1).

A key element of the most recent review of the Scalefish Fishery Management Plan was the introduction of maximum soak times for gillnets, a measure specifically intended to improve fishing practices (DPIW 2009). The new arrangements took effect in November 2009 and specify that recreational gillnets may only be set for a maximum of two hours in Shark Refuge Areas or a maximum of six hours in all other waters apart from Macquarie Harbour[1]. It is unclear whether these more restrictive regulations have contributed to the slight reduction in licence numbers observed since their introduction (refer Fig. 1).

## 1.4 Need for information and study objectives

In addition to management changes, there have been conspicuous declines in the abundance of several key gillnet species as well as increasing community concern about the potential impacts of gillnetting, both recreational and commercial, on target and non-target species. There is, therefore, an urgent need to better understand how recent management initiatives have influenced netting practices, and to objectively assess the impact of the method on target and non-target species.

The only comprehensive assessment of the recreational gillnet fishery was undertaken in the late 1990s (Lyle 2000), prior to the implementation of management changes relating to night netting. At the time recreational gillnet catches were similar to or higher than commercial catches for several key species, including blue warehou, bastard trumpeter, striped trumpeter, silver trevally, leatherjacket, and mullet (Lyle 2000). More recent information to assess the effectiveness of management changes in terms of reducing by-catch and potential wastage is limited. The 2000/01 National Recreational Fishing Survey (Lyle 2005) and 2007/08 state-wide fishing survey (Lyle *et al*. 2009) provide some information on recreational netting but only in the context of the general recreational fishery. As gillnetting is a specialist activity, more directed studies are required to provide the level of data resolution sufficient to assess changes in fishing practices and implications for target species and by-catch.

Declines in commercial catches of several key gillnet species, notably blue warehou and bastard trumpeter, since the mid-1990s imply declining abundances which may be linked to fishing (Hartmann and Lyle 2011). There have also been credible reports that in some sheltered waters, including Shark Refuge Areas, recreational nets are

[1] Soak time regulations were also introduced for commercial fishers, with a maximum soak time of six hours in all state waters, exceptions being fishers endorsed to take scalefish in Macquarie Harbour and those endorsed for unattended night netting.

increasingly being used to target escapee salmonids (mainly Atlantic salmon), with effort increasing sharply after major escape events.

Community concerns in relation to gillnetting have been particularly evident in the debate surrounding the introduction of marine protected areas. The Resource Planning and Development Commission (RPDC) noted that gillnetting presented a considerable risk to reef fishes, being capable of indiscriminate catches of a wide range of species, and concluded that gillnetting should be prohibited from all marine protected areas (RPDC 2008). In late 2008 the Minister for Fisheries announced the creation of 14 marine protected areas in south-eastern Tasmania (Bruny Bioregion). The Minister noted that while fishing would be permitted in most MPAs, the objective of maintaining healthy ecosystems and biodiversity would be achieved through sustainable fishing rules. In this respect, understanding the impacts of gillnets on shallow reef fish communities in particular, represents a high priority for the Government.

The present study was developed against this background with two main objectives, the first focuses on assessing recreational gillnet participation, effort, catch rates, and catch composition, and the second is to describe current gillnet fishing practices in the context of recent management changes and varying species availability. The study will assist in evaluating outcomes of management changes and provide information that will assist in considering the future directions noted in the Report to the Minister on the 2009 Scalefish Fishery Review. In particular the findings will assist in providing information in terms of net usage, motivations, target species, by-catch and wildlife interactions that can be used in developing future policy for the appropriate use of gillnets. A review of the Scalefish Fish Management Plan is due in 2013/14 for implementation by November 2014.

# 2 METHODS

## 2.1 Survey design

An off-site survey instrument using the methodology successfully applied in previous surveys of recreational fishing in Tasmania was implemented. The survey involved a two-stage process; an initial telephone interview to establish eligibility and collect profiling information; and follow-up telephone-diary survey in which gillnet fishing activity was monitored in detail over a twelve month period.

### 2.1.1 Survey sample

The primary sample was selected from the 2008/09 recreational licensing database administered by the Department of Primary Industries, Parks, Water and Environment, and was supplemented with licence-holders from the 2009/10 database who did not hold a gillnet licence during 2008/09. While the majority of licence holders are Tasmanian residents, a small number of interstate and overseas residents also take out licences. Commercial fishers are eligible to hold recreational licences, although restrictions controlling recreational gear and its use on commercial fishing trips apply.

All persons with graball and/or mullet net licences were included in the 'population' of licence-holders and the database was divided into five regional strata. For Tasmanian residents, regions corresponded to ABS statistical divisions (SDs), namely Greater Hobart, Southern, Northern and Mersey-Lyell. Interstate residents were grouped into a fifth 'Interstate' stratum. A random sample based on a constant sampling fraction was applied to each of the strata with the exception of Mersey-Lyell, where a higher sampling intensity was applied (approximately 50% greater than for the other strata). The higher sampling rate for Mersey-Lyell was intended to improve precision for estimates of fishing activities off the north and west coasts. For analytical purposes, data were treated as if they were derived from two strata, namely 'Mersey-Lyell' and 'Elsewhere'. By undertaking the initial regional stratification within the Elsewhere stratum, it was possible to achieve a sample that properly reflected the relative numbers of licence-holders based on their area of residence.

### 2.1.2 Screening survey

Respondents were contacted by telephone during November and December 2009 and asked how many days they had fished with gillnets during the previous 12 months and, if appropriate, what were the main species targeted and caught during that period. Respondents who had not already taken out a gillnet licence for the 2009/10 licensing year (November 2009-October 2010) were asked about their likelihood to renew their graball and/or mullet net licences. Sampling was conducted without replacement, i.e. persons without a telephone listing or those who did not respond were not substituted in the sample.

### 2.1.3 Telephone-diary survey

Respondents who were licensed at screening or indicated an intention to renew their gillnet licence(s) for the 2009/10 licensing year were invited to participate in the diary survey which covered the period 1 January to 31 December 2010. Being based on a calendar year this meant that, in practice, the survey covered ten months of the 2009/10 licensing year (January-October) and two months of the 2010/11 licensing year (November-December).

Those who agreed to participate were mailed a simple fishing diary and letter of introduction. Diarists were contacted by telephone shortly afterwards to confirm receipt of the diary and to have reporting requirements explained. Diarists were then contacted regularly by telephone throughout the diary period by survey interviewers who recorded details of any graball and/or mullet net fishing activity since last contact. The frequency of the contact was tailored to the needs and behaviour (level of fishing activity) of individual respondents and thus detailed information was routinely collected soon after each fishing event, minimising problems of recall bias for any non-diarised data. By maintaining regular contact, interviewers were also able to immediately clarify any misunderstandings or inconsistencies at the time of the interview, thereby ensuring overall data quality and completeness.

Most diarists were contacted at least once a month between January and December 2010, even if no fishing activity was planned. Information recorded for each gillnet activity or 'event' included the date, fishing location, net type used (graball or mullet net), number of nets fished (to cover group fishing), species targeted (up to two), start and finish times (including any significant breaks from fishing), number of times the net was checked/hauled within this period, and catch composition by numbers kept (harvested) and numbers released or discarded (i.e. by-catch). The reason or reasons for release/discarding was recorded by species and for each fishing event. Fishing locations were allocated into one of 16 coastal regions (Fig. 4), however, for reporting it was necessary to aggregate some regions to ensure that there was a minimum of 160 fishing events within each reporting region. Five major regions were defined for spatial reporting of fishing activity; D'Entrecasteaux Channel (DEC), South-east, East, North and West coasts (Fig. 4).

By definition, a fishing event was described in terms of method (graball or mullet net), target species and fishing region. If more than one method was used or different regions were fished on a given day, separate events were recorded. For example, two separate events were recorded if a respondent used a graball net and mullet net on the same day, with catch and effort information linked separately to each net type.

In the case of overnight sets, start time was taken as the time the net was set or the last time it was checked on the previous day, and the end time was generally recorded as the earliest time the net was checked on the following day.

As recreational gillnet fishers are permitted one graball and/or one mullet net, catches have been standardised to numbers of fish per net to cover situations where multiple nets were used (i.e. fishing with other licensed gillnet fishers).

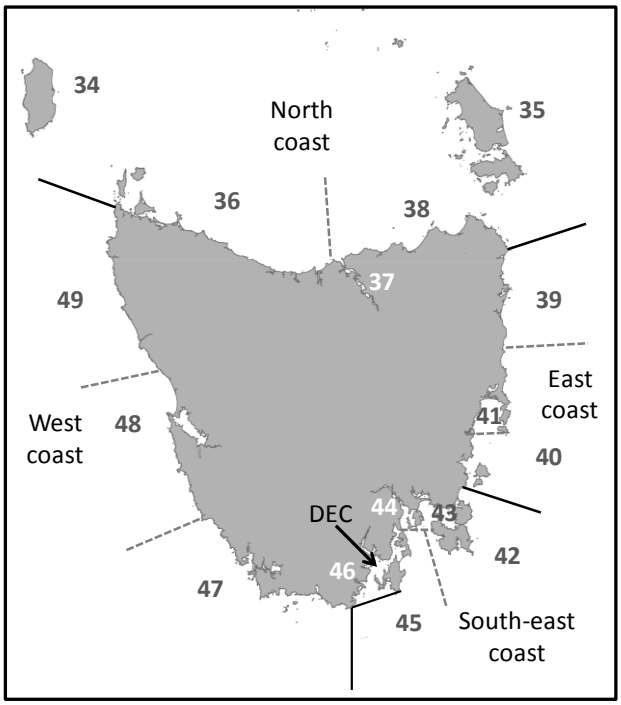


**Fig. 4.** Map of Tasmania showing fishing regions. Solid lines indicate boundaries for reporting regions, dashed grey lines and numbers indicate regions at which event data was originally collected.

## 2.2 Data analysis

### 2.2.1 Catch and effort

The licensing status (licence types and dates of issue) was established for all diarists by reference to the 2009/10 licence database (covering the period January to October 2010) and the 2010/11 licence database (November to December 2010) and expansion factors calculated as the size of the licensed population divided by the number of licensed diarists within each stratum. However, since the number of fishers licensed increases progressively during the season, the sample (i.e. number of *licensed diarists*) and total number of licensed fishers (i.e. *licensed population*) changed throughout the enumeration period. In order to account for this dynamic, the number of licence holders registered and the number of licensed diarists at the end of each month provided the basis for calculating expansion factors that were applied to fishing activity for the given month.

The survey scope was confined to licensed recreational gillnet fishing activities; namely, the use of graball and mullet nets. Any gillnet activity reported by diarists whilst unlicensed (either prior to renewing a licence or by diarists who did not renew licences) was considered out of scope and thus excluded from all analyses. The base unit for catch and effort analysis was the total monthly effort and catch for each licensed respondent and this was expanded by the relevant monthly expansion factor.

The 'bootstrap' sampling method was used to estimate harvest and effort confidence limits, determined using the percentile method (Haddon 2001). In each instance 1000 simulations were conducted.

# 3 RESULTS

## 3.1 Response rates

### 3.1.1 Screening survey

From a random sample of 1077 licence-holders selected from the 2008/09 or 2009/10 licence databases, 139 (12.9%) either had no telephone listing or the reported phone number was disconnected or incorrect. This represented sample loss and reduced the effective sample to 938. Contact was made with 874 respondents, of whom 837 fully responded, representing a screening survey response rate of 89%. Non-contacts (despite multiple attempts by telephone over a period of several weeks) accounted for 7% of the sample and refusals a further 4% (Fig. 5).

Amongst the respondents, 91 indicated that they were not likely to renew their gillnet licence(s) during 2010 and hence were not eligible for inclusion in the diary survey[2]. The balance (746) indicated they were likely to renew their licence(s) or already had a gillnet licence for 2010, out of which 645 (87%) agreed to participate in the diary survey (Fig. 5).

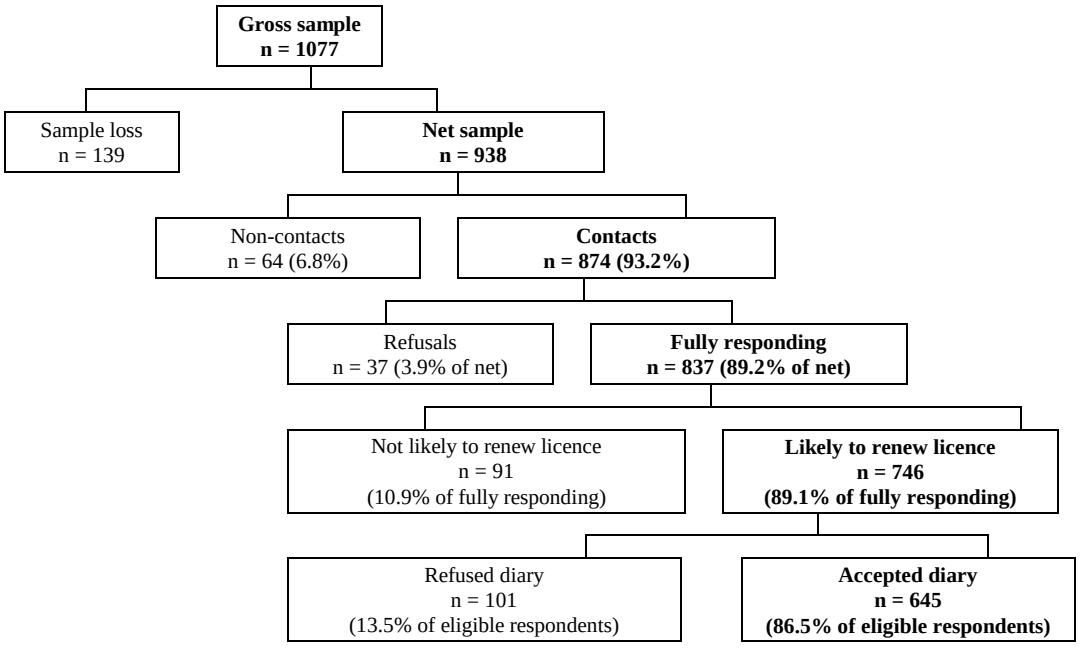


**Fig. 5**. Diagrammatic representation of the screening survey response profile (n is sample size).

[2] The licence status of these respondents was checked during the 2010 season and 30 'unexpected' renewals (33%) were identified.

### 3.1.2 Telephone-diary survey

Diary response was high, with 610 diarists or 95% of respondents who accepted the diary participating for the entire survey period (Fig. 6). Based on the total number of eligible respondents identified at screening (746), the effective response rate for the diary survey was 82%.

Of the responding diarists, 6% (37) did not take up a gillnet licence during 2010, despite rating themselves as 'quite likely' to 'very likely' to do so, resulting in and effective sample of 573 gillnet licence-holders who participated in the survey. Given the high response rates, possible biases arising from non-response were not considered to be a significant problem in this study and analyses do not incorporate non-response adjustments.

Data for the diarists who partially responded (i.e. declined to participate for the full period or with whom contact was lost) was excluded from all analyses.

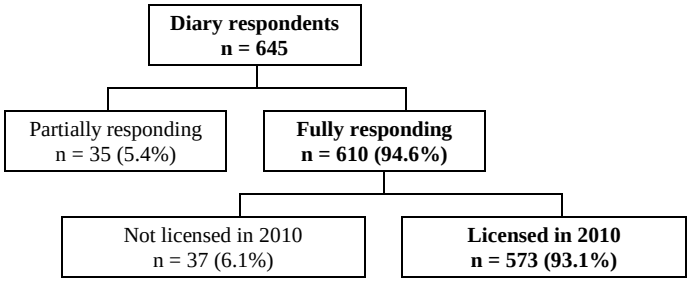


**Fig. 6** Diagrammatic representation of the diary survey response profile (n is sample size).

The numbers of graball and mullet net licences in the licensed population and the sample of responding diarists are presented in Table 1. Overall about one in 16 gillnet licence holders participated in the survey, noting that some respondents were only licensed in one of the two licence years. The slightly higher representation of mullet net licence holders was a consequence of the regional stratification that was applied when sampling from the licensed population. Specifically, licence holders from the Mersey-Lyell region were sampled at a higher rate (about 1 in 12 licence holders) compared with elsewhere (about 1 in 18) and had the highest proportion of mullet net registrations amongst gillnet licence holders[3].

Fully responding diarists reported a total of 1629 fishing events during the survey period, 1610 (~99%) of which were valid events[4].

[3] Overall about 14% of gillnet licence holders residing in the Mersey-Lyell region held a mullet net licence (often along with a graball licence) compared 9% of gillnet licence holders residing in other areas.
[4] Events reported by diarists whilst unlicensed were considered out of scope and invalid.

**Table 1 Total number of gillnet licence holders by licence year and sampled period, numbers sampled (fully responding) and sample fraction by licence type.**

| Licence type | Licence holders | Diarists | % sampled |
|---|---|---|---|
| **2009/10 licence year: Jan – Oct 2010** | | | |
| Graball | 8,956 | 560 | 6.3 |
| Mullet net | 922 | 67 | 7.3 |
| Total persons | 9,109 | 556 | 6.1 |
| **2010/11 licence year: Nov – Dec 2010** | | | |
| Graball | 7,411 | 437 | 5.9 |
| Mullet net | 805 | 53 | 6.6 |
| Total persons | 7,527 | 441 | 5.9 |

## 3.2 Screening survey

### 3.2.1 2008/09 licence year

The screening survey provided some basic information about the gillnet fishery as it related to the 2008/09 licence year. During 2008/09 an estimated 71.6% (SE ±1.5%) of the 9,321 registered recreational gillnet licence holders (i.e. 6,670 ± 144) fished with gillnets at least once during the year. Based on activity levels (days fished) recalled for the previous 12 months, over half of the active fishers (3,415 ± 155) reported gillnetting for five or fewer days and less than 5% (427 ± 68) reported more that 20 days gillnet fishing.

Amongst those respondents who reported using gillnets in the 12 months prior to the screening survey, almost half reported that either bastard trumpeter or blue warehou were their main target species, and a further 18% identified salmonids (predominantly escapee Atlantic salmon) as their main target species (Table 2). In terms of catch (regardless of target species), 28% of respondents identified bastard trumpeter, 17% salmonids and 15% blue warehou as the main species caught with gillnets (Table 2). Non-targeted species such as wrasse, leatherjackets, sharks and rays also featured amongst the main catch groups, highlighting the issue of by-catch in recreational netting.

Although subject to recall bias, the screening survey has identified several important factors about the fishery: first, a relatively large proportion of the registered gillnet licence-holders either do not gillnet or only use gillnets infrequently each year; and second, that bastard trumpeter, blue warehou and Atlantic salmon are the dominant species targeted and caught by gillnets. The issue of by-catch was also evident, with a number of non-target species reported as the main species captured.

**Table 2 Main target species and main catch for gillnets based on screening interview responses for those respondents who reported fishing with gillnets in the 12 months prior to November 2009.**

No. of respondents = 580.

| Species | Main target | % respondents | Main catch | % respondents |
|---|---|---|---|---|
| Bastard trumpeter | 142 | 24.5 | 161 | 27.8 |
| Blue warehou | 142 | 24.5 | 89 | 15.3 |
| Salmonids | 106 | 18.3 | 100 | 17.2 |
| Australian salmon | 27 | 4.7 | 30 | 5.2 |
| Other scalefish | 11 | 1.9 | 17 | 2.9 |
| Mullet | 10 | 1.7 | 18 | 3.1 |
| Flounder | 9 | 1.6 | 14 | 2.4 |
| Jackass morwong | 7 | 1.2 | 15 | 2.6 |
| Flathead | 6 | 1.0 | 10 | 1.7 |
| Striped trumpeter | 4 | 0.7 | 6 | 1.0 |
| Banded morwong | 2 | 0.3 | 5 | 0.9 |
| Shark/ray | 1 | 0.2 | 13 | 2.2 |
| Wrasse | - | - | 27 | 4.7 |
| leatherjacket | - | - | 18 | 3.1 |
| Cod | - | - | 6 | 1.0 |
| Boarfish | - | - | 5 | 0.9 |
| Gurnard | - | - | 4 | 0.7 |
| No specific target/catch | 113 | 19.5 | 42 | 7.2 |

## 3.3 Diary survey

Information reported in this section relates to analyses of diary data provided by fully responding licence holders, and is presented as expanded estimates to represent the activity of all recreational gillnet licence holders during 2010.

Not all licensed diarists reported gillnet fishing during the survey period; when expanded to represent all persons holding a gillnet licence sometime during 2010 (i.e. 10,271 persons) the data suggested that 64.3% (SE ±2.0%) used gillnets at least once during the year. Although a slightly lower proportion than indicated for 2008/09, comparisons are complicated because the latter is based on estimates derived from two partial seasons (January – October for 2009/10 and November – December for 2010/11). However, when expressed as the number of licensed persons who gillnetted at least once during 2010 the estimated number was almost identical to that for 2008/09 (6,604± 205 in 2010 compared with 6,670 ± 144 in 2008/09).

### 3.3.1 Catch and effort

Recreational gillnetters fished for a combined total of 25,720 net-days (95% confidence interval of 22,142 – 28,901) during 2010, catching an estimated 173,922 marine organisms (95% CI of 147,165 – 202,905), of which almost 65% were retained (harvested) (112,521; 95% CI of 93,026-133,486) and the remainder released or discarded (61,401; 95% CI of 50,582-73,312). Graball nets accounted for 96.4% of the total catch and 94.8% of the retained catch numbers.

A small proportion (1.5%) of the effort involved days on which both graball and mullet nets were used; the total estimated net set-days (counting two days if a graball and mullet net was used on a given day) was 26,088. Of this total, graball nets accounted for 96.7% and mullet nets just 3.3% of the effort.

Recreational gillnet effort exhibited marked seasonality, being most intense during January, falling to an intermediate level between February and April, such that the first four months accounted for almost 63% of the annual effort. Between May and October effort remained at a low level before rising to intermediate levels in November and December (Fig. 7).

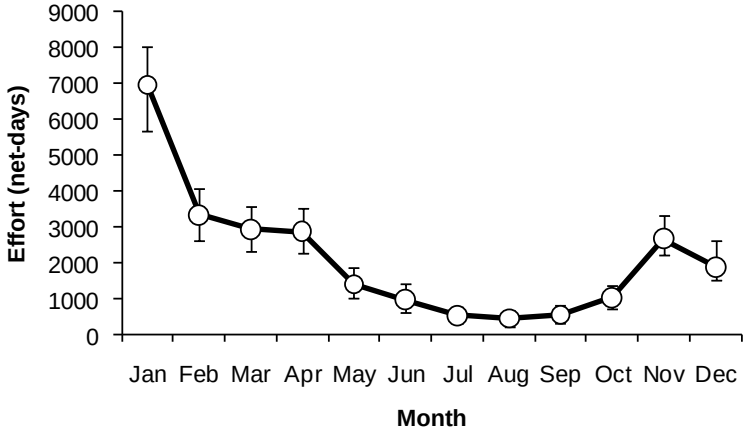


**Fig. 7** Recreational gillnet effort (number of net-days) by month during 2010. Error bars represent 95% confidence interval.

Overall, an average of 4.4 marine organisms were retained for each net set-day, with a further 2.5 organisms released or discarded. There was, however, considerable variability in individual catch rates, with almost 20% of all sets producing no catch and almost 35% of sets resulting in no retained catch (Fig. 8). There was a steady decline in the proportion of sets as catch numbers increased, with almost 80% of combined gillnet effort producing catches (kept plus released/discarded) of 10 or fewer organisms per set.

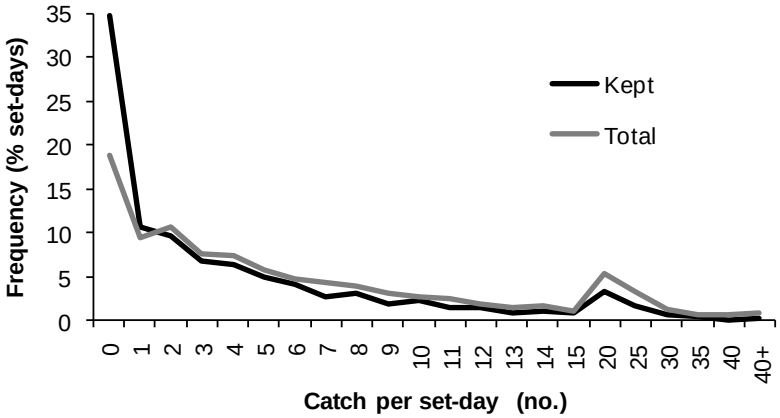


**Fig. 8** Catch per set distribution (% of total net set-days) based on kept and total (kept plus released/discarded) catch numbers for 2010. Catches >15 have been grouped into bins of 5 individuals.

### 3.3.2 Catch composition

*Total catch, retained and released/discarded components*

More than 70 taxa were reported by respondents, including a diverse range of teleosts (scalefish), chondrichthyan fishes (sharks and rays) and invertebrates, including cephalopods (squids) and crustaceans. A listing of taxa and groupings used for data reporting are provided in Appendix I.

Catch estimates by species or taxonomic group are provided in Table 3[5]. Bastard trumpeter, blue warehou and wrasse dominated catches, collectively accounting for 45% of total numbers. In descending order, other species of significance included Atlantic salmon, leatherjackets, various species of sharks and marblefish. Bastard trumpeter and blue warehou together represented 45% of the total retained catch, Atlantic salmon contributed a further 10%, with Australian salmon, jackass morwong, mullet and wrasse of secondary importance. Wrasse dominated the released/discarded (by-catch) component (26%) of the catch, with marblefish, various species of sharks, leatherjackets, bastard trumpeter and banded morwong accounting for a further 43% of the by-catch numbers.

Release/discarding rates varied depending upon species, ranging from species that were typically released or discarded to those that were mainly retained (Tables 3 and 4). High release/discarding rates (>70%) were reported for wrasse, banded morwong, gurnard, marblefish, sharks (other than gummy shark), and skates and rays. By contrast, low release rates (<10%) were reported for blue warehou, Atlantic salmon, Australian salmon, sweep and trout. Relatively low release rates (10-19%) were also evident for bastard trumpeter, mullet, jackass morwong, silver trevally, flathead and striped trumpeter. Species with intermediate rates of release or discarding (20-49%) included cod, jack mackerel, black bream, boarfish, gummy shark, leatherjacket, flounder and luderick.

[5] The fact that nil catches (kept or released) were reported by survey participants does not necessarily mean that the actual catch was nil, rather the result suggests that catches are likely to be small and/or rare.

**Table 3 Catch composition (numbers) and % released by recreational gillnetting during 2010.**
+ catch estimate < 500; - nil catch reported; values in parentheses represent 95% confidence limits

| Species | Kept (no.) | Rel/discard (no.) | Total catch (no.) | % released |
|---|---|---|---|---|
| Bastard trumpeter | 27,527 (21,517-34,155) | 4,795 (3,010-6,889) | 32,323 (25,424-39,829) | 14.8 |
| Blue warehou | 22,723 (16,514-29,780) | 2,236 (781-44,40) | 24,960 (18,258-32,526) | 9.0 |
| Wrasse | 4,671 (3,030-6,465) | 15,877 (11,697-20,560) | 20,548 (16,009-25,616) | 77.3 |
| Atlantic salmon | 10,932 (7,139-15,429) | 822 (228-1,782) | 11,754 (7,643-16,599) | 7.0 |
| Leatherjacket | 4,207 (2,779-5,911) | 5,511 (4,234-6,953) | 9,718 (7,612-12,267) | 56.7 |
| Australian salmon | 8,099 (5,555-11,336) | 691 (268-1,168) | 8,790 (6,082-12,050) | 7.9 |
| Other shark | 668 (284-1,105) | 6,026 (3,874-8,299) | 6,694 (4,442-8,948) | 90.0 |
| Marblefish | + | 6,049 (3,876-8,476) | 6,549 (4,138-9,492) | 92.4 |
| Mullet | 4,812 (1,922-9,406) | 881 (373-1,541) | 5,694 (2,485-10,298) | 15.5 |
| Jackass morwong | 5,024 (2,590-7,995) | 606 (245-1,170) | 5,630 (3,128-8,716) | 10.8 |
| Banded morwong | 1,082 (449-2,041) | 4,348 (2,559-6,577) | 5,430 (3,318-8,184) | 80.1 |
| Silver trevally | 4,215 (2,494-6,427) | 1,048 (265-2,192) | 5,264 (2,931-8,023) | 19.9 |
| Flounder | 2,049 (983-3,618) | 3,014 (1,431-5,236) | 5,064 (2,999-7,967) | 59.5 |
| Cod | 2,462 (1,353-3,765) | 1,250 (667-1,974) | 3,712 (2,344-5,281) | 33.7 |
| Gurnard | 931 (311-1,891) | 2,612 (1,335-4,361) | 3,544 (1,946-5,567) | 73.7 |
| Flathead | 2,856 (784-6,389) | + | 3,249 (978-7,118) | 12.1 |
| Other scalefish | 2,183 (1,228-3,171) | 955 (562-1,444) | 3,138 (2,055-4,302) | 30.4 |
| Jack mackerel | 1,954 (609-3,838) | 642 (17-1,844) | 2,596 (966-4,852) | 24.7 |
| Sweep | 1,439 (116-3,410) | + | 1,564 (137-3,713) | 8.0 |
| Black bream | 970 (205-1,990) | + | 1,414 (377-2,726) | 31.4 |
| Gummy shark | 616 (358-952) | 570 (362-1,035) | 1,186 (869-1,856) | 48.1 |
| Trout | 1,103 (608-1,768) | + | 1,136 (631-1,796) | 2.9 |
| Boarfish | 651 (353-976) | + | 1,086 (693-1,494) | 40.0 |
| Skates & rays | - | 1,066 (731-1431) | 1,066 (731-1,431) | 100.0 |
| Other taxa | + | 521 (231-923) | 657 (328-1,074) | 79.3 |
| Striped trumpeter | 536 (197-942) | + | 608 (229-1,073) | 11.9 |
| Luderick | + | + | 534 (0-1,613) | 69.2 |
| Total | 112,521 (93,026-133,486) | 61,401 (50,582-73,312) | 173,922 (147,165-202,950) | 35.5 |

**Table 4 Summary table indicating groupings based on the proportion of the catch for key species that was released or discarded from recreational gillnets during 2010.**

**Kept** → **Released**

| Proportion released/ discarded | | | | | |
|---|---|---|---|---|---|
| **< 10%** | **10 - 19%** | **20 - 49%** | **50 - 69%** | **70 - 89%** | **90%+** |
| Blue warehou | Bastard trumpeter | Cod | Leatherjacket | Wrasse | Marblefish |
| Atlantic salmon | Mullet | Jack mackerel | Flounder | Banded morwong | Other shark |
| Australian salmon | Jackass morwong | Black bream | Luderick | Gurnard | Skates & rays |
| Sweep | Silver trevally | Boarfish | | | |
| Trout | Flathead | Gummy shark | | | |
| | Striped trumpeter | | | | |

*Reasons for release or discarding*

The reasons why fish are released or discarded vary and include adherence to regulations (size and bag limits, closed seasons or protected species), ethical factors such as catch and release fishing, as well as due to damage or poor quality or perceived undesirability, often based on eating qualities. To better understand fisher motivations in relation to releasing or discarding species, respondents were asked to identify the reason(s) for release and the numbers of each species to which the reason applied. This information was reported for each event and sought to attribute a main reason for each individual fish. Based on terminology used by the respondent, the following release categories were identified: 'too small' - implying that the fish was too small to be retained (not necessarily due to size limits regulations); 'undersized' – implying some knowledge and adherence to size limit regulations; 'catch and release' – implying a voluntary release ethic[6] (no inference about fish size); 'too many' – implying a catch number in excess of needs; and 'over the limit' – implying knowledge and adherence to bag or possession limits. Other reasons for release included poor eating qualities, damaged or poor quality, and protected species.

The breakdown of reasons for release of the main species is presented in Fig. 9. Size (too small/undersized) was the primary reason for the release for bastard trumpeter, flathead and flounder. Species for which poor eating qualities were identified as an important reason for release included gurnard, cod, wrasse, marblefish, banded morwong, leatherjacket and boarfish. Although discard rates were low, damage to catch (mostly predator damage) was a relatively important reason for discarding Atlantic salmon, blue warehou, silver trevally and mullet as well as jackass morwong, bastard trumpeter and Australian salmon. Catches in excess to requirements (too many/over the limit) was also a relatively important reason cited for the release/discarding of blue warehou and silver trevally and to a lesser extent for mullet, Atlantic salmon and bastard trumpeter. Poor eating qualities were identified as reasons for discarding some shark and ray species (e.g. draughtboard shark, skates and rays) along with regulations prohibiting the retention, especially when caught in shark refuge areas (e.g. gummy shark).

[6] Catch and release is most often associated with 'sport or game' fishing but is not an aspiration particularly relevant to passive fishing methods such as gillnet fishing apart from being linked to a conservation ethic.

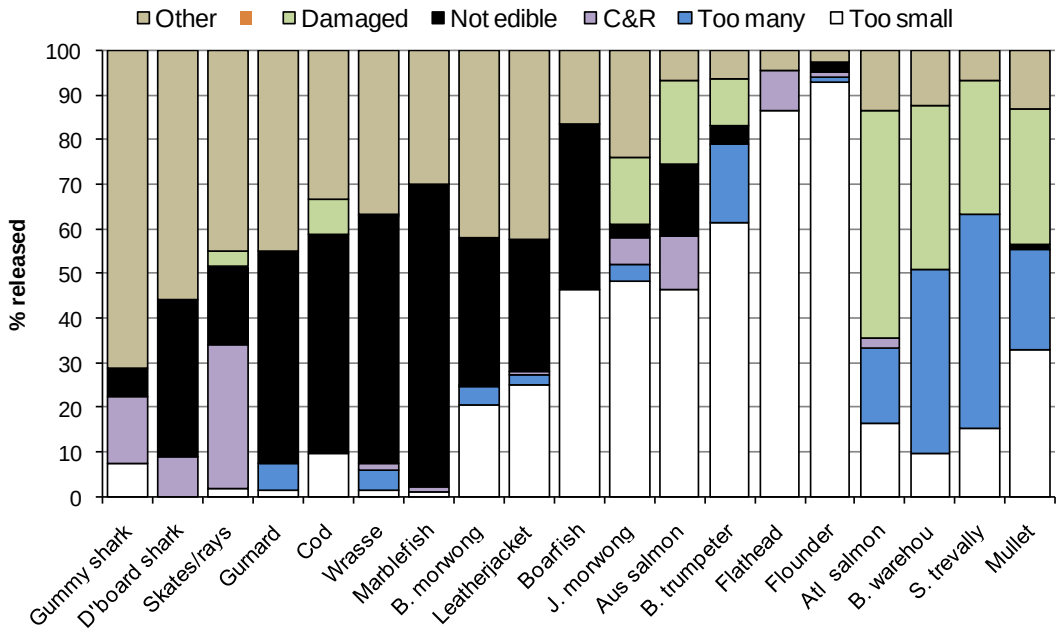


**Fig. 9** Relative importance (% total release/discard numbers) of reasons for release of key species taken by recreational gillnets during 2010.

*Catch composition by method*

Graball and mullet net catch compositions differed markedly (Figs. 10 & 11, Appendices II & III); bastard trumpeter, blue warehou, wrasse and Atlantic salmon were the main species taken by graball whereas mullet and Australian salmon dominated the mullet net catch.

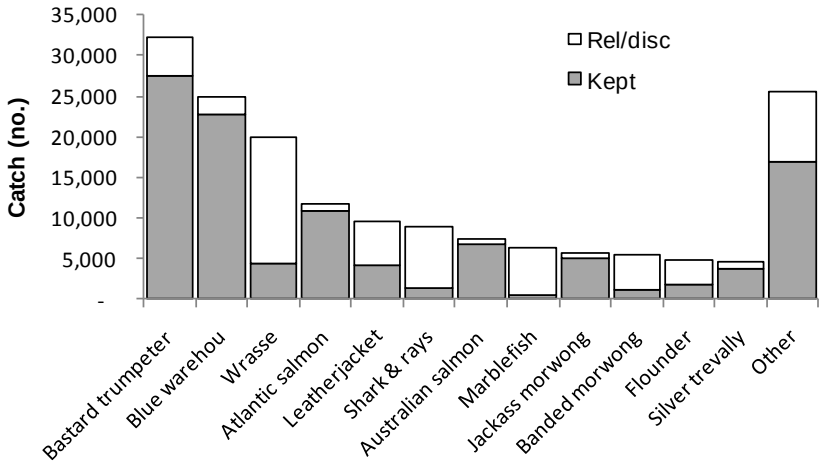


**Fig. 10** Catch estimates (numbers) for key species taken by recreational graball during 2010 showing kept and released/discarded components.

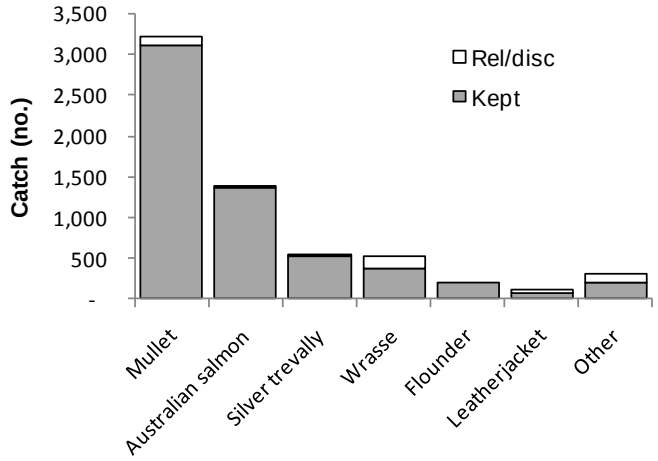


**Fig. 11** Catch estimates (numbers) for key species taken by recreational mullet nets during 2010 showing kept and released/discarded components.

### 3.3.3 Regional catch and effort

Regional catch and effort (refer Fig. 4) are summarised in Table 5 and Fig. 12. Recreational gillnet activity was focussed in the south-east, with the D'Entrecasteaux Channel and the south-east coast regions collectively accounting for around half of the state-wide catch and effort. Catch and effort levels were comparable (around 20%) between the east and west coast regions while the north coast accounted for around 10% of the gillnet activity. Although a relatively minor activity compared with graball usage, almost two thirds of the mullet net effort occurred off the north coast, with flow-on implications for the regional catch composition (refer below).

**Table 5. Recreational gillnet effort by method and by fishing area during 2010**
Values in parentheses represent the 95% confidence intervals, + value less than 100.

| | Effort (net days) | | Catch (number) | |
|---|---|---|---|---|
| Area | Graball | Mullet net | Kept | Released/discarded |
| DEC | 8,012 | - | 26,342 | 16,323 |
| | (5,922 – 10,399) | | (15,736 – 41,202) | (11,272 – 22,793) |
| SE Coast | 7,172 | + | 29,826 | 16,965 |
| | (5,758 – 8,777) | | (22,554 – 38,121) | (11,711 – 22,592) |
| E Coast | 4,144 | + | 21,620 | 14,017 |
| | (2,897 – 5,509) | | (13,996 – 30,259) | (9,091 – 19,729) |
| N Coast | 1,629 | 533 | 13,113 | 4,238 |
| | (1,063 – 2,307) | (146 – 1,067) | (6,674 – 20,847) | (2,151 – 6,716) |
| W Coast | 3,917 | + | 21,620 | 9,858 |
| | (3,001 – 5,067) | | (15,263 – 29,026) | (6,101 – 14,530) |

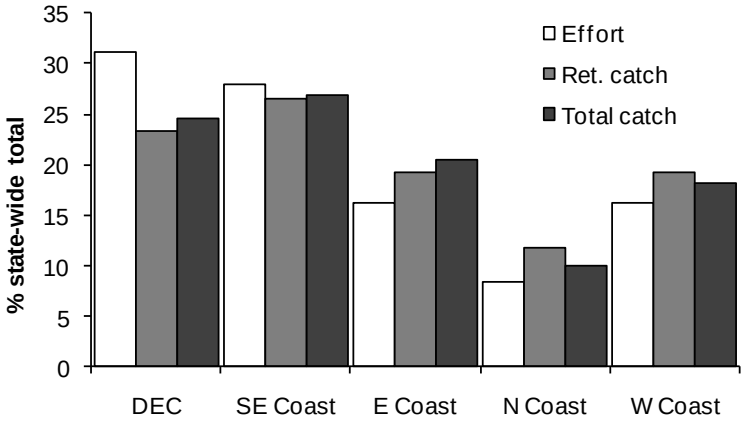


**Fig. 12** Regional gillnet effort and catch (retained and total) as a proportion of the 2010 state-wide totals.

Gillnet catch composition exhibited marked regional variability, reflecting a combination of spatial variability in species distribution and abundance, targeting practices and gear selectivity (specifically due to the two gillnet types used by recreational fishers). Catch details are provided in Appendices IV and V and summarised in Figs. 13 and 14.

Bastard trumpeter featured prominently in catches taken from all regions apart from the north coast whereas blue warehou was more restricted, being a dominant component of catches from the D'Entrecasteaux Channel, south-east and east coast regions (Fig. 13). Wrasse represented a significant by-catch (most were released or discarded) in all regions while Atlantic salmon were restricted to the west coast (almost exclusively in Macquarie Harbour) and the D'Entrecasteaux Channel, areas of significant salmonid aquaculture activity. Australian salmon and mullet dominated gillnet catches from the north coast, reflecting the comparatively high levels of mullet net usage in that region. Of the remaining species, the largest catches of flounder occurred in Macquarie Harbour (although the release rate was high) while jackass morwong and banded morwong were relatively important components of the east coast catches.

Catch data for individual species was also examined regionally, though it is recognised that regional variability in effort and targeting practices will influence catch levels (Fig. 14). Catches of wrasse were more or less evenly distributed between the coastal regions while silver trevally catch levels were similar in all regions apart from the west coast. The largest catches of bastard trumpeter, blue warehou and leatherjacket were taken from the south-east coast, with the two adjoining regions (D'Entrecasteaux Chanel and east coast) and, for bastard trumpeter the west coast, also relatively important. Marblefish were more or less equally distributed between the D'Entrecasteaux Channel, south-east and east coast regions with relatively low numbers taken from the west and north coasts. Catches of banded morwong and jackass morwong were particularly concentrated off the east coast whereas Australian salmon and mullet were greatest off the north coast. Atlantic salmon were restricted to the west coast and D'Entrecasteaux

Channel while the majority of the flounder taken by gillnet were from the west coast (specifically Macquarie Harbour) where night netting is still permitted[7].

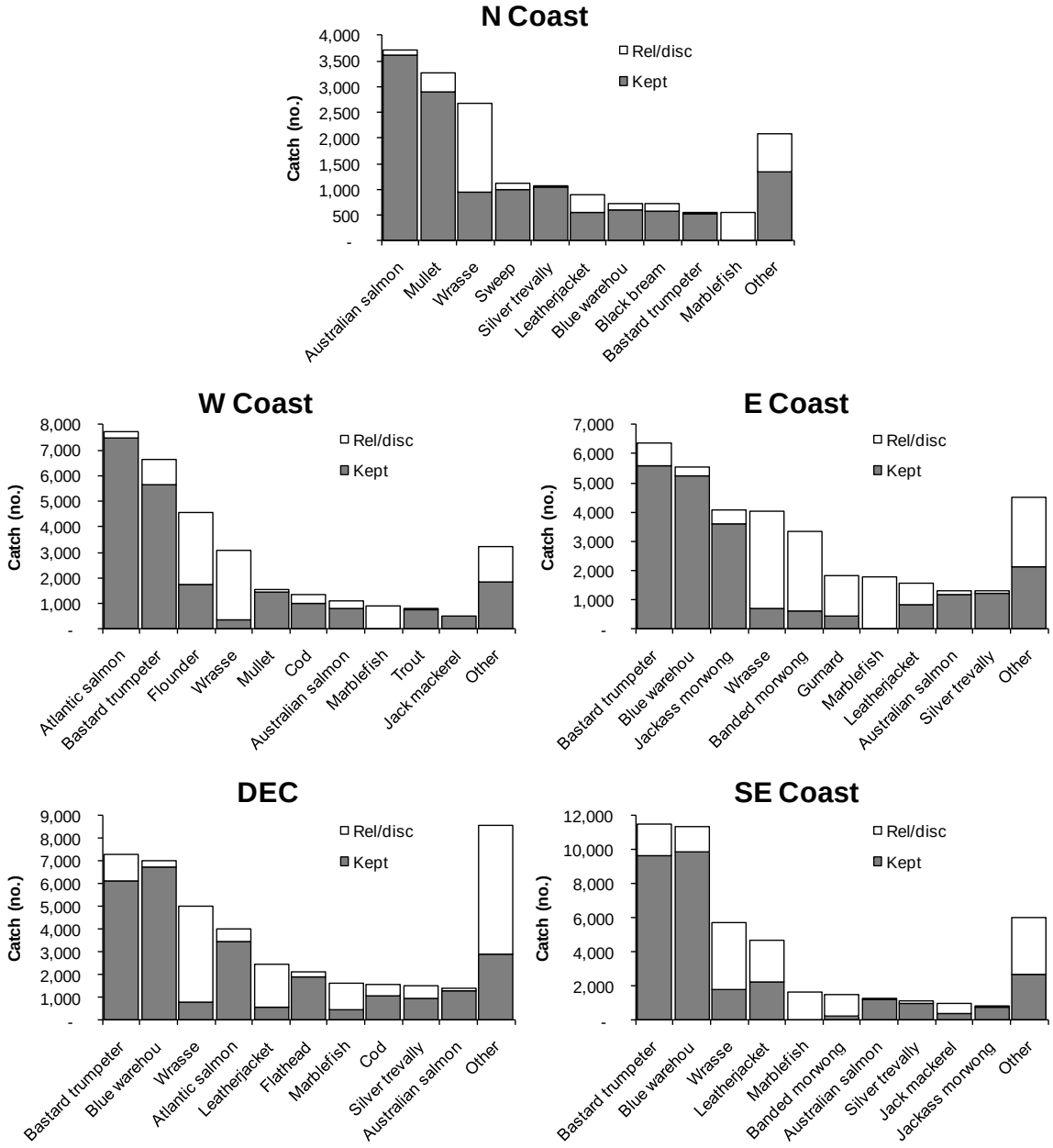


**Fig. 13** Recreational gillnet catches (numbers) by region for key species.

[7] Flounder are typically targeted with large mesh graballs that are fished overnight.

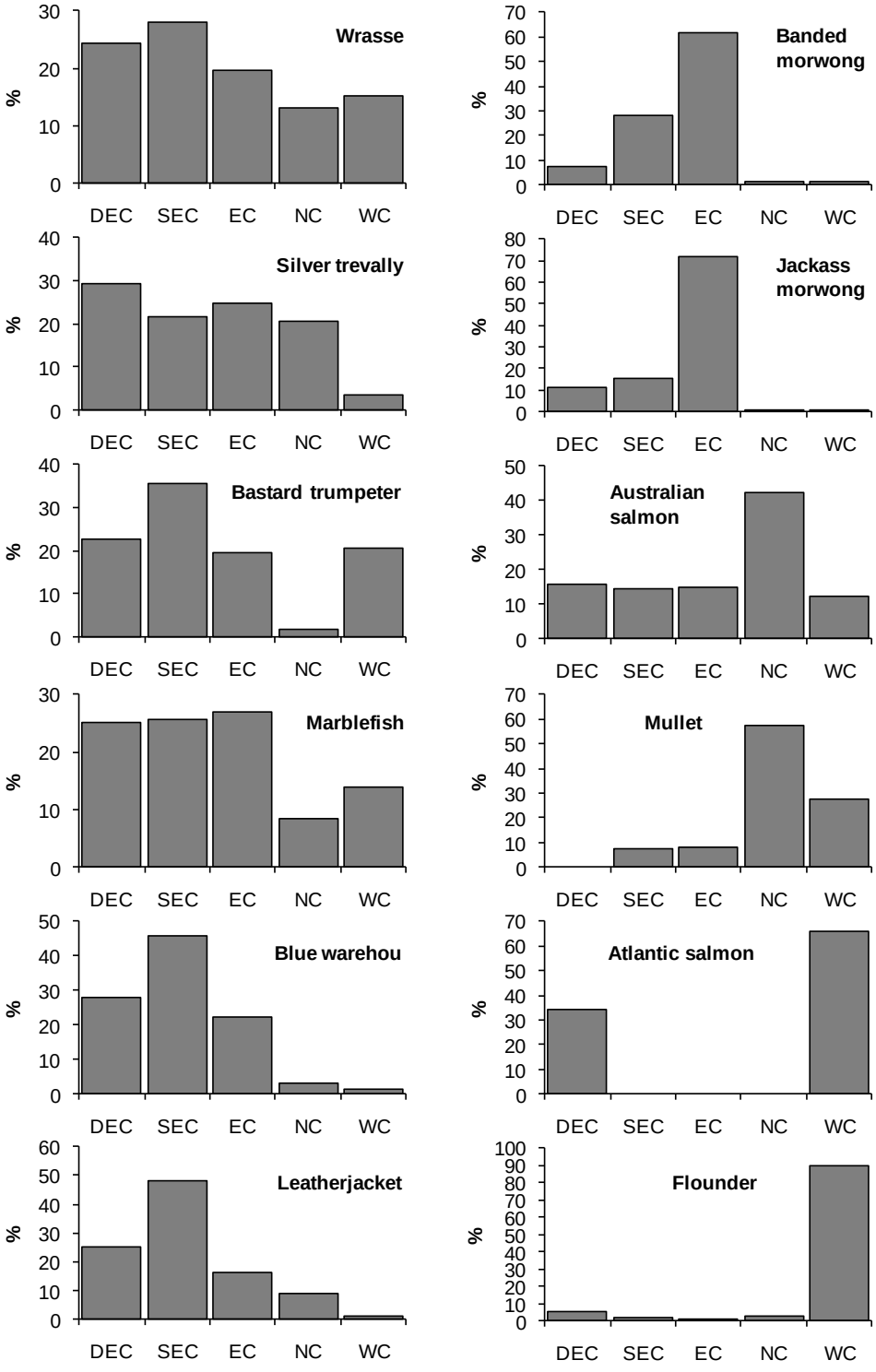


**Fig. 14** Relative catch (% total numbers kept and released/discarded) by region for selected species.

### 3.3.4 Fishing practices – set and soak times

Information about when gillnets were set and hauled enabled inferences to be made about fishing practices. The peak time of day for setting gillnets was between about 07:00-09:00, with three-quarters of all nets set before midday (Fig. 15). Conversely,

over two-thirds of all nets were hauled during the afternoon. There was a secondary peak in setting of gear in the late afternoon, presumably to fish the period either side of sunset when fish are often active. Overnight sets, which accounted for 8.4% of all gillnet sets, were generally set after about 16:00 and hauled by 09:00 the following day.

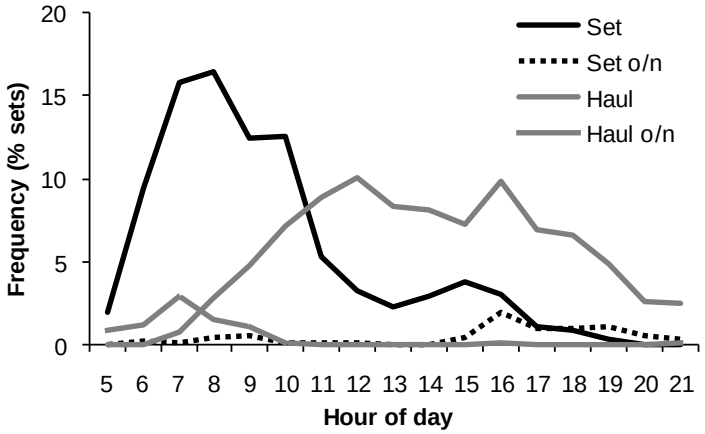


**Fig. 15** Set and haul times (hour of day) distributions for recreational gillnet fishing during 2010. Set and haul times for overnight (o/n) sets are indicated by the dashed lines.

Set duration was defined as the time between setting the gear for the first time on a given day to the time that it was last hauled that day or, for overnight sets, from the time the net was set or last checked on a given day to the earliest time that it was checked or hauled on the following day. The median set duration was 4 hours, with 70% of day sets being less than 6 hours and 4% exceeding 11 hours (Fig. 16). Overnight sets were typically fished for periods of over 10 hours.

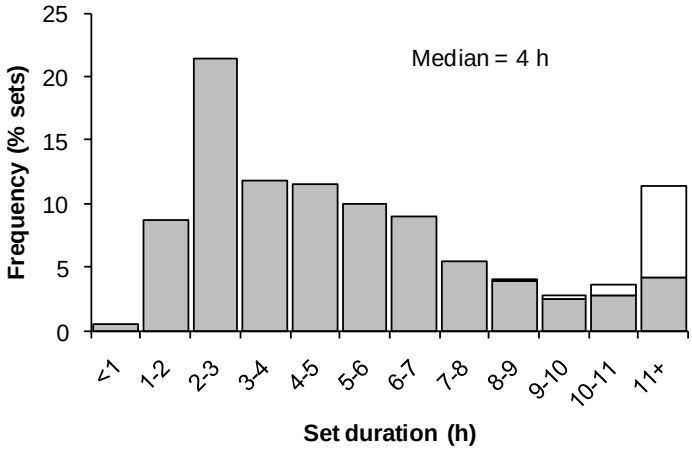


**Fig 16** Frequency distribution of set duration (hours) for recreational gillnet fishing during 2010. Day sets are indicated by the shaded bars and overnight sets by the open bars.

By contrast, soak time was defined as the set duration divided by the number of times the net was checked or hauled for each set, noting that it is common practice for fishers to haul and reset gillnets more than once in a day. The median soak time was 3.5 hours, with 12% of day-set soak times being less than 2 hours and 78% less than 6 hours (Fig. 17). Soak times exceeding 11 hours for daytime sets accounted for 1% of the total effort.

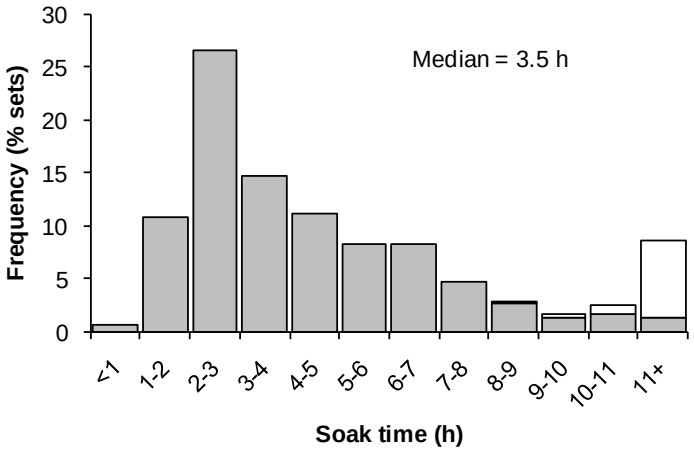


**Fig. 17** Frequency distribution of soak times (hours) for recreational gillnet fishing during 2010. Day sets are indicated by the shaded bars and overnight sets by the open bars.

### 3.3.5 Target and non-target catch

In order to understand targeting practices, respondents were routinely asked whether they were fishing for particular species for each event, whether they caught anything or not. Non-targeted effort was often articulated by respondents as 'fishing for a feed' or 'nothing in particular'.

Knowledge of targeting enables effort and catch rates to be attributed appropriately since recreational fisheries are typically characterised by a high proportion of nil catch events. Almost 30% of the graball net effort was reported as not directed towards any particular species. Bastard trumpeter and blue warehou were the most commonly cited target species with salmonids, mainly Atlantic salmon but also trout (escaped rainbow trout and wild brown trout), of secondary importance as a target species for graball nets (Table 6). By contrast, mullet nets were primarily used to target mullet, with only a small proportion of non-targeted effort.

**Table 6 Effort by nominated target species**

| | Graball | | Mullet net | | Combined | |
|---|---|---|---|---|---|---|
| Target | Net-days | % | Net-days | % | Net-days | % |
| Blue warehou | 7,470 | 30.0 | 18 | 2.1 | 7,488 | 29.1 |
| Bastard trumpeter | 7,382 | 29.7 | 41 | 4.9 | 7,423 | 28.9 |
| Salmonids | 4,350 | 17.5 | 23 | 2.7 | 4,373 | 17.0 |
| Mullet | 105 | 0.4 | 602 | 71.3 | 707 | 2.7 |
| No target | 7,252 | 29.2 | 94 | 11.2 | 7,347 | 28.6 |
| Total | 24,875 | | 845 | | 25,720 | |

By relating catches with targeted effort it is possible to make inferences about the significance of the targeting practices for both target and non-target species. For instance, effort targeted at blue warehou accounted for 70% of the total catch of this species, indicating a high level of targeting for the species. Based on the composition

of the targeted effort, blue warehou accounted for about 30% of the catch numbers, with bastard trumpeter and wrasse the main by-product and by-catch, respectively (Fig. 18).

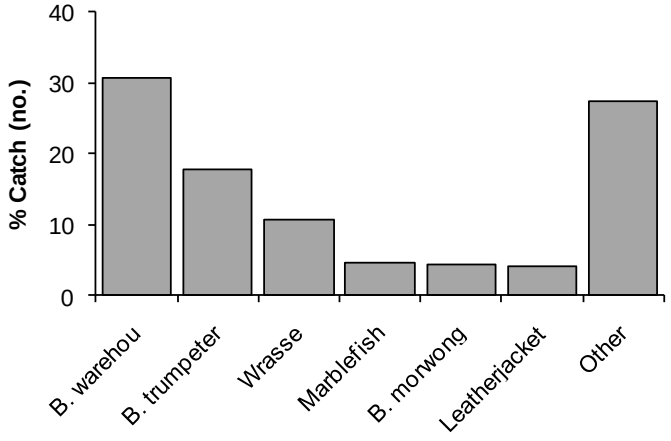


**Fig. 18** Catch composition (% total numbers) for gillnet effort where blue warehou was a nominated target species.

Although the most commonly netted species, effort targeted at bastard trumpeter accounted for just over half (54%) of the total catch of this species, implying a lesser degree of targeting. For targeted effort, bastard trumpeter accounted for a third of the catch, with wrasse and blue warehou the main by-catch and by-product respectively (Fig. 19).

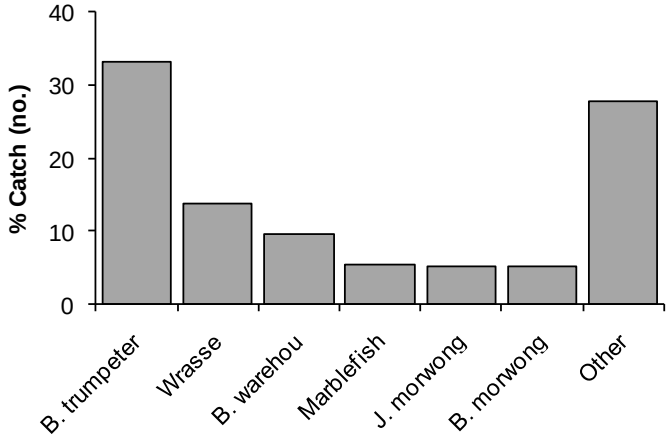


**Fig. 19** Catch composition (% total numbers) for gillnet effort where bastard trumpeter was a nominated target species.

Effort targeted at salmonids accounted for 76% of the total catch of Atlantic salmon confirming the highly targeted nature of the fishery. The species represented almost half the catch composition when targeted; flounder, cod and wrasse were secondary by-product/by-catch species (Fig. 20).

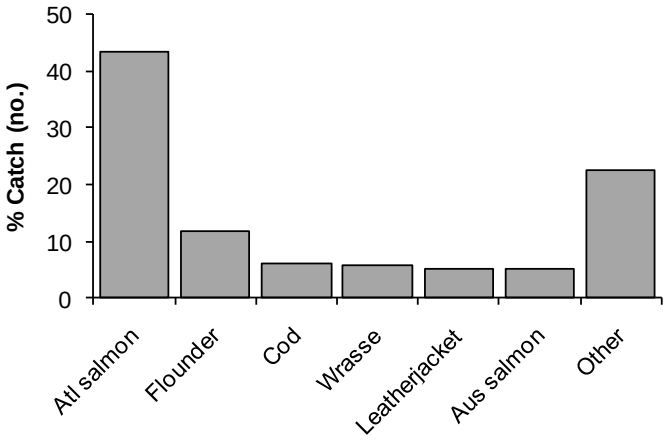


**Fig. 20** Catch composition (% total numbers) for gillnet effort where Atlantic salmon was a nominated target species.

Effort targeted at mullet accounted for 58% of the total catch of the species, but when targeted mullet was the dominant species; Australian salmon represented the main by-product (Fig. 21).

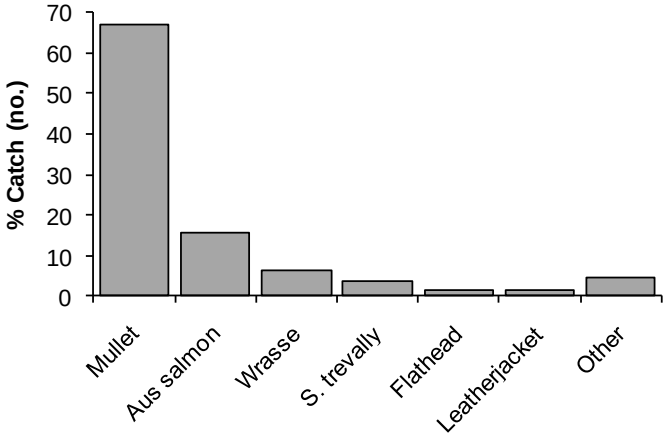


**Fig. 21** Catch composition (% total numbers) for gillnet effort where mullet was a nominated target species.

### 3.3.6 Wildlife interactions

Respondents were encouraged to report wildlife (sea birds and marine mammals) interactions associated with gillnet fishing based on whether there was damage or loss of fish from the nets, damage or loss of gear and whether the interactions resulted in the entanglement of sea birds or marine mammals. No information pertaining to wildlife interactions (whether they occurred or not) was reported for just over half (51%) of all gillnet sets, implying that the interaction rates represent significant underestimates (potentially by a factor of two). Notwithstanding this, seals were assessed to have caused loss or damage to fish in 4% of all gillnet sets and damage to gear in 2% of sets, with seals sighted in the vicinity of gear in 13% of all sets.

There were no reports of the incidental capture of seals or other marine mammals in gillnets.

Respondents reported two separate instances where seabirds (cormorants) were captured in gillnets, representing an interaction rate of 0.1% based on raw data. This is likely to represent a minimum rate since respondents may be disinclined to report such occurrences given the negative publicity associated with such occurrences and, as noted above, no information regarding wildlife interactions was available for over half of the reported effort.

## 3.4 Comparison with commercial catches

Catch information reported during the diary survey was based on numbers rather than weight or size (length) since these latter parameters tend to be less reliably estimated when self-reported by recreational fishers. However, the weight of the recreational harvest is of interest to resource managers, researchers, the broader fishing community (commercial and recreational) and other stakeholder groups with an interest in the aquatic environment. Commercial production is generally reported in terms of weight and thus to permit comparisons between sectors it is desirable to report recreational harvest by weight.

It is possible to approximate recreational harvest weights by multiplying numbers caught by the average weight of an individual. However, achieving accuracy and precision in determining average weight for a species is complex because fish populations tend to exhibit structuring based on size (and age) over a range of temporal and spatial scales. There are also issues of gear selectivity, skill and personal ethics of individual fishers that will also affect the sizes of fish captured and retained. Ideally all of these factors should be taken into account when calculating average individual weight estimates. As this is rarely the case in large-scale studies, and was beyond the scope of this survey, the simple application of an average individual weight will introduce an additional degree of uncertainty to the harvest (weight) estimates. Furthermore, in some instances related species have been grouped together for reporting purposes, thereby confounding the notion of a simple average individual weight for all of the species in the group. *For these reasons it is necessary to view harvest weights as indicative rather than absolute point estimates of recreational fishery production*.

In the absence of on-site (creel) surveys conducted at the same time as the present survey, size composition information derived from research fishing using graball nets undertaken during 2011 (B. Chuwen, unpubl. data) and gillnet size composition information from on-site surveys conducted in the late 1990s (Lyle and Campbell 1999) have been used to approximate the average size of fish retained in recreational gillnets. Length/weight relationships (refer Lyle and Campbell 1999) have been used to derive average weights from the length data and these have been applied to harvest numbers to calculate catch weights (Table 7).

For the key species, the estimated gillnet catch was in the order of 30 tonnes for both bastard trumpeter and blue warehou during 2010, around 15 tonnes for Australian salmon and less than 5 tonnes each for species such as jackass morwong, mullet, flathead, flounder and banded morwong (Table 7). In practice, most of the species are also taken by other recreational fishing methods, such that with the possible exceptions of bastard trumpeter and blue warehou and to a lesser extent Atlantic salmon, the gillnet

component of the recreational harvest represents a relatively minor component of the total harvest. For instance Lyle *et al*. (2009) found that the line catch of Australian salmon, flathead, jackass morwong, silver trevally and mullet far exceeded the gillnet catch. In the case of mullet there was also a significant beach seine component while the spear catch of flounder greatly exceeded that for gillnets.

The provision of harvest weights for selected species enables comparison with commercial production and has relevance for stock assessment and management, including issues relating to resource sharing. Recreational gillnet catches were roughly equivalent to or greater than production from the Tasmanian commercial scalefish fishery for species such as bastard trumpeter, blue warehou, mullet and leatherjacket (Table 7). Conversely, compared with the commercial sector, the recreational gillnet harvest represented a minor component (<10%) of the total catch for Australian salmon, flounder, flathead and banded morwong. By considering commercial gillnet catches only, the recreational component was also significant for species such as Australian salmon, jackass morwong and cod.

**Table 7 Comparison of recreational gillnet and commercial catches of selected species.**
[A]IMAS gillnet trials 2011; [B]gillnet catches reported by Lyle & Campbell (1999); [C]commercial data relates to 2010

| | Recreational gillnet | | | Commercial[C] | | Recreational % | |
|---|---|---|---|---|---|---|---|
| | Total no. | Av. wt (kg) | Total wt (t) | Total (t) | Gillnet only (t) | Combined total | Gillnet only |
| Bastard trumpeter | 27,528 | 0.99[A] | 27.3 | 9.8 | 9.0 | 73.6 | 75.2 |
| Blue warehou | 22,724 | 1.43[B] | 32.5 | 24.2 | 23.8 | 57.3 | 57.7 |
| Atlantic salmon | 10,932 | na | | | | | |
| Australian salmon | 8,100 | 1.71 [B] | 13.9 | 190.0 | 6.2 | 6.8 | 69.2 |
| Jackass Morwong | 5,025 | 0.42 [B] | 2.1 | 4.4 | 1.2 | 32.3 | 63.6 |
| Mullet | 4,813 | 0.35 [B] | 1.7 | 1.9 | 0.3 | 47.2 | 85.0 |
| Leatherjacket | 4,207 | 0.55 [B] | 2.3 | 2.6 | 0.5 | 46.9 | 81.1 |
| Flathead | 2,856 | 0.28 [B] | 0.8 | 61.5 | 1.5 | 1.3 | 34.8 |
| Cod | 2,462 | 0.56 [B] | 1.4 | 2.6 | 1.9 | 35.0 | 42.4 |
| Flounder | 2,050 | 0.31 [B] | 0.6 | 5.3 | 1.5 | 10.2 | 28.6 |
| Banded morwong | 1,082 | 1.52 [A] | 1.6 | 43.0 | 43.0 | 3.6 | 3.6 |

## 3.5 Comparison with previous surveys

Catch and effort information for recreational gillnetting in Tasmania is available from three previous surveys which, when combined with the present survey, encompass a period of major management change in terms of permitted gillnet practices. Comparison between surveys provides some valuable insights into changing fisher behaviour in response to changing regulations as well as fluctuations in resource availability.

A telephone-diary survey of recreational licence holders was conducted over a 17 month period between late 1996 and mid 1998 (Lyle 1999), results pertaining to gillnet licence holders for the 12 months of 1997 have been re-analysed and are reported here. At the time, recreational fishers were permitted to licence up to two 50 m graballs and

one 50 m mullet net, with no restrictions in relation to night netting or soak times. General fishing surveys conducted in 2000/01 (Lyle 2005) and 2007/08 (Lyle *et al*. 2009) also provided information on recreational gillnetting, although as a relatively rare activity in the context of the overall recreational fishery, gillnet data from these surveys was more limited in terms of the number of reported events and thus subject to greater statistical uncertainty. Notwithstanding this, results are of interest since the 2000/01 survey occurred after the introduction of a requirement to mark day and night sets differently (requiring fishers to haul nets at least once every 12 hours or so) and the implementation of bag limits for most species, while the 2007/08 survey followed the introduction of a prohibition on night sets in all areas apart from Macquarie Harbour. Finally, the current survey was conducted immediately following the implementation of maximum soak time regulations.

### 3.5.1 Catch and effort

Catch and effort information for each of the surveys is provided in Table 8 and Appendix VI. For the purpose of effort comparisons, net-sets rather than net-days have been used as this recognises that prior to November 2002 licence-holders could use up to two graballs and/or one mullet net on a given day whereas in subsequent years the maximum was one graball and/or one mullet net. Gillnetting effort was very similar in the two earliest surveys, at around 43,000 net set-days of effort, but in more recent years net effort has fallen sharply, to roughly half this level[8]. As a proportion of total gillnet effort, mullet nets account for only a very small but consistent proportion, 2.7% of sets in 1997 and 3.3% in 2010[9].

Although effort levels have varied over time the relative distribution of gillnet effort around Tasmania has remained remarkably stable, being most heavily concentrated (> 60%) off the south-east coast (inclusive of the D'Entrecasteaux Channel) (Fig. 22). The east and west coasts have tended to attract comparable levels of gillnet effort (~15% each), with the lowest activity consistently reported from the north coast (< 10%).

Average catches (numbers of fish per set) declined from over six fish retained in 1997 to just over four fish per net set-day in 2000/01 and have remained stable since that time (Fig. 23). Information on the released or discarded components of the catch was not collected as part of the 1997 survey but subsequent surveys suggest that by-catch levels have remained at about two fish per net set-day. A range of factors are likely to have contributed to the observed decline in catch rates, including variation in the availability and/or abundance of key species, changed targeting practices, introduction of catch limits (possession and bag limits), increased size limits for some species (e.g. bastard trumpeter and striped trumpeter), etc. It is also worth highlighting that there were few restrictions on gillnet usage during 1997 and it was common practice for nets to be set fishing for much longer periods than in recent years. Reduced soak times since 1997, therefore, may in part account for the lower catch rates in 2010.

[8] It should be noted that the basis for data expansion differs between general population and licence-based surveys (primary sampling unit for general population surveys being the household whereas for licence surveys the primary sampling unit is the licence-holder) and thus comparisons in absolute rather than relative terms for catch and effort should be viewed with some caution.

[9] Graball and mullet net effort was not distinguished in the 2000/01 and 2007/08 surveys.

**Table 8 Comparison of retained catch estimates for recreational gillnetting**
+ indicates < 500 individuals, - not reported

| **Species** | 1997 | 2000/01 | 2007/08 | 2010 |
|---|---|---|---|---|
| Bastard trumpeter | 38,546 | 31,864 | 23,105 | 27,528 |
| Blue warehou | 71,306 | 13,630 | 8,287 | 22,724 |
| Mullet | 17,933 | 36,849 | 6,461 | 4,813 |
| Jackass morwong | 12,679 | 34,597 | 2,164 | 5,025 |
| Australian salmon | 13,028 | 14,987 | 2,078 | 8,100 |
| Flounder | 17,607 | 13,586 | 1,680 | 2,050 |
| Atlantic salmon | 3,933 | 7,859 | 8,420 | 10,932 |
| Leatherjacket | 12,561 | 13,334 | 1,029 | 4,207 |
| Cod | 15,381 | 3,733 | 817 | 2,462 |
| Wrasse | 7,273 | 7,491 | 910 | 4,671 |
| Silver trevally | 9,630 | 3,084 | 3,391 | 4,216 |
| Flathead | 11,205 | 5,225 | 725 | 2,856 |
| Other scalefish | 7,186 | 2,663 | 3,811 | 3,788 |
| Jack mackerel | 12,006 | 519 | - | 1,954 |
| Striped trumpeter | 6,593 | 3,909 | - | 536 |
| Gurnard | 5,577 | 3,113 | 1,347 | 931 |
| Sharks & rays | 3,628 | + | 598 | 669 |
| Black bream | 2,071 | 654 | 1,459 | 971 |
| Banded morwong | 790 | 1,074 | 1,153 | 1,082 |
| Trout | 2,150 | + | + | 1,103 |
| Gummy shark | 1,808 | 988 | + | 616 |
| Marblefish | 2,175 | 666 | - | 500 |
| Boarfish | 1,407 | 715 | + | 652 |
| Other taxa | 887 | 684 | - | + |
| Cephalopod | 616 | + | + | + |
| Total | 277,977 | 201,225 | 67,437 | 112,385 |
| **Total net sets** | **43,984** | **43,004** | **15,738** | **26,088** |

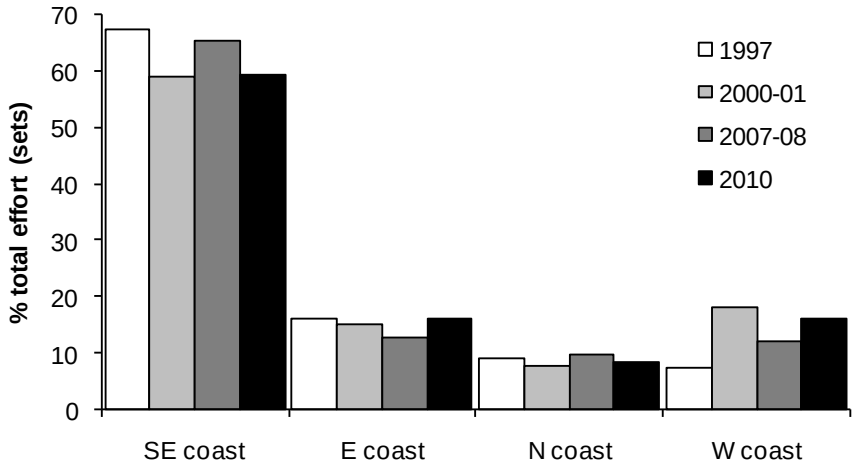


**Fig. 22** Regional distribution of recreational gillnet effort (% of total gillnet sets) by survey year

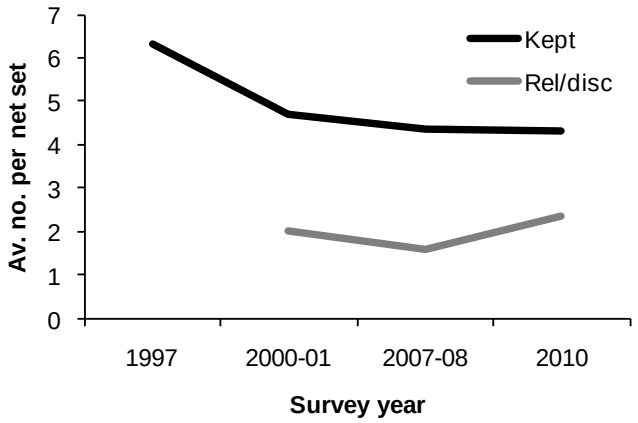


**Fig. 23** Average catch (numbers kept and numbers released/discarded) per net set-day by survey year.

Retained catch estimates for each of the four surveys are presented in Table 8 and retained and released/discarded catch estimates for survey conducted since 2000/01 are provided in Appendix VI. Consistent with the reduction in recreational gillnet effort, estimated catches have fallen from around 278,000 individuals in 1997 to just over 110,000 in 2010.

A major feature of the recreational gillnet fishery has been the importance of bastard trumpeter, with retained catches ranging between 23,000 and 38,000 individuals per year. In absolute terms, only the catch of Atlantic salmon has increased over time, other species have either fluctuated or declined. The most conspicuous variation has been for blue warehou, with a sharp decline in the catch after 1997, a trend that is consistent with that observed in Tasmanian commercial landings (Hartmann and Lyle 2011) and can be linked to the impacts of overfishing mainly in the Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF) (Woodhams *et al*. 2011).

Catches of mullet, which are taken primarily by mullet nets, were comparatively low in 2007/08 and 2010, presumably reflecting the combined efforts of the ban on night netting and reduction in net length, both restrictions implemented post-2001, coupled with a general reduction in netting effort. Similarly, the reduction of flounder catches has coincided with restrictions on night netting in most areas of the State since the early 2000s, flounder being traditionally targeted in night sets by recreational and commercial fishers.

Relatively high catches of striped trumpeter were taken by gillnet in 1997, but catches have remained low since, especially since 2007/08. A combination of factors appears to have contributed to this trend; in 1997 the minimum size limit for the species was 33 cm TL and juveniles derived from a very significant recruitment event based on a strong 1993 year class were abundant in inshore waters, especially off the south-east coast (Murphy and Lyle 1999). Between the early 1990s and mid-2000s there has, however, been a protracted period of below average recruitment (Hartmann and Lyle 2011) which has resulted in low abundances of juvenile striped trumpeter associated with the shallow inshore reefs. This coupled with progressive increases in minimum size limit (from 33 to 35 cm TL in 1998, 45 cm in 2004 and 50 cm in 2009), has meant that many of the fish vulnerable to graball nets would be below legal size, providing little incentive to target the species.

Proportional contributions to the retained catch for the key species are summarised in Fig. 24 and highlight substantial inter-annual variability for species such blue warehou, jackass morwong and mullet. As noted above, variability in blue warehou was most likely linked to availability (and consequent targeting), whereas the situation for jackass morwong may reflect an artefact of sampling (noting the particularly high estimate for 2000/01 was influenced by a small number of unusually high catches). Flounder have gradually declined in significance as a gillnet species whereas Atlantic salmon have become an increasingly important component of the gillnet catch since the late 1990s.

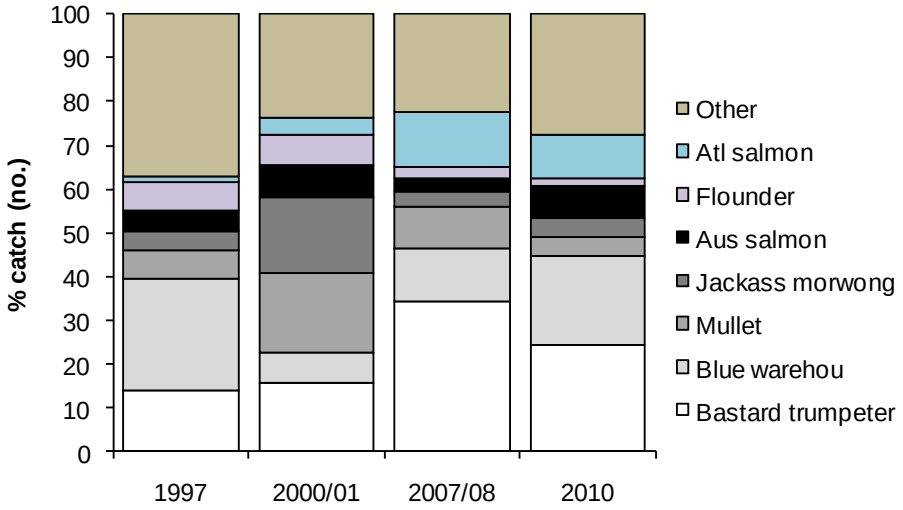


**Fig. 24** Retained catch composition (% numbers) for recreational gillnets by survey year.

### 3.5.2 Overnight netting

A major change in the regulations surrounding recreational gillnetting has been in relation to night netting; first with the implementation of a requirement to mark nets as being day or night sets in 1998 and then the prohibition of night netting in all areas apart from Macquarie Harbour in 2004. Prior to the introduction of night netting restrictions almost three quarters of the total gillnet effort (net set-days) involved overnight sets, the practice being more prevalent for graball (76%) than mullet net (50%) usage (Table 9). Overnight sets accounted for just over half the effort in 2000/01, suggesting that the requirement to mark night sets may have reduced the prevalence of leaving nets unattended for long periods. Following the prohibition on night netting, survey data indicate a significant reduction in overall gillnet effort, with overnight sets reduced to less than 10% of the total, confirming that the measure has been very effective in reducing recreational gillnet effort. During 2010 the vast majority of the night netting effort occurred in Macquarie Harbour. There were, however, a small number of overnight sets reported outside of that area suggesting a low level of non-compliance with the management measure, although in some instances respondents reported that unfavourable sea conditions meant it was unsafe to retrieve gillnets[10].

[10] Note there is provision for fishers to leave nets in overnight if it is deemed unsafe to retrieve the net prior to nightfall.

**Table 9 Proportion (%) of overnight gillnet sets by survey year and gillnet type.**
nd – net type not distinguished

| Year | Graball | Mullet net | Combined |
|---|---|---|---|
| 1997 | 75.5 | 49.5 | 74.9 |
| 2000/01 | nd | nd | 56.9 |
| 2007/08 | nd | nd | 2.0 |
| 2010 | 8.6 | 1.3 | 8.4 |

### 3.5.3 Targeted effort

Reported targeting practices are summarised in Fig. 25 and indicate that gillnet effort has become increasingly (proportionally) focussed on Atlantic salmon, whereas effort targeted at flounder has declined over time and targeted effort for mullet, the main target species for mullet net users, has remained stable in relative terms. By contrast, effort targeted at blue warehou and bastard trumpeter has been highly variable, being lowest in 2000/01, when the importance of both species to the retained catch was also at its lowest levels (Fig. 24). In 1997 and 2010, both stood out as key target species with little variation in the relative importance between surveys, implying an enduring importance attributed of these species by gillnet fishers.

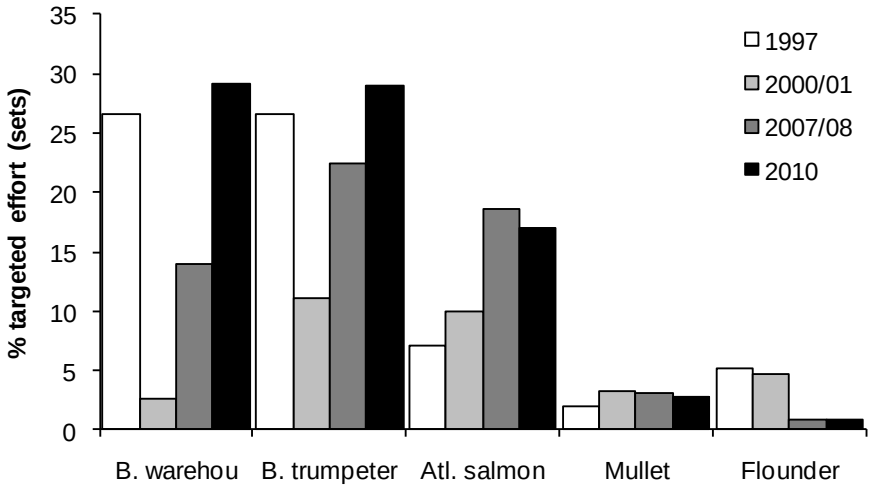


**Fig. 25** Targeted gillnet effort as a percentage of total effort (net sets) for key species by survey year.

### 3.5.4 By-catch

Estimates of released or discarded catch are reported in Appendix VI for surveys conducted since 2000, such by-catch information was not collected as part of the 1997 survey which was focussed on harvest. As a proportion of total catch, about 30% was released or discarded in each of the years surveyed. Wrasse, sharks and rays (excluding gummy shark), leatherjackets, bastard trumpeter, marblefish and banded morwong were

the main by-catch species. The most conspicuous trends during recent years has been increases in the proportions of wrasse, marblefish and banded morwong (reef associated species) and declines in the proportion of leatherjackets and sharks and rays in the by-catch (Fig. 26). The drivers for such changes remain unclear, further research would be necessary to determine whether they are indicative of changes in fish community composition or subtle changes in fishing practices.

Release/discard rates for wrasse, sharks and rays, marblefish were very high across all years (> 70%), with rates for leatherjacket and banded morwong also high (> 50%) (Appendix VI). By contrast, release rates were consistently low (<15%) for Atlantic salmon, Australian salmon, blue warehou, jackass morwong and bastard trumpeter. Interesting there has been an increasing rate of discarding of flounder, from around 2% in 2000/01 to 60% in 2010. As indicated in Fig. 9, the primary reason for discarding flounder was small size. Flounder are typically targeted with large mesh graball nets known as flounder nets (140 mm mesh size rather than the usual 105-110 mm). As noted in targeting practices, there has been a decline in effort for flounder and thus the increased rate of discarding may also be linked to a reduction in the use of large mesh "flounder" nets, resulting in a higher proportion of smaller flounder being retained in standard graball nets.

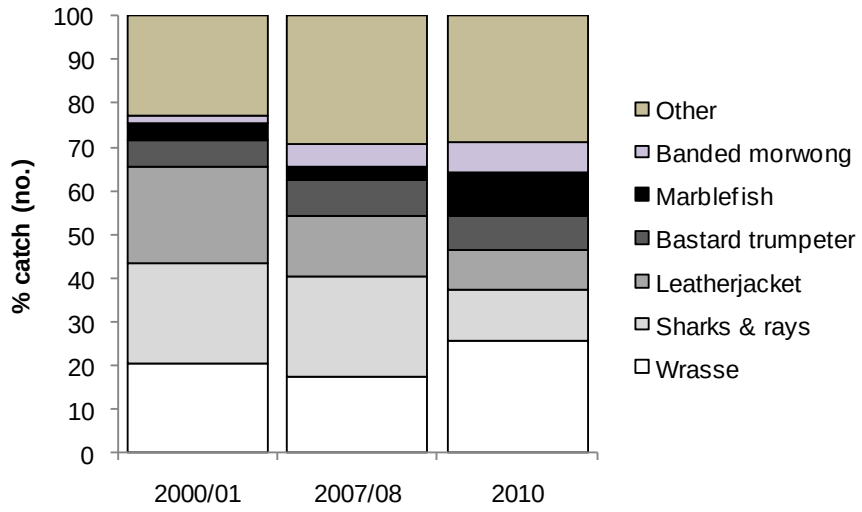


**Fig. 26** Relative species composition (% total numbers) for gillnet by-catch (released or discarded component) by survey year.

# 4 DISCUSSION

Recreational fishers have a long history of gillnet usage in Tasmania, targeting species that have traditionally been difficult to catch using angling methods, species such as bastard trumpeter, blue warehou, flounder and mullet. The recent development of the salmonid aquaculture industry has also provided further opportunities for gillnet fishers, with escapee Atlantic salmon and ocean trout (farmed rainbow trout) readily taken by gillnets. However, poor fishing practices, notably excessively long soak times have long been seen as a major contributor to wastage and by-catch in gillnets, including the incidental capture of wildlife (e.g. seabirds). Furthermore, the perceived indiscriminate nature of gillnets coupled with high and largely unregulated levels of recreational netting effort and have given rise to general concerns about the impacts of netting on inshore fish communities. Since the introduction of licensing in 1995, a series of management measures have been progressively introduced to improve recreational fishing practices, reduce wastage and by-catch and address these some of these concerns. The present study provides a comprehensive assessment of the current status of recreational gillnetting in Tasmania, demonstrating the effectiveness of these management measures and contributing objective information into the on-going debate surrounding the sustainability of the method.

The earliest survey of recreational gillnet fishing was conducted in 1995 and established that about 70% of graball fishers either 'occasionally' or 'mostly' set nets overnight (Lyle and Smith 1998). The common practice of overnight netting was confirmed in a more in-depth examination of net fishing conducted between 1996-98, with approximately three quarters of all recreational gillnet effort involving overnight sets (Lyle 2000). In the same study it was also established that more than one in four overnight sets were deployed in the morning and not checked or hauled until the following day, resulting in effective soak times of 24 hours or greater. Following the introduction in late 1998 of a requirement to differentially mark (buoy) day and night sets to reduce such excessive soak times, night netting was still found to account for over half of all gillnet sets in 2000/01 (Lyle 2005).

The prohibition on night netting in most areas implemented in late 2004 appears to have had a significant and dual impact on netting effort, not only has the ban achieved a marked reduction in the proportion of night sets (currently < 10%) but there has been a concomitant and substantial reduction in recreational netting effort overall. For instance, recreational gillnet effort (based on net sets) in 2010 was about 60% of the level in 1997, this has occurred despite 40% more gillnet licence-holders in 2010.

The present study highlights that licence numbers do not necessarily reflect trends in catch and effort. This is partly due to variability in the level of latent capacity (i.e. non active licence-holders) and variability in the effort expended by active fishers. In relation to the former, over 85% of gillnet licence holders used gillnets at least once a year during 1995/96 (Lyle and Smith 1998) while in 2008/09 just over 70% did any gillnetting. The licensing system, where fishers pay a base fee for the first licence

category[11] and a nominal fee for additional licence types provides an incentive to purchase multiple licences on the off-chance that opportunities may arise for their use. There is, for instance, ample anecdotal evidence that Atlantic salmon escape events or a good run of target species such as blue warehou influence localised netting activity levels.

Linked to the decline in effort in recent years has been a more than halving of the retained catch, this decline was accentuated by a fall in catch rates, from an average over 6 fish retained per net set in 1997 to just over 4 fish per set throughout the past decade. While variability in the abundance of target species such as blue warehou has contributed to this trend, changes in fishing practices (no night netting, shorter average set durations[12], reduction in the length of mullet nets, larger minimum size limits for some species influencing release/discarding rates, etc) have also been contributing factors.

Although effort and fishing practices have clearly changed over the past decade or so, several characteristics of the recreational gillnet fishery have remained consistent, including the relative distribution of effort around the state, the relativity between graball and mullet net effort, and the overall composition of the catch. Gillnet effort has been typically concentrated off the south-east of the state, including the D'Entrecasteaux Channel, followed by the east and west coast regions in importance. While the north coast has consistently attracted the lowest gillnet effort, the region represents the most important area of mullet net usage.

Historically, bastard trumpeter and blue warehou have been and remain the main species targeted and caught by graball whereas yellow eye mullet is the main species targeted using mullet nets. Flounder, on the other hand, have tended to decline in importance as a gillnet species since the late 1990s, partly influenced by the ban on night netting but also the increasing tendency of fishers to target the species using spears (Lyle 2005, Lyle *et al*. 2009). The other conspicuous change has been the increase in the importance of Atlantic salmon as a target species for recreational gillnetters, in particular in Macquarie Harbour and the D'Entrecasteaux Channel, the major salmonid growing areas.

The recreational gillnet fishery can be broadly divided into several sub-fisheries based on habitat and target species. Bastard trumpeter and/or blue warehou are primarily targeted on coastal reef areas, with a species such as wrasse, marblefish, leatherjackets, jackass morwong and banded morwong common by-catch or by-product species. In sheltered inshore waters Atlantic salmon escapees and, to a lesser extent in recent years, flounder are targeted, with cod, wrasse, leatherjackets and Australian salmon the main by-catch or by-product species. Mullet nets are used primarily to target mullet in non-reef areas, with Australian salmon representing a minor component of the catch.

[11] The recreational licensing system in Tasmania includes the following licence categories - graball, mullet net, beach seine, set-line, rock lobster pot, rock lobster dive, rock lobster ring, abalone, and scallop dive.

[12] For instance, the average duration of a day set in the late 1990s was 6.8 hours (Lyle 2000) whereas in 2010 it was down to 4.6 hours.

In terms of catch weights, bastard trumpeter and blue warehou dominated, each accounting for around 30 tonnes in 2010. Although the catch of bastard trumpeter was numerically greater in 1997, an increased minimum size limit (33 cm TL in 1997 compared with 38 cm in 2010) resulted in the weight of the 2010 catch being slightly higher (Lyle 2000). The 2010 catch of blue warehou was, on the other hand, only about a quarter of magnitude of that in 1997. By comparison with commercial production for 2009/10, the recreational catch of bastard trumpeter was almost three times greater than the commercial take whereas blue warehou catches were comparable between sectors. Other species for which the 2010 recreational gillnet catch was significant when compared with the commercial gillnet catch included mullet, Australian salmon (although gillnet catches were small by comparison with other fishing methods for both sectors), jackass morwong, leatherjacket and cod. The most conspicuous difference between the commercial and recreational gillnet fisheries was banded morwong; the species supports a targeted commercial fishery but are typically released or discarded by recreational gillnetters. Recreational gillnets also represent an important source of fishing pressure on escapee salmonids, playing a role in removing what are in effect introduced species. Overall the present findings confirm previous studies (e.g. Lyle 2000) in establishing recreational gillnetting as a key contributor to the total fishing pressure exerted on a range of inshore scalefish species.

While the consequence of gillnet capture is self-evident for the retained component of the catch, about one third of the catch is released or discarded, raising the question of whether or not these fish survive. Species such as wrasse, banded morwong, gurnards, marblefish, and some sharks and rays are commonly released or discarded, mainly because they are not considered to have good eating qualities. For others, including the main target species, not all of the catch is retained, with factors such as size and possession limits, condition or quality of the fish, influencing whether or not individuals are kept or not. The probability of by-catch survival is likely to vary between species and be a function of soak time, how individual fish are meshed (if gill movement is restricted then fish may ‘suffocate’), extent of physical damage caused by meshing (loss of scales, cuts and bruising), and predator damage. Lyle *et al*. (2000) examined the effects gillnet fishing practices (soak time and mesh size) on the condition of the catch. They found that species such as flounder, banded morwong, marblefish, gurnards, draughtboard shark, skates and rays were particularly resilient, generally remaining alive in nets, even those with relatively long soak times. Bastard trumpeter, boarfish, elephant fish and spurdogs were also comparatively resilient, although mortality rates increased in long (overnight) sets. By contrast, species such as blue warehou, mullet, wrasse and gummy shark had relatively high mortality rates regardless of soak time while species such as short-fin pike and jack mackerel rarely survived net capture. Although Lyle *et al*. (2000) did not assess post release survival, it is clear that by-catch mortality has the potential to be significant for species such as wrasse but may be relatively low for banded morwong, marblefish, gurnards, some shark species, skates and rays assuming that fishers handle them carefully when removing them from nets.

The Institute for Marine and Antarctic Studies is currently undertaking a field-based study to examine the impacts of gillnetting on by-catch and biodiversity, with particular attention to the relationships between soak times, capture condition and post-release survival. This study, scheduled for completion in 2013, should provide valuable additional information regarding the effectiveness of current management regulations

(maximum soak times) and build on our understanding of the broader implications of gillnetting on fish communities and not just the target species.

## Acknowledgments

Funding assistance for this study was provided by the Fishwise Community Grants Scheme administered by the Department of Primary Industries, Parks, Water and Environment.

Kelly Bolch provided invaluable assistance with the management of the survey and our team of proficient and committed interviewers - Elizabeth, Helen, Jennie, Sheelagh, Shirley, and Virginia - contributed to the success of the survey, encouraging the co-operation of fishers and maximising response rates, as well as ensuring data quality and completeness. Thanks are also due to Graeme Ewing for developing the R-code to undertake the bootstrap analysis.

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

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## Appendix I. Recreational gillnet catch composition by reporting group, common and scientific names and relative catch levels (kept and released/discarded) for 2010.

+++++ >10,000; ++++ 5,000-10,000; +++ 1,000 – 4,999; ++ 500 – 999; + <500.

| Reporting group | Common name | Scientific name(s) | Catch (nos) |
|---|---|---|---|
| Atlantic salmon | Atlantic salmon | *Salmo salar* | +++++ |
| Australian salmon | Australian salmon | *Arripis* spp | ++++ |
| Banded morwong | Banded morwong | *Cheilodactylus spectabilis* | ++++ |
| Bastard trumpeter | Bastard trumpeter | *Latridopsis forsteri* | +++++ |
| Black bream | Black bream | *Acanthopagrus butcheri* | +++ |
| Blue warehou | Blue warehou | *Seriolella brama* | +++++ |
| Boarfish | Longsnout boarfish | *Pentaceropsis recurvirostris* | +++ |
| Cod | Cod | Moridae | +++ |
| Flathead | Southern sand flathead | *Platycephalus bassensis* | +++ |
| | Tiger flathead | *Neoplatycephalus richardsoni* | |
| | Flathead, unspec. | Platycephalidae | |
| Flounder | Greenback flounder | *Rhombosolea tapirina* | ++++ |
| | Longsnout flounder | *Ammotretis rostratus* | |
| Gummy shark | Gummy shark | *Mustelus antarcticus* | +++ |
| Gurnard | Gurnard | Scorpaenidae, Neosebastidae & Triglidae | +++ |
| Jack mackerel | Jack mackerel | *Trachurus declivis* | +++ |
| Jackass morwong | Jackass morwong | *Nemadactylus macropterus* | ++++ |
| Leatherjacket | Leatherjacket | Monacanthidae | ++++ |
| Luderick | Luderick | *Girella* spp | ++ |
| Marblefish | Marblefish | *Aplodactylus arctidens* | ++++ |
| Mullet | Yellow-eye mullet | *Aldrichetta forsteri* | ++++ |
| | Sea mullet | *Mugil cephalus* | |
| Silver trevally | Silver Trevally | *Pseudocaranx dentex* | ++++ |
| Striped trumpeter | Striped trumpeter | *Latris lineata* | ++ |
| Trout | Brown trout | *Salmo trutta* | + |
| | Rainbow trout | *Oncorhynchus mykiss* | ++ |
| Sweep | Sweep | *Scorpis* spp. | +++ |
| Wrasse | Purple wrasse | *Notolabrus fucicola* | +++++ |
| | Bluethroat wrasse | *Notolabrus tetricus* | |
| Other scalefish | Barracouta | *Thyrsites atun* | + |
| | Dory | Zeidae | + |
| | Herring cale | *Olisthops cyanomelas* | + |
| | Latchet | *Pterygotrigla polyommata* | + |
| | Ling | *Genypterus* spp | + |

**Appendix I. Continued.**

| Reporting group | Common name | Scientific name(s) | Catch (nos) |
|---|---|---|---|
| Other scalefsh | Longfin pike | *Dinolestes lewin*i | + |
| | Magpie perch | *Cheilodactylus nigripes* | + |
| | Old wife | *Enoplosus armatus* | + |
| | Red velvetfish | *Gnathanacanthus goetzeei* | + |
| | Shortfin pike | *Sphyraena novaehollandiae* | + |
| | Skipjack tuna | *Katsuwonus pelamis* | + |
| | Stargazer | Uranoscopidae | + |
| | Tailor | *Pomatomus saltatrix* | + |
| | Toad/pufferfish | Various families | + |
| | Whiting | Sillaginidae | + |
| | Whiptails | Various families | + |
| | Yellowtail kingfish | *Seriola lalandi* | + |
| | Unident. fish | Various | + |
| Other ‘sharks’ | School shark | *Galeorhinus galeus* | + |
| | Dogfish | *Squalus* spp | ++ |
| | Draughtboard shark | *Cephaloscyllium laticeps* | +++ |
| | Elephantfish | *Callorhinchus milii* | ++ |
| | Port Jackson shark | *Heterodontus portjacksoni* | + |
| | Saw shark | *Pristiophorus* spp | + |
| | Seven-gill shark | *Notrynchus cepedianus* | + |
| | Thresher shark | *Alopias vulpinus* | + |
| | Unspec. shark | Various families | + |
| Skates &rays | Eagle ray | *Myliobatus australis* | + |
| | Unspec. skates & rays | Various families | +++ |
| Other taxa | Southern rocklobster | *Jasus edwardsii* | + |
| | Crabs | Brachyura | + |
| | Gould’s squid | *Nototodarus gouldi* | + |
| | Southern calamari | *Sepioteuthis australis* | + |
| | Cuttlefish | *Sepia* spp | + |
| | Octopus | Octopodidae | + |
| | Scallop | Pectinidae | + |
| | Oysters | Ostreidae & *Pteriidae* spp | + |
| | Sea Urchin | Class Echinoidea | + |

**Appendix II. Recreational graball catch estimates for 2010.**

Values in parentheses represent 95% confidence limits; + catch estimate < 500; - nil catch

| Species | Kept (no.) | Rel/discard (no.) | Total catch (no.) |
|---|---|---|---|
| Bastard trumpeter | 27,527 (21,755 – 34,676) | 4,777 (3,092 – 6,798) | 32,305 (25,506 – 39,738) |
| Blue warehou | 22,705 (16,420 – 30,362) | 2,236 (818 – 4,448) | 24,942 (17,770 – 33,156) |
| Wrasse | 4,304 (2,819 – 5,967) | 15,709 (11,607 – 20,428) | 20,013 (15,393 – 24,881) |
| Atlantic salmon | 10,932 (7,171 – 15,356) | 822 (187 – 1,767) | 11,754 (7,856 – 16,673) |
| Leatherjacket | 4,126 (2,709 – 5,989) | 5,477 (4163 – 6,921) | 9,603 (7,428 – 12,166) |
| Australian salmon | 6,743 (4,541 – 9,529) | 668 (276 – 1,143) | 7,411 (5,008 – 10,304) |
| Other shark | 668 (290 – 1,148) | 6,026 (3,917 – 8,590) | 6,694 (4,405 – 9,113) |
| Marblefish | + | 5,957 (3,966 – 8,317) | 6,457 (42,87 – 9,331) |
| Jackass morwong | 5,024 (2,604 – 7,876) | 606 (217 – 1,097) | 5,630 (32,25 – 8,854) |
| Banded morwong | 1,082 (441 – 1,982) | 4,348 (2,571 – 6,726) | 5,430 (3,355 – 7,660) |
| Flounder | 1,852 (752 – 3,384) | 3,014 (1,304 – 5,158) | 4,867 (2,539 – 7,558) |
| Silver trevally | 3,699 (2,166 – 5,403) | 1,013 (232 – 2,198) | 4,713 (2,602 – 7,454) |
| Cod | 2,427 (1,379 – 3,749) | 1,250 (657 – 2,000) | 3,677 (2,248 – 5,071) |
| Gurnard | 931 (301 – 1,886) | 2,612 (1,389 – 4,349) | 3,544 (1,907 – 5,634) |
| Flathead | 2,768 (713 – 6,438) | + | 3,161 (881 – 6,824) |
| Other scalefish | 2,137 (1,253 – 3,193) | 955 (534 – 1,465) | 3,092 (1,985 – 4,170) |
| Jack mackerel | 1,954 (583 – 3,849) | 642 (17 – 1,786) | 2,596 (910 – 4,582) |
| Mullet | 1,695 (612 – 3,080) | 777 (279 – 1,398) | 2,472 (1137 – 4,066) |
| Sweep | 1,439 (232 – 3,228) | + | 1,564 (138 – 3,547) |
| Black bream | 970 (248 – 1,952) | + | 1,414 (413 – 2,718) |
| Gummy shark | 616 (376 - 985) | 570 (399 – 1,014) | 1,186 (873 – 1,825) |
| Trout | 1,103 (582 – 1,727) | + | 1,136 (588 – 1,789) |
| Boarfish | 651 (363 - 988) | + | 1,086 (711 – 1,467) |
| Skates & rays | - | 1,066 (748 - 1440) | 1,066 (737 – 1,418) |
| Other taxa | + | 521 (200 - 917) | 645 (297 – 1,077) |
| Striped trumpeter | 536 (194 - 949) | + | 608 (243 – 1,086) |
| Luderick | + | + | 534 (0 – 1,409) |
| Total | 106,676 | 60,913 | 167,600 |

**Appendix III. Recreational mullet net catch estimates for 2010.**

Values in parentheses represent 95% confidence limits; + catch estimate < 500; - nil catch

| Species | Kept (no.) | Rel/discard (no.) | Total catch (no.) |
|---|---|---|---|
| Mullet | 3,117 (494 – 7,362) | + | 3,221 (493 – 7,460) |
| Australian salmon | 1,355 (412 – 2,652) | + | 1,379 (429 – 2,576) |
| Silver trevally | 516 (0 – 1,394) | + | 551 (0 – 1,351) |
| Wrasse | + | + | 535 (88 – 1,124) |
| Flounder | + | - | + |
| Leatherjacket | + | + | + |
| Marblefish | - | + | + |
| Flathead | + | - | + |
| Other scalefish | + | - | + |
| Cod | + | - | + |
| Blue warehou | + | - | + |
| Bastard trumpeter | - | + | + |
| Other taxa | + | - | + |
| Total | 5,832 | 475 | 6,306 |

**Appendix IV. Recreational gillnet catch estimates (retained numbers) by fishing region for 2010.**

Values in parentheses represent 95% confidence limits; + catch estimate < 500; - nil catch

| Species | DEC | SE Coast | E Coast | N Coast | W Coast |
|---|---|---|---|---|---|
| Bastard trumpeter | 6,109 (3230-10176) | 9,661 (6490-13426) | 5,606 (3379-8170) | 520 (90-1145) | 5,629 (2858-9303) |
| Blue warehou | 6,732 (3160-12001) | 9,842 (6032-14063) | 5,228 (2176-9311) | 608 (17-1485) | + |
| Atlantic salmon | 3,474 (1685-5627) | - | - | - | 7,457 (4146-11652) |
| Australian salmon | 1,306 (305-2916) | 1,179 (433-2121) | 1,182 (352-2188) | 3,618 (1705-5808) | 813 (294-1548) |
| Jackass morwong | 607 (129-1322) | 753 (289-1343) | 3,618 (1478-6475) | + | + |
| Mullet | - | + | + | 2,889 (823-5747) | 1,441 (194-3496) |
| Wrasse | 827 (322-1614) | 1,809 (889-2839) | 724 (308-1246) | 942 (82-2180) | + |
| Silver trevally | 976 (263-1926) | 968 (340-1681) | 1,222 (352-2530) | 1,048 (224-2343) | - |
| Leatherjacket | 580 (268-948) | 2,230 (972-3856) | 821 (376-1362) | 556 (94-1189) | + |
| Flathead | 1,892 (91-5339) | + | + | + | + |
| Cod | 1,055 (323-2172) | + | + | + | 1,027 (395-1797) |
| Other scalefish | + | 696 (234-1291) | + | 625 (194-1190) | + |
| Flounder | + | + | - | + | 1,762 (703-3323) |
| Jack mackerel | 604 (0-1860) | + | + | - | 512 (0-1436) |
| Sweep | - | - | - | 1,005 (0-2716) | + |

**Appendix IV. Continued**

| Species | DEC | SE Coast | E Coast | N Coast | W Coast |
|---|---|---|---|---|---|
| Trout | + | - | - | - | 1,067 (572-1670) |
| Banded morwong | + | + | 624 (101-1461) | + | + |
| Black bream | + | + | + | 576 (0-1458) | - |
| Gurnard | + | + | + | + | + |
| Boarfish | + | + | + | - | + |
| Gummy shark | + | + | + | + | + |
| Other shark | + | + | + | + | + |
| Striped trumpeter | + | + | + | - | + |
| Marblefish | + | - | - | + | - |
| Luderick | + | - | + | - | - |
| Other taxa | + | + | + | + | + |
| Skates & Rays | - | - | - | - | - |

**Appendix V. Recreational gillnet catch estimates (released/discarded numbers) by fishing region for 2010.**

Values in parentheses represent 95% confidence limits; + catch estimate < 500; - nil catch

| Species | DEC | SE Coast | E Coast | N Coast | W Coast |
|---|---|---|---|---|---|
| Bastard trumpeter | 1,180 (522-2079) | 1,824 (726-3278) | 758 (303-1359) | + | 997 (387-1708) |
| Blue warehou | + | 1,543 (267-3649) | + | + | - |
| Atlantic salmon | 543 (71-1402) | - | - | - | + |
| Australian salmon | + | + | + | + | + |
| Jackass morwong | + | + | + | + | - |
| Mullet | - | + | + | + | + |
| Wrasse | 4,192 (2549-6347) | 3,924 (2234-5874) | 3,301 (1779-5042) | 1,723 (784-3008) | 2,735 (864-5271) |
| Silver trevally | 572 (35-1553) | + | + | + | + |
| Leatherjacket | 1,861 (1178-2723) | 2,470 (1545-3438) | 772 (381-1247) | + | + |
| Flathead | + | + | + | - | - |
| Cod | 544 (107-1228) | + | + | - | + |
| Other scalefish | + | + | + | + | + |
| Flounder | + | + | + | + | 2,776 (1120-4954) |
| Jack mackerel | - | 553 (0-1651) | + | - | - |
| Sweep | - | - | - | +) | + |
| Trout | - | - | - | - | + |
| Banded morwong | + | 1,256 (700-1925) | 2,712 (1198-4880) | + | + |
| Black bream | + | - | + | + | - |
| Gurnard | 756 (291-1397) | + | 1,402 (418-2950) | + | + |
| Boarfish | + | + | + | + | - |

**Appendix V. Continued.**

| Species | DEC | SE Coast | E Coast | N Coast | W Coast |
|---|---|---|---|---|---|
| Gummy Shark | + | + | + | + | + |
| Other shark | 2,873 (1385-4818) | 1,523 (693-2503) | 806 (252-1416) | + | 710 (106-1672) |
| Striped trumpeter | - | + | + | - | - |
| Marblefish | 1,155 (492-2122) | 1,670 (724-2970) | 1,770 (768-2991) | 536 (125-1217) | 916 (184-1950) |
| Luderick | + | - | + | - | - |
| Other taxa | + | + | + | + | + |
| Skates & Rays | + | + | + | + | + |

**Appendix VI. Estimated gillnet catch (kept, released/discarded and total) numbers and percentage released/discarded by survey period**

+ < 500 individuals, - nil catch reported.

| | 2000/01 | | | | 2007/08 | | | | 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Kept** | **Rel/disc** | **Total** | **% rel/disc** | **Kept** | **Rel/disc** | **Total** | **% rel/disc** | **Kept** | **Rel/disc** | **Total** | **% rel/disc** |
| Trout | + | - | + | - | + | - | + | 0.0 | 1,103 | + | 1,137 | 3.0 |
| Atlantic salmon | 7,859 | + | 8,107 | 3.1 | 8,420 | - | 8,420 | 0.0 | 10,932 | 823 | 11,755 | 7.0 |
| Australian salmon | 14,987 | + | 15,330 | 2.2 | 2,078 | + | 2,167 | 4.1 | 8,100 | 691 | 8,791 | 7.9 |
| Blue warehou | 13,630 | + | 13,753 | 0.9 | 8,287 | - | 8,287 | 0.0 | 22,724 | 2,237 | 24,961 | 9.0 |
| Jackass morwong | 34,597 | + | 34,830 | 0.7 | 2,164 | + | 2,293 | 5.6 | 5,025 | 606 | 5,631 | 10.8 |
| Striped trumpeter | 3,909 | 814 | 4,724 | 17.2 | - | | | | 536 | + | 609 | 11.9 |
| Flathead | 5,225 | + | 5,650 | 7.5 | 725 | + | 1,043 | 30.5 | 2,856 | + | 3,249 | 12.1 |
| Bastard trumpeter | 31,864 | 5,417 | 37,281 | 14.5 | 23,105 | 2,076 | 25,181 | 8.2 | 27,528 | 4,795 | 32,323 | 14.8 |
| Mullet | 36,849 | 2,145 | 38,994 | 5.5 | 6,461 | 1,897 | 8,359 | 22.7 | 4,813 | 882 | 5,694 | 15.5 |
| Silver trevally | 3,084 | + | 3,101 | 0.5 | 3,391 | + | 3,499 | 3.1 | 4,216 | 1,049 | 5,264 | 19.9 |
| Jack mackerel | 519 | - | 519 | - | - | | | | 1,954 | 642 | 2,597 | 24.7 |
| Scalefish - other | 2,663 | 5,501 | 8,164 | 67.4 | 3,811 | 641 | 4,452 | 14.4 | 3,788 | 1,449 | 5,238 | 27.7 |
| Black bream | 654 | + | 781 | 16.2 | 1,459 | - | 1,459 | 0.0 | 971 | + | 1,414 | 31.4 |
| Cod | 3,733 | 1,273 | 5,006 | 25.4 | 817 | 1,292 | 2,109 | 61.3 | 2,462 | 1,250 | 3,713 | 33.7 |
| Boarfish | 715 | + | 1,028 | 30.4 | + | + | + | 26.6 | 652 | + | 1,086 | 40.0 |
| Gummy shark | 988 | 3,373 | 4,361 | 77.3 | + | 1,485 | 1,751 | 84.8 | 616 | 570 | 1,186 | 48.1 |
| Cephalopod | + | - | + | - | + | - | + | 0.0 | + | + | + | 51.8 |
| Leatherjacket | 13,334 | 19,843 | 33,177 | 59.8 | 1,029 | 3,510 | 4,539 | 77.3 | 4,207 | 5,511 | 9,718 | 56.7 |
| Flounder | 13,586 | + | 13,826 | 1.7 | 1,680 | 808 | 2,488 | 32.5 | 2,050 | 3,015 | 5,064 | 59.5 |
| Gurnard | 3,113 | 4,373 | 7,486 | 58.4 | 1,347 | + | 1,670 | 19.4 | 931 | 2,613 | 3,544 | 73.7 |
| Wrasse | 7,491 | 18,566 | 26,057 | 71.3 | 910 | 4,498 | 5,408 | 83.2 | 4,671 | 15,878 | 20,549 | 77.3 |
| Banded morwong | 1,074 | 1,662 | 2,736 | 60.8 | 1,153 | 1,315 | 2,467 | 53.3 | 1,082 | 4,348 | 5,430 | 80.1 |
| Sharks & rays | + | 20,440 | 20,910 | 97.8 | 598 | 5,798 | 6,561 | 88.4 | 669 | 7,094 | 7,763 | 91.4 |
| Other taxa | 684 | 1,031 | 1,715 | 60.1 | - | + | + | 100.0 | + | + | + | 92.1 |
| Marblefish | 666 | 3,405 | 4,072 | 83.6 | - | 743 | 743 | 100.0 | 500 | 6,049 | 6,549 | 92.4 |
| **Total** | **202,354** | **89,911** | **292,265** | **30.8** | **68,724** | **25,427** | **94,151** | **27.0** | **112,521** | **61,401** | **173,922** | **35.3** |