# FISHERY ASSESSMENT REPORT

# TASMANIAN SCALEFISH FISHERY ASSESSMENT - 1998

*Compiled by J. M. Lyle and A. R. Jordan*

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This assessment of the scalefish resource is the first to be produced by the Tasmanian Aquaculture and Fisheries Institute (TAFI) and uses input from the Scalefish Fishery Assessment Working Group (SFAWG).

The SFAWG met on 24 April 1998 to consider background documents and provide input into the assessments. The Working Group participants were:

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|---|---|
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# Scalefish Fishery Assessment 1998

## Summary

The scalefish fishery has existed for many years as an important component of the Tasmanian fishing industry. It is a multi-species fishery involving a wide variety of fishing methods. In addition, many scalefish species are important to the recreational fishery.

Management in the past has generally involved minimal controls on catch and effort. The introduction of the Scalefish Management Plan in 1998, however, seeks to identify participants in the fishery and define their level of access (in terms of the amount and type of gear that can be used) as a means of constraining effort (directly) and catch (indirectly) to at least historic levels.

An important element of the management plan is the explicit identification of performance indicators. These indicators have two primary functions;

- monitor performance of the management plan in relation to effort and catch levels, and
- provide reference points against which the status of fish stocks can be assessed.

**Fishery Assessment**

In this, the first formal assessment of the scalefish fishery, the fishery is described in terms of catch composition and catch levels. Catch history for the period 1969/70 - 1997/98 is presented, with more detailed analyses of catch and effort by method for the period 1995/96 - 1997/98.

A major limitation of this assessment is the lack of a time series of catch and effort data from which trend analysis can be conducted; it was not until 1995 that a catch return providing daily records of fishing activity was introduced. In essence, catch, effort and catch rate (catch per unit effort - CPUE) information are only available for a three year period, too short a time frame to discern trends in these parameters. In relation to catch, while such data has been collected for many years, jurisdictional and administrative changes over time complicate the interpretation of such information.

From the point of view of assessing fishery performance against trigger points relating to catch, effort and CPUE it should be noted that for this assessment available data fall within the reference period. As such this report details catch, effort and CPUE levels by fishing method and key species against which future performance can be assessed.

**Species assessments**

More detailed assessments are provided for striped trumpeter, banded morwong, sea garfish and wrasse. Descriptions of the fisheries, including fishing methods, seasonality and spatial distribution of catches are provided. In each case the 1998 assessment is largely restricted to an evaluation of catch, effort and CPUE data for the period 1995/96 - 1997/98.

*Striped trumpeter*

Although annual catches of striped trumpeter have been relatively stable over the three year period CPUE for the principal fishing methods (dropline, handline and graball) have generally increased. Recent strong recruitment of 1993 and 1994 cohorts is thought to have contributed

to this trend. The resource status is unknown but indicators based on catch and effort are likely to be influenced by recruitment variability.

*Banded morwong*

The fishery for banded morwong has expanded recently with the development of live fish markets for the species. Banded morwong are long-lived (up to 80 years) and productivity appears to be very low. In addition, the species tends to remain residential on particular reefs, suggesting that it will be susceptible to localised overfishing.

Research and commercial catch sampling has indicated that there is structuring within the overall population at a small spatial scale (to the level of a particular reef), which suggests that stock assessment needs to be undertaken at this level. However, commercial data are collected at the fishing block (¼ degree or 30 x 30 nautical mile) level, which may be too coarse to detect more localised depletions. Given the limited data available, analyses of catch, effort and CPUE have been undertaken at two different spatial scales (regional and block level). Catch, effort and CPUE has tended to be higher in the north-east compared to the south-east coast of Tasmania. It is unclear whether these differences reflect differences in general productivity between regions and/or the longer period of exploitation in the south-east (ie the resource may have been fished down to a greater extent in the south-east). Although catch and CPUE have declined only slightly over the past three years (based on analyses at regional and block levels) it is unclear whether this is indicative that current catch levels are more or less sustainable or that fishing is simply depleting accumulated biomass.

*Sea garfish*

Sea garfish catches, especially those taken by dip nets, have generally risen over the past three years. CPUE for beach seine has remained relatively stable whereas dip net catch rates have increase markedly. There is evidence to suggest that the fishery in the north-east, particularly around Flinders Island is targeting different size classes to that in the south-east. Differences may be attributed, in part at least, to the predominant fishing methods used in the two regions but may indicate some spatial structuring within the population. Resource status is unknown.

*Wrasse*

The development of live fish markets for wrasse, along with those for banded morwong, have resulted in increased catches in recent years. Two main species are involved, purple wrasse and blue-throat wrasse, though it is not possible to distinguish catches of either species from commercial catch returns. Overall, CPUE for the two main fishing methods (handline and fish trap) have been relatively stable over the past three years. Although wrasse are comparatively short-lived, attaining maturity well before they are recruited to the fishery, they demonstrate strong site attachment and, therefore, assessment needs to be based on an appropriate spatial scale. Collection and analysis of catch and effort data at the level of fishing block may mask more localised changes in abundance. Resource status is unknown.

Evaluation of trigger points has not been undertaken for these key species because:

- available catch, effort and CPUE data fall within the reference period against which these performance indicators are to be assessed, and
- biological information against which biological performance indicators could be assessed is limited.

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# 1 Management Objectives and Strategies

## 1.1 Major objectives

- To maintain fish stocks at sustainable levels by restricting the level of fishing effort directed at scalefish, including the amount and types of gear that can be used.
- To optimise yield and/or value per recruit.
- To mitigate any adverse interactions that result from competition between different fishing methods or sectors for access to shared fish stocks and/or fishing grounds.
- To maintain or provide reasonable access to fish stocks for recreational fishers.
- To minimise the environmental impact of scalefish fishing methods generally, and particularly in areas of special ecological significance.
- To reduce by-catch of juveniles and non-target species.
- To implement effective and efficient management.

## 1.2 Primary Strategies

- Limit total fishing capacity by restricting the number of licences available to operate in the fishery.
- Define allowable fishing methods and amounts of gear that can be used in the scalefish fishery.
- Monitor the performance of the fishery over time, including identification and use of biological reference points (or limits) for key scalefish species.
- Protect fish nursery areas in recognised inshore and estuarine habitats by prohibiting or restricting fishing in these areas.
- Employ measures to reduce the catch and mortality of non-target or undersized fish.
- Manage some developing fisheries under permit conditions.

## 1.3 Performance Indicators

The performance of the Scalefish Fishery Management Plan in meeting the objectives of maintaining biomass and recruitment, will be measured through a combination of performance indicators relating to the sustainability of the key target species, and the fisheries dependent on these species.

Performance indicators (or trigger points) will be assessed relative to the years 1990 to 1997, and/or the first two years of the management plan where such time series data do not exist. Analysis of fishery performance under this (initial) strategy will be examined and measured variously by the use of:

- trends in effort in the fishery;
- variations in the total catch of a species from year to year, or between seasons, regions and sectors;
- trends in catch per unit effort (CPUE) for a species;
- significant changes in biological characteristics of a fish species or population, such as a change in size or age structure; and
- other indicators of fish stock stress - e.g. disease or pollution effects.

It is recognised, however, that not all performance indicators are suitable for all species or fishing methods.

## 1.4 Trigger Points

Trigger points are levels of, or rates of change in, the 'performance' of the scalefish fishery that are considered to be outside the normal variation of the stock(s) and the fishery. The trigger points provide a framework against which the performance of the fishery can be assessed, and (if necessary) flag the need for management action.

A trigger point will be reached when one or more of the following criteria are met:

- total catch of a key target species is outside of the 1990 to 1997 range; or when, total catch of a key target species declines or increases in one year more than 30% from the previous year.
- fishing effort for any gear type, or effort targeted towards a species or species group, increases by 10% from the highest of the 1995 to 1997 levels.
- CPUE of a key target species is less than 80% of the lowest annual value for the period 1995 to 1997.
- a significant change in the size composition of commercial catches for key target species; or when monitoring of the size/age structure of a species indicates a significant change in the abundance of a year class (or year classes), with particular importance on pre-recruit year classes.
- a change in the catch of ‘trash’ or non-commercial fish relative to 1990 to 1997 records; or when incidental mortality of non-commercial species or undersized commercial fish is unacceptably high.
- significant numbers of fish are landed in a diseased or clearly unhealthy condition; or when a pollution event occurs that may produce risks to fish stocks, the health of fish habitats or to human health; or when,
- any other indication of fish stock stress is observed.

For the purposes of the current assessment, catch, effort and CPUE values are based on data for the period 1990/91 to 1997/98 and, therefore, fall within the reference period against which performance is to be assessed. In essence then, this fishery assessment report serves to *define* trigger points rather than *evaluating* fishery performance against these reference points.

# 2 The Fishery

## 2.1 General Background

The scalefish fishery has had a long history in Tasmania, developing soon after European settlement. In the early years fishing was mainly limited to sheltered bays and estuaries but over time has expanded to include coastal, shelf and upper slope waters.

The fishery is a multi-method and multi-species fishery, management of which is complicated by jurisdictional issues, with several key fish stocks harvested across a number of jurisdictions.

A wide range of fishing gears, the most important being gillnet, hooks and seine nets, are used to harvest a diverse range of scalefish, shark and cephalopod species. Other fishing gear in use include traps, Danish seine, otter trawl, dip nets, spears, etc. A listing of common and scientific names of species reported in catches is presented in Appendix 2.1.

Historically, Australian salmon, blue warehou and barracouta have been the major commercial scalefish species in terms of volume. Species of secondary importance include flathead, flounder, jackass morwong, bastard trumpeter, striped trumpeter and garfish.

With the exception of small scale operators (boats <20 m LOA), which are subject to the general scalefish management regime, the purse seine fishery for jack mackerel has operated under separate management arrangements since 1985.

Developments in markets and fish handling have resulted in recent increases in effort targeted at species such as banded morwong and wrasse, these rocky reef species being sold on the premium 'live fish' market.

Blue eye trevalla have traditionally been an important offshore species to Tasmania but, under a recent Offshore Constitutional Settlement (OCS) agreement, the Commonwealth has assumed management responsibility for the species, along with blue grenadier, gemfish, hapuka and others. Stock assessment of Commonwealth species is undertaken by the South East Fishery Assessment Group (SEFAG).

Shark, particularly school shark and gummy shark, have also been an important component of the catch in terms of both volume and value. In the longer term, the Commonwealth is likely to assume management responsibility for these species. Stock assessment for school and gummy shark is currently undertaken by the Southern Shark Fishery Assessment Group (SSFAG).

The main cephalopods taken are the southern calamary, arrow squid and octopus, catches of the latter increasing in recent years in response to market expansion.

Scalefish also represent the mainstay of the recreational fishery, with many of the same species targeted by both recreational and commercial fishers. Line fishing is the primary fishing method employed by recreational anglers but the use of gillnets and beach seines by recreational fishers is also permitted. Flathead, Australian salmon and barracouta are the main

line caught species, with blue warehou, bastard trumpeter, flounder and mullet comprising the bulk of the net catch.

## 2.2 Catch History

Although commercial catch returns have been collected in Tasmania since the 1940's only recent data are available for analysis. Unless otherwise specified, all catch data presented in this report have been derived from information provided by fishers in General Fishing Returns and relate only to catches reported in fishing blocks (either one degree or quarter degree) that include, or are adjacent to, Tasmanian State Fishing Waters (Fig. 2.1). Because of licensing arrangements, however, some catches may have been taken in Commonwealth waters by 'dual licensed' fishers. Other data restrictions and adjustments are discussed in Appendix 2.2.

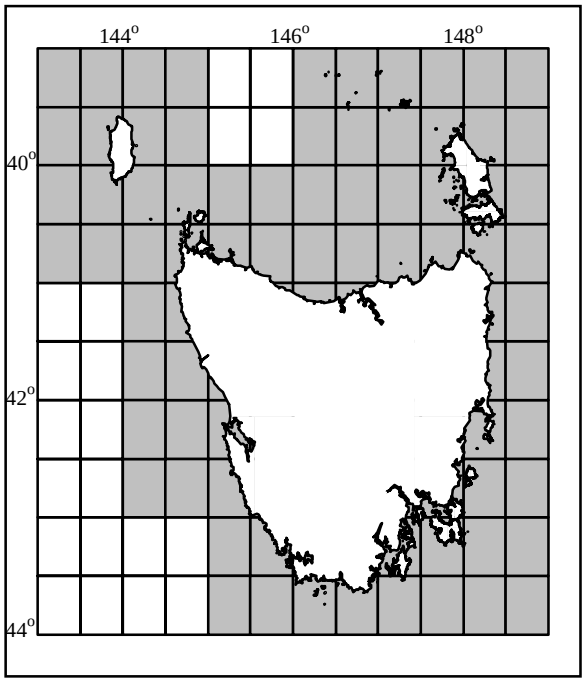



**Fig. 2.1** Shaded blocks represent fishing blocks used in calculation of catch figures.

Since 1969, annual[1] finfish production has generally ranged between 2000 and 5000 tonnes (Fig. 2.2). Catches of around 10000 tonnes were, however, reported in 1973/74 when particularly large quantities of jack mackerel and skipjack tuna were taken (refer also to Appendix 2.3). Total catches rose from around 2000 tonnes in the 1970s to about 5000 tonnes by the late 1980's before falling to around 2000 tonnes in recent years.

Scalefish catches fluctuated between 700-1500 tonnes p.a. from the late-1970's through to the late 1980's, increasing sharply to about 2500 tonnes in 1987/88, a level that was maintained until 1995/96. More recent catches have been somewhat lower, in the order of 1500-1700 tonnes p.a. Shark catches, on the other hand, increased gradually from around 700 tonnes in

[1] Based on July - June.

the early 1970's to over 2500 tonnes by the mid 1980's before declining to just 500 tonnes in 1997/98.

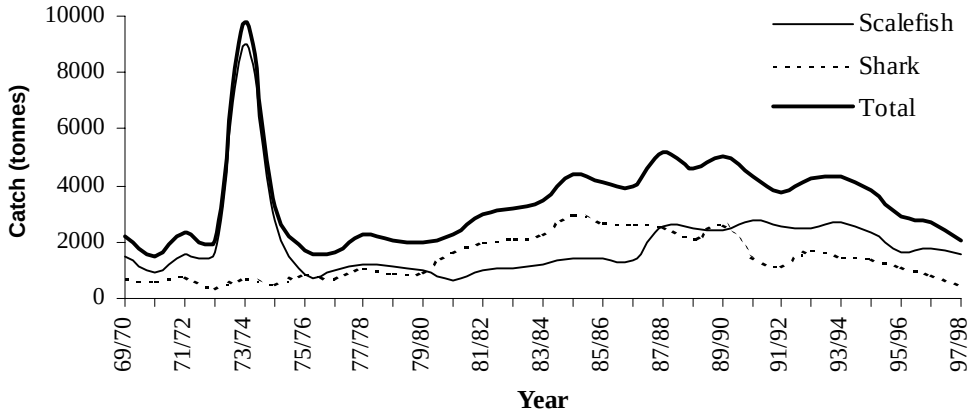



**Fig. 2.2** Annual catches for scalefish, shark and total production based on Tasmanian General Fishing Returns, for the period 1969/70 - 1997/98.

Several administrative changes in relation to reporting of catches have occurred since 1970 and have influenced the observed production levels. For instance, data prior to 1980 relate only to Tasmanian landings, whereas subsequent data also include landings made outside of Tasmania. In addition, since the early 1990s dual endorsed shark fishers have been encouraged to report catches on Victorian catch returns to avoid possible double counting of catches. Similarly, since late 1997 all operators with Commonwealth licences have been required to report catches on Commonwealth logbooks (and ceased reporting on the Tasmanian logbook), including catches taken from State waters. There is also the unknown impact on reporting accuracy of the change over from a monthly to a daily catch return in 1995.

Notwithstanding the above, catches are also influenced by other factors, including market considerations, gear and technological developments, changing fishing practices, management of other species and resource availability. As a consequence caution needs to be exercised when interpreting the significance of the observed catch trends.

Annual catches by species for the period 1969/70-1989/90 are provided in Appendix 2.3 while the more recent catch history is presented in Table 2.1. The importance of Australian salmon to the fishery is clearly evident, with catches generally exceeding 500 tonnes p.a. and peaking at over 1400 tonnes in 1974/75. Barracouta catches have undergone marked fluctuations, peaking at over 450 tonnes p.a. during the early 1970s before falling to less than 30 tonnes p.a. between 1978/79 and 1982/83. Catches rose again to over 200 tonnes p.a. between 1988/89 and 1992/93 but subsequently declined to current levels of less than about 60 tonnes p.a.

Exceptionally high catches of jack mackerel and skipjack tuna in 1973/74 were largely the result of targeted purse seine fishing operations. The fishing company involved, however, ceased operations after a single season (Williams *et al.* 1986). The subsequent development of the purse seine fishery for jack mackerel in the mid-1980s is not reflected in this analysis since a separate catch return system applies to that fishery (Williams *et al.* 1986).

Fishers often refer to blue warehou as “trevally” in catch returns and this has resulted in considerable confusion in the coding of species, blue warehou often being incorrectly coded as silver trevally, a problem particularly evident in pre-1990 data (Appendix 2.3). If it is assumed that most, if not all, of the fish coded as silver trevally are blue warehou, then it is apparent that the fishery for the species developed in the late 1970’s, yielding annual catches of 200-300 tonnes by the late 1980’s. Since 1995/96 catches have been lower at around 100-200 tonnes.

The fishery for blue eye trevalla expanded in the late 1980’s, with annual catches being maintained at over 300 tonnes. The fishery is now incorporated as part of the South East Non-trawl Fishery and since late 1997 all catch and effort data have been reported directly to the Commonwealth.

School and gummy shark have consistently accounted for the bulk of the shark catch, with saw shark of secondary importance. School shark dominated until the early 1980’s when gummy shark became the dominant species. Gummy shark catches peaked at over 1000 tonnes p.a. throughout the 1980’s, whereas school shark catches peaked at this level during the mid-1980’s. Reported catches have declined over subsequent years, the decrease exacerbated in recent years by dual endorsed fishers reporting catches to other jurisdictions.

A range of other species are also of importance to the fishery, many of which have undergone significant changes in catch levels over time. For instance, flathead, jackass morwong and whiting catches each increased in the late 1980s and early 1990s to over 100 tonnes p.a., largely due to expansion of inshore trawl activity (Lyle 1994a). Catches have declined sharply since, reflecting the decline in trawl effort.

The fishery for sea garfish experienced a relatively rapid expansion in the late 1980s to over 60 tonnes p.a., a level that has been maintained to the present. Both bastard and striped trumpeter catches increased in the late 1980’s to approximately 50 tonnes p.a. and have been relatively stable since that time.

The development of live fish markets for banded morwong and wrasse in the early 1990s is reflected in the sharp rise in catches, with banded morwong and wrasse currently yielding around 70 and 100 tonnes p.a., respectively.

**Table 2.1 Annual catch (whole weight) by species for the period 1990/91 to 1997/98 based on General Fishing Returns.**

| | *Catch (t)* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Species* | *90/91* | *91/92* | *92/93* | *93/94* | *94/95* | *95/96* | *96/97* | *97/98* |
| Alfonsino | 0 | 0 | 0.1 | 0 | 0.1 | 0.4 | 1.8 | 0.8 |
| Anchovy | 0 | 0 | 3.1 | 12.9 | 11.8 | 5.5 | 4.2 | 15.4 |
| Atlantic salmon | 0 | 0 | 0 | 1.7 | 0.1 | 0 | 0.2 | 0 |
| Australian salmon | 815.9 | 651.9 | 867.0 | 878.8 | 682.1 | 412.9 | 287.3 | 475.4 |
| Barracouta | 351.5 | 268.3 | 205.4 | 59.6 | 25.2 | 20.1 | 53.8 | 64.6 |
| Boarfish | 7.2 | 9.4 | 7.6 | 10.1 | 9.1 | 7.2 | 10.0 | 6.1 |
| Bream | 5.7 | 3.5 | 1.4 | 7.4 | 7.2 | 2.5 | 9.9 | 1.0 |
| Butterfish | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cardinal fish | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cod, deep sea | 0 | 0.9 | 4.6 | 2.4 | 1.8 | 2.2 | 1.4 | 0.1 |
| Cod, bearded rock | 0.6 | 0.4 | 0.9 | 2.4 | 0.6 | 4.7 | 3.8 | 1.8 |
| Cod, red | 0.1 | 0 | 1.3 | 1.3 | 0.5 | 0.5 | 1.5 | 0.5 |
| Cod, unspec. | 9.3 | 10 | 4.8 | 8.4 | 9.8 | 14.9 | 8.6 | 7.5 |
| Dory, john | 0.3 | 0 | 0 | 0.1 | 0.1 | 0.3 | 0.1 | 0 |
| Dory, king | 0.8 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 |
| Dory, mirror | 0 | 0 | 0.4 | 0 | 0 | 0 | 0.2 | 0.1 |
| Dory, silver | 0.4 | 0.5 | 0 | 0.4 | 0.5 | 0.1 | 0.3 | 0.5 |
| Dory, unspec. | 1.3 | 0.8 | 5.6 | 0.6 | 0.4 | 0 | 0.3 | 0.6 |
| Eel | 0.2 | 0.5 | 0.9 | 2.2 | 3.1 | 2.2 | 1.4 | 1.7 |
| Flathead | 165.3 | 118.1 | 98.8 | 121.4 | 91.1 | 57.8 | 51.7 | 62.6 |
| Flounder | 44.0 | 36.8 | 31.8 | 27.3 | 27.1 | 33.4 | 29.3 | 26.7 |
| Garfish | 80.9 | 80.1 | 82.3 | 82.9 | 69.3 | 58.0 | 91.6 | 80.6 |
| Gurnard | 18.6 | 18.4 | 13.2 | 13.1 | 9.8 | 9.0 | 8.2 | 5.7 |
| Gurnard perch | 0.1 | 0.2 | 1.0 | 0.6 | 1.9 | 0.4 | 0.1 | 0.8 |
| Gurnard, red | 0.1 | 0.2 | 1.0 | 1.0 | 1.0 | 0.9 | 0.3 | 0.7 |
| Hardyheads | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.2 | 0 |
| Herring cale | 0 | 0.3 | 0 | 0 | 1.1 | 1.1 | 0.5 | 1.7 |
| Kingfish, yellowtail | 1.3 | 0.2 | 2.8 | 0.1 | 0.3 | 1.2 | 0.3 | 0.1 |
| Knifejaw | 0.2 | 0 | 0.1 | 0.5 | 0.2 | 0 | 0.1 | 0.1 |
| Latchet | 13.9 | 10.0 | 6.5 | 12.4 | 11.9 | 6.1 | 3.3 | 1.9 |
| Leatherjacket | 12.2 | 14.0 | 13.1 | 23.3 | 27.7 | 15.0 | 12.6 | 13.2 |
| Ling | 5.1 | 13.6 | 30.0 | 41.6 | 33.2 | 20.4 | 23.5 | 10.9 |
| Luderick | 0.7 | 0.6 | 0.2 | 1.5 | 2.4 | 1.6 | 0.5 | 0.3 |
| Mackerel, blue | 3.0 | 2.1 | 0.3 | 8.5 | 5.7 | 2.0 | 1.3 | 1.0 |
| Mackerel, jack | 6.1 | 11.1 | 32.8 | 48.4 | 39.7 | 26.2 | 19.3 | 19.6 |
| Marblefish | 0.2 | 0.9 | 0.3 | 1.0 | 1.8 | 3.8 | 5.6 | 3.0 |
| Mixed | 99.7 | 66.1 | 61.0 | 52.9 | 15.0 | 11.5 | 13.7 | 9.4 |
| Morwong, banded | 7.0 | 6.9 | 39.2 | 145.5 | 105.8 | 87.9 | 79.0 | 71.7 |
| Morwong, blue | 0 | 0.3 | 0.3 | 0 | 0 | 0 | 0 | 0 |
| Morwong, dusky | 0.4 | 0 | 0 | 0.1 | 0.1 | 0 | 0 | 0 |
| Morwong, grey | 0 | 0.2 | 1.9 | 2.5 | 2.0 | 0 | 0.1 | 0.1 |
| Morwong, jackass | 136.9 | 111.9 | 83.2 | 117.6 | 63.1 | 27.5 | 18.8 | 33.1 |
| Morwong, red | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Morwong, unspec. | 2.2 | 1.9 | 2.7 | 5.6 | 3.3 | 3.4 | 5.9 | 6.7 |
| Mullet | 31.2 | 22.2 | 26.2 | 19.5 | 23.8 | 12.0 | 11.2 | 15.5 |
| Nannygai | 0 | 0.3 | 0 | 1.1 | 0.3 | 0.4 | 1.0 | 0.1 |
| Other | 0 | 0 | 0 | 0 | 0.1 | 0.8 | 0.5 | 2.3 |
| Perch, magpie | 1.2 | 3.2 | 0.3 | 5.7 | 2.7 | 1.9 | 1.5 | 0.6 |
| Perch, ocean | 1.7 | 0.2 | 4.1 | 4.6 | 1.3 | 2.8 | 3.8 | 2.3 |

**Table 2.1 Continued**

| | Catch (t) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Species* | *90/91* | *91/92* | *92/93* | *93/94* | *94/95* | *95/96* | *96/97* | *97/98* |
| Pike, long-finned | 0.1 | 0 | 0.1 | 0.3 | 0.2 | 0.3 | 3.1 | 3.6 |
| Pike, short-finned | 10.4 | 9.5 | 11.0 | 12.4 | 18.6 | 13.7 | 15.2 | 17.7 |
| Pilchard | 0.1 | 0 | 0.7 | 1.7 | 0.3 | 0.7 | 0 | 0 |
| Rays bream | 0 | 1.2 | 0.6 | 0.2 | 0.5 | 1.9 | 2.0 | 0 |
| Red bait | 0 | 0.7 | 0.8 | 0 | 0 | 0.1 | 0 | 0 |
| Red fish | 0.2 | 0 | 0 | 0 | 0.8 | 0 | 0 | 0.1 |
| Red mullet | 0.4 | 0 | 0.2 | 0.3 | 0.1 | 0.2 | 0.1 | 0 |
| Silverfish | 0.4 | 0 | 0.2 | 0 | 0.3 | 0 | 0.4 | 0.1 |
| Snapper | 0 | 0 | 0 | 0 | 0.2 | 0.2 | 0.2 | 0.9 |
| Stargazer | 10.7 | 3.0 | 1.2 | 4.3 | 1.5 | 0.2 | 0 | 0.3 |
| Sweep | 1.5 | 1.4 | 0.8 | 0.8 | 2.0 | 1.1 | 0.5 | 0.6 |
| Tailor | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 |
| Thetis fish | 0 | 0 | 0 | 0 | 0 | 1.1 | 0 | 0 |
| Trevalla, unspec. | 1.1 | 20.9 | 10 | 0.8 | 1.4 | 0 | 0 | 3.5 |
| Trevalla, white | 0.6 | 0 | 0.1 | 0 | 0.2 | 0 | 0.1 | 0 |
| Trevally, silver | 15.0 | 12.2 | 2.5 | 5.9 | 15.5 | 5.9 | 4.2 | 4.1 |
| Trevally, unspec. | 5.6 | 1.4 | 9.5 | 2.4 | 6.1 | 0 | 0 | 0 |
| Trout, rainbow | 0 | 0 | 0.5 | 0 | 0 | 0.4 | 0.7 | 3.6 |
| Trumpeter, bastard | 63.3 | 37.2 | 34.0 | 54.8 | 50.8 | 60.7 | 51.8 | 39.6 |
| Trumpeter, striped | 74.5 | 58.2 | 52.7 | 56.5 | 72.4 | 61.3 | 79.5 | 74.1 |
| Trumpeter, unspec. | 0.7 | 0 | 0 | 0.4 | 0.1 | 0.2 | 0.1 | 0.6 |
| Warehou, blue | 257.6 | 317.6 | 187.7 | 250.1 | 205.4 | 94.3 | 128.5 | 171.0 |
| Warehou, spotted | 0.7 | 0.4 | 4.2 | 8.8 | 3.4 | 14.6 | 15.6 | 4.2 |
| Whiptail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Whiting | 124.2 | 152.3 | 84.3 | 97.9 | 81.4 | 26.6 | 39.3 | 48.1 |
| Whiting, King George | 0.1 | 0.4 | 0.1 | 0.1 | 0.2 | 0.1 | 0.3 | 0.2 |
| Wrasse | 57.2 | 71.7 | 97.3 | 142.4 | 178.0 | 87.6 | 110.1 | 98.8 |
| **Total** | **2450.2** | **2154.3** | **2134.7** | **2366.6** | **1933.9** | **1230.0** | **1221.1** | **1418.3** |
| **Excl. Aus salmon** | **1634.3** | **1502.4** | **1267.7** | **1487.8** | **1251.8** | **817.1** | **933.9** | **942.9** |
| | | | | | | | | |
| **'Commonwealth' species** | | | | | | | | |
| Blue grenadier | 3.6 | 0.1 | 3.2 | 5.2 | 4.2 | 8.8 | 12.3 | 1.4 |
| Gemfish | 3.4 | 1.7 | 1.0 | 0.4 | 0.9 | 5.1 | 6.1 | 2.8 |
| Hapuka | 7.2 | 4.9 | 19.1 | 21.4 | 16.0 | 2.4 | 1.3 | 3.6 |
| Oreo | 0.5 | 0 | 0.1 | 0 | 0 | 0.1 | 0 | 0 |
| Trevalla, blue eye | 206.6 | 296.5 | 261.2 | 288.7 | 347.7 | 382.4 | 515.4 | 104.8 |
| **Total** | **221.3** | **303.2** | **284.6** | **315.6** | **368.8** | **398.7** | **535.1** | **112.6** |
| | | | | | | | | |
| **Tunas** | | | | | | | | |
| Tuna, albacore | 36.7 | 72.9 | 43.4 | 26.9 | 3.4 | 1.4 | 4.8 | 5.5 |
| Tuna, skipjack | 13.8 | 14.1 | 8.2 | 0.6 | 0.7 | 0.3 | 0.4 | 0.3 |
| Tuna, southern bluefin | 46.7 | 24.1 | 10.8 | 2.3 | 1.8 | 0.6 | 0.9 | 0 |
| Tuna, unspec. | 11.3 | 10.2 | 8.9 | 4.9 | 1.1 | 0.2 | 0.5 | 0.4 |
| **Total** | **108.4** | **121.3** | **71.3** | **34.7** | **7.1** | **2.4** | **6.5** | **6.3** |

**Table 2.1 Continued**

| | *Catch (t)* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Species* | *90/91* | *91/92* | *92/93* | *93/94* | *94/95* | *95/96* | *96/97* | *97/98* |
| **Shark** | | | | | | | | |
| Shark, angel | 0.6 | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.7 | 0.2 |
| Shark, blue whaler | 0.6 | 0 | 0.3 | 0.5 | 0.5 | 0.2 | 0.2 | 0.7 |
| Shark, bronze whaler | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 |
| Shark, elephant | 42.4 | 40.7 | 48.2 | 51.4 | 43.2 | 55.5 | 48.7 | 21.3 |
| Shark, gummy | 770.2 | 557.7 | 985.2 | 904.5 | 871.6 | 715.2 | 538.4 | 328.2 |
| Shark, saw | 121.4 | 66.1 | 121.7 | 140 | 148.4 | 116.6 | 72.5 | 26.8 |
| Shark, school | 457.1 | 395.3 | 469.6 | 345.3 | 333.1 | 239.5 | 170.8 | 70.7 |
| Shark, seven-gilled | 1.7 | 3.7 | 2.7 | 2.1 | 2.7 | 6.1 | 4.9 | 4.4 |
| Shark, spurdog | 0.1 | 0 | 0.2 | 1.5 | 3.1 | 0.3 | 1.4 | 0.5 |
| Shark, unspecified | 78.5 | 50.5 | 43.2 | 38.3 | 24.5 | 28.4 | 15.5 | 10 |
| Skates & rays | 2.6 | 7.4 | 5.1 | 6.3 | 5.9 | 7.4 | 2.0 | 3.6 |
| **Total shark** | **1475.5** | **1121.7** | **1676.5** | **1490.2** | **1433.2** | **1169.5** | **855.0** | **467.2** |
| **Excl. school & gummy sh.** | **248.2** | **168.7** | **221.7** | **240.4** | **228.5** | **214.8** | **145.8** | **68.2** |
| | | | | | | | | |
| **Cephalopod** | | | | | | | | |
| Calamary | 8.2 | 7.5 | 5.8 | 9.7 | 12.6 | 32.8 | 19.0 | 25.2 |
| Cuttlefish | 0.5 | 0.7 | 0 | 1.1 | 0.8 | 0.2 | 0.3 | 0.2 |
| Octopus | 32.2 | 35.2 | 47.4 | 58.2 | 55.3 | 77.1 | 40.8 | 42.6 |
| Squid, arrow | 35.1 | 7.2 | 7.0 | 7.7 | 8.6 | 2.6 | 2.5 | 9.7 |
| **Total cephalopod** | **75.9** | **50.6** | **60.1** | **76.7** | **77.4** | **112.3** | **62.6** | **77.7** |
| | | | | | | | | |
| **Crustacean** | | | | | | | | |
| Crab, sand | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crab, surf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crab, unspec. | 0 | 0.1 | 7.1 | 27.9 | 4.2 | 0.3 | 2.1 | 4.9 |
| **Total crustacean** | **0** | **0.1** | **7.1** | **27.9** | **4.2** | **0.3** | **2.1** | **4.9** |
| | | | | | | | | |
| **Grand total** | **4331.4** | **3751.2** | **4234.3** | **4311.5** | **3824.6** | **2913.5** | **2682.4** | **2087.0** |

## 2.3 Fishing methods

Several different types of gear are employed in the fishery but fishing method alone, however, does not adequately describe the fishery. Factors such as gear configuration (eg mesh size, arrangement and number of hooks, etc), habitat fished (eg substrate, depth, exposure, etc), fishing practices (eg set duration, bait, time of day/tide, etc), region and season, are important considerations in defining what species are targeted and caught. Commercial catch returns only provide some of this information and only as a daily summary of fishing activity.

Lyle (1998) recognised that the fishery is in effect comprised of several sub-fisheries which can be defined in terms of fishing method and species targeted/caught. Recognition of the sub-fisheries is critical for correct interpretation of trends in catch, effort and catch rate, all of which are influenced by the dynamics of the fishery, and in particular, changes in targeting practices.

### 2.3.1 Seine methods

*Beach seine*

Australian salmon is the main species taken by beach seine, accounting for 80% of the combined 1995/96 to 1997/98 beach seine catch (Table 2.2). Garfish are of secondary importance, accounting for just over 10% of the combined catch.

Based on an analysis of species associations (ie the level of co-occurrence of particular species in catches) and the relative importance of particular species (by weight) in individual catches, Lyle (1998) demonstrated that the beach seine fishery is comprised of at least two major sub-fisheries, one targeting Australian salmon (with a minor by-catch of garfish) and the other targeting garfish. Species such as short-fin pike and calamary occur largely as a by-catch of beach seining for garfish.

*Purse seine*

Calamary comprised almost 40% of the purse seine catch, with jack mackerel, anchovy and garfish also of some significance (Table 2.2**).** Data support the existence of a target fishery for calamary (in which garfish are also commonly caught), in addition to a small-scale purse seine fishery for jack mackerel and a developing one for anchovy[2] (Lyle 1998).

**Table 2.2 Total catch and catch compositions for seine fishing methods for the period 1995/96-97/98.**

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Beach seine | Australian salmon | 387.2 | 253.8 | 437.5 | **80.1** |
| | Calamary | 1.5 | 3.3 | 2.4 | **0.5** |
| | Garfish | 43.6 | 60.1 | 44.0 | **11.0** |
| | Jack mackerel | 13.6 | 6.2 | 3.7 | **1.7** |
| | Mullet | 5.7 | 4.4 | 7.9 | **1.3** |
| | Pike, short-finned | 4.1 | 7.1 | 5.3 | **1.2** |
| | Trevally, silver | 2.2 | 9.3 | 1.5 | **1.0** |
| | Other | 9.4 | 20.0 | 13.4 | **3.2** |
| | **Total** | **467.3** | **364.1** | **515.8** | **100.0** |
| Purse seine | Anchovy | 1.5 | 1.1 | 12.5 | **14.1** |
| | Australian salmon | 1.7 | 1.3 | 1.6 | **4.3** |
| | Calamary | 21.0 | 10.6 | 10.0 | **38.7** |
| | Garfish | 4.6 | 5.4 | 2.1 | **11.2** |
| | Jack mackerel | 4.1 | 9.4 | 11.7 | **23.5** |
| | Mullet | 0.4 | 2.0 | 2.8 | **4.9** |
| | Other | 2.0 | 0.7 | 1.1 | **3.5** |
| | **Total** | **35.2** | **30.4** | **41.8** | **100.0** |

[2] Probably a mix of fish of the fam. Clupeidae and Engraulidae

### 2.3.2 Gillnets

*Graball*

By definition, a graball is a gillnet with mesh size in the range 100-140 mm. A wide variety of scalefish and shark species are represented in graball catches (Table 2.3). Blue warehou, banded morwong and bastard trumpeter together account for over 60% of the total catch. Species of secondary importance include wrasse, flounder, jackass morwong, Australian salmon and striped trumpeter. Collectively, sharks accounted for just 4% of the graball catch.

Targeted fisheries exist for blue warehou and for banded morwong along with a small targeted fishery for flounder. Bastard trumpeter and wrasse are largely taken as a by-catch when targeting either blue warehou or banded morwong (Lyle 1998).

*Shark net*

Shark nets are gillnets with mesh sizes of greater than 150 mm. Gummy shark comprise the bulk (over 60%) of the overall shark net catch, followed by school shark and saw shark in importance (Table 2.3). In addition to shark, a number of scalefish species are also taken as by-catch, the most important being striped trumpeter. Collectively scalefish represent a very minor component (about 5%) of the shark net catch.

*Small mesh net*

Small mesh nets are gillnets of mesh size in the range 70-100 mm, the use of which is restricted, by regulation, to the north coast of Tasmania. Blue warehou and, to a lesser extent, Australian salmon, mullet (mainly yellow-eye mullet *Aldrichetta forsteri*) and short-finned pike dominate the catch (Table 2.3). Based on catch composition and relative importance of the major species, it is apparent that a target fishery exists for blue warehou, with Australian salmon occurring as a common by-catch (Lyle 1998). A mixed fishery also exists for species such as mullet, short-finned pike and Australian salmon.

**Table 2.3 Total catch and catch compositions for net fishing methods for the period 1995/96-97/98.**

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Graball net | Australian salmon | 13.0 | 14.1 | 16.3 | **3.8** |
| | Boarfish | 4.2 | 4.7 | 3.4 | **1.1** |
| | Cod | 5.4 | 5.9 | 4.7 | **1.4** |
| | Flounder | 18.7 | 11.9 | 13.8 | **3.8** |
| | Morwong, banded | 85.8 | 78.5 | 70.4 | **20.3** |
| | Morwong, jackass | 17.6 | 11.4 | 14.6 | **3.8** |
| | Shark, gummy | 4.3 | 9.1 | 12.9 | **2.3** |
| | Shark, other | 5.9 | 6.8 | 6.8 | **1.7** |
| | Trumpeter, bastard | 59.3 | 50.3 | 38.7 | **12.8** |
| | Trumpeter, striped | 10.3 | 16.5 | 17.0 | **3.8** |
| | Warehou, blue | 50.6 | 111.9 | 160.6 | **27.9** |
| | Wrasse | 19.2 | 16.0 | 18.7 | **4.7** |
| | Other | 52.8 | 41.5 | 52.6 | **12.7** |
| | **Total** | **347.1** | **378.7** | **430.6** | **100.0** |
| Shark net | Shark, elephant | 53.3 | 44.3 | 17.0 | **5.3** |
| | Shark, gummy | 649.9 | 459.9 | 263.1 | **63.1** |
| | Shark, saw | 114.0 | 70.7 | 25.2 | **9.6** |
| | Shark, school | 133.6 | 135.4 | 50.9 | **14.7** |
| | Shark, other | 16.3 | 11.6 | 7.4 | **1.6** |
| | Trumpeter, striped | 8.7 | 13.3 | 5.8 | **1.3** |
| | Other | 37.2 | 41.3 | 17.9 | **4.4** |
| | **Total** | **1012.9** | **776.6** | **387.3** | **100.0** |
| Small mesh net | Australian salmon | 3.6 | 6.1 | 3.5 | **15.2** |
| | Barracouta | 1.5 | 1.0 | 4.2 | **7.8** |
| | Cod | 0.4 | 1.1 | 0.2 | **2.0** |
| | Flathead | 1.4 | 0.8 | 0.9 | **3.5** |
| | Jack mackerel | 1.6 | 0.2 | 0.2 | **2.3** |
| | Mullet | 2.8 | 3.4 | 4.0 | **11.8** |
| | Pike, short-finned | 4.8 | 2.1 | 1.4 | **9.5** |
| | Warehou, blue | 20.7 | 9.3 | 4.3 | **39.5** |
| | Other | 1.8 | 3.1 | 2.3 | **8.3** |
| | **Total** | **38.7** | **27.0** | **21.1** | **100.0** |

### 2.3.4 Hook fishing methods

*Shark longline*

School and gummy shark clearly dominate the shark longline catch, comprising approximately 85% of the overall catch weight (Table 2.4). Scalefish, such as striped trumpeter and ling, represent a minor by-catch.

*Dropline*

The importance of blue eye trevalla as a dropline species is clearly evident, the species accounting for over 85% of the combined dropline catch (Table 2.4). Blue eye trevalla are fished on the continental slope (generally > 350 m depth) and are taken together with other

deepwater species such blue grenadier, gemfish, hapuka and ling. On the continental shelf (generally < 200 m), however, striped trumpeter represent the main target species, with jackass morwong and ocean perch taken as by-catch (Lyle 1998).

*Handline*

Of the species caught on handlines, wrasse have consistently dominated catches (44% by weight overall), with striped trumpeter and flathead of secondary importance (Table 2.4). Wrasse are targeted using handlines whereas striped trumpeter appear to be taken either as a by-catch of wrasse fishing (in depths of < 20 m) or may be targeted in their own right (generally at depths of > 40 m) (refer Section 4.2 & Lyle 1998). A small handline fishery also exists for flathead.

*Trolling*

Barracouta is the main species (72% by weight overall) caught by trolling, with Australian salmon and short-finned pike of minor significance, followed by albacore tuna (Table 2.4).

*Other*

Trotline and bottom longline are minor hook fishing methods, which take a range of shark (mainly school and gummy shark ) and scalefish (mainly flathead, ling and striped trumpeter).

**Table 2.4: Total catch and catch compositions for hook fishing methods for the period 1995/96-97/98.**

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Shark longline | Ling | 5.1 | 0.7 | 0.5 | **1.7** |
| | Shark, gummy | 48.5 | 65.0 | 46.4 | **44.4** |
| | Shark, school | 98.4 | 31.0 | 15.8 | **40.3** |
| | Shark, other | 9.4 | 6.2 | 4.1 | **5.4** |
| | Trumpeter, striped | 5.1 | 1.3 | 1.4 | **2.2** |
| | Other | 17.1 | 2.6 | 1.8 | **6.0** |
| | **Total** | **183.5** | **106.8** | **70.0** | **100.0** |
| Dropline | Blue grenadier | 8.3 | 12.1 | 0.9 | **1.9** |
| | Gemfish | 4.5 | 6.0 | 2.8 | **1.2** |
| | Hapuka | 2.0 | 1.2 | 3.6 | **0.6** |
| | Ling | 6.2 | 10.2 | 2.7 | **1.7** |
| | Morwong, jackass | 2.1 | 1.2 | 0.8 | **0.4** |
| | Trevalla, blue eye | 362.3 | 506.7 | 104.6 | **85.5** |
| | Trumpeter, striped | 16.5 | 27.7 | 20.1 | **5.7** |
| | Other | 15.3 | 14.2 | 6.2 | **3.1** |
| | **Total** | **417.2** | **579.4** | **141.6** | **100.0** |
| Handline | Australian salmon | 2.9 | 1.5 | 2.6 | **2.6** |
| | Barracouta | 1.5 | 2.7 | 3.5 | **2.9** |
| | Flathead | 9.2 | 9.7 | 10.0 | **10.8** |
| | Morwong, jackass | 2.5 | 1.4 | 2.2 | **2.3** |
| | Ocean perch | 1.4 | 1.6 | 1.0 | **1.5** |
| | Trumpeter, striped | 13.0 | 14.9 | 24.2 | **19.5** |
| | Wrasse | 29.2 | 46.8 | 42.0 | **44.1** |
| | Other | 16.2 | 15.6 | 12.2 | **16.4** |
| | **Total** | **76.0** | **94.2** | **97.7** | **100.0** |
| Trolling | Australian salmon | 3.7 | 6.2 | 6.3 | **10.3** |
| | Barracouta | 12.2 | 47.6 | 53.6 | **72.1** |
| | Pike, short-finned | 1.6 | 3.8 | 8.8 | **9.1** |
| | Tuna, albacore | 0.8 | 2.9 | 4.9 | **5.5** |
| | Tuna, other | 0.5 | 1.1 | 0.8 | **1.5** |
| | Other | 0.8 | 0.5 | 1.3 | **1.6** |
| | **Total** | **19.6** | **62.1** | **75.7** | **100.0** |

### 2.3.5 Trap methods

*Fish traps*

Wrasse for the live fish trade are targeted with fish traps and clearly dominate the catch (over 75% by weight). Leatherjackets represent the main by-catch in this fishery (Table 2.5).

*Other*

Octopus pots are specifically designed to catch octopus (Table 2.5). A number of species are taken incidentally in rock lobster pots, the main species being octopus, striped trumpeter, cod and conger eels.

**Table 2.5** Total catch and catch compositions for trap fishing methods for the period 1995/96-97/98.

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Fish trap | Leatherjacket | 6.6 | 7.3 | 8.2 | **14.8** |
| | Wrasse | 32.7 | 45.5 | 35.7 | **76.6** |
| | Other | 2.6 | 4.4 | 5.9 | **8.7** |
| | **Total** | **41.8** | **57.2** | **49.8** | **100.0** |
| Octopus trap | Octopus | 57.0 | * | * | **100.0** |
| | **Total** | **57.0** | ***** | ***** | **100.0** |
| Rock lobster | Cod | 3.0 | 1.7 | 0.8 | **13.5** |
| pot | Crab, unspecified | 0.2 | 2.0 | 4.8 | **17.1** |
| | Eel | 0.7 | 1.0 | 1.4 | **7.5** |
| | Ling | 1.0 | 0.1 | 0.8 | **4.6** |
| | Octopus | 6.1 | 2.5 | 1.3 | **24.1** |
| | Trumpeter, striped | 2.8 | 2.0 | 2.6 | **18.1** |
| | Other | 2.9 | 1.7 | 1.5 | **15.2** |
| | **Total** | **16.8** | **11.2** | **13.1** | **100** |

* For confidentiality reasons, where 5 or fewer vessels are involved catches can not be shown.

### 2.3.6 Trawl methods

Flathead and school whiting (*Sillago bassensis*) are the main species taken by Danish seine, whereas spotted warehou, jackass morwong and flathead are the major otter trawl species (Table 2.6). Targeting is a feature of the trawl fishery, for example when whiting are targeted by Danish seine, flathead tend to represent a minor catch whereas when flathead are targeted (in deeper water and with larger codend mesh size) whiting are rarely caught. The relative mix of species in the catch, therefore, tends to be determined more by targeting practices than availability.

**Table 2.6** Total catch and catch compositions for 'trawl' fishing methods for the period 1995/96-97/98.

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Danish seine | Cod | * | * | * | **1.9** |
| | Flathead | * | * | * | **44.4** |
| | Flounder | * | * | * | **1.5** |
| | Whiting | * | * | * | **48.0** |
| | Other | * | * | * | **4.2** |
| | **Total** | * | * | * | **100** |
| Otter trawl | Barracouta | * | * | * | **1.8** |
| | Flathead | * | * | * | **18.4** |
| | Ling | * | * | * | **5.2** |
| | Morwong, jackass | * | * | * | **24.2** |
| | Warehou, blue | * | * | * | **3.6** |
| | Warehou, spotted | * | * | * | **33.5** |
| | Other | * | * | * | **13.3** |
| | **Total** | * | * | * | **100.0** |

* For confidentiality reasons, where 5 or fewer vessels are involved catches can not be shown.

### 2.3.7 Other methods

Spears (and lights) are used to target flounder and to a lesser extent calamary in shallow water (Table 2.7). Dip nets are used to target garfish at night, with moderate quantities of calamary also taken generally by this method.

**Table 2.7: Total catch and catch compositions for 'other' fishing methods for the period 1995/96-97/98.**

| | | *Catch (t)* | | | |
|---|---|---|---|---|---|
| *Method* | *Species* | *1995/96* | *1996/97* | *1997/98* | *%* |
| Spear | Calamary | 2.4 | 3.1 | 2.9 | **18.0** |
| | Flounder | 8.7 | 15.3 | 10.3 | **73.0** |
| | Garfish | 0.5 | 0.1 | 0.0 | **1.4** |
| | Octopus | 0.6 | 0.2 | 0.2 | **2.2** |
| | Skate & rays | 1.5 | 0.0 | 0.0 | **3.2** |
| | Other | 0.3 | 0.5 | 0.4 | **2.3** |
| | **Total** | **14.0** | **19.2** | **13.7** | **100.0** |
| Dip net | Calamary | * | 1.3 | 3.7 | **9.7** |
| | Garfish | * | 21.4 | 27.4 | **84.3** |
| | Other | * | 1.4 | 1.9 | **6.0** |
| | **Total** | ***** | **24.1** | **33.1** | **100** |

* For confidentiality reasons, where 5 or fewer vessels are involved catches can not be shown.

## 2.4 Catching Sector

The types of vessels involved in the fishery range from small aluminium and wooden dinghies, to large steel vessels that take scalefish as part of diversified fishing operations (e.g. as an adjunct to rock lobster fishing). The design and gear set-up on the vessel reflects the particular operation that each is pursuing (e.g. mesh net boats deploying large amounts of net will often have net reels on board). The size of vessel used determines the operational range and weather conditions in which a vessel may fish.

The nature of the fishing operations is highly diverse with target species and gear configurations varying seasonally and by area. The fleet is also highly responsive to changes in market conditions, altering fishing patterns and target species according to demand and price. Such factors exert a significant influence on catch and effort data compiled from the fishery.

## 2.5 Management arrangements

### 2.5.1 Previous management arrangements

*Commercial fishery*

Until the introduction of the Scalefish Management Plan, the commercial fishery operated with minimal management controls on catch and effort. Access to much of the fishery was restricted only by the requirement that participants held a Tasmanian Fishing Boat Licence (TFBL) and/or a Commercial Fisherman's Licence. Generally there was no limit on the amount of graball net which could be set and, until recently, there were no limits on the

number of hooks which could be set, with the exception of shark and rock lobster fishers. All operators could also use a beach seine, spears, jigs, dip nets and up to two fish traps with no additional licences.

Other fishing methods or activities, including the use of purse seine nets and the targeting of shark (by hook or large mesh shark nets), required additional separate licences which were subject to additional specific conditions.

Other controls in the fishery have included size limits for key species and area closures, principally shark nursery areas and areas vulnerable to netting such as river mouths and estuaries, in which partial or all fishing activity is prohibited. Limits on the quantity of fishing gear that could be deployed also applied regionally.

*Recreational fishery*

In 1995, recreational net licences (graball, mullet net[3] and beach seine) were introduced. The number of nets issued to an individual was restricted to a maximum of two graball, one mullet net and one beach seine. A range of area closures to net fishing have also applied for many years.

Apart from shark nursery areas, there were few restrictions on the number of hooks that could be set. Size limits and bag limits were in place for selected species.

### 2.5.2 Scalefish Management Plan

*Commercial fishery*

The Scalefish Management Plan was introduced in 1998 and, for the commercial component of the fishery, identifies participants in the fishery and defines their level of access in terms of the amount and type of gear that can be used (DPIF 1998). The plan is structured around a 'base' licence which permits the use of gillnets, hooks and fish traps, with three levels of access (gear allocation) based on previous catch history.

Additional licences are required for specified gear, such as beach seine and purse seine. Pending development of new management arrangements for shark in southern Australia, separate fishing licences for Shark Hook and Shark Gillnet have been introduced.

The management plan also provides for the creation of separate fishing licences for Banded Morwong, Wrasse and Australian Salmon, with non-licence holders either prohibited from taking the species (banded morwong) or restricted in the quantities that can be held or landed. A number of species are also managed under permit conditions as developmental fisheries. Other management controls in the fishery include area closures and size limits for key species.

While not controlling effort directly, the new management arrangements have been developed to cap any potential expansion in effort, especially latent effort[4], largely by limiting the

[3] Mullet net is a small mesh net with mesh size of 60-70 mm.

[4] Note: in each year between 1990-96 an average of 220 operators (range 189-272) reported nil fishing activity for scalefish for each 12 month period (Lennon 1998)

amount of gear that any operator can use. However, the actual response to the new licensing arrangements in terms of catch and effort in the fishery will need to be monitored over time. Specifically, performance indicators (triggers) that relate to effort and catch will need to be assessed and evaluated.

*Recreational fishery*

New rules relating to the recreational fishery include restrictions on the number of hooks that can be set on a line, limits on the number of gillnets per boat and a reduction in the length of mullet nets.

Additional size limits and some bag limits have also been introduced.

# 3 Fishery Assessment

## 3.1 Data sources

Prior to 1995, catch returns were provided as monthly summaries of catches (landings) but were often incomplete in terms of detailing effort and gear information. Limitations of the old catch returns have been discussed in some detail by Lennon (1998) and, in summary, they provide basic information about production levels but are of little value in providing a meaningful basis for catch and effort analysis. In 1995 a new general fishing catch return was introduced, replacing the monthly return, with catch and effort information collected on a daily basis for each method used.

For the purposes of this assessment, analyses of *effort and catch rates* are restricted to data provided in the new logbook and for the period July 1995 - June 1998. Although introduced in early 1995, the new logbook was not widely adopted by operators until July 1995. For the reference period relating to *catch*, logbook data for the period July 1990 to June 1998 have been used. All catch returns available as at September 1998 have been incorporated into the analyses[5].

In terms of reporting annual data, a financial (July-June) rather than calendar year has been adopted. The primarily justification being that it better reflects the seasonality in the fishery for most species, with the bulk of the catch (and effort) taken from late spring to early autumn[6].

Data restrictions and manipulations are detailed in Appendix 2.2.

Limited information is available regarding the recreational fishery for scalefish. A state-wide survey of fishing activity by licensed recreational fishers was conducted between December 1996 - April 1998 and provides information about recreational gillnet effort and catches (Lyle, unpubl. data).

## 3.2 Recent Catch Trends

As the primary focus of this assessment is the Tasmanian scalefish fishery, limited references will be made to 'Commonwealth' species, tuna or shark. Cephalopods, principally octopus and calamary are, however included, as calamary is covered by the Scalefish Management Plan.

Overall production, excluding 'Commonwealth' species, tuna and school and gummy shark, was relatively stable at around 2400 tonnes during the period 1990/91 to 1994/95 (Fig. 3.1). More recent catches have been in the order of 1500 tonnes.

Over this period the number of vessels reporting at least some catch has fallen from almost 500 (1990/91) to just 370 (1997/98). The decline in the number of vessels fishing (and hence catch) is influenced to some extent to administrative changes in reporting of activity on the

[5] Approximately 10% of all 1997/98 catch returns remain outstanding. However, as they largely relate to the autumn/winter months the impact on catches is likely to be minor.

[6] An exception is garfish, refer to Section 6.

General Fishing Returns (refer section 2.2). Although participation in terms of number of operators is high, it is significant that the top 20 vessels (based on cumulative catch) have consistently accounted for about 50% of the overall catch. This clearly emphasises the diversity in the scale of individual operations, with some operators dependent on the fishery and others involved on a part-time basis, many of whom participate in other fisheries (eg rock lobster).

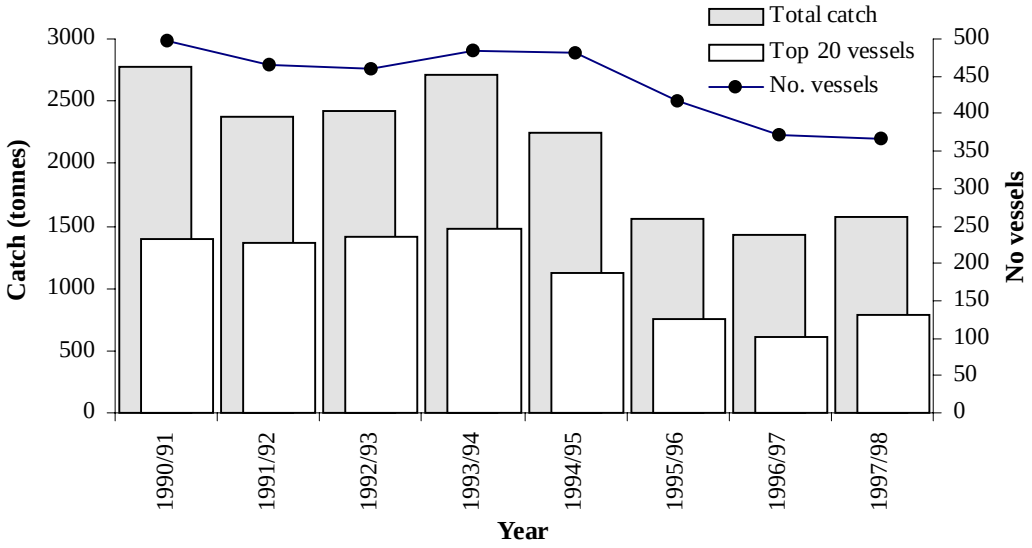



**Fig. 3.1** Annual catch and number of vessels reporting fishing activity in the Tasmania scalefish fishery since 1990.

Annual catches by species since 1990/91 are presented in Table 2.1. In effect, data represent reference points against which future catches will be assessed, a trigger being reached if catches fall outside this 'historic' range. Recent catch trends for the major species are summarised in Fig. 3.2.

Australian salmon have consistently dominated the scalefish catch, and apart from the last three years, catches have been in excess of 650 tonnes p.a. The recent decline in landings largely reflects a decline in the beach seine catch destined for the bait fish market, itself a response to reduced market demand.

Barracouta catches have declined markedly since 1992/93, poor market acceptance of the product and possibly reduced abundance have contributed to this trend. Periodic fluctuations in apparent abundance of barracouta in southern Australia have been well documented (Blackburn 1957).

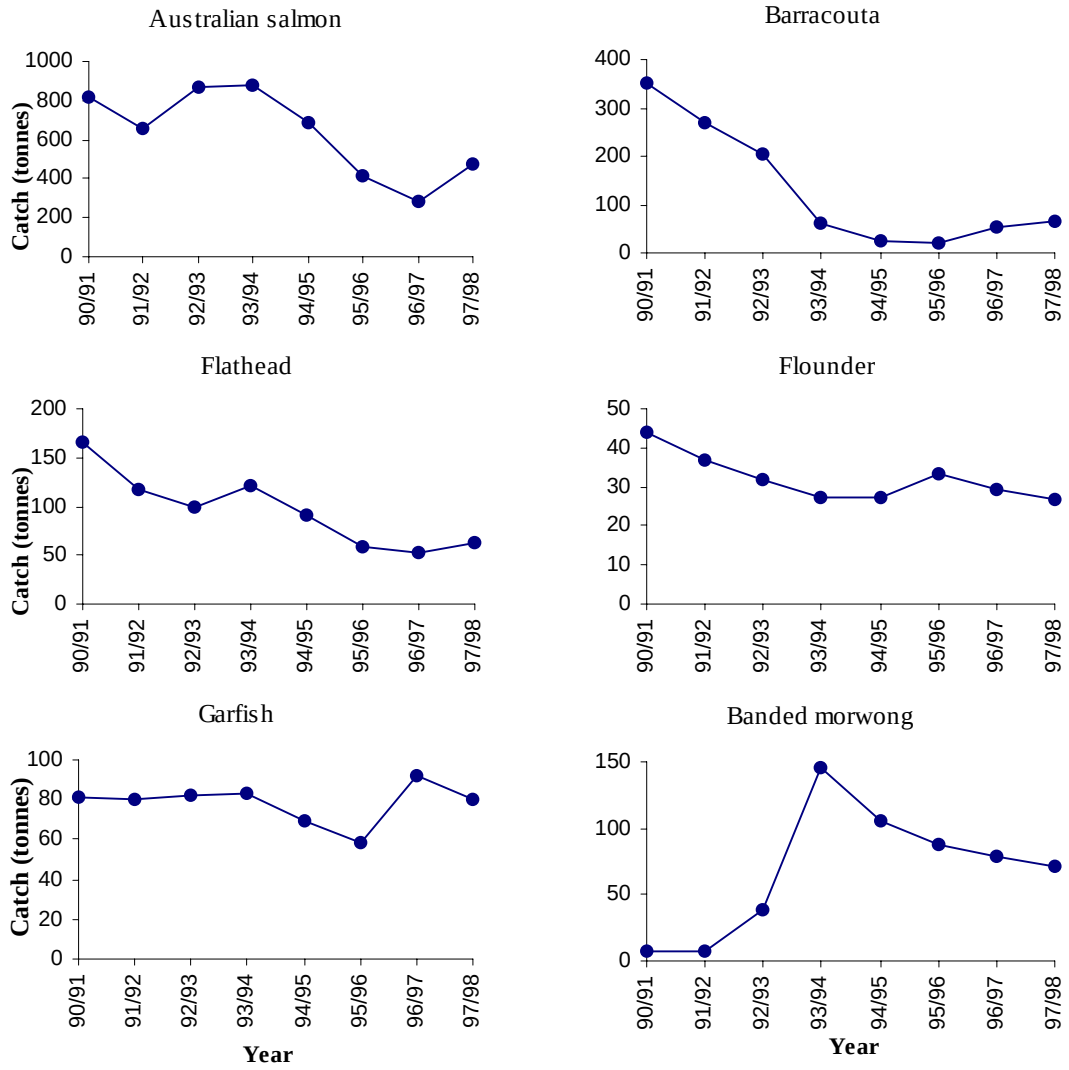
Catches of flathead, jackass morwong and whiting have all declined substantially in recent years, the decline in inshore trawl (otter trawl and Danish seine) fishing activity being a major contributing factor. For instance, between 1990 and 1993 there were between 9 and 12 otter trawl and Danish seine vessels operating in Tasmanian waters each year (Lyle 1994a), whereas since 1995 this number has fallen to 2-5 vessels.

Catch histories for garfish, flounder, bastard and striped trumpeter are characterised by relatively minor fluctuations since 1990.

The development of live fish markets for banded morwong and wrasse in 1993 resulted in a marked increase in the catches of both species. Since 1995/96, wrasse catches have stabilised at around 100 tonnes p.a. whereas banded morwong catches have undergone a slight decline, from almost 90 tonnes in 1995/96 to just over 70 tonnes in 1997/98.

Blue warehou catches demonstrate large fluctuations between years. This species is also harvested in the Commonwealth managed South East Fishery by both trawl and gillnet methods. Based on the spatial and temporal pattern of catches in the overall fishery, blue warehou appear to undergo a seasonal migration into Tasmanian inshore waters in late spring, moving away to the north in autumn. The size of the Tasmanian catch, therefore, appears to be highly dependent on the strength of the migration into coastal waters and the duration that the fish remain there, itself apparently related to water temperature and availability of feed (especially salps)[7].

Calamary and octopus catches have generally increased since the early 1990s, due largely to the recent expansion in targeted fishing for the species. A drop in effort, specifically potting effort, in the last two years accounts for the recent decline in the octopus catch (section 3.3.1).




[7] Blue warehou assessment is undertaken by the South East Fishery Assessment Group and data for the Tasmanian component of the fishery is factored into the analyses.

**Fig. 3.1** Annual catches for key species for the period 1990/91 - 1997/98.

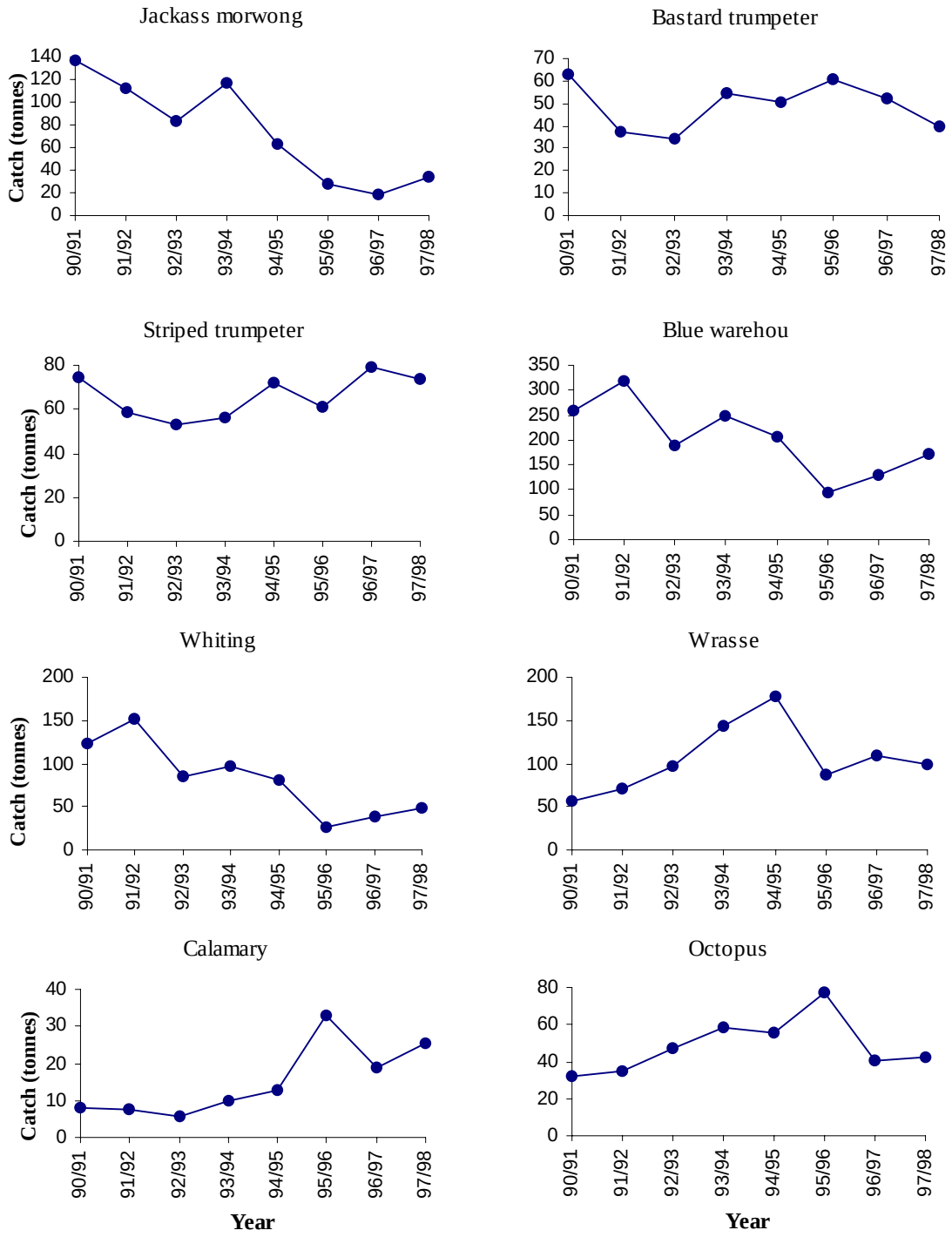



**Fig. 3.1** Continued

## 3.3 Effort

The Scalefish Management Plan contains two trigger points that relate to fishing effort, one based on effort relating to a particular gear type and the other based on effort targeted towards a species or species group. A trigger point is reached where effort increases by 10% from the highest of the 1995-1997 levels.

### 3.3.1 Method based effort

Method based effort triggers are intended more as indicators of fishery performance than as meaningful biological reference points. Specifically, the Scalefish Management Plan has been developed to limit the potential for expansion of fishing effort by defining/limiting access to the fishery. The impact or performance of the new management arrangements may, therefore, be assessed in terms of trends in fishing effort, which need to be considered at the level of fishing method. In undertaking such an evaluation it needs to be recognised that the new licensing arrangements did not take effect until November 1998, and thus impacts will not be evident for a complete year until 1999/2000.

Catch, effort and catch per unit effort (CPUE) by method is presented in Table 3.1[8]. Unstandardised CPUE has been calculated as total catch divided by total effort. Since a range of fishing methods are represented it has been necessary to express effort in different units according to the specific fishing method (Table 3.2).

Dropline fishing has been restricted to depths of less than 200 m to exclude fishing for blue eye trevalla. As less than 1% of the striped trumpeter catch is reported from depths greater than 200 m, this depth restriction effectively encompasses the target dropline fishery for striped trumpeter.

Data presented in Table 3.1 constitute reference points against which future levels of effort can be assessed. For most methods there is no obvious consistent trend in effort levels over the three year period. Handline, trolling and dip net fishing methods are exceptions, with effort increasing each year whereas purse seine and small mesh net effort levels have declined consistently.

Given the short time series available few inferences about the status of the fishery can be made based on these data.

[8] Shark net and shark longline have been excluded from the analysis as the methods are primarily used to target shark (refer also section 2.3).

**Table 3.1 Total catch, effort and CPUE by fishing method for the period 1995/96-97/98.**

| | *Method* | *Year* | *Catch (kg)* | ***Effort*** [+] | *CPUE* [+] |
|---|---|---|---|---|---|
| Seine | Beach seine | 1995/96 | 466338 | **1018** | 458.09 |
| | | 1996/97 | 363638 | **1325** | 274.55 |
| | | 1997/98 | 515194 | **1155** | 446.06 |
| | *Beach seine* | *1995/96* | *79137* | ***938*** | *84.37* |
| | *(excl Aust salmon)* | *1996/97* | *109834* | ***1258*** | *87.34* |
| | | *1997/98* | *77648* | ***939*** | *82.69* |
| | Purse seine | 1995/96 | 35179 | **416** | 84.57 |
| | | 1996/97 | 30432 | **321** | 94.80 |
| | | 1997/98 | 41792 | **315** | 132.67 |
| Gillnet | Graball | 1995/96 | 342050 | **219414** | 1.56 |
| | | 1996/97 | 368821 | **228303** | 1.62 |
| | | 1997/98 | 416408 | **196560** | 2.12 |
| | Small mesh net | 1995/96 | 38515 | **10953** | 3.52 |
| | | 1996/97 | 26889 | **7940** | 3.39 |
| | | 1997/98 | 20929 | **7746** | 2.70 |
| *Hook* | Dropline | 1995/96 | 19604 | **444** | 44.14 |
| | (< 200m) | 1996/97 | 29507 | **419** | 70.40 |
| | | 1997/98 | 21297 | **463** | 46.03 |
| | Handline | 1995/96 | 73593 | **17047** | 4.32 |
| | | 1996/97 | 89587 | **21358** | 4.19 |
| | | 1997/98 | 94002 | **23509** | 4.00 |
| | Troll | 1995/96 | 18204 | **2521** | 7.22 |
| | | 1996/97 | 58102 | **7578** | 7.67 |
| | | 1997/98 | 69846 | **10020** | 6.97 |
| Traps | Fish trap | 1995/96 | 41815 | **8229** | 5.08 |
| | | 1996/97 | 57196 | **10700** | 5.35 |
| | | 1997/98 | 49684 | **9779** | 5.08 |
| | Octopus pot | 1995/96 | 57056 | **875354** | 0.07 |
| | | 1996/97 | * | * | 0.06 |
| | | 1997/98 | * | * | 0.06 |
| 'Trawl' | Danish seine | 1995/96 | * | * | 143.07 |
| | | 1996/97 | * | * | 195.86 |
| | | 1997/98 | * | * | 188.66 |
| | Otter trawl | 1995/96 | * | * | 64.62 |
| | | 1996/97 | * | * | 75.81 |
| | | 1997/98 | * | * | 54.96 |
| Other | Spear | 1995/96 | 13943 | **1372** | 10.17 |
| | | 1996/97 | 19211 | **1836** | 10.46 |
| | | 1997/98 | 13743 | **1541** | 8.92 |
| | Dip net | 1995/96 | * | * | 17.45 |
| | | 1996/97 | 24124 | **1509** | 15.99 |
| | | 1997/98 | 33088 | **1668** | 19.83 |

* Five or fewer vessels involved, catch and effort data not shown

[+] For units of effort and CPUE refer to Table 3.2.

**Table 3.2 Table of effort and CPUE units**

| *Method(s)* | *Effort units* | *CPUE units* |
|---|---|---|
| Beach seine/purse seine | No. of shots | kg per shot |
| Graball/small mesh net | 100 m net hour | kg per 100 m net hour |
| Dropline | 100 hook lifts | kg per 100 hooks |
| Handline/troll | Line hours | kg per line hour |
| Fish trap/octopus pot | No. trap or pot lifts | kg per trap or pot lift |
| Danish seine | No. of shots | kg per shot |
| Otter trawl | Hours trawled | kg per trawl hour |
| Spear/dip net | Fisher hours | kg per fisher hour |

### 3.3.2 Species based effort

Catch, effort and unstandardised CPUE for the major species or species groups by fishing method are presented in Table 3.3. As is evident from section 2.3, individual species may be taken by a variety of methods, either as a target or non-targeted by-catch.

Targeting is an important and relevant issue when considering effort, a fact that is highlighted in the species based performance indicators outlined in the scalefish plan. Although targeting is not reported in the General Fishing Returns some inferences can be made by considering the relative importance of a species to each catch. Based on experience in other fisheries and field observations in this fishery, when a species is targeted it will, generally, account for a significant proportion of the catch. There will, however, be times when target species are either not caught or only represent a minor component of the catch. In such instances, the correct classification of fishing operations will be difficult and targeted fishing effort at a particular species will be incorrectly classified.

For the purposes of this general fishery overview, however, the issue of whether effort is targeted or not is not addressed. Rather, effort is recorded when a species is reported in the catch (either when targeted or taken as by-catch).

Although based on only three data points trends are apparent in a number of cases (Table 3.3). There is evidence of a marked decline in graball effort for flathead and flounder, moderate declines for banded morwong and Australian salmon and a general increase in effort for blue warehou. Graball effort for other species tended to fluctuate with no consistent pattern over the three years. For barracouta small mesh net effort declined strongly whereas trolling effort increased markedly. Dip net effort for garfish and calamary has increased over the three years.

In relation to the status of the fishery and resources, few inferences can be made on the basis of recent effort levels. Information presented in Table 3.3, however, represent reference data against which future performance will be assessed.

**Table 3.3 Catch, effort and catch rate by method for key species. Based on General Fishing Returns for the period 1995/96 - 1997/98.**

| *Species* | *Method* | *Year* | *Catch (kg)* | *Effort*$^{+}$ | *CPUE*$^{+}$ |
|---|---|---|---|---|---|
| Australian salmon | Beach seine | 1995/96 | 387201 | 207 | 1870.54 |
| | | 1996/97 | 253804 | 236 | 1075.44 |
| | | 1997/98 | 437546 | 352 | 1243.03 |
| | Graball | 1995/96 | 12969 | 11245 | 1.15 |
| | | 1996/97 | 14094 | 10919 | 1.29 |
| | | 1997/98 | 16308 | 8074 | 2.02 |
| | Handline | 1995/96 | 2873 | 1642 | 1.75 |
| | | 1996/97 | 1484 | 744 | 1.99 |
| | | 1997/98 | 2579 | 1391 | 1.85 |
| | Small mesh net | 1995/96 | 3642 | 3303 | 1.10 |
| | | 1996/97 | 6074 | 3636 | 1.67 |
| | | 1997/98 | 3514 | 3452 | 1.02 |
| | Troll | 1995/96 | 3666 | 681 | 5.38 |
| | | 1996/97 | 6187 | 891 | 6.94 |
| | | 1997/98 | 6233 | 671 | 9.28 |
| Barracouta | Graball | 1995/96 | 1447 | 3345 | 0.43 |
| | | 1996/97 | 1428 | 3718 | 0.38 |
| | | 1997/98 | 1465 | 1698 | 0.86 |
| | Small mesh net | 1995/96 | 1495 | 4623 | 0.32 |
| | | 1996/97 | 1034 | 2398 | 0.43 |
| | | 1997/98 | 4225 | 1838 | 2.30 |
| | Handline | 1995/96 | 1542 | 1333 | 1.16 |
| | | 1996/97 | 2679 | 832 | 3.22 |
| | | 1997/98 | 3518 | 1035 | 3.40 |
| | Troll | 1995/96 | 12206 | 1590 | 7.68 |
| | | 1996/97 | 47625 | 6295 | 7.57 |
| | | 1997/98 | 53450 | 8973 | 5.96 |
| Flathead | Graball | 1995/96 | 4031 | 21110 | 0.19 |
| | | 1996/97 | 2212 | 13718 | 0.16 |
| | | 1997/98 | 2739 | 7908 | 0.35 |
| | Handline | 1995/96 | 9212 | 5421 | 1.70 |
| | | 1996/97 | 9728 | 5231 | 1.86 |
| | | 1997/98 | 9969 | 6398 | 1.56 |
| | Danish seine | 1995/96 | * | * | 68.71 |
| | | 1996/97 | * | * | 81.58 |
| | | 1997/98 | * | * | 96.17 |
| | Otter trawl | 1995/96 | * | * | 19.02 |
| | | 1996/97 | * | * | 17.02 |
| | | 1997/98 | * | * | 5.68 |
| Flounder | Graball | 1995/96 | 18721 | 71138 | 0.26 |
| | | 1996/97 | 11886 | 47513 | 0.25 |
| | | 1997/98 | 13718 | 34584 | 0.40 |
| | Spear | 1995/96 | 8677 | 1192 | 7.28 |
| | | 1996/97 | 15265 | 1693 | 9.02 |
| | | 1997/98 | 10281 | 1427 | 7.20 |
| Garfish | Beach seine | 1995/96 | 43589 | 696 | 62.63 |
| | | 1996/97 | 60089 | 1046 | 57.47 |
| | | 1997/98 | 43787 | 718 | 60.98 |

**Table 3.3 Continued**

| *Species* | *Method* | *Year* | *Catch (kg)* | *Effort*$^{+}$ | *CPUE*$^{+}$ |
|---|---|---|---|---|---|
| Garfish | Dip net | 1995/96 | * | * | 12.91 |
| | | 1996/97 | 21375 | 1486 | 14.39 |
| | | 1997/98 | 27429 | 1612 | 17.02 |
| | Purse seine | 1995/96 | 4581 | 286 | 16.02 |
| | | 1996/97 | 5360 | 120 | 44.67 |
| | | 1997/98 | 2082 | 35 | 59.49 |
| Banded morwong | Graball | 1995/96 | 85845 | 68803 | 1.25 |
| | | 1996/97 | 78531 | 64564 | 1.22 |
| | | 1997/98 | 70379 | 58187 | 1.21 |
| Jackass morwong | Graball | 1995/96 | 17551 | 13379 | 1.31 |
| | | 1996/97 | 11431 | 11758 | 0.97 |
| | | 1997/98 | 14583 | 20997 | 0.69 |
| | Dropline | 1995/96 | 2120 | 271 | 7.81 |
| | | 1996/97 | 1180 | 476 | 2.48 |
| | | 1997/98 | 755 | 118 | 6.37 |
| | Handline | 1995/96 | 2525 | 1961 | 1.29 |
| | | 1996/97 | 1411 | 1141 | 1.24 |
| | | 1997/98 | 2248 | 1336 | 1.68 |
| Bastard trumpeter | Graball | 1995/96 | 59292 | 76793 | 0.77 |
| | | 1996/97 | 50346 | 80425 | 0.63 |
| | | 1997/98 | 38571 | 58310 | 0.66 |
| Striped trumpeter | Graball | 1995/96 | 10257 | 17068 | 0.60 |
| | | 1996/97 | 16480 | 23430 | 0.70 |
| | | 1997/98 | 16973 | 14807 | 1.15 |
| | Dropline | 1995/96 | 16533 | 546 | 30.29 |
| | | 1996/97 | 27746 | 736 | 37.72 |
| | | 1997/98 | 19822 | 524 | 37.83 |
| | Handline | 1995/96 | 13035 | 3494 | 3.73 |
| | | 1996/97 | 14873 | 3815 | 3.90 |
| | | 1997/98 | 24247 | 6028 | 4.02 |
| Blue warehou | Graball | 1995/96 | 50636 | 42045 | 1.20 |
| | | 1996/97 | 111897 | 86533 | 1.29 |
| | | 1997/98 | 160574 | 85778 | 1.87 |
| | Small mesh net | 1995/96 | 20726 | 4093 | 5.06 |
| | | 1996/97 | 9265 | 3363 | 2.76 |
| | | 1997/98 | 4309 | 3551 | 1.21 |
| Whiting | Danish seine | 1995/96 | * | * | 94.08 |
| | | 1996/97 | * | * | 134.45 |
| | | 1997/98 | * | * | 183.40 |
| Wrasse | Graball | 1995/96 | 19159 | 30426 | 0.63 |
| | | 1996/97 | 16030 | 27253 | 0.59 |
| | | 1997/98 | 18596 | 32874 | 0.57 |
| | Handline | 1995/96 | 29195 | 7620 | 3.83 |
| | | 1996/97 | 46830 | 13232 | 3.54 |
| | | 1997/98 | 41936 | 11077 | 3.79 |
| | Fish trap | 1995/96 | 32655 | 7813 | 4.18 |
| | | 1996/97 | 45548 | 10331 | 4.41 |
| | | 1997/98 | 35601 | 9365 | 3.80 |

**Table 3.3 Continued**

| *Species* | *Method* | *Year* | *Catch (kg)* | *Effort*[+] | *CPUE*[+] |
|---|---|---|---|---|---|
| Calamary | Beach seine | 1995/96 | 1453 | 163 | 8.91 |
| | | 1996/97 | 3324 | 319 | 10.44 |
| | | 1997/98 | 2433 | 267 | 9.11 |
| | Purse seine | 1995/96 | 20969 | 322 | 65.12 |
| | | 1996/97 | 10561 | 226 | 46.73 |
| | | 1997/98 | 10015 | 236 | 42.44 |
| | Spear | 1995/96 | 2384 | 269 | 8.87 |
| | | 1996/97 | 3111 | 333 | 9.35 |
| | | 1997/98 | 2929 | 328 | 8.93 |
| | Dip net | 1995/96 | * | * | 4.66 |
| | | 1996/97 | 1340 | 563 | 2.38 |
| | | 1997/98 | 3705 | 760 | 4.88 |
| Octopus | Graball | 1995/96 | 5463 | 1173 | 4.66 |
| | | 1996/97 | 1962 | 2039 | 0.96 |
| | | 1997/98 | 4051 | 2848 | 1.42 |
| | Octopus pot | 1995/96 | 56985 | 875304 | 0.07 |
| | | 1996/97 | * | * | 0.06 |
| | | 1997/98 | * | * | 0.06 |

* Five or fewer vessels involved, catch and effort data not shown
[+] For units of effort and CPUE refer to Table 3.2.

## 3.4 Catch rates

Trends in catch rate (CPUE) for a species are defined as performance indicators. CPUE values by method for key species are presented in Table 3.3 and, effectively, a trigger will be reached if future CPUE values are less than 0.8 times the lowest value for the period 1995/96 to 1997/98.

In a number of instances consistent trends in CPUE are apparent. For example, graball CPUE for Australian salmon, striped trumpeter and blue warehou generally increased whereas CPUE for jackass morwong and for wrasse exhibited a slight decline over the three years. For striped trumpeter, dropline and handline CPUE were also observed to increase slightly. Danish seine CPUE for flathead and whiting increased, as did purse seine CPUE for garfish, trolling CPUE for Australian salmon and small mesh net and handline CPUE for barracouta. By contrast, CPUE declined for barracouta taken by trolling, flathead caught by trawl, blue warehou taken by small mesh nets and calamary by purse seine. Catch rates for other species/methods tended to fluctuate without a consistent pattern or, as in the case of banded morwong (graball) and octopus (octopus pots), were relatively stable over the period.

In view of the lack of an adequate time series of CPUE data it is not possible to draw inferences about the status of any of the stocks based on this information.

## 3.5 Recreational fishery

### 3.5.1 Gillnet fishery

Since the introduction of licences for recreational nets in 1995/96, the number of licensed nets has increased steadily from around 8900 to 10100, suggesting a potential increase in recreational netting effort over the period (Table 3.4).

**Table 3.4 Number of recreational gillnet licences issued by licensing year.**

| *Licence type* | *1995/96* | *1996/97* | *1997/98* |
|---|---|---|---|
| Graball Net 1 | 5615 | 6290 | 6685 |
| Graball Net 2 | 2612 | 2678 | 2683 |
| Mullet Net | 656 | 684 | 738 |
| **Total No. Licences** | **8883** | **9652** | **10106** |

Preliminary results from a State-wide survey of recreational gillnetting indicate that in 1997 a total of 307500 hundred meter net hours of effort was expended for a catch of approximately 236 tonnes of finfish (Table 3.5). By comparison, commercial graball effort was around 190000 hundred meter net hours, producing a catch of 373 tonnes.

Blue warehou clearly dominate the recreational catch representing about 45% of the catch. Species of secondary importance include bastard trumpeter, Australian salmon, silver trevally and striped trumpeter. For several species it is evident that the recreational component of the gillnet catch is significant in relation to the commercial catch (Table 3.5), and therefore it is important that the impact of the recreational fishery is also taken into account in stock assessments.

**Table 3.5 Comparison of catch and effort for recreational and commercial graball fisheries for 1997.**

| | *Gillnet catch (tonnes)* | |
|---|---|---|
| *Species* | *Recreational* | *Commercial* |
| Blue warehou | 105.6 | 109.3 |
| Bastard trumpeter | 23.7 | 50.4 |
| Australian salmon | 19.4 | 13.0 |
| Silver trevally | 17.8 | 1.3 |
| Striped trumpeter | 11.6 | 17.7 |
| Cod | 8.9 | 5.5 |
| Leatherjacket | 7.0 | 2.7 |
| Jackass morwong | 5.6 | 13.6 |
| Flounder | 4.6 | 12.5 |
| Jack mackerel | 2.3 | 2.5 |
| Other | 29.5 | 144.5 |
| **Total** | **236** | **373** |
| *Effort (100 m net hours)* | *307531* | *189267* |

### 3.5.2 Other methods

Apart from gillnetting, there has been no comprehensive assessment of the recreational scalefish fishery. However, information about fishing activity by recreational licence holders has been collected. Although data analysis is incomplete, it is evident that species such as flathead, Australian salmon, barracouta and striped trumpeter are important to the line fishery

while flounder are commonly targeted using spears. Catches of several species are likely to be significant when compared with the size of the commercial catch.

## 3.6 Evaluation of trigger points

No evaluation of trigger points has been conducted since available catch and effort data fall within the reference period against which future performance of the fishery will be assessed.

## 3.7 Uncertainties

While considerable effort has been made to ensure comparability of commercial catch and effort data over time (refer Appendix 2.2), it is acknowledged that some recent administrative changes (refer section 2.2) in the reporting of catches have, nonetheless, exerted an influence on observed catch and effort trends.

Other uncertainties in this fishery assessment relate to limitations in catch and effort data, both in terms of short time series available and the detail of information collected from the commercial fishery. Within the context of the time series available, three years of data collection is insufficient to infer meaningful trends in the status of either the fishery or fish stocks. In addition, since the new logbook was designed to encompass a diverse range of fishing activities compromises have been necessary, with data collection on a daily rather than operational (set or shot) basis. The lack of information about targeting also complicates interpretation of CPUE.

Catch and effort (at the fishing method and species levels) are influenced by a combination of factors which include fishers matching their fishing operations against changing market requirements and/or resource availability as well as responses to changing management arrangements. The latter will result in further uncertainty regarding the underlying causes of any observed trends in catch and effort. There is, therefore, a clear need to factor in the dynamics of the fishery, including impacts of management change when assessing the fishery as a whole.

## 3.8 Implications for Management

In many respects the commercial fishery is in a state of flux, not only in response to changing marketing requirements and/or resource availability but also to management changes. Not only has the introduction of the Scalefish Management Plan defined access and gear entitlements but recent changes in other fisheries, such as the Tasmanian rock lobster fishery (move to a ITQ management system) and the Commonwealth non-trawl fishery, are also likely to have an impact on fisher's behaviour. For example, it is possible that there will be an effort shift into the less regulated (in terms of catch) scalefish fishery.

As an indicator of fishery and resource status, a considerable time series of catch and effort data is required. In the short to medium term, considerable uncertainty will be associated with this fishery in regards to the implications of trends in catch and effort.

# 4 Striped Trumpeter (*Latris lineata*)

## 4.1 Stock structure and Life-History

Striped trumpeter are distributed throughout southern Australia, from Sydney around to Kangaroo Island in South Australia, including Tasmania. The species is also found in New Zealand. They are reported to grow to 1.2 m in length and 25 kg in weight (Gomon *et al*. 1994). While they occur mainly on the continental shelf over rocky bottom to depths of about 300 m, juveniles are known to occur on shallow reefs throughout Tasmania.

As nothing is known of the stock structure of striped trumpeter in Australian waters a common stock throughout its range is assumed for management purposes.

Very little is known of the life-history of striped trumpeter. Spawning occurs from July to early October, depending on geographical location (Ruwald *et al.* 1991), with spawning commencing and finishing earlier at lower latitudes. Females reach maturity at a smaller size and age (44 cm and 5 years) than males (53 cm and 8 years) (Hutchinson 1994). Striped trumpeter are multiple spawners, highly fecund (100 000 to 400 000 eggs for females weighing 3.2 and 5.2 kg, respectively) and produce small pelagic eggs (1.3 mm diameter) with a single oil droplet (Ruwald *et al.* 1991, Ruwald 1992, Hutchinson 1994). Larval rearing trials indicate a complex and extended larval phase, with metamorphosis from the post-larval 'paperfish' stage probably occurring up to nine months after hatching. The distribution of larvae and recruitment processes are unknown.

While no information is available on the size and timing of settlement, small juveniles at around 18 cm have been caught on shallow reefs throughout south-eastern Tasmania in January (Murphy and Lyle 1999). Juveniles appear to remain in shallow reefs for several years, with most fish moving less than 5 km over this time, although a small proportion have been found to move between 5 and 30 km. There is some indication from tagging data of movement of larger juveniles into deeper offshore reefs. This is supported by data from the commercial fishery which shows fish around 45 cm entering the offshore fishery.

Growth in juveniles is rapid, reaching a mean length of around 28 cm after two years and 42 cm after four years, with most growth occurring during summer and autumn (Murphy and Lyle 1999). Older fish grow significantly slower, with a large range in size-at-age in fish over approximately 50 cm. Maximum age is currently estimated to be 31 years, and while this has yet to be validated, the incremental structure in sectioned otoliths is clear and unambiguous. Age composition, mortality rates and productivity have not been estimated.

Few biological parameters have been defined for striped trumpeter (see Appendix 2.4). The growth parameters defined are represented by few fish >70 cm and is from unvalidated age estimates in fish > 5 years old.

## 4.2 The Fishery

### 4.2.1 Brief history

Striped trumpeter have been fished commercially in Tasmania since the late 1800's, with almost 5500 fish reported from the Hobart fish market during 1888. Catches during the 1970's were small at less than 0.5 tonne per year, although this may reflect the misreporting of

fish as bastard trumpeter. During the 1980's catches increased steadily, reaching a peak of around 78 tonnes in 1989/90 (see Appendix 2.3).

Little information is available on the relative importance of different fishing methods prior to 1995 as the old Monthly General Fishing Return had hook fishing methods defined only as longlining or trolling, with other hook methods generally coded as 'other' methods. Assuming that most, if not all, of the 'other' category in returns refer to hook fishing (dropline and handline), then over 75% of the total catch in each year was taken on hooks (Lyle 1994b). Most of the remainder was taken by gillnet and in 1989 gillnets accounted for 60% total catch. Southern shark endorsed operators account for a large portion of the gillnet catch by targeting scalefish, primarily blue warehou, on deep reef areas.

Since 1990, landings from vessels with exclusively a TFBL have remained between around 50 to 80 tonnes per year, peaking in 1996/97 (Fig. 4.1). The fishing blocks used for calculation of catches are presented in Fig. 2.1. The inclusion of catches from vessels with either Victorian or dual Tasmanian and Victorian licences fishing south of 39°12' increases these landings to around 70 to 100 tonnes per year, peaking at 111 tonnes in 1990/91 (Fig. 4.1).

The value of the striped trumpeter fishery has fluctuated considerably since 1990, driven by variations in catch levels and price. With striped trumpeter currently commanding a beach price of around $5 per kg the fishery has an estimated annual value of approximately $0.4 million (Fig. 4.1).

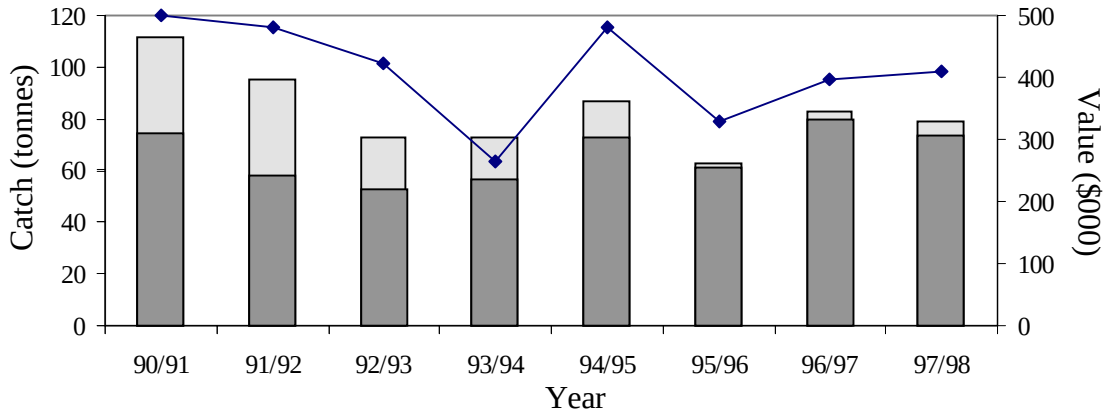



**Fig. 4.1** Annual landings (bars) and value ($,000) (CPI adjusted) (diamonds) of striped trumpeter in Tasmania between July 1990 and June 1998. Dark bars represent landings from vessels with only a TFBL while the light bars represents landings from vessels with Victorian only or dual Tasmanian and Victorian licences.

Small fisheries for striped trumpeter also exist in Victoria and South Australia where catches have been less than 5 tonnes per annum in recent years (Stewart *et al*. 1991).

There appears to be little seasonality in landings, although in some years, particularly in 1997, catches were highest during summer and autumn, falling to relatively low levels during winter and early spring (Fig. 4.2). Few fishers target striped trumpeter consistently throughout the year, rather the species is taken sporadically, often when rock lobster fishing or as an adjunct to other types of fishing.

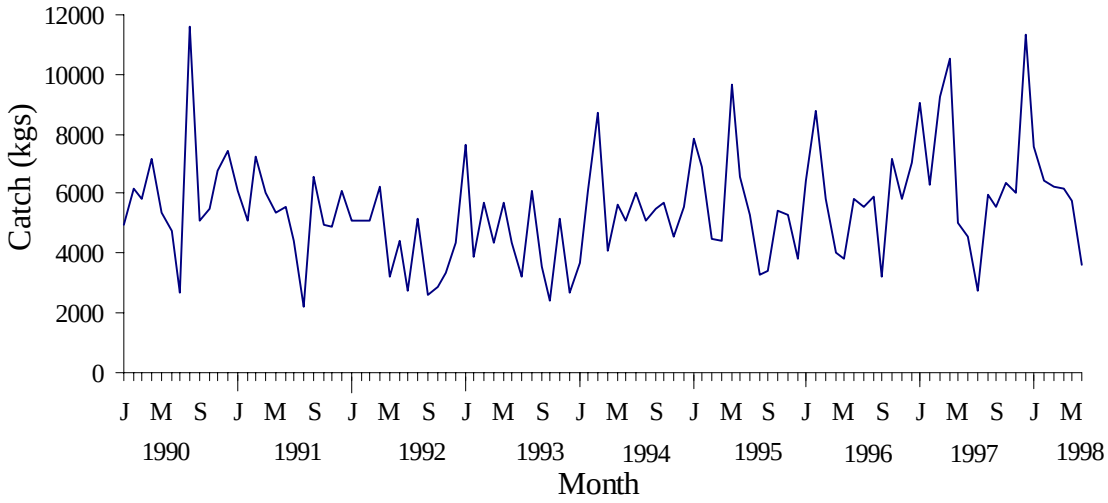



**Fig. 4.2** Monthly landings of striped trumpeter in Tasmania between January 1990 and June 1998.

### 4.2.2 Current situation

*Commercial Fisheries*

Striped trumpeter are currently taken by a wide range of fishing methods, including hook and gillnet. Incidental catches are occasionally taken in rock lobster pots. Hook fishing is the most important fishing method and involves the use of multi-hook handlines and droplines which account for around 55% of the catch (Fig. 4.3). Striped trumpeter are target fished, although there is generally a considerable by-catch of ocean perch and jackass morwong. Handlines (hand operated winch type), droplines and trotlines are employed with hooks baited with either squid, octopus or fish. Fishing operations are conducted over hard bottom, with droplines fished in depths of 60-140 m and handlines between 40-80 m and 120-160 m (Fig. 4.4).

There is evidence of an increase in the catch of striped trumpeter by dropline in 1996/97 and 1997/98, particularly in the deeper reef areas (around 140 m) in 1996/97. This was not consistent with handline catches which only showed an increase in 1997/98. Striped trumpeter are also taken on longlines as a by-catch of fishing for school shark.

Southern Shark Fishery endorsed operators also take a by-catch of striped trumpeter in gillnets when targeting shark or scalefish (mainly blue warehou) on reef areas between approximately 80-120 m. Reflecting their more inshore distribution, juvenile striped trumpeter are generally taken in graball nets in inshore reef areas less than 20 m deep (Fig. 4.4), and are often taken along with a number of other scalefish species. Between 1995 and 1998 the graball catch represented around 20% of Tasmanian landings.

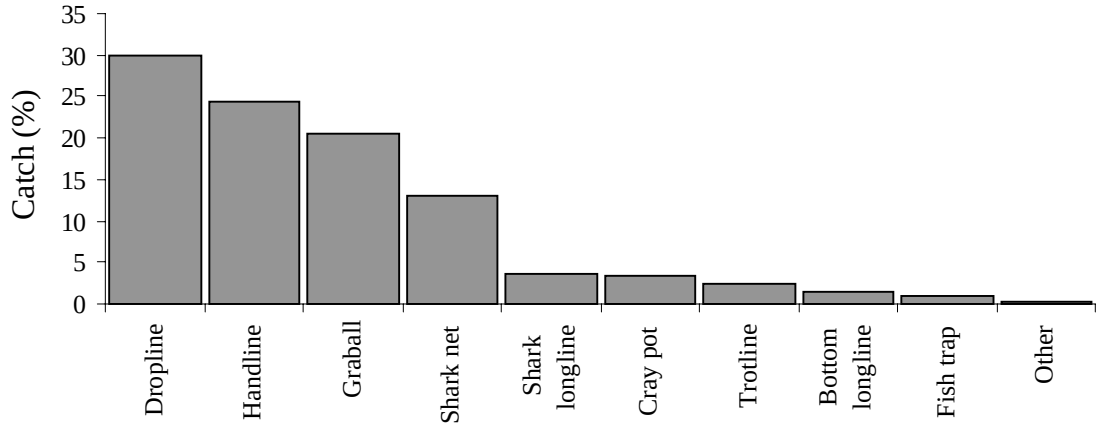



**Fig. 4.3** Proportion of catches of striped trumpeter by fishing method between July 1995 and June 1998.

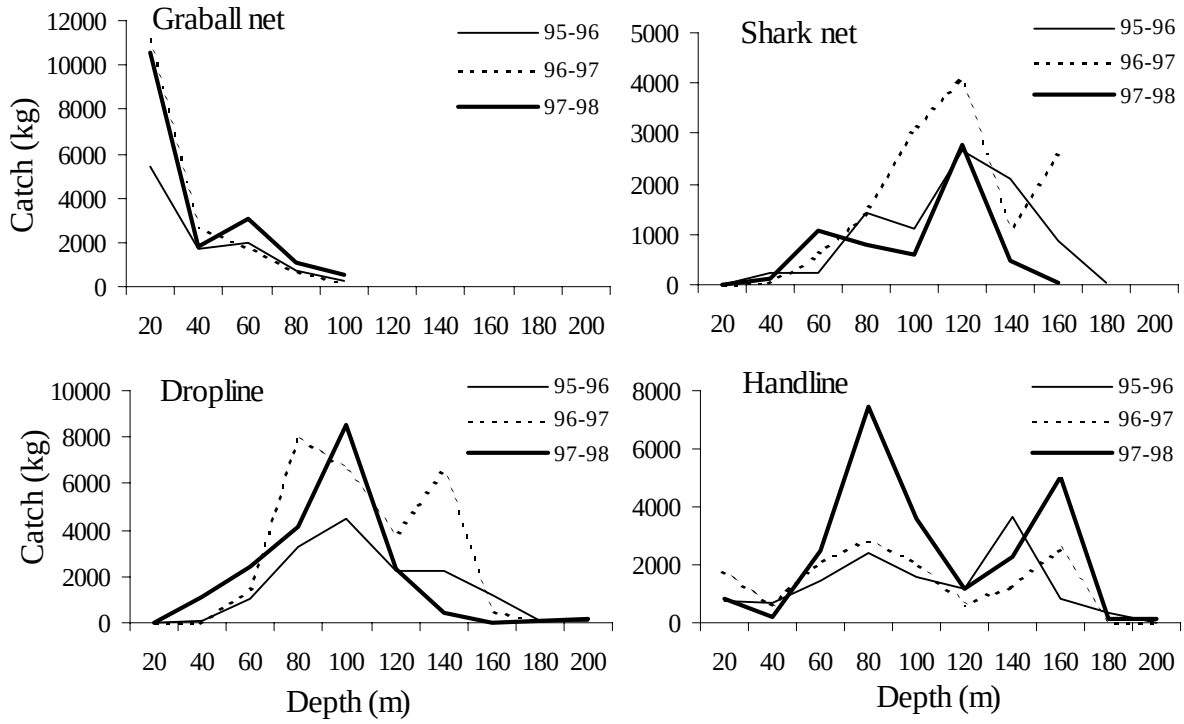



**Fig. 4.4** Catch (kg) of striped trumpeter in 1995/96, 1996/97 and 1997/98 by graball, shark net, dropline and handline across 20 m depth classes.

In order to examine the spatial distribution of catches, returns for 1995/96 to 1997/98 have been summarised by fishing block (Fig. 4.5). Striped trumpeter are taken commercially around the entire Tasmanian coastline, with the greatest portion of the catch being taken from shelf grounds along the length of the east and south-east coasts and off Flinders Island. Highest catches have been consistently taken off north-eastern Tasmania (blocks 4H and 5H), which accounted for about 42% of the total catch. The next most important area is in the south-east (block 7G), which has accounted for 20% of the catch over the past three years. Relatively small catches are taken from the north-west, west and south-west coasts. There are few indications of a significant shift in the spatial distribution of catches between years, although there is some evidence of an increase in catches in the north-east in 1996/97.

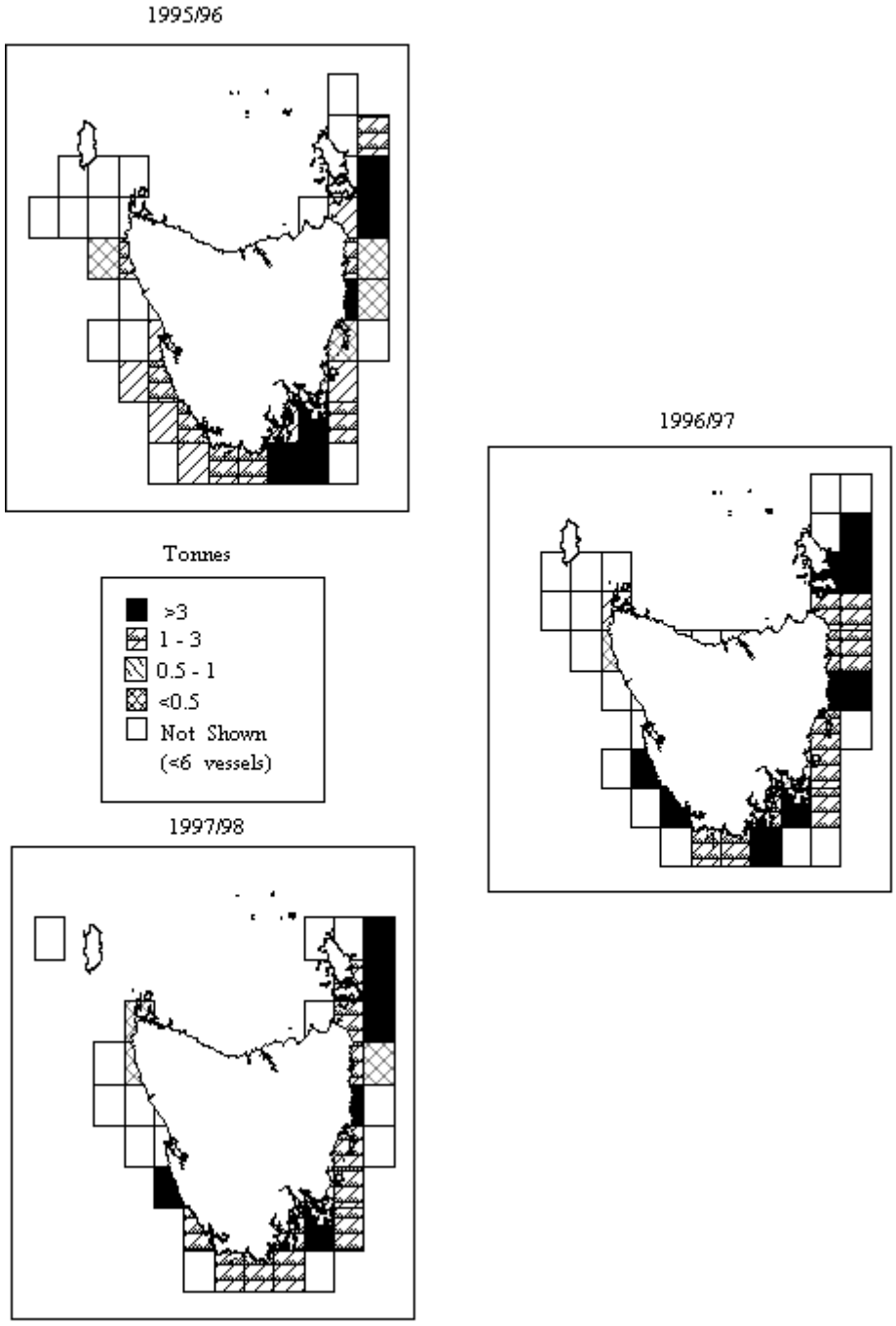



**Fig. 4.5** Spatial distribution of striped trumpeter catches throughout Tasmania by financial year between July 1995 and June 1998.

There is little data available on the size composition of striped trumpeter in commercial catches. Limited catch sampling of the hook caught component of the fishery shows fish ranging from 42 to 85 cm, with the majority of the catch between 50 and 70 cm (Fig. 4.6). This indicates that striped trumpeter enter the offshore hook fishery at around 45 cm, at an age of around 5-6 years. As growth slows considerably around this age, the dominant 50-70 cm size class represents fish over a broad range of ages.

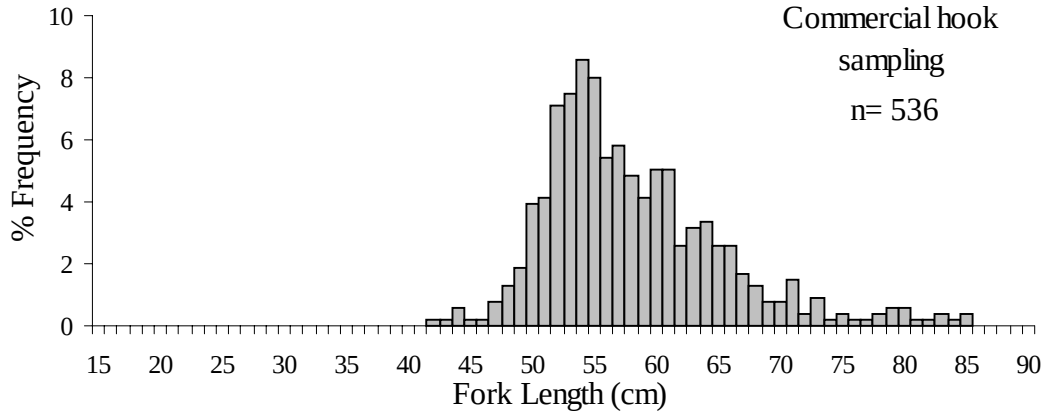



**Fig. 4.6** Size composition of striped trumpeter in commercial hook catches in Tasmania (based on 1990-93 data).

*Recreational fishery*

Striped trumpeter are fished for by recreational anglers using gillnets and hooks, although the size of the overall catch, main fishing areas and level of fishing activity are unknown. Preliminary estimates of the 1997 recreational gillnet catch indicate a catch of almost 12 tonnes, which compares with a commercial graball catch of around 18 tonnes for the same period (see Table 3.5). The size of the recreational hook catch is unknown, though it is clear that fishers target the species on shallow as well as deep water reefs.

Juvenile striped trumpeter have been relatively abundant in inshore waters over recent years (Murphy and Lyle 1999), and recreational anglers are known to target the species along with bastard trumpeter. While limited data is available on the size composition of recreational catches, recent catch sampling of both graball and hook caught fish revealed fish over a large size range (33 to 82 cm), with the majority of fish between 40 and 60 cm (Fig. 4.7) (Lyle and Campbell 1998).

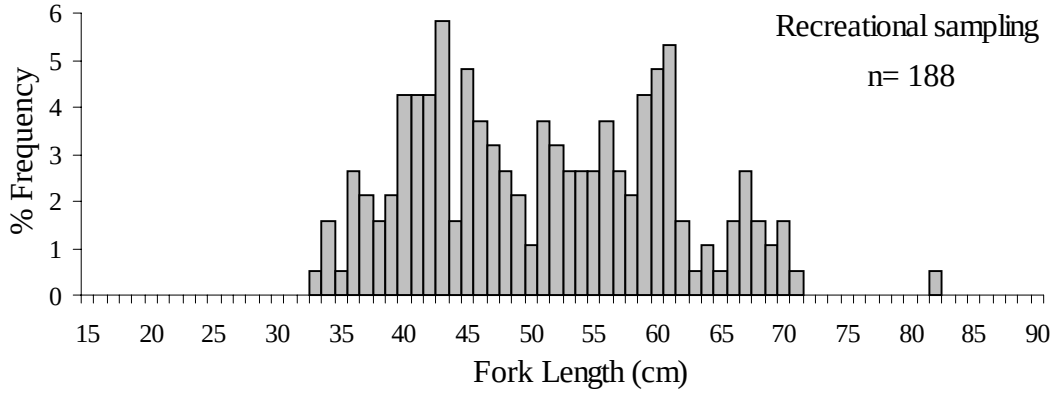



**Fig. 4.7** Size composition of striped trumpeter in the recreational fishery across Tasmania.

## 4.3 Previous Assessments

No previous assessments have been conducted on striped trumpeter. Catch data previously summarised for the years 1980-92 show a considerable increase in landings over this period (Lyle 1994). However, the lack of data on fishing effort meant that there was no information on the significance of this increase in relation to the sustainability of the resource. Hence,

while there are anecdotal reports from fishers of localised overfishing, insufficient data is available to support this conclusion.

## 4.4 Current Assessment

### 4.4.1 Recent Developments

While little research has been conducted on striped trumpeter, a recent study by Murphy and Lyle (1999) in Tasmanian waters examined aspects of mesh selectivity, movement and age and growth of juveniles. They found evidence of strong recruitment of the 1993, and to a lesser extent, the 1994 year-classes into inshore reefs of south-eastern Tasmania. Anecdotal evidence suggests that prior to this time very few striped trumpeter had recruited to inshore reefs for at least 20 years. There was also little evidence of older year-classes in inshore waters during the 1995 to 1997 survey period. The strength of the 1993 and 1994 cohorts allowed juvenile growth to be described.

This evidence of strong recruitment of the 1993 and 1994 year-classes has important implications for the interpretation of trends in catch and CPUE in the fishery. While there are no data to assess the relative strength of the subsequent year-classes, the expected movement of these two year-classes into the offshore hook fishery is expected to influence catches in this sector in the coming years.

The size composition of striped trumpeter from inshore reefs of south-eastern Tasmania was examined between 1995 and 1997 using 64, 89, 105 and 114 mm mesh (Murphy and Lyle 1999). All fish caught were juveniles, with fish ranging from 18 to 47 cm and most fish between 27 and 42 cm (Fig. 4.8). The overall size composition was strongly influenced by a single cohort representing the 1993 year class that grew in size during the period of the study and the size of the meshes used.

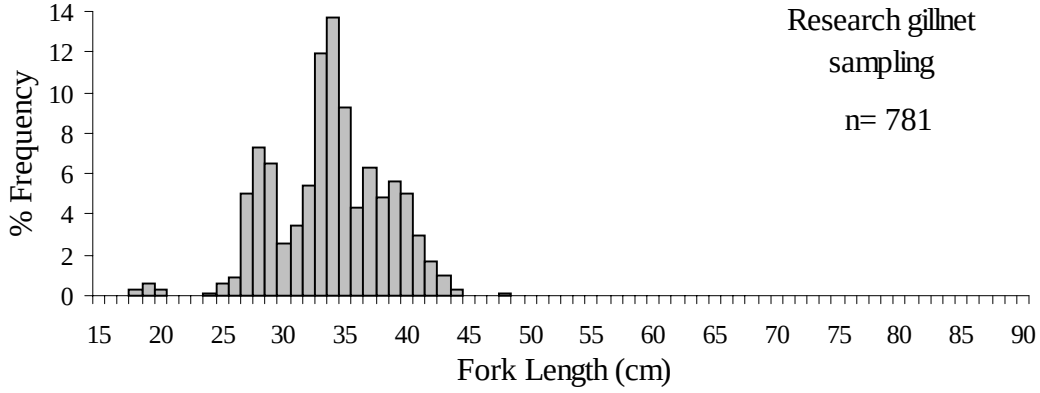



**Fig. 4.8** Size composition of striped trumpeter taken in research sampling of inshore reef areas throughout eastern and south-eastern Tasmania.

### 4.4.2 1998 Assessment

Given the lack of targeted assessment research, the 1998 assessment is restricted to analysis of trends in catch, effort and catch per unit effort (CPUE) for the period 1995/96 to 1997/98. The estimate of CPUE relates to the catch rate of striped trumpeter taken in both targeted and non-targeted fishing operations. Although several types of fishing gears are used to catch striped trumpeter, examination of trends in these parameters have been restricted to those for

dropline, handline and graball net, these methods accounting for around 75% of landings for the period of analysis.

There has been no significant change in the annual catch of striped trumpeter combined across all fishing gears over the past three years, with catches ranging from 61.3 to 79.5 tonnes.

The dropline catch, effort and CPUE peaked in 1996/97, with no evidence of a trend over the last three years (Fig. 4.9). In contrast, handline catches show a consistent increase in catch, effort and CPUE over the same period, representing increases of 86, 75 and 8%, respectively from 1995/96 to 1997/98 (Fig. 4.10). The increase in handline catch appears to be driven largely by an increase in effort with only a minor increase in CPUE over the three years. The absence of size composition data from the handline fishery during this period precludes an assessment of the relative significance of the strong 1993 year-class on dropline and handline catches. However, as the mean size of the 1993 year-class was around 38 cm in November 1996 (Murphy and Lyle 1999), it is unlikely that the increase in the dropline catch in that year resulted from the movement of this year-class from inshore reefs into deeper water where dropline effort is targeted.

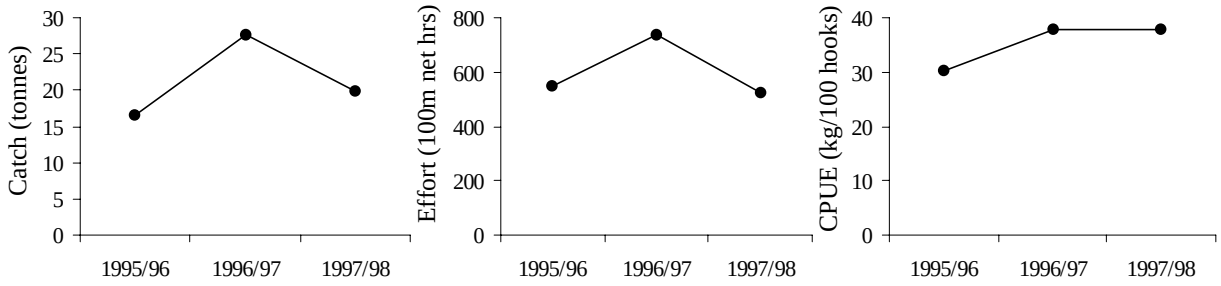



**Fig. 4.9** Catch, effort and catch per unit effort (CPUE) of striped trumpeter by dropline between 1995/96 and 1997/98 in Tasmania.

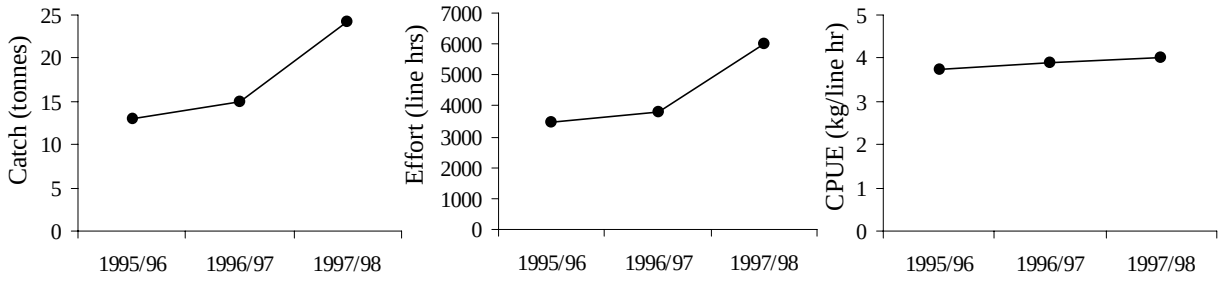



**Fig. 4.10** Catch, effort and catch per unit effort (CPUE) of striped trumpeter by handline between 1995/96 and 1997/98 in Tasmania.

While there is a trend of increased catch and CPUE in graball nets over the three years, effort showed a considerable decrease in 1997/98 (Fig. 4.11). The increase in catch and CPUE most likely reflects the presence of the strong 1993 and 1994 year-classes in the fishery with fish becoming vulnerable to graballs around mid 1996. The increase in catch and CPUE also probably reflects the increase in average weight of fish in inshore waters due to growth of the two year-classes.

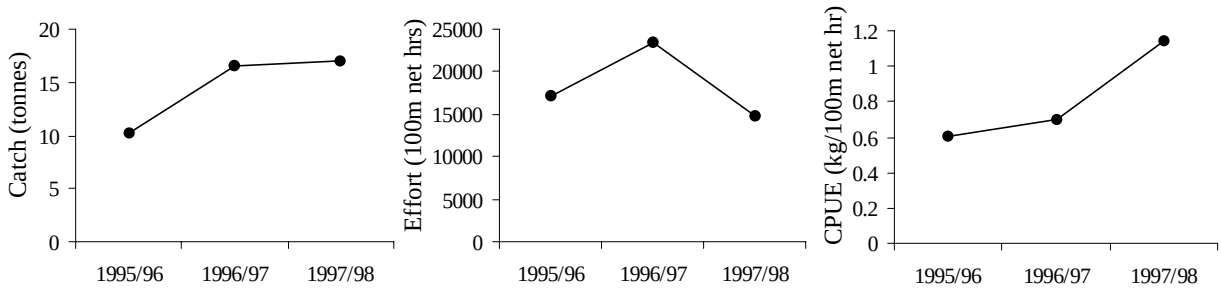



**Fig. 4.11** Catch, effort and catch per unit effort (CPUE) of striped trumpeter by graball net between 1995/96 and 1997/98 in Tasmania.

### 4.4.2 Performance Indicators

*Total catch*

*i. Total catch of a key target species is outside of the 1990/91 to 1997/98 range; or when,*

*ii. total catch of a key target species declines or increases in one year more than 30% from the previous year.*

Total catches of striped trumpeter for the period 1990/91 to 1997/98 ranged from 62.8 to 111.6 tonnes (Table 4.1). Catches outside this range will indicate that a trigger point has been reached.

**Table 4.1 Total annual catch of striped trumpeter (tonnes) between 1990/91 and 1997/98. Includes catches taken by Victorian and Tasmanian vessels from Tasmanian waters.**

| *Financial Year* | *Catch (tonnes)* |
|---|---|
| 1990/91 | 111.6 |
| 1991/92 | 95.0 |
| 1992/93 | 72.5 |
| 1993/94 | 72.5 |
| 1994/95 | 87.0 |
| 1995/96 | 62.8 |
| 1996/97 | 82.8 |
| 1997/98 | 78.8 |

*Fishing effort*

*Fishing effort for any gear type, or effort targeted towards a species or species group, increases by 10% from the highest of the 1995-97 levels.*

Maximum fishing effort occurred in the dropline and graball component of the fishery in 1996/97 and the handline component in 1997/98 (Table 4.2). A trigger point will be reached if effort increases by more than 10% of these values.

*Catch rates (CPUE)*

*In a given year, the CPUE of a key target species is less than 80% of the lowest value for the 1995-97 period.*

There has been little variation in the range of CPUE values between years for hook methods, while graball net CPUE almost doubled over this period (Table 4.2). The lowest CPUE

occurred for all methods in 1995/96. If CPUE in future years is less than 80% of these values then a trigger point will have been reached.

**Table 4.2 Estimates of effort and catch per unit effort (CPUE) of striped trumpeter for dropline, handline and graball net for the financial years 1995/96 to 1997/98.**

| *Method* | *Year* | *Effort +* | *CPUE +* |
|---|---|---|---|
| Dropline | 1995/96 | 545.8 | 30.29 |
| | 1996/97 | 735.6 | 37.72 |
| | 1997/98 | 524.0 | 37.83 |
| Handline | 1995/96 | 3493.8 | 3.73 |
| | 1996/97 | 3814.9 | 3.90 |
| | 1997/98 | 6027.7 | 4.02 |
| Graball net | 1995/96 | 17068.2 | 0.60 |
| | 1996/97 | 23430.4 | 0.70 |
| | 1997/98 | 14807.4 | 1.15 |

\+ For units of effort and CPUE refer to Table 3.2

*Change in size composition*

i. *A significant change in the size composition of commercial catches for key species; or when,*

ii. *monitoring of the size/age structure of a species indicates a significant change in the abundance of a year class (or year classes), with particular importance on pre-recruit year classes.*

Inshore research sampling in 1995 and 1996 found evidence of strong recruitment of two year-classes (1993 and 1994) which are expected to appear in the offshore fishery over the next few years. No pre-recruit surveys have been conducted since that time.

## 4.5 Evaluation of Trigger Points

Available catch, effort and CPUE data fall within the reference period against which future performance will be assessed and, therefore, no assessment against these performance indicators has been made. The lack of representative sampling of striped trumpeter from commercial catches precludes an assessment of changes in size and/or age composition.

## 4.6 Implications for Management

It is expected that trends in catch and CPUE in the fishery in future years will be influenced by the strong recruitment of the 1993 and 1994 year-classes. Based on anectodal evidence from divers and net fishers there is evidence of poor recruitment in subsequent years.

While catches have been relatively stable over the past decade, it is unclear whether catch levels are sustainable. As little is known about the size of the resource, age composition and extent of movement of fish in deeper water, information on sustainability will require a more rigorous assessment than is possible through examination of commercial catch and effort data.

A legal minimum size of 35 cm currently applies for striped trumpeter. The suitability of this size limit in terms of what is taken by the inshore fishery and size at maturity is unknown.

### 4.7 Research Needs

Stock assessment, recruitment variability and gear interactions of striped trumpeter has been accorded a high research priority by the Scalefish Fishery Research Advisory Group.

There is a need to define life-history and population parameters for striped trumpeter (including growth and mortality, reproductive biology, movements, etc) and to conduct yield per recruit analysis to determine the appropriate legal minimum size. Given the paucity of information regarding the offshore fisheries for striped trumpeter, basic size and age composition data is needed for this component of the fishery in order to determine the appropriate harvest strategies.

Given the evidence of considerable recruitment variability, there is also a need to conduct sampling of inshore reefs in order to assess the relative abundance of pre-recruits. Such information would be valuable in order to assess the influence the movement of juveniles from the inshore graball fishery into the hook fishery in deeper water has on both catch and CPUE.

# 5 Banded Morwong (*Cheilodactylus spectabilis*)

## 5.1 Stock structure and Life-History

Banded morwong are a rocky reef species found from about Sydney (NSW) to southern Tasmania and eastern Victoria (Gomon *et al*. 1994). They are also found in New Zealand waters. While they occur down to about 50 m, females and juveniles inhabit the shallow sections of the reef with males dominating deeper reef regions (McCormick 1989a). However, on many southern Tasmanian reefs large changes in depth occur over short distances suggesting depth stratification of the population may be less pronounced than that described from New Zealand.

There is no information on the stock structure of banded morwong in Tasmania. The relationship of the populations throughout its range (southern New South Wales, Victoria, Tasmania and New Zealand) is unknown.

In Tasmanian waters, banded morwong are caught in a spawning condition between late February and May, with the distribution of oocytes indicating they are serial spawners. Sexual maturity in females begins at between 30 and 32 cm FL, equivalent to 4 to 5 years of age (Murphy and Lyle 1999). Length at 50% maturity is 32 cm. Individuals have been found to be highly territorial, spawning on the same reef over several years (McCormick 1989b). The eggs and larvae are concentrated on the surface. Considerable numbers of *Cheilodactylus* sp. larvae have been caught some distance off the shelf break of eastern Tasmania suggesting that banded morwong have a pelagic stage that are distributed in offshore waters (Barry Bruce pers. comm). Juveniles appear in shallow water on rocky reefs and tidepools between September and December after a pelagic phase of around 4-6 months (Wolf 1998).

Movement of large juvenile and adult banded morwong is limited. In an extensive tagging study conducted in Tasmania, Murphy and Lyle (1999) found that almost 80% of recaptures occurred within 2 km of the site of release and 90% within 5 km. Less than 4% were recaptured greater than 10 km from the tagging site. There was no obvious relationship between the distance moved and the time at liberty, nor was there evidence that distance moved differed with fish size.

In Tasmania, growth in female banded morwong is relatively rapid for the first 5-6 years, until about 35 cm, and then slows dramatically (Murphy and Lyle 1999). In contrast, males grow rapidly for the first 10-12 years, until about 45 cm, before slowing. Maximum recorded ages for female and male banded morwong are 86 and 81 years, respectively Murphy and Lyle (1999). The maximum size of banded morwong in Tasmania is likely to be approximately 60 cm, which is considerably smaller than that previously reported of 100 cm (Last *et al*. 1983). The age composition of the banded morwong population indicates variations in the strength of recruitment (Murphy and Lyle 1999).

The range of biological parameters that have been defined for banded morwong in Tasmania are presented in Appendix 2.5.

## 5.2 The Fishery

### 5.2.1 Brief history

In 1993, development of live fish markets for banded morwong resulted in a dramatic expansion in fishing effort directed at this species. Reported landings increased from just 7 tonnes in 1991/92 to 39 tonnes the following year, and by 1993/94 landings had peaked at over 145 tonnes (Fig. 5.1). However, it is likely that the 1993/94 catch was overstated since fishers believed that the banded morwong fishery was about to become a limited entry fishery based on catch history. In fact, on the 31st May 1994, a Ministerial statement was issued to all fishers indicating that catches prior to that date would not be used in determining catch history in the scalefish fishery. Since 1994/95, reported landings have declined gradually from 106 tonnes to around 72 tonnes in 1997/98.

Historically, banded morwong had little commercial value and were used mainly as rock lobster bait. These species currently command a beach price of between $7-12 per kg for live fish. Based on value, by 1993/94 banded morwong had become the most important scalefish species, with an estimated annual value of approximately $0.9 million (Fig. 5.1). Over recent years the value of the fishery has remained at around $0.6-0.7 million. The primary markets for Tasmanian banded morwong are Asian restaurants in mainland Australia, with small quantities exported to south-east Asia.

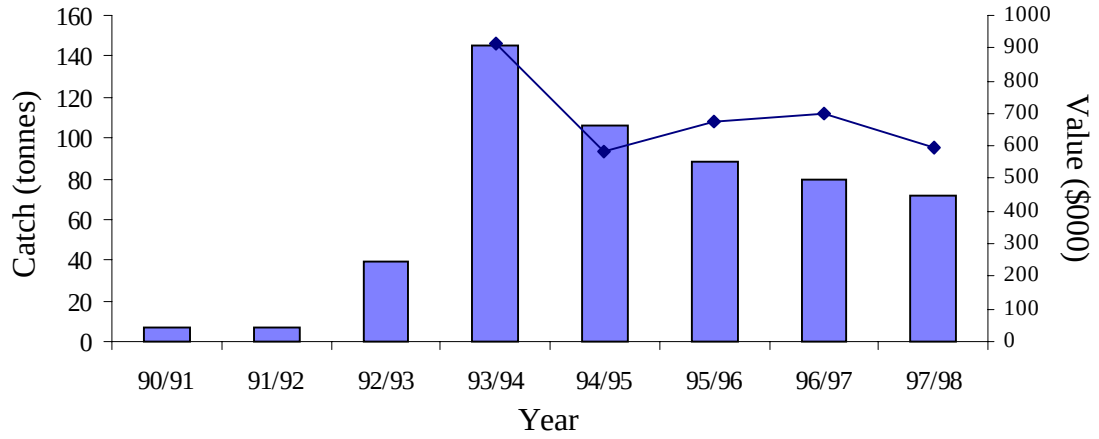



**Fig. 5.1** Annual landings (bars) of banded morwong in Tasmania between July 1990 and June 1998 and value ($,000) (CPI adjusted) (diamonds) between July 1993 and June 1998.

During its early development all holders of a TFBL had unrestricted access to the live fish fishery. Many small diversified fishers showed considerable interest in the fishery and over 130 licence holders reported catches of banded morwong and/or wrasse in 1993 (Murphy 1994). In an attempt to limit catch and effort in these rapidly expanding fisheries, various management restrictions were introduced. In late 1994, minimum and maximum size limits were applied to banded morwong (33 and 43 cm FL, respectively). Rationale for the size limits was twofold; firstly to maintain adequate egg production by protecting large adults and secondly to reflect market requirements by restricting the size range to that of highest value. A closed season for banded morwong (March and April inclusive) was introduced in early 1995 and was timed to coincide with the peak spawning period. The closed season was implemented to minimise wastage of fish at a time when post-capture mortality rates are highest.

In 1996, an interim *Live Fish Endorsement* was introduced, with eligibility based on demonstrated catch history. This effectively restricted the number of fishers with access to live banded morwong and wrasse to around 90. As part of the recently released Scalefish Management Plan, provision has been made to create a separate *Fishing Licence* for the taking of live banded morwong (DPIF 1998). The introduction of this licence has significantly reduced the number of fishers able to market live banded morwong because more stringent qualification criteria were applied compared to the interim *Live Fish Endorsement*[9].

The seasonality in the fishery reflects primarily the high level of catches that occur immediately prior to and after the closed season (March and April inclusive) (Fig. 5.2). Catches are relatively stable during winter and spring.

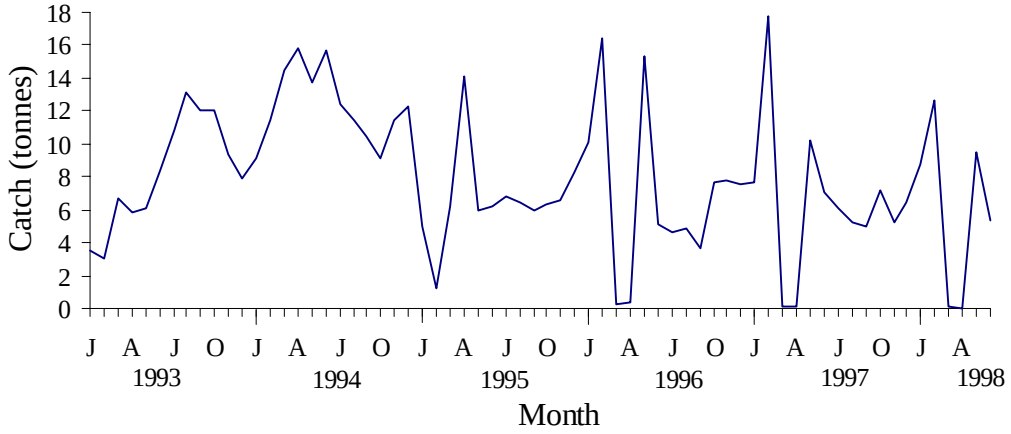



**Fig. 5.2** Monthly landings of banded morwong in Tasmania between January 1993 and June 1998

### 5.2.2 Current situation

*Commercial Fisheries*

Banded morwong are targeted almost exclusively with large mesh gillnets (primarily 130-140 mm stretched mesh) for the live fish market (Fig. 5.3). Some operators also target wrasse using lines or traps while nets are set for banded morwong. In addition to targeted fishing, both banded morwong and wrasse are taken as a by-catch in commercial gillnets targeting trumpeters and blue warehou set on inshore rocky reefs.

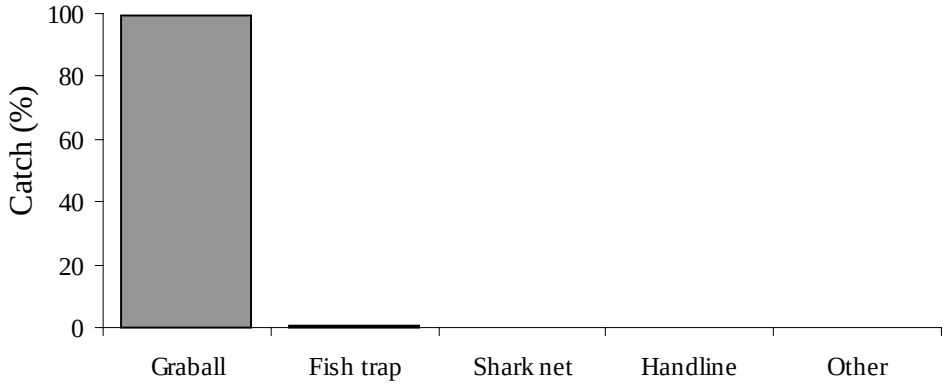



**Fig. 5.3** Proportion of catches of banded morwong by fishing method between July 1995 and June 1998.

[9] Approximately 25 banded morwong licences have been issued.

Fishing operations are conducted over hard bottom, with nets fished primarily in the 10-20 m depth range (Fig. 5.4). Fishers tend to operate in these depths for a number of reasons. Firstly, on the south-east coast inshore reefs tend to drop off rapidly into depths of >10 m and then extend out from the coast to a depth of 20 to 30 m before the substrate becomes sand. Secondly, catch rates of banded morwong are highest in the 10 to 20 m depth stratum, while that of marble fish, the dominant by-catch species is considerably lower in depths >10 m (Murphy and Lyle 1999). Gear damage is also reduced in depths >10 m, with nets largely out of any surge effect caused by swell and thus minimising the problems of entanglement, especially with bull kelp.

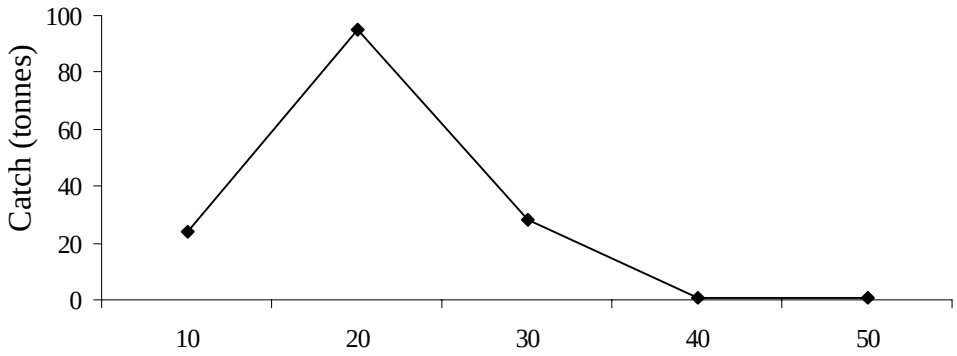



**Fig. 5.4** Catch (tonnes) of banded morwong in Tasmania by graball net between July 1995 and June 1998 by 10 m depth classes.

The banded morwong fishery is centered mainly along the east coast of Tasmania, between St Helens in the north and the Tasman Peninsula in the south, with the largest catches coming from the central east coast around Bicheno (Fig. 5.5). Smaller catches are made along the south coast and around Flinders Island. There has been no evidence of a shift in the distribution of catches over the past three years.

*Recreational fishery*

Banded morwong are of little importance to recreational fishers throughout Tasmania, the species being taken occasionally in gillnets fished over rocky reefs. There is no evidence of targeted fishing for the species (Lyle, unpubl. data).

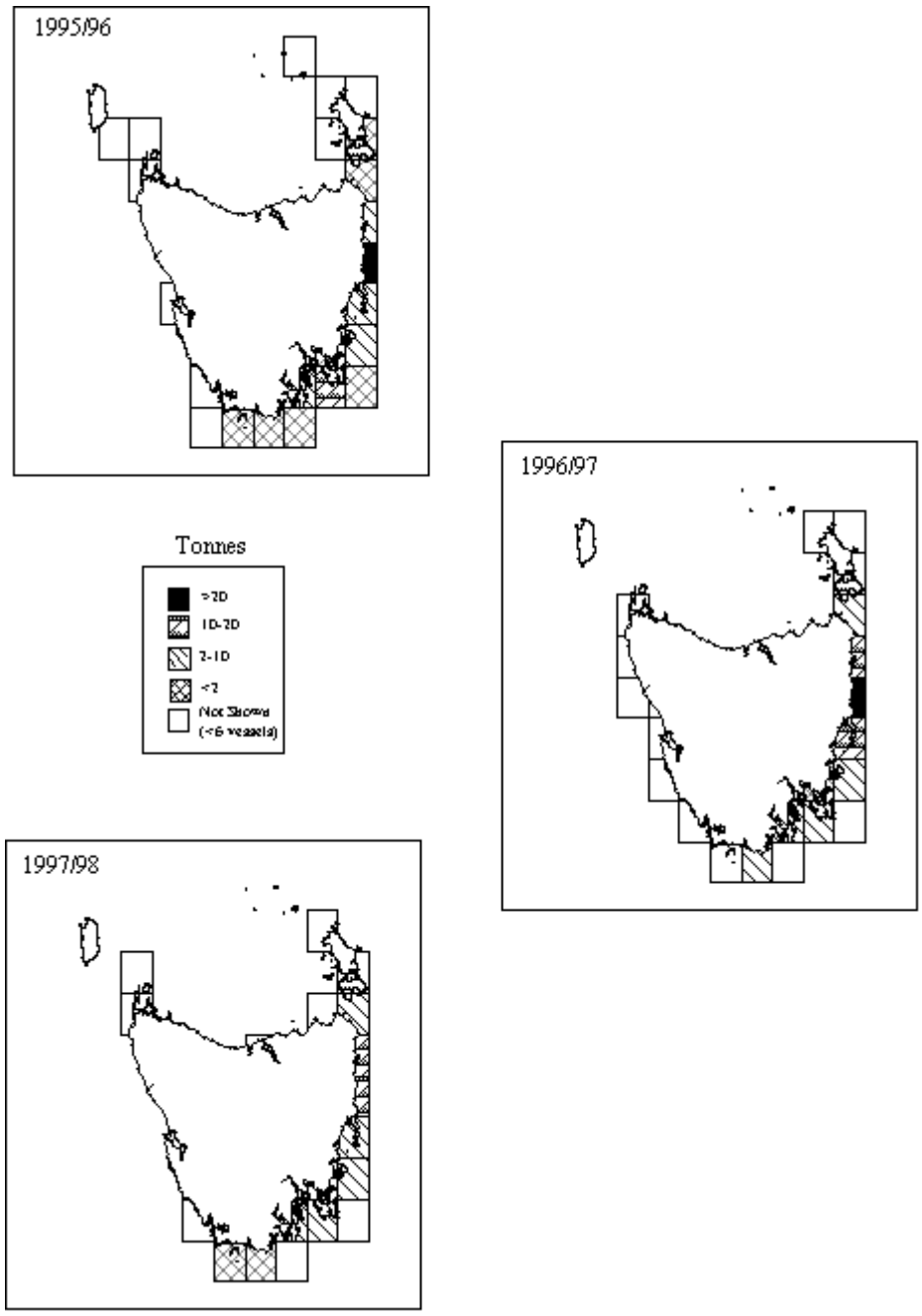



**Fig. 5.5** The spatial distribution of banded morwong catches throughout Tasmania by financial year between July 1995 and June 1998.

## 5.3 Previous Assessments

No previous assessments have been conducted on banded morwong.

## 5.4 Current Assessment

### 5.4.1 Recent Developments

A recent detailed study of the fishery and biology of banded morwong examined aspects of mesh selectivity, movement, reproductive biology, size composition and age and growth in Tasmanian waters (Murphy and Lyle 1999). This study also assessed the potential effect on yield of varying minimum size limits for female and male banded morwong at different combinations of fishing and natural mortality through yield per recruit (YPR) analyses. The percentage of virgin egg production maintained at different minimum size limits was also estimated through egg per recruit (EPR) analyses. On the basis of YPR and EPR analyses (plus considerations of the number of individuals retained, value per kg, and effects on fishing practices), the minimum and maximum size limits for banded morwong were recently increased from 33 and 43 cm to 36 and 46 cm FL, respectively.

Considerable information was also obtained on the size composition of banded morwong from the commercial fishery, which is skewed to the right, with a dominant mode at approximately 37-43 cm (Fig. 5.6). During 1995 and 1996, commercial monitoring found fish within the legal size range made up around 70% of the catch, with between 5 and 7% below the legal minimum size (*i.e.* < 33 cm) and 23 to 28% above the legal maximum size at that time (*i.e.* >43 cm) (Murphy and Lyle 1999). There was no obvious change in the proportion of under and/or over sized fish over the three years 1995-97. On July 1$^{st}$ 1998, the minimum and maximum size limits for banded morwong were raised to 36 and 46 cm FL, respectively.

There is considerable variability in the size composition of the catch between regions and seasons on the east coast, which is partially explained by distinct size structuring by sex (Fig. 5.6). Despite males attaining a larger sizes than females, there were significantly more females in the overall catch, with the proportion of females varying between regions in most seasons. The 37-43 cm mode in commercial catches is dominated by females whereas the secondary mode at 46-51 cm is comprised almost entirely of males. Other regional differences in size composition reflect actual differences in the population.

There is also evidence of differences in size structure at a small spatial scale, with particular reefs having a distinct size and presumably age structure (Murphy and Lyle 1999). The implication of this finding, coupled with the lack of movement, is that the banded morwong resource is comprised of a large number of discrete populations which are characteristic of particular reefs.

Population size structure, corrected for mesh selectivity, suggests that a large proportion of the population is >45 cm (Murphy and Lyle 1999) (Fig. 5.7). Males are therefore under-represented in commercial catches. In contrast, catches of females more closely reflect the predicted population structure indicating that commercial nets effectively select for most sizes of females. Model predictions of low numbers of banded morwong < 30 cm suggests that either fish below this size are considerably less vulnerable to all mesh sizes of net that were trialed or that few fish below this size had recruited to rocky reefs in the years prior to the mesh selectivity study.

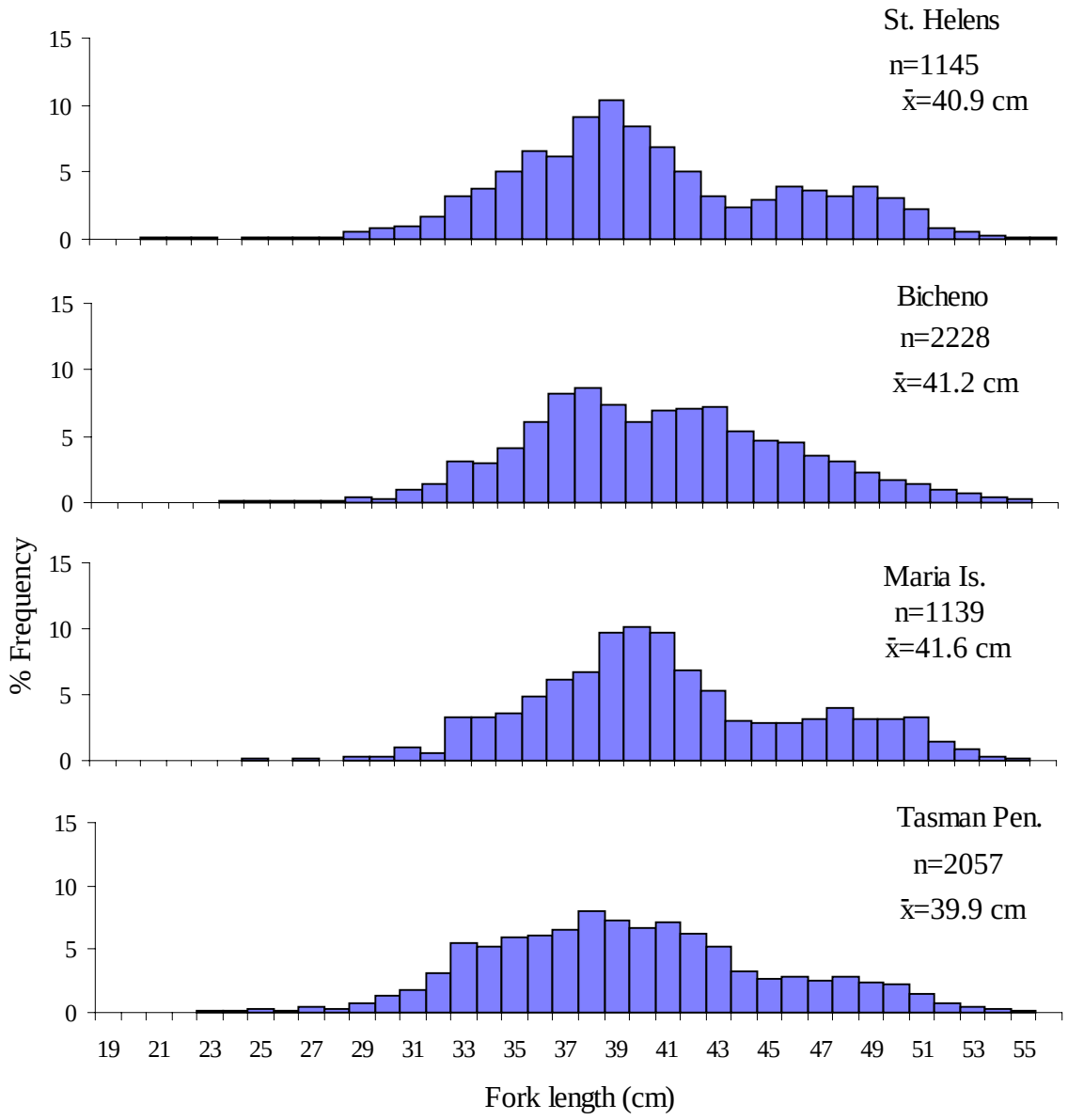



**Fig. 5.6** Size composition of banded morwong from commercial catch sampling in four areas of eastern Tasmania. (mean lengths are indicated).

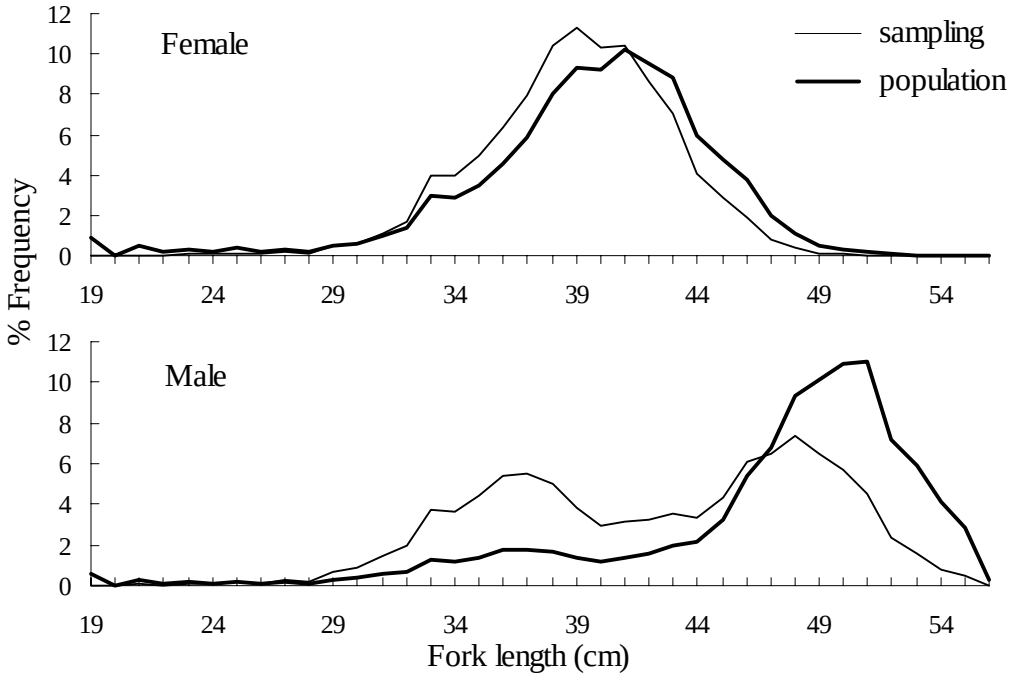



**Fig. 5.7** Size composition of banded morwong by sex from commercial catch sampling conducted between December 1994 and November 1997 and of predicted population size composition (after adjustment for selectivity of 133mm mesh).

### 5.4.2 1998 Assessment

Given the considerable differences in the structure of reef habitats of the east coast north of the Schouten Is area, and evidence of population structuring at a small spatial scale, analysis of catches have been separated into north-east and south-east regions (Fig. 5.8).

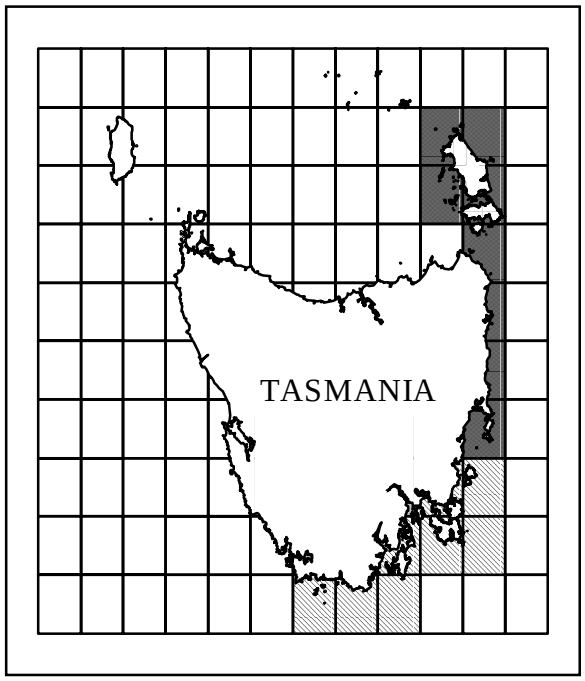



**Fig. 5.8** Spatial distribution of north-east (dark shading) and south-east (light shading) regions throughout Tasmania used for analysis of trends in the banded morwong fishery.

Given the lack of targeted assessment research, the 1998 assessment is restricted to analysis of trends in catch, effort and catch per unit effort (CPUE) for the period of 1995/96 to 1997/98. As graball net is the primary fishing method used to catch banded morwong, examination of trends in these parameters have been restricted to this method. While the estimate of CPUE relates to banded morwong taken in both targeted and non-targeted graball fishing operations, the majority of the catch is targeted and therefore CPUE primarily reflects this component of the catch.

There has been a consistent decline in the annual catch of banded morwong combined across all fishing gears over the past three years, ranging from 88 tonnes in 1995/96 to 72 tonnes in 1996/97 (see Fig. 5.1).

There is clear evidence of differences in the graball catch, effort and CPUE between regions, with the south-east characterised by consistently lower catches, higher effort and lower CPUE (Fig. 5.9). There is no clear trend in catches, although a slight decrease occurred in the north-east in 1997/98. Both effort and CPUE have been relatively stable in both regions over the three years. While CPUE has remained relatively stable, it is unclear whether this indicates current catch levels are sustainable or that fishing has not impacted significantly on banded morwong populations. It is also possible that new reef areas are being exploited and catches are therefore being maintained at stable levels. These differences in CPUE by region were also confirmed through commercial catch sampling and research fishing (Murphy and Lyle 1999).

It is unclear why CPUE differ so markedly between the two regions. While the structure of the reefs (and hence productivity) differs, it may be significant that the south-east region was fished more consistently that the north-east in the early years of the fishery.

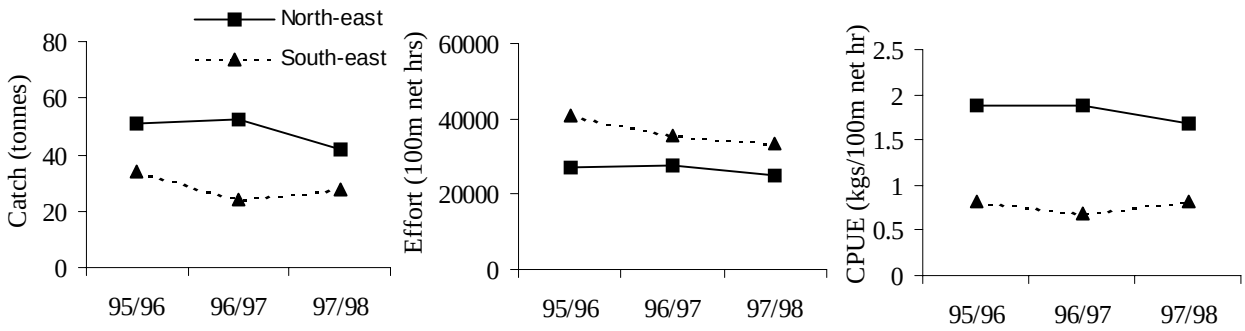



**Fig. 5.9** Catch, effort and catch per unit effort (CPUE) of banded morwong by graball net in north-east and south-east regions of Tasmania between 1995/96 and 1997/98.

In recognising the small spatial scale of the populations, further analysis has been undertaken at the level of ¼ degree blocks. Given the high level of catches in the adjacent east coast blocks 5H1, 5H3 and 6H1 (see Appendix 2.2), which together account for around 60% of all banded morwong landings between 1995/96 and 1997/98, trends in graball catch, effort and CPUE have been examined individually for these blocks (Fig. 5.10). Firstly, there has been a considerable decrease in both catch and effort in block 5H3 over the three years with little overall change in CPUE. In contrast, there was an increase in catch and effort in block 5H1 and a slight decrease in CPUE over the three years. There was no clear trend in catch, effort or CPUE in block 6H1.

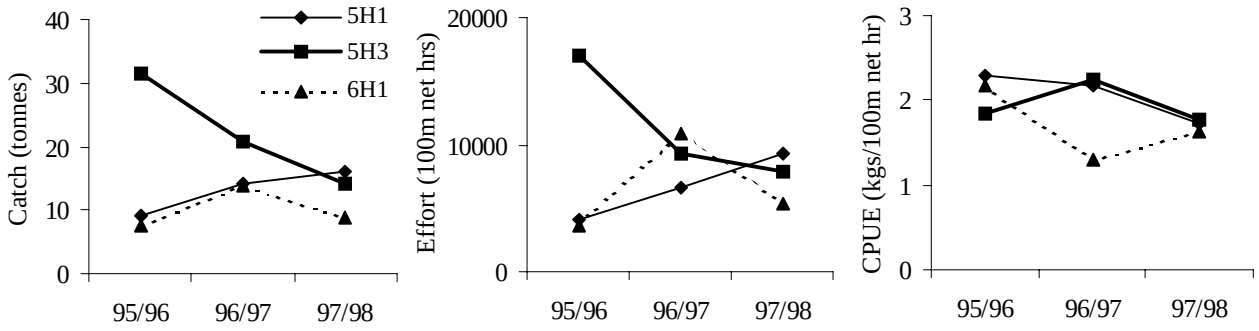



**Fig. 5.10** Catch, effort and catch per unit effort (CPUE) of banded morwong by graball net in fishing blocks 5H1, 5H3 and 6H1 in eastern Tasmania between 1995/96 and 1997/98.

Commercial catch sampling found evidence of seasonal differences in CPUE, being highest in the autumn spawning season (closed season) and lowest during winter (Murphy and Lyle 1999). Research fishing indicated mesh size had a significant influence on CPUE, being highest in the 133 mm mesh (the mesh size closest to that used in the commercial fishery). Despite some evidence of size structuring of the population by depth, this factor did not have a significant effect on CPUE. All of the above factors have implications for the interpretation of such data from the commercial fleet as variations in catch rates from the fishery may reflect shifts in effort across these temporal and spatial scales or changes in the dominant mesh size used rather than changes in the abundance of the stock.

### 5.4.3 Performance Indicators

*Total catch*

*i. Total catch of a key target species is outside of the 1990/91 to 1997/98 range; or when,*

*ii. total catch of a key target species declines or increases in one year more than 30% from the previous year.*

Total catch of banded morwong for the period 1990/91 to 1997/98 ranged from 6.9 to 145.5 tonnes (Table 5.2). However, given the rapid increase in landings of banded morwong over this period there is little value in the use of this range in assessing future trends in catch levels. This is particularly the case for pre 1993/94 data, prior to the development of the fishery, and the 1993/94 catch, since it is likely that catches were significantly overstated because of expectations that the fishery was about to become a limited entry fishery with access based on catch history. Therefore, it is proposed that catches outside the 1994/95 to 1997/98 range be used to indicate whether a trigger point has been reached. More significantly, a trigger will be reached if regional and/or individual fishing block catches decline or increase by more than 30% from one year to the next.

**Table 5.2 Annual catch of banded morwong in Tasmania between July 1990 and June 1998.**

| *Financial Year* | *Catch (tonnes)* |
|---|---|
| 1990/91 | 6.9 |
| 1991/92 | 6.9 |
| 1992/93 | 39.2 |
| 1993/94 | 145.5 |
| 1994/95 | 105.8 |
| 1995/96 | 87.9 |
| 1996/97 | 79.0 |
| 1997/98 | 71.7 |

*Fishing effort*

*Fishing effort for any gear type, or effort targeted towards a species or species group, increases by 10% from the highest of the 1995-97 levels.*

Maximum fishing effort occurred in the graball fishery in the north in 1996/97 and the south in 1995/96 (Table 5.3). A trigger point will be reached if regional effort increases by more than 10% of these values. Analysis in future years may also be conducted at the level of individual fishing blocks.

*Catch rates (CPUE)*

*In a given year, the CPUE of a key target species is less than 80% of the lowest value for the 1995-97 period.*

There has been little variation in the range of CPUE values between years (Table 5.3). The lowest CPUE occurred in the north in 1995/96 and the south in 1997/98. If CPUE in future years is less than 80% of these values then a trigger point will have been reached. Analysis in future years may also be conducted at the level of individual fishing blocks.

**Table 5.3 Annual estimates of graball net effort and catch per unit effort (CPUE) for banded morwong by region from 1995/96 to 1997/98.**

| *Region* | *Financial year* | *Effort +* | *CPUE +* |
|---|---|---|---|
| North | 1995/96 | 27202 | 1.89 |
| | 1996/97 | 27808 | 1.88 |
| | 1997/98 | 24726 | 1.69 |
| South | 1995/96 | 40997 | 0.82 |
| | 1996/97 | 35387 | 0.69 |
| | 1997/98 | 33196 | 0.83 |

+ For units of effort and CPUE refer to Table 3.2

*Change in size composition*

i. *A significant change in the size composition of commercial catches for key species; or when,*

ii. *monitoring of the size/age structure of a species indicates a significant change in the abundance of a year class (or year classes), with particular importance on pre-recruit year classes.*

During 1995 to 1997, commercial monitoring found fish within the legal size range made up around 70% of the catch (Murphy and Lyle 1999). There was no obvious change in the proportion of under and/or over sized fish in the samples over time. There is considerable variability in the size composition of the catch between regions and seasons which will strongly influence the spatial and temporal pattern of future commercial monitoring. In any future analysis of size compositions, the impact of changes in size limits will need to be taken into account.

## 5.5 Evaluation of Trigger Points

Available catch, effort and CPUE data fall within the reference period against which future performance will be assessed and, therefore, no assessment against these performance indicators has been made.

The lack of representative sampling of banded morwong size or age composition since June 1997 precludes an assessment of changes in size and/or age composition.

## 5.6 Implications for Management

While CPUE over the past three years has declined very little, it is unclear whether this is indicative that the current catch levels are sustainable or that fishing is simply depleting the accumulated biomass, which is not yet reflected by significant changes in CPUE. As little is known about the size of the resource, the sustainability of current catch levels is unknown and will require a more rigorous assessment than is possible through examination of CPUE data. However, based on life history, in particular the longevity of the species, banded morwong have low productivity. Therefore, if overfishing occurs stock recovery will be slow even if the fishing effort is significantly reduced. In addition, being a residential species on a given reef the potential for localised depletion is high.

Changes to mesh sizes in the fishery will have implications for the interpretation of catch and CPUE data from the commercial fleet. For example, variations in catch rates may reflect changes in the dominant mesh size used rather than changes in the abundance. In addition, recent changes to minimum and maximum legal size limits will influence CPUE, making interpretation of CPUE difficult in future assessments.

The age structure of the banded morwong population indicates variations in the strength of recruitment, which will have implications for the size composition and catch rates in the fishery.

## 5.7 Research Needs

Stock assessment of banded morwong has been accorded a high research priority by the Scalefish Fishery Research Advisory Group. An integral component of the stock assessment is the establishment and monitoring of suitable biological trigger points for this fishery. As commercial monitoring of the banded morwong fishery concluded in June 1997, on-board commercial catch sampling of the fishery is a high priority because of inferences that can be made about the effect that fishing is having on the size and sex structure of the population. However, given the considerable variability in the size composition of the catch between regions and seasons, future monitoring needs to be at the scale of individual reef areas. This degree of sampling intensity may be difficult to achieve in a fishery of this size because of the dependence on the prevailing weather and sea conditions when deciding on a fishing location and the propensity of individual fishers to seasonally target different regions.

Changes to the minimum and maximum size limits for banded morwong were also introduced in the Scalefish Management Plan in late 1998. There is a need to assess the effect these changes have on catch rates in order to correctly interpret future CPUE data with reference to the existing data that form the basis of trigger points.

# 6 Sea Garfish (*Hyporhamphus melanochir*)

## 6.1 Stock structure and Life-History

The southern sea garfish is endemic to Australian waters and is distributed from Eden in NSW to Kalbarri in Western Australia, including Bass Strait and Tasmanian waters (Gomon *et al*. 1994). They are found in sheltered bays, clear coastal waters and estuaries to depths of about 20 m. Fish school near the surface at night, and close to the bottom often over seagrass beds during the day. They are predominantly herbivores with around 75% of their diet being comprised of seagrass and algal filaments (Klumpp and Nichols 1983). Other diet items include diatoms, insect larvae, worms and small crustaceans, particularly amphipods (St Hill 1996).

Morphometric studies suggest sea garfish may form two populations in Australia, i.e. an eastern stock around NSW, Victoria and Tasmania and a western stock around South Australia and Western Australia.

Sea garfish in eastern Tasmania spawn over an extended period of at least five months from October to February (Jordan *et al*. 1998). However, the bulk of spawning occurs between October and December, with a lower level of spawning activity in the latter half of the spawning period. The extended spawning period is also related to the fact that sea garfish are serial spawners, with asynchronous oocyte development occurring simultaneously in reproductively active ovaries (St Hill 1996).

Sea garfish eggs are around 2.93 mm in diameter and are negatively buoyant, sinking immediately to the bottom after fertilization and become attached to filamentous drift algae (Jordan *et al*. 1998). There is no evidence in eastern Tasmania that eggs are attached in clusters on seagrass blades as has been suggested in the literature. In this region spawning occurs in shallow areas (<5 m deep) over beds of drift algae which is the dominant shallow water soft-sediment habitat. However, seagrass beds may be of greater significance around areas such as Flinders Island where the majority of shallow water habitat consists of seagrass beds (principally *Posidonia australis* and *Amphibolis antarctica*). Sea garfish have a long egg duration of around 28-30 days and are unusual in that they hatch out as large (7.8-8.5 mm) post-flexion larvae. There is little information available on early life-history and recruitment of sea garfish. Small juveniles (0+ cohort) have been caught in shallow sheltered waters of eastern Tasmania (Jordan *et al*. 1998). In south western Australia, sea garfish may spend the first year of life in estuarine areas and the first 2 years in inshore waters (Lenanton 1982).

Growth of male and female sea garfish in eastern Tasmania is relatively rapid for approximately the first 3 years, achieving a length of around 20 cm by 2 years of age and 25 to 30 cm by 3 years (Jordan *et al*. 1998). Growth then slows appreciably, reaching a maximum age of around 9 years when fish may be 40 cm long and weigh around 0.35 kg. After 3-4 years there is an increasing variation in size-at-age with fish at a length of 30 cm ranging from 3 to 8 years old. Insufficient data is available to determine whether males and females grow at the same rate.

The range of biological parameters that have been defined for sea garfish in Tasmania are presented in Appendix 2.6.

## 6.2 The Fishery

### 6.2.1 Brief history

The majority of the Australian sea garfish catch is taken from South Australian waters with landings in this fishery around 500 tonnes in 1995/96. Other significant fisheries exist in Victoria (primarily Port Phillip Bay, Western Port Bay and Corner Inlet) and Western Australia where landings are generally around 150 and 50 tonnes, respectively. Sea garfish are also an important recreational species throughout southern Australia.

Tasmanian landings of sea garfish were small during the 1970's, generally been around 20-30 tonnes (Fig. 6.1). During the 1980's there was a trend of increasing landings, reaching a peak of around 109 tonnes in 1990. Anecdotal evidence suggests this rise in catches was due to interest in the Japanese market. However, expectations were not realised and catches fell in 1991 and have since fluctuated around 60 to 90 tonnes over recent years.

The value of the sea garfish fishery has fluctuated considerably since 1990, driven mainly by variations in catch levels as prices have been relatively stable until recent years. With sea garfish currently commanding a beach price of around $4-5 per kg the fishery has an estimated annual value of approximately $0.4 million (Fig. 6.1).

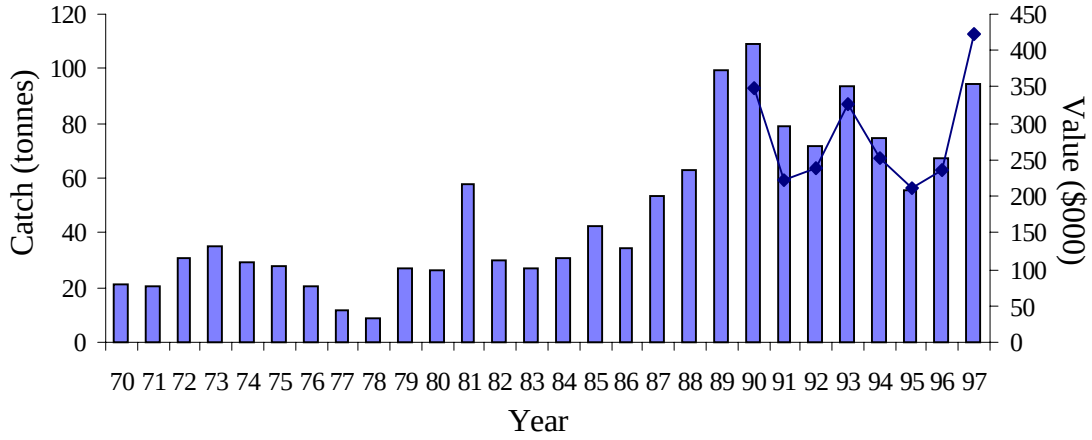



**Fig. 6.1** Annual landings (bars) of sea garfish in Tasmania by calendar year between 1970 and 1997 and value ($000) (CPI adjusted) (diamonds) between 1990 and 1997.

In order to examine the temporal and spatial trends in the fishery throughout Tasmania, catches have been divided into three regions (north-east, south-east and north-west) which is generally consistent with the biological analysis of the fishery presented in Jordan *et al*. (1998) (Fig. 6.2).

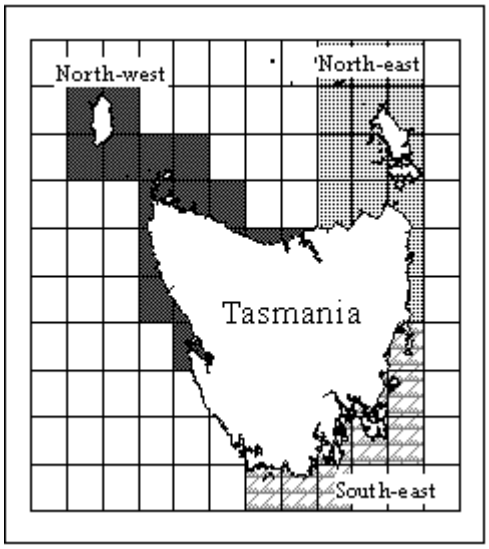



**Fig. 6.2** Spatial distribution of regions throughout Tasmania used for analysis of trends in the sea garfish fishery.

Tasmanian sea garfish landings show a distinct seasonal trend in both north-east and south-east regions with most landings being made during autumn/winter (Fig. 6.3). Seasonal analysis has not been conducted for the north-west as it represents <10% of the total fishery landings. In the north-east the small catches during summer appear to reflect a decrease in fishing effort due to both the availability of schools and increased proportion of by-catch in beach seines. In contrast, a distinct peak in landings occurred in the south-east in the summer of 1996/97 reflecting the increase in dipnet catches in this region. Due to the winter peak in landings, analysis of the sea garfish fishery is conducted on a calendar year to avoid the splitting up of 'fishing years'.

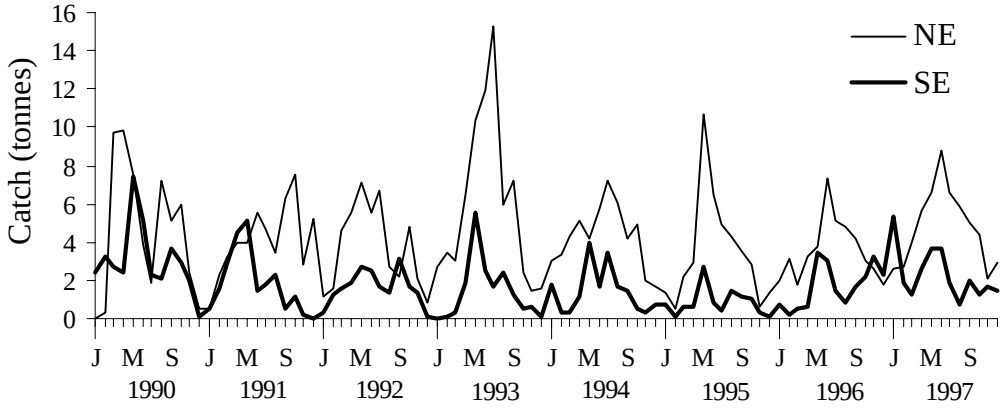



**Fig. 6.3** Monthly landings (tonnes) of sea garfish in north-east (NE) and south-east (SE) Tasmania between January 1990 and December 1997.

### 6.2.2 Current situation

*Commercial Fisheries*

While sea garfish are taken by many fishing methods, beach seining accounted for around 68% of the catch between July 1995 and December 1997 (Fig. 6.4). The majority of the beach seine catch is taken in the north-east with smaller amounts in the north-west. Over this same period around 20% of the sea garfish catch was taken by dipnet, with the majority

coming from the south-east. The purse seine catch, which represented around 6% of landings, came exclusively from the north-east while all spear catches were made in the south-east.

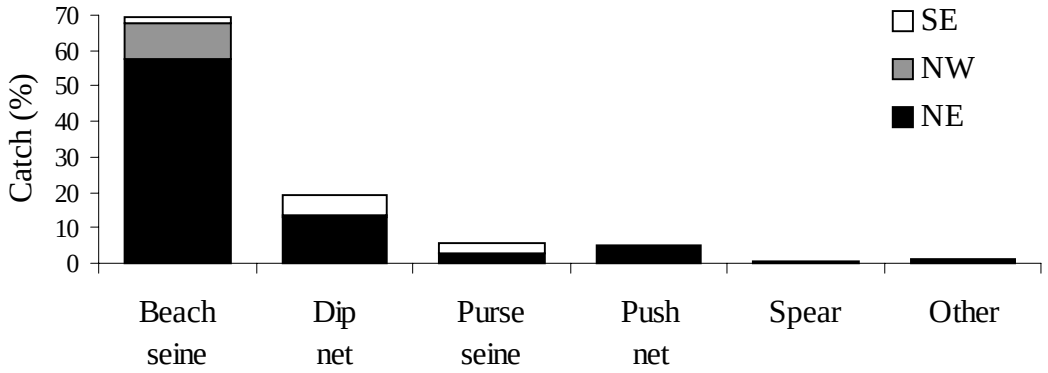



**Fig. 6.4** Proportion of catches of sea garfish by fishing method and region between July 1995 and December 1997.

Both beach seine and dip net fishing are conducted close to shore almost exclusively in depths of <10 m (Fig. 6.5). Traditional beach seine operations involve deploying a net from the beach around an area of water or school of fish back to the beach and then hauling the net into the shallows. Dip nets are used during the night over shallow areas of sand, seagrass and reef to target surface fish that are attracted to lights.

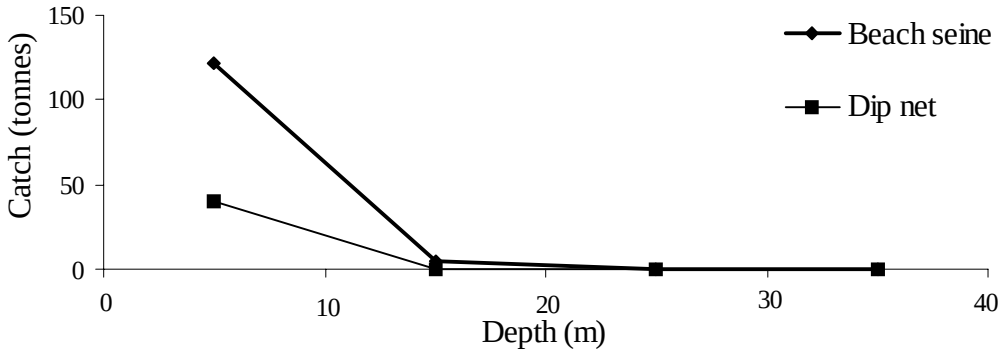



**Fig. 6.5** Catch (tonnes) of sea garfish in Tasmania by beach seine across depths between July 1995 and December 1997.

In order to examine the spatial distribution of catches, returns for the calendar years 1995 to 1997 have been summarised by fishing block (Fig. 6.6). Sea garfish are taken commercially around the entire Tasmanian coastline (apart from the west coast), with the greatest portion of the catch being taken along the length of the east and south-east coasts and off Flinders Island. Highest catches are consistently taken around Flinders Island (blocks 4G2 and 4H1), accounting for about 58% of the total catch. The next most important area is in the south-east (blocks 6H1, 6G4, and 7G2), representing 25% of the catch over the past three years. A considerable proportion of the catch from this region is made in the estuary blocks of Great Oyster Bay, Blackman Bay, Frederick Henry Bay and Pittwater. Around 3% of the overall catch was taken from the Tamar River while relatively small catches are taken from the north-west coast. The spatial structure of the fishery has been relatively consistent over the period 1995-97, although there is some evidence for an increase in landings in the north-east in 1997.

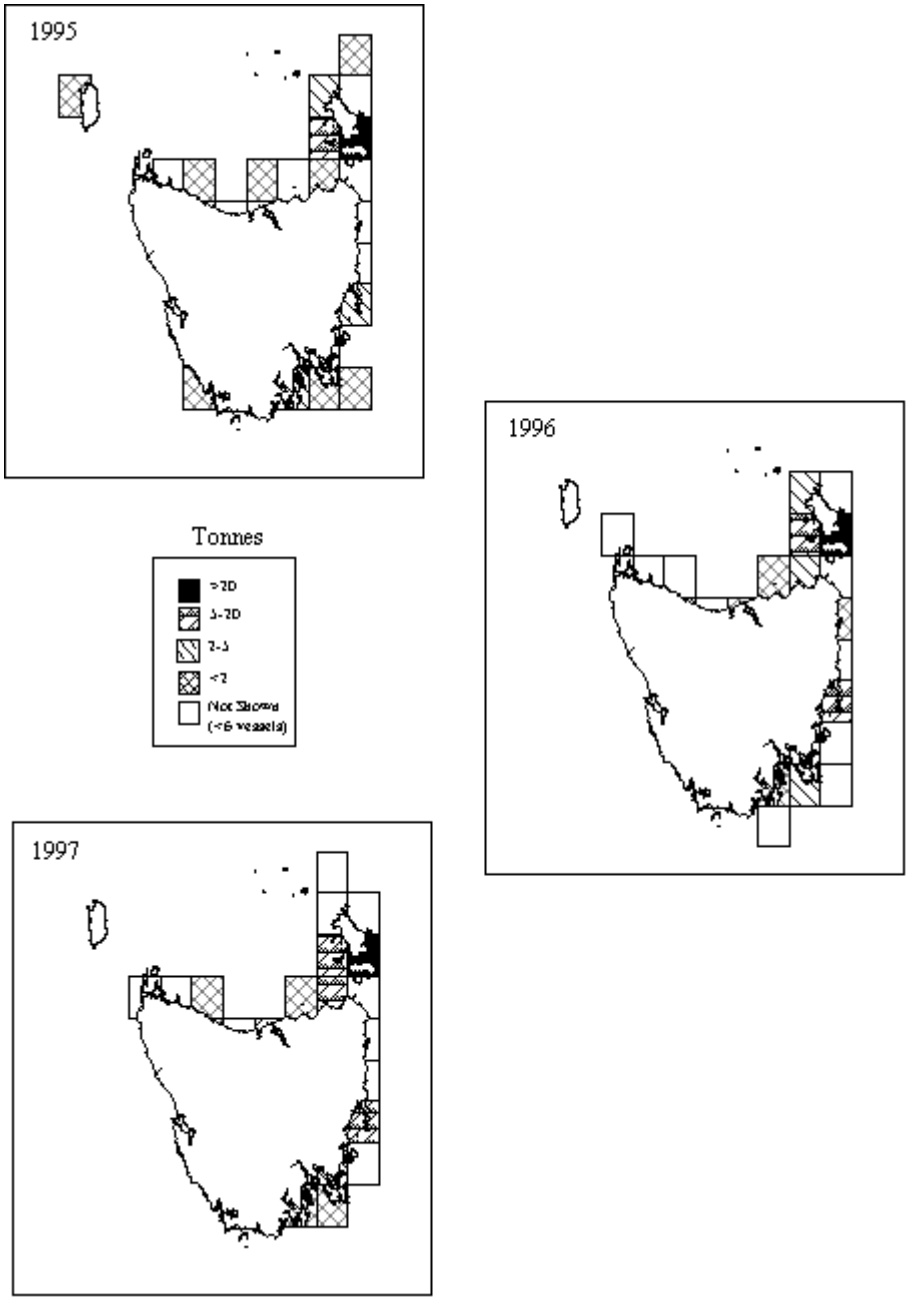



**Fig. 6.6** Spatial distribution of sea garfish catches throughout Tasmania by calendar year between January 1995 and December 1997.

Sea garfish sampled from the commercial fishery on the south-east ranged from 19 to 42 cm, with the distribution consisting of a single mode skewed to the left, with a mean of 30.7 cm (Fig. 6.7). The size range of fish was narrow with over 90% of fish between 25 and 35 cm and few fish >35 cm.

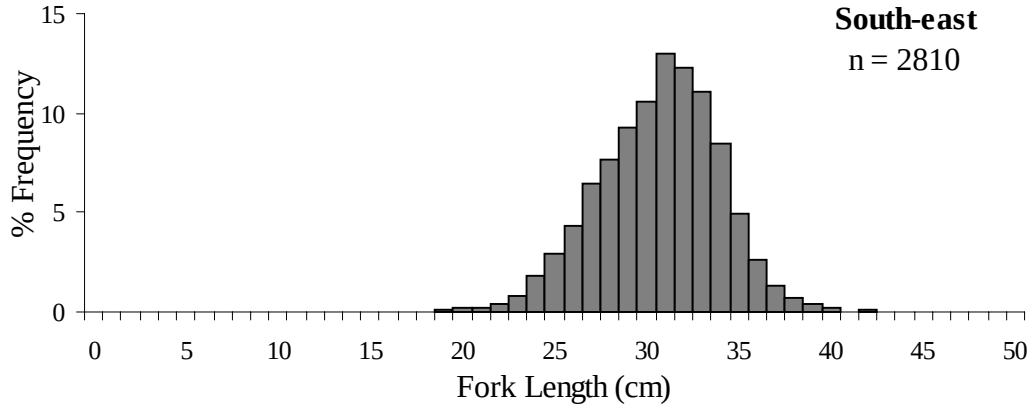



**Fig. 6.7** Size composition of sea garfish from the commercial fishery on the south-east region of Tasmania. n is sample size.

Sea garfish sampled from the commercial fishery on the north-east region of Tasmania ranged from 16 to 46 cm, with the distribution consisting of a several possible modes with an overall mean of 32.3 cm (Fig. 6.8). The size range of fish was, however, considerably broader than that from the south-east, with only 71% of fish between 25 and 35 cm and 26% of fish >35 cm.

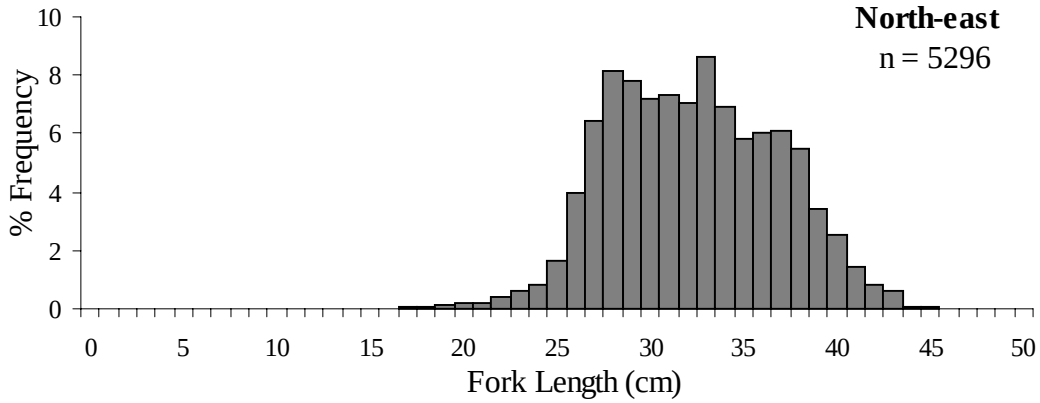



**Fig. 6.8** Size composition of sea garfish from the commercial fishery on the north-east region of Tasmania. n is sample size.

A maximum of 9 age-classes are represented in the dipnet fishery in south-eastern Tasmania, dominated by 4 and 5 year old fish (Fig. 6.9). It is possible that larger fish are under-represented in dipnet catches, with larger fish remaining in deeper water outside the effective range of the gear. Further sampling will be required by beach seine on the east coast before the size composition of the entire population can be assessed. Despite this, the present data show no evidence of variable recruitment in the population of sea garfish, with no particular year-class dominant, although this may be influenced to some extent by gear selectivity.

The lack of aged samples from the north-east and north-west regions precludes an assessment of the extent of spatial variations in growth and age composition. Such analysis will need to be conducted before population models can be advanced for this species across the entire distribution of the commercial fishery.

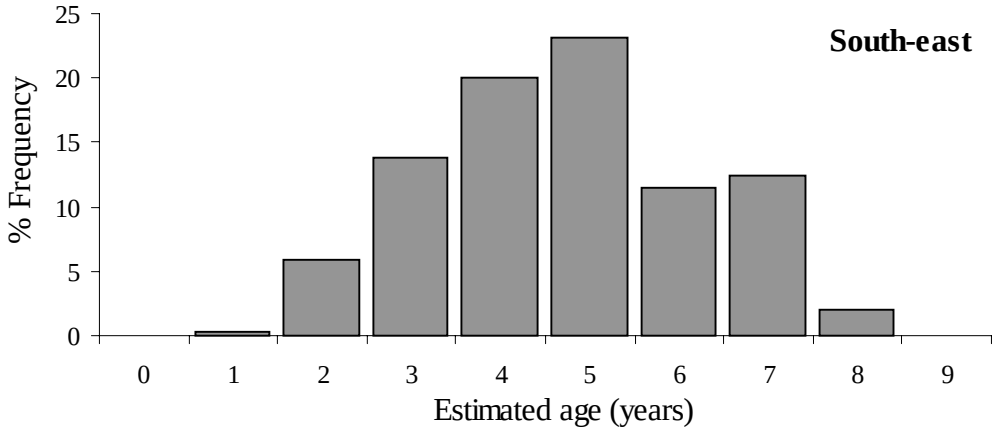



**Fig. 6.9** Age composition of sea garfish in commercial catches from the south-east region of Tasmania.

*Recreational fishery*

Sea garfish are mainly taken by recreational fishers in beach seines. They are also occasionally taken in gillnets, on line or are speared. The size of the catch is unknown, but is unlikely to be significant in relation to the commercial catch.

## 6.3 Previous Assessments

No previous assessments have been conducted on sea garfish in Tasmania.

## 6.4 Current Assessment

### 6.4.1 Recent Developments

A recent study of the fishery and biology of sea garfish examined aspects of reproductive biology, early-life-history, size composition and age and growth in Tasmanian waters (Jordan *et al*. 1998). In addition, aspects of reproduction, growth and feeding of sea garfish in Tasmania were examined by St Hill (1996).

### 6.4.2 1998 Assessment

Given the lack of targeted assessment research, the 1998 assessment is restricted to analysis of trends in catch, effort and catch per unit effort (CPUE) for the calendar years of 1995 to 1997. As beach seine and dipnets are the primary fishing methods, examination of trends in these parameters are restricted these methods. The estimates of CPUE relates to the catch rate of sea garfish taken in both targeted and non-targeted fishing operations.

There is a considerable change in the annual catch of sea garfish combined across all fishing gears over the past three years, ranging from 55 tonnes in 1995 to 94 tonnes in 1997 (see Fig. 6.1).

There is evidence of an increase in the beach seine catch over the past three years, although some of this reflects the absence of some catch data in 1995 that appeared on the old logbook[1] (Fig 6.10). Inclusion of this data would increase the 1995 catch by 5.8 tonnes to 45.8 tonnes while this has increased to 60 tonnes in 1997. The low effort value for 1995 also reflects the

absence of effort data for catches recorded on the old logbook. Therefore, the CPUE data for 1995 may also be unrepresentative of the value for the full calendar year.

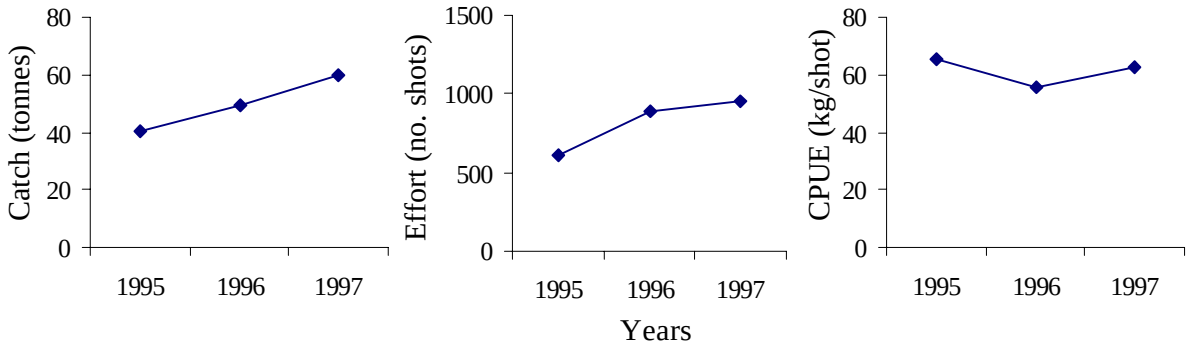



**Fig. 6.10** Catch, effort and catch per unit effort (CPUE) of sea garfish by beach seine in Tasmania between 1995 and 1997 (based on new logbook data only).

There has been a considerable increase in dip net catch, effort and CPUE over the 1996 to 1997 period (Fig. 6.11). The catch increased from around 10 tonne in 1996 to over 28 tonnes in 1997. Likewise, effort increased considerably between 1996 and 1997 with the increase in catch likely to be driven entirely by an equivalent increase in dip net effort. While CPUE has also increased, the 1995 may be unrepresentative as it reflects to some extent the absence of some catch data from early 1995. The increase in CPUE is also likely to reflect an increase in the efficiency of fishers using dip nets to target sea garfish.

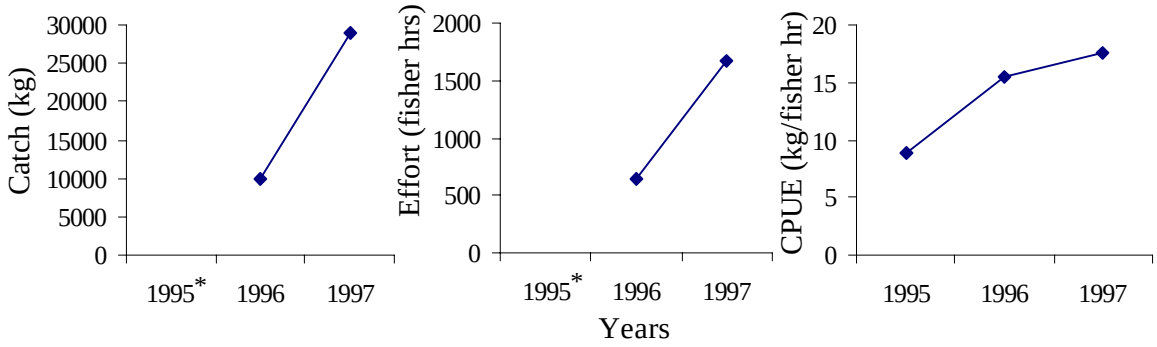



**Fig. 6.11** Catch, effort and catch per unit effort (CPUE) of sea garfish by dip net in Tasmania between 1995 and 1997. * For confidentiality reasons, catch and effort cannot be shown in 1995 as 5 or fewer vessels are involved.

[1] The new logbook was not introduced until March 1995.

### 6.4.3 Performance Indicators

*Total catch*

*i. Total catch of a key target species is outside of the 1990 to 1997 range; or when,*

*ii. total catch of a key target species declines or increases in one year more than 30% from the previous year.*

Total catch of sea garfish for the 1990 to 1997 calendar years ranged from 109.0 to 55.4 tonnes (Table 6.1). Catches outside this range will indicate that a trigger point has been reached. Likewise, catches are not to decline or increase by more than 30% of the 1997 catch of 94.2 tonnes.

**Table 6.1 Total annual catch of sea garfish in Tasmania between 1990 and 1997.**

| *Financial Year* | *Catch (tonnes)* |
|---|---|
| 1990 | 109.0 |
| 1991 | 78.9 |
| 1992 | 71.6 |
| 1993 | 93.7 |
| 1994 | 74.3 |
| 1995 | 55.4 |
| 1996 | 67.6 |
| 1997 | 94.2 |

*Fishing effort*

*Fishing effort for any gear type, or effort targeted towards a species or species group, increases by 10% from the highest of the 1995-97 levels.*

Maximum fishing effort occurred in the beach seine fishery in 1997 while dipnet effort has increased considerably over the past two years to a peak in 1997 (Table 6.2). A trigger point will be reached if effort increases by more than 10% of these values.

**Table 6.2 Estimates of effort of sea garfish for beach seine and dip net for the calendar years 1995 to 1997**

| *Method* | *Year* | *Effort +* |
|---|---|---|
| Beach seine | 1995 | * |
| | 1996 | 883 |
| | 1997 | 954 |
| Dip net | 1995 | * |
| | 1996 | 650 |
| | 1997 | 1662 |

\+ For units of effort refer to Table 3.2

* as the 1995 data is incomplete, and for dipnet it also represents 5 or fewer vessels, it has been excluded from the trigger point assessment.

*Catch rates (CPUE)*

*In a given year, the CPUE of a key target species is less than 80% of the lowest value for the 1995-97 period.*

As sea garfish are a schooling species and catch rates can remain stable even with a decreasing stock abundance, CPUE is therefore not likely to be a sensitive parameter for indicating trends in abundance for this species.

*Change in size composition*

i. *A significant change in the size composition of commercial catches for key species; or when,*

ii. *monitoring of the size/age structure of a species indicates a significant change in the abundance of a year class (or year classes), with particular importance on pre-recruit year classes.*

There is considerable difference in the size, and possibly age structure of sea garfish in the commercial fishery between south-east and north-east regions, although the significance of these differences are still to be examined. The size/age compositions have not been followed through time and no pre-recruit surveys have been conducted.

## 6.5 Evaluation of Trigger Points

Available catch, effort and CPUE data fall within the reference period against which future performance will be assessed and, therefore, no assessment against these performance indicators has been made. The lack of representative sampling of sea garfish from commercial catches precludes an assessment of changes in size and/or age composition.

## 6.6 Implications for Management

Although current catch levels in the Tasmanian garfish fishery have fluctuated over recent years, interest in garfish is high and it is possible that effort may increase over a relatively short period, particularly in the dipnet sector, which may result in over-exploitation. Such a concern is related to the new licencing arrangements where all holders of a scalefish fishing licence are also entitled to use a dipnet. There is little information available on the stock structure of sea garfish which is required before the appropriate size of spatial management regions can be developed.

Seagrass is important to the life history of garfish and therefore the distribution and health of seagrass beds is an important issue for the garfish fishery. Recent reports of large reductions in the size of seagrass beds around Tasmania are of concern.

## 6.7 Research Needs

Stock assessment, critical habitat requirements, impact of management arrangements and gear interactions of sea garfish has been accorded a high research priority by the Scalefish Fishery Research Advisory Group.

Information indicating the level of fishing pressure which can be sustained on garfish is required. This could probably be best achieved by sampling from the commercial fishery and estimating key population parameters for modelling in yield per recruit analysis. Integral to this is the need to analyse otoliths for age, validate annuli, construct age length keys and estimate mortality parameters for sea garfish.

The significance of seagrass habitats for spawning and feeding of sea garfish will require further sampling in areas along the north coast and Flinders Island. Information on the stock structure of sea garfish is required.

# 7 Wrasse (Family: Labridae)

## 7.1 Stock structure and Life-History

Eight species of wrasse occur in Tasmanian waters with purple wrasse (*Pseudolabrus fucicola*) and blue-throated wrasse (*P. tetricus*) the two main commercial species. Both species are distributed in south-east Australia (Tasmania, Victoria, New South Wales and South Australia) with purple wrasse also occurring in New Zealand. The other six wrasse species have overlapping ranges with some encompassing southern Western Australia and New Zealand. Purple wrasse are found in very shallow water up to depths of 25 m while blue-throat wrasse generally occurs in deeper water up to 50 m. The stock structure of wrasse in Australian waters has not been examined.

The sex of purple wrasse appears to be genetically based and occurs before sexual maturity is reached (Barrett 1995). In contrast, a small proportion of blue-throated wrasse between 27 and 32 cm change from female to male accompanied by a colour change. Sex reversal appears to be determined by a combination factors including social structure and size or age of individuals (Barrett 1995). Functional males with the female colour morphology have been found. Length at first maturity of females for both species is about 15 cm, which corresponds to around 2 to 3 years old. This small size at maturity means fish may spawn for at least 4 to 5 years before reaching the lower size limit of 28 cm. Spawning in Tasmania occurs throughout their range between August and January (Barrett 1995). There are no estimates of fecundity.

Wrasse eggs and larvae are believed to be pelagic and larvae recruit to rocky reefs at approximately 1.5 to 2.0 cm in length. Growth in juveniles is rapid, reaching a mean length of around 12-15 cm after two years and 20 cm after four years, with growth considerably slower in older fish (Barrett 1995). The maximum age for purple and blue-throat wrasse is about 17 and 10 years, respectively (Barrett 1995). Age composition, mortality rates and productivity have not been estimated.

While male blue-throats are territorial, females are home ranging and sedentary on inshore rocky reefs showing strong site attachment (Barrett 1995).

Few biological parameters have been defined for blue-throat and purple wrasse (see Appendix 2.7). The growth parameters defined are represented by few fish >30 cm and are based on unvalidated age estimates.

## 7.2 The Fishery

### 7.2.1 Brief history

Up until the early 1990’s wrasse species were not generally targeted by commercial fishers, although small quantities obtained as a by-catch of the gillnet fishery have been sold in Tasmania as 'winter bream' (see Appendix 2.3). Wrasse have also traditionally been used by rock lobster fishers as bait. Wrasse are commonly recorded by fishers as either parrotfish, kelpies or mixed reef fish, especially when used as bait, and therefore the two species cannot be separated on catch returns. Indications from analysis of logbook data and preliminary commercial sampling indicates landings are dominated by purple wrasse, particularly in the south-east, reflecting the species preference for waters <10 m.

The exporting of live fish, predominantly to Asian restaurants in mainland Australia, began in Tasmania in early 1993. While the main target species was banded morwong, a market and separate fishery for purple and blue-throated wrasse have developed over recent years. As a result catches increased rapidly in the early 1990's, reaching a peak of around 178 tonnes in 1994/95 (Fig. 7.1). Since 1995/96 catches have ranged between 88 and 110 tonnes.

In 1996, an interim *Live Fish Endorsement* was introduced, with eligibility based on demonstrated catch history, with approximately 90 endorsements issued. These endorsements were an interim measure which was replaced with a specific fishing licence for live wrasse in November 1998. By imposing more stringent catch history criteria the number of live wrasse fishers has been further limited to approximately 59. Non-endorsed wrasse fishers will continue to have a trip limit of 30 kg which may be sold, but only in a dead form. Under Offshore Constitutional Settlement (OCS) agreements between Tasmania and the Commonwealth, all wrasse species will be managed under State jurisdiction with no Commonwealth by-catch provision applying.

The value of the wrasse fishery has fluctuated considerably since 1991, driven by variations in catch levels and price. With wrasse currently commanding a beach price of around $6 per kg for live fish, the fishery has an estimated annual value of approximately $0.6 million (Fig. 7.1).

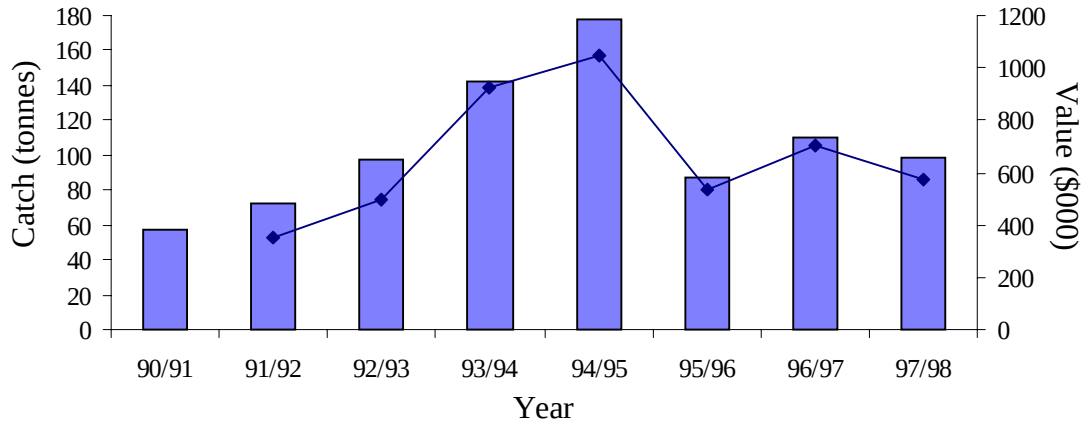



**Fig. 7.1** Total annual landings (bars) of wrasse in Tasmania between July 1990 and June 1988 and fishery value ($000) (CPI adjusted) (diamonds) between July 1991 and June 1998.

The monthly landings of wrasse throughout Tasmania appear erratic, generally peaking in December and being lowest in May (Fig. 7.2).

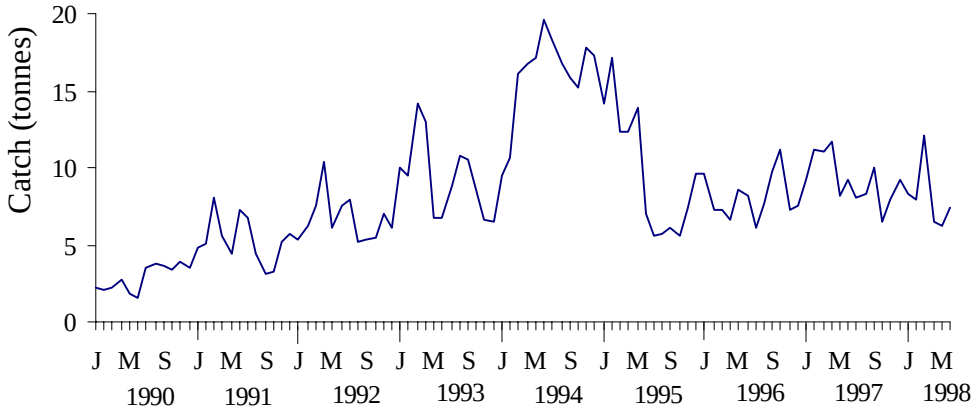



**Fig. 7.2** Monthly landings of wrasse in Tasmania between January 1990 and June 1998.

### 7.2.2 Current situation

*Commercial Fisheries*

Wrasse are taken primarily by handlines, fish traps and graball nets, although few graball caught fish are sold on the live fish market. Incidental catches are also regularly taken in rock lobster pots. Relatively even quantities of fish have been taken by handline and trap fishing, accounting for around 41% and 38% of the catch, respectively over the past three years (Fig. 7.3). Wrasse are targeted over shallow hard bottom reefs close to shore as fish are particularly susceptible to barotrauma. The majority of trap caught fish are taken in depths of <10 m, while a higher proportion of the handline catch is taken in depths of 10-20 m (Fig. 7.4).

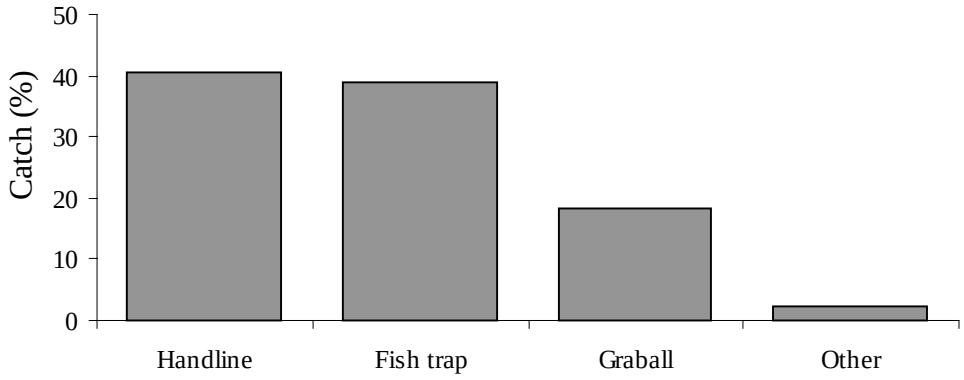



**Fig. 7.3** Catch of wrasse in Tasmania by fishing method from July 1995 to June 1998

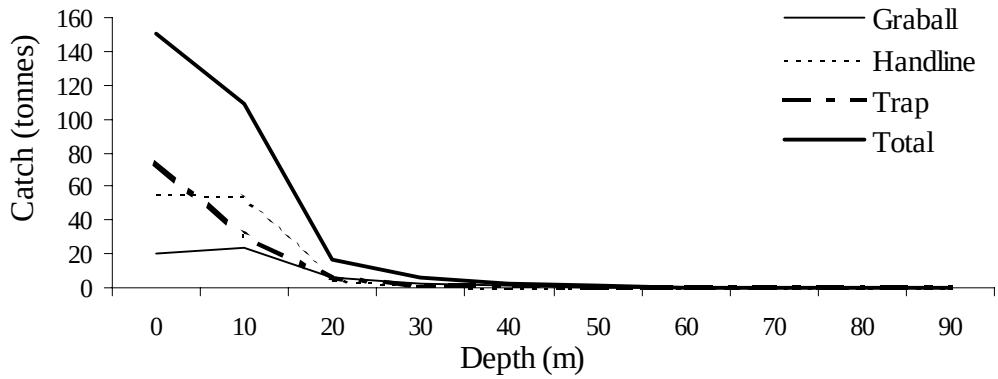



**Fig. 7.4** Catch (tonnes) of wrasse by graball, handline and trap by 10 m depth interval between July 1995 and June 1998.

In order to examine the spatial distribution of catches, returns for period 1995/96 to 1997/98 have been summarised by fishing block (Fig. 7.5). Wrasse are taken commercially around the entire Tasmanian coastline, with the greatest portion of the catch taken along the length of the east and south-east coasts and off the west coast of Flinders Island. Highest catches have been consistently taken off south-eastern Tasmania (block 7G) (see Appendix 2.2), accounting for about 26% of the total catch over the three years. Relatively small catches are taken from the north-west, west and south-west coasts. There are few indications of a shift in the spatial distribution of catches between years, although there is some evidence of an increase in landings around the Flinders Island area since 1996-97.

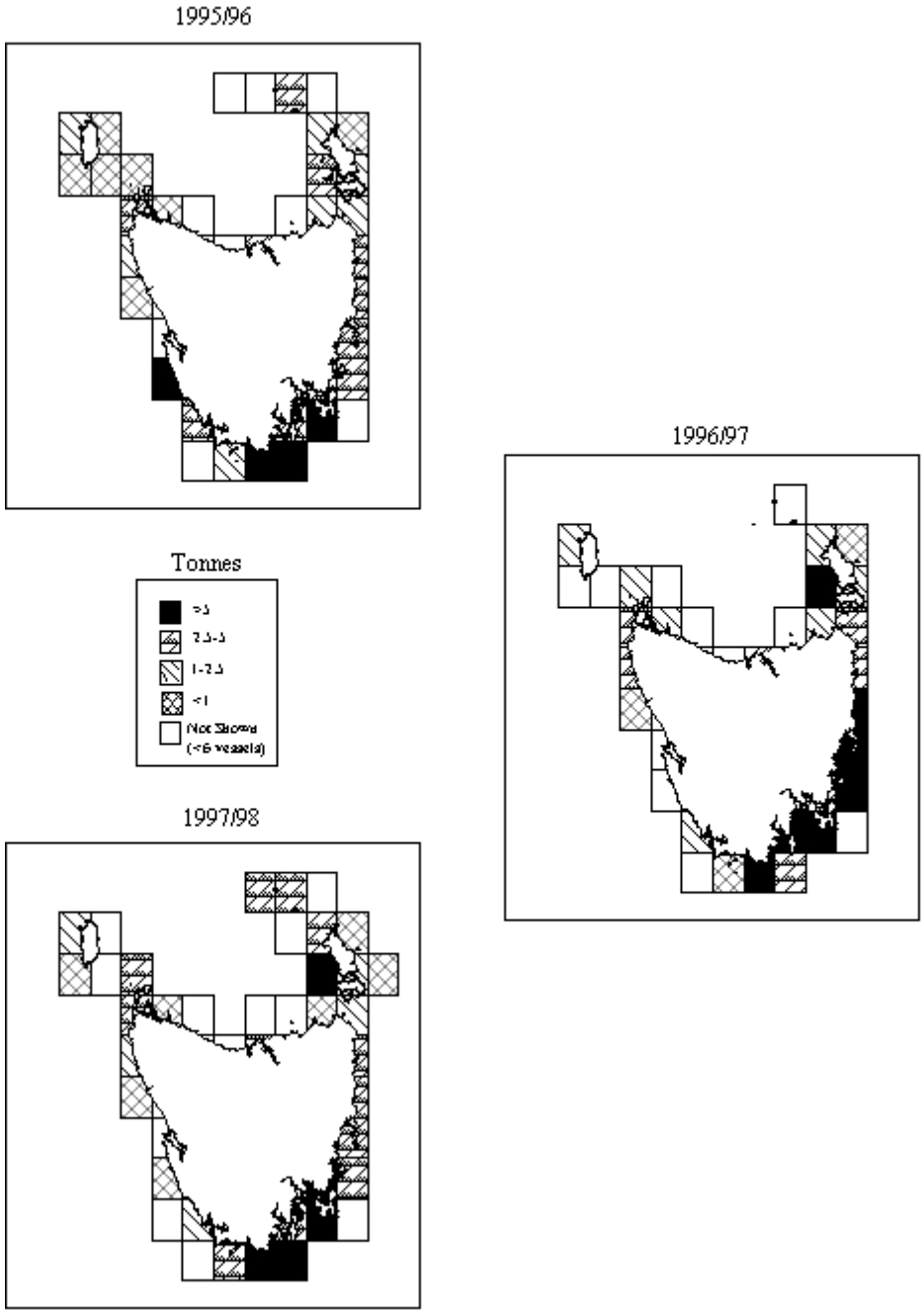



**Fig. 7.5** Spatial distribution of wrasse catches throughout Tasmania by financial year between July 1995 and June 1998.

There is little data available on the size composition of wrasse in commercial catches. Limited catch sampling of trap caught fish has been conducted, with purple wrasse ranging from 17 to 38 cm, although the majority of the catch is between 25 and 31 cm (Fig. 7.6). This indicates that fish are first caught in the trap fishery at around 22 cm (~5 years old). This may however be influenced by variations in growth rate around the state. Around 48% of the total catch numbers consists of legal sized fish (ie. between 28-43 cm).

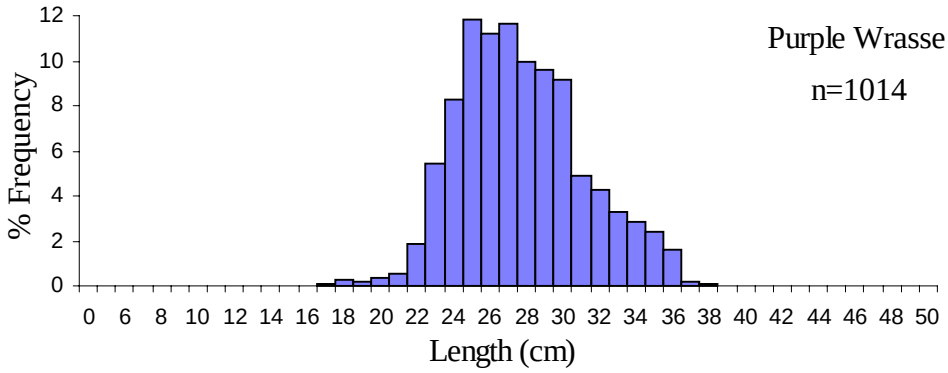



**Fig. 7.6** Size composition of purple wrasse in the commercial trap fishery in Tasmania.

Few blue-throat wrasse have been sampled from the trap fishery, with the limited data indicating fish range from 22 to 40 cm (Fig. 7.7).

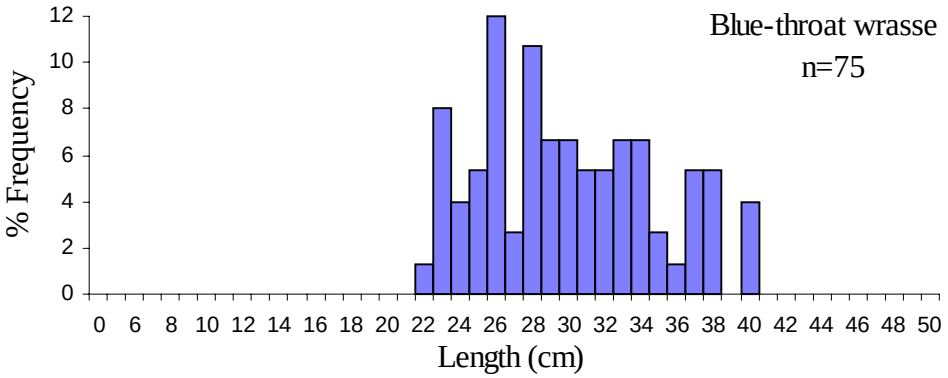



**Fig. 7.7** Size composition of blue-throat wrasse in the commercial trap fishery in Tasmania.

No size composition data is available for the line catch.

*Recreational fishery*

Wrasse appear to be of limited importance to recreational fishers throughout Tasmania. The species are taken relatively frequently in gillnets and on lines when fishing over reefs. A small number are also taken in recreational rock lobster pots and by spearfishing. As the species are not prized for their eating qualities, fish are often used for bait in rock lobster pots. The size of the recreational catch is unknown.

## 7.3 Previous Assessments

As no previous assessments have been conducted on wrasse, the current status of wrasse stocks in Tasmanian waters is unknown. There are no estimates of biomass or sustainable yield.

## 7.4 Current Assessment

### 7.4.1 Recent Developments

A recent study of the biology of purple and blue-throat wrasse examined aspects of movement, reproductive biology and age and growth in south-eastern Tasmanian waters (Barrett 1995).

A project is currently being conducted examining aspects of abundance, distribution and age and growth of blue-throat and purple wrasse on the north and east coasts of Tasmania (Greif 1999). Underwater visual counts, multiple mark recapture and depletion methods are being undertaken at sites along the north coast which will provide a useful assessment of the possible methods for estimating population abundance in these species.

### 7.4.2 1998 Assessment

Given the lack of targeted assessment research, the 1998 assessment is restricted to an analysis of trends in catch, effort and catch per unit effort (CPUE) for the period 1995/96 to 1997/98. As fish traps and handlines are the primary fishing methods, examination of trends in these parameters are restricted these methods. The estimates of CPUE relates to the catch rate of wrasse taken in both targeted and non-targeted fishing operations, although the vast majority of the catch for both methods is the result of targeted fishing.

There has been little change in the annual catch of wrasse combined across all fishing gears over the past three years, ranging from 88 tonnes in 1995/96 to110 tonnes in 1996/97 (see Fig. 7.1).

For traps, catch, effort and CPUE all peaked in 1996/97. While catch and effort values were lower in 1997/98, there was an overall increase in catch and effort of 9% and 19% respectively over the three years (Fig. 7.8). The change in catches generally reflected the changes in effort over this period. While CPUE decreased only slightly (around 9% since 1995/96), it is unclear whether this is indicative of a general decline in overall abundance.

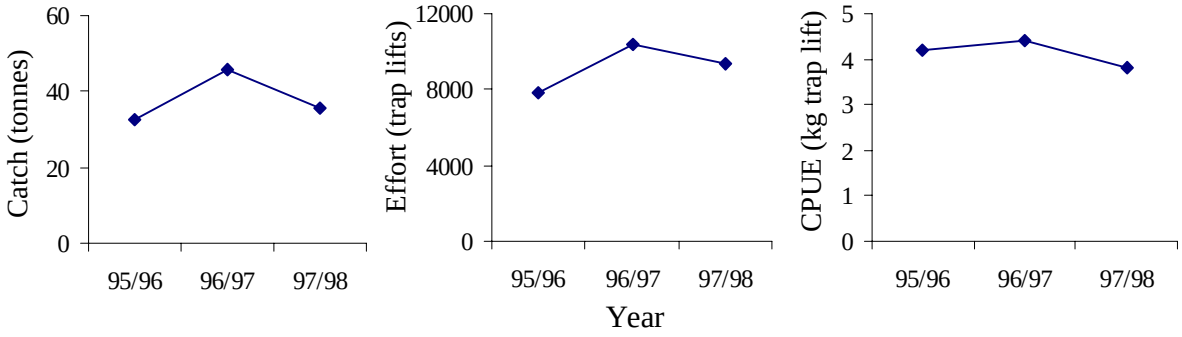



**Fig. 7.8** Catch, effort and catch per unit effort (CPUE) of wrasse by fish trap in Tasmania between July 1995 and June 1998.

Similarly, the handline component of the fishery shows a peak in catch and effort in 1996/97 which relates to an increase of 44 and 46%, respectively since 1995/96 (Fig. 7.9). Therefore, the increase in catch appears to be driven entirely by an increase in handline effort with CPUE relatively stable over the three year period only fluctuating by <10%.

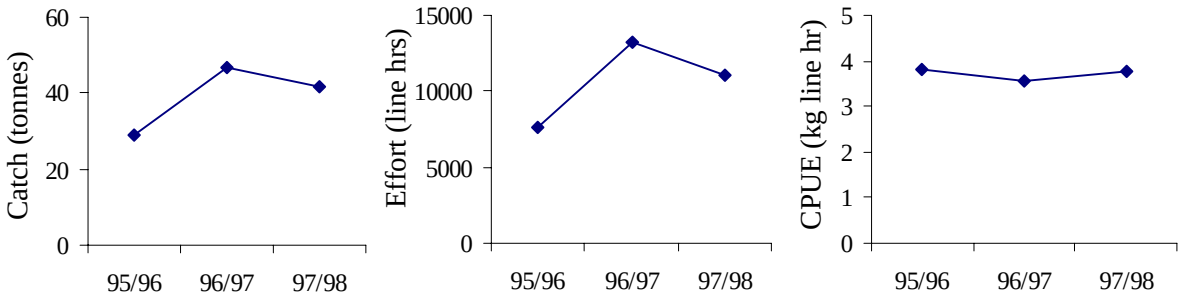



**Fig. 7.9** Catch, effort and catch per unit effort (CPUE) of wrasse by handline in Tasmania between July 1995 and June 1998.

### 7.4.3 Performance Indicators

*Total catch*

*i. Total catch of a key target species is outside of the 1990/91 to 1997/98 range; or when,*

*ii. total catch of a key target species declines or increases in one year more than 30% from the previous year.*

Total catch of wrasse for the period 1990/91 to 1997/98 ranged from 57 to 178 tonnes (Table 7.1). However, given the rapid increase in landings of wrasse over this period there is little value in the use of the 1990/91 to 1992/93 catches in establishing the historical range. Therefore, catches outside the 1993/94 to 1997/98 range will indicate that a trigger point has been reached. More significantly, catches are not to decline or increase by more than 30% of the 1997/98 catch of 98.8 tonnes.

**Table 7.1 Annual catch of wrasse in Tasmania between 1990/91 and 1997/98.**

| *Financial Year* | *Catch (tonnes)* |
|---|---|
| 1990/91 | 57.2 |
| 1991/92 | 71.7 |
| 1992/93 | 97.3 |
| 1993/94 | 142.4 |
| 1994/95 | 178.0 |
| 1995/96 | 87.6 |
| 1996/97 | 110.1 |
| 1997/98 | 98.8 |

*Fishing effort*

*Fishing effort for any gear type, or effort targeted towards a species or species group, increases by 10% from the highest of the 1995-97 levels.*

Maximum fishing effort occurred in both the handline and trap fishery in 1996/97 (Table 7.2). A trigger point will be reached if effort increases by more than 10% of these values

*Catch rates (CPUE)*

*In a given year, the CPUE of a key target species is less than 80% of the lowest value for the 1995-97 period.*

There has been little variation (<10%) in the range of CPUE values over the three years. The lowest CPUE occurred in the handline component of the fishery in 1996/97 and trap in 1997/98 (Table 7.2). If CPUE in future years is less than 80% of these values then a trigger point will have been reached. Because wrasse are a highly residential species future analysis should be conducted at the regional or ¼ degree block level as more data becomes available.

**Table 7.2 Estimates of effort and catch per unit effort (CPUE) of wrasse for handline and trap fishing methods for the financial years 1995/96 to 1997/98.**

| *Method* | *Year* | *Effort +* | *CPUE +* |
|---|---|---|---|
| Handline | 1995/96 | 7619 | 3.83 |
| | 1996/97 | 13231 | 3.54 |
| | 1997/98 | 11076 | 3.79 |
| Trap | 1995/96 | 7813 | 4.18 |
| | 1996/97 | 10331 | 4.41 |
| | 1997/98 | 9365 | 3.80 |

+ For units of effort and CPUE refer to Table 3.2

*Change in size composition*

i. *A significant change in the size composition of commercial catches for key species; or when,*

ii. *monitoring of the size/age structure of a species indicates a significant change in the abundance of a year class (or year classes), with particular importance on pre-recruit year classes.*

During 1998, limited commercial monitoring of the trap fishery found fish within the legal size range made up around 48% of the catch. There is likely to be considerable variability in the size composition of the catch between regions reflecting possible difference in growth and/or recruitment which will strongly influence the spatial and temporal pattern of future commercial monitoring.

## 7.5 Evaluation of Trigger Points

Available effort and CPUE data fall within the reference period against which future performance will be assessed. The lack of representative sampling of wrasse size or age composition precludes an assessment of changes in size and/or age composition.

## 7.6 Implications for Management

Management concerns have been expressed about the sustainability of the harvest of wrasse for the live export trade and while input controls are being applied to the wrasse fishery the sustainability of the current catch levels is unknown.

As the fishery is based on two species, there is a clear need to obtain catch and biological information at the species level.

## 7.7 Research Needs

Stock assessment, impact of management arrangements and impact of different fishing gear of wrasse has been accorded a high research priority by the Scalefish Fishery Research Advisory Group.

Research into the recruitment rates of juveniles to reefs, total biomass estimates and the sustainability of current fishing levels need to be undertaken. There is also a need to define population parameters for purple and blue-throat wrasse (including growth and mortality) and to conduct yield per recruit analysis to determine the appropriate legal minimum and maximum size limits.

Commercial monitoring of the wrasse fishery should be undertaken because of the inferences that can be made about changes in size and sex structure of the population, parameters that provide suitable biological trigger points for this fishery. However, given the likely variability in the size composition of the catch between regions and seasons, monitoring of the fishery that aims to detect changes in population structure and catch rates will, therefore, need to be at the scale of individual reef areas.

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**Appendix 2.1** Common and scientific names for species reported in General Fishing catch returns.

| *Common name* | *Scientific name* | *Common name* | *Scientific name* |
|---|---|---|---|
| Alfonsino | *Beryx* spp. | Rays bream | Fam.Bramidae |
| Anchovy | Fam. Engraulidae | Red bait | *Emmelichthys nitidus* |
| Atlantic salmon | *Salmo salar* | Red fish | Fam. Berycidae |
| Australian salmon | *Arripis* spp. | Red mullet | *Upeneichthys* sp. |
| Barracouta | *Thyrsites atun* | Silverfish | Fam. Atherinidae |
| Boarfish | Fam. Pentacerotidae | Snapper | *Pagrus auratus* |
| Bream | *Acanthopagrus butcheri* | Stargazer | Fam. Uranoscopidae |
| Butterfish | Spp unknown | Sweep | *Scorpis* spp |
| Cardinal fish | Fam Apogonidae | Tailor | *Pomatomus saltator* |
| Cod deep sea | *Mora moro* | Thetis fish | *Neosebastes thetidis* |
| Cod, bearded rock | *Pseudophycis barbata* | Trevalla, white | *Seriolella caerulea* |
| Cod, red | *Pseudophycis bachus* | Trevally, silver | *Pseudocaranx dentax* |
| Cod, unspec. | Fam. Moridae | Trout, rainbow | *Oncorhynchus mykiss* |
| Dory, john | *Zeus faber* | Trumpeter, bastard | *Latridopsis forsteri* |
| Dory, king | *Cyttus traversi* | Trumpeter, striped | *Latris lineata* |
| Dory, mirror | *Zenopsis nebulosus* | Trumpeter, unspec. | Fam. Latridae |
| Dory, silver | *Cyttus australis* | Warehou, blue | *Seriolella brama* |
| Dory, unspec. | Fam. Zeidae | Warehou, spotted | *Seriolella punctata* |
| Eel | *Conger* sp. | Whiptail | Fam. Macrouridae |
| Flathead | Fam Plactycephalidae. | Whiting | Fam. Sillaginidae |
| Flounder | Fam. Pleuronectidae | Whiting, King George | *Sillaginoides punctata* |
| Garfish | *Hyporhamphus melanochir* | Wrasse | *Pseudolabris* spp. |
| Gurnard | Fam. Triglidae & Fam. Scorpaenidae | **'Commonwealth' species** | |
| Gurnard perch | *Neosebastes scorpaenoides* | Blue grenadier | *Macruronus noveazelandiae* |
| Gurnard, red | *Chelidonichthys kumu* | Gemfish | *Rexea solandri* |
| Hardyheads | Fam. Atherinidae | Hapuka | *Polyprion oxygeneios* |
| Herring cale | *Odax cyanomelas* | Oreo | Fam. Oreosomatidae |
| Kingfish, yellowtail | *Seriola lalandi* | Trevalla, blue eye | *Hyperoglyphe antartica* |
| Knifejaw | *Oplegnathus woodwardi* | **Tunas** | |
| Latchet | *Pterygotrigla polyommata* | Albacore | *Thunnus alalunga* |
| Leatherjacket | Fam. Monocanthidae | Skipjack | *Katsuwonus pelamis* |
| Ling | *Genypterus* spp. | Southern bluefin | *Thunnus maccoyii* |
| Luderick | *Girella tricuspidata* | Tuna, unspec. | Fam. Scombridae |
| Mackerel, blue | *Scomber australasicus* | **Sharks** | |
| Mackerel, jack | *Trachurus declivis* | Shark, angel | *Squatina australis* |
| Marblefish | *Aplodactylus arctidens* | Shark, blue whaler | *Prionace glauca* |
| Morwong, banded | *Cheliodactylus spectabilis* | Shark, bronze whaler | *Carcharhinus brachyurus* |
| Morwong, blue | *Nemadactylus valenciennesi* | Shark, elephant | *Callorhynchus milii* |
| Morwong, dusky | Fam. Cheilodactylidae | Shark, gummy | *Mustelus antarcticus* |
| Morwong, grey | *Nemadactylus douglasii* | Shark, saw | *Pristophorus spp.* |
| Morwong, jackass | *Nemadactylus macropterus* | Shark, school | *Galeorhinus galeus* |
| Morwong, red | Fam. Cheilodactylidae | Shark, seven-gilled | *Notorynchus cepedianus* |
| Morwong, unspec. | Fam. Cheilodactylidae | Shark, spurdog | Fam. Squalidae |
| Mullet | Mugilidae | | |
| Nannygai | *Centroberyx affinis* | **Cephalopod** | |
| Perch, magpie | *Cheilodactylus nigripes* | Calamary | *Sepioteuthis autralis* |
| Perch, ocean | *Helicolenus* spp | Cuttlefish | *Sepis* spp. |
| Pike, long-finned | *Dinolestes lewini* | Octopus | *Octopus* spp. |
| Pike, short-finned | *Sphyraena novaehollandiae* | Squid, arrow | *Nototodarus gouldi* |
| Pilchard | Fam. Clupeidae | | |

**Appendix 2.2** Data restrictions and adjustments

As noted in Section 2.2 there have been a number of administrative changes that have effected the collection of catch and effort data from the fishery. The following restrictions and adjustments have been applied when analysing the data as an attempt to ensure comparability between years, especially when examining trends over time.

## i) Correction of old logbook landed catch weights

All catch data reported in the old general fishing return (generally prior to 1995) represent landed catch and as such are assumed to represent processed weights. For example, where a fish is gilled and gutted, the reported landed weight will be the gilled and gutted and not whole weight. By contrast, in the new logbook all catches are reported in terms of weight and product form (whole, gilled and gutted, trunk, fillet, bait or live), such that if a catch of a species is reported as gilled and gutted then the equivalent whole weight can be estimated by applying a standard *conversion factor*[10].

Without correcting for product form, old logbook and new logbook catch weights are not strictly compatible. In an attempt to correct for this and provide a 'best estimate', a *correction factor* was calculated using catch data from the new logbook and applied to catches reported in the old logbook. A species based ratio of the sum of estimated whole weights (adjusted for product form) to the sum of reported catch weights was used as the correction factor (Lennon 1998).

## ii) Area restriction

Unless otherwise stated, only catch and effort data reported in the following fishing blocks (one degree) has been used in the analyses (see Appendix Fig. 2.2.1)

'3F','3G','3C','3D','3H','4C','4D','4E','4F','4G','4H','5D','5E','5F','5H','6D','6E','6H','6G','7E', '7F','7G','7H'

In addition, catches from estuary blocks have been included.

## iii) Species restrictions

In analyses of *total catch* and *total effort* by fishing method, the following species have been excluded:

Blue eye trevalla, blue grenadier, gemfish, hapuka, tunas (all species), and school and gummy shark

The primary rationale for these exclusions relates to the fact that these species are managed by the Commonwealth and, over time, reporting of fishing for these species has been increasingly done on logbooks other than the General Fishing Return.

[10] Conversion factors to whole weights are 1.00 for whole, live or bait; 2.50 for fillet; 1.50 for trunk; and 1.18 for gilled and gutted.

### iv) Vessel restrictions

In all analyses of catch and effort, catches from six vessels (four Victorian based and two Tasmanian based) have been excluded. These vessels are known to have fished consistently in Commonwealth waters and their catches of species such as blue warehou and ling tend to significantly distort catch trends. In fact, all four Victorian vessels and one Tasmanian vessel ceased reporting on General Fishing Returns in 1994. Subsequent to the introduction of the South East Fishery Non-trawl logbook (GN01) in 1997, the remaining Tasmanian vessel ceased reporting fishing activity on the Tasmanian logbook.

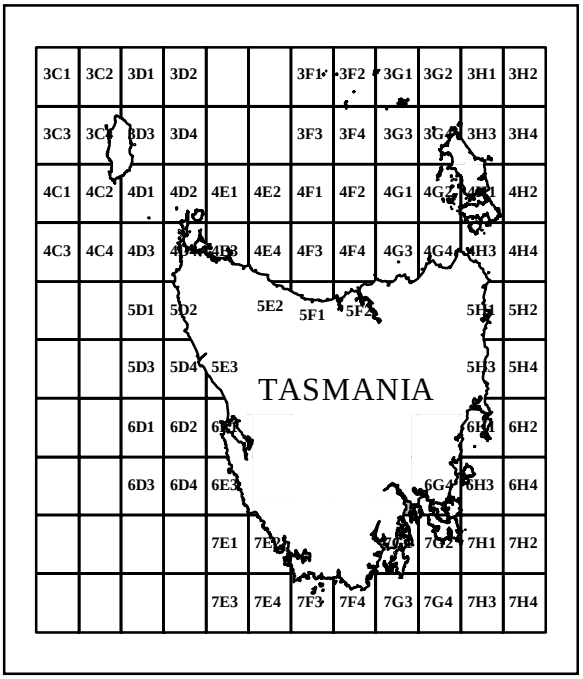


**Fig. 2.2.1** Block numbers for fishing blocks used in calculation of catch figures.

**Appendix 2.3.** Annual catch (whole weight) by species for the period 1969/70-1989/90 based on General Fishing Returns.

| | *Catch (t)* | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *69/70* | *70/71* | *71/72* | *72/73* | *73/74* | *74/75* | *75/76* | *76/77* | *77/78* | *78/79* | *79/80* | *80/81* | *81/82* | *82/83* | *83/84* | *84/85* | *85/86* | *86/87* | *87/88* | *88/89* | *89/90* |
| Anchovy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0 | 0 |
| Atlantic salmon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Australian salmon | 62.0 | 209.5 | 777.3 | 722.2 | 885.3 | 1464 | 467.3 | 571.6 | 651.8 | 604.9 | 513.8 | 202.6 | 473.6 | 495.6 | 431.6 | 610.8 | 728.9 | 624.1 | 941.5 | 1015 | 400.3 |
| Barracouta | 1313 | 435.7 | 452.4 | 680.3 | 495.0 | 476.2 | 76.5 | 87.2 | 129.0 | 28.1 | 27.0 | 3.7 | 2.3 | 3.5 | 86.0 | 55.9 | 67.0 | 53.3 | 73.8 | 207.1 | 337.3 |
| Boarfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0.2 | 0.8 | 0.9 | 1.6 | 1.3 | 2.3 | 2.4 | 9.8 | 14.0 | 10.6 |
| Bream | 0.1 | 0 | 0.1 | 0.9 | 0.3 | 0.3 | 0.4 | 0.4 | 6.1 | 1.0 | 0 | 0.1 | 0.3 | 0 | 0 | 1.2 | 0 | 0.2 | 0.6 | 0.6 | 5.4 |
| Butterfish | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0.4 | 0 | 0 | 1.4 | 0.2 | 0 |
| Cardinal fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 |
| Cod deep sea | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1.0 | 0.5 | 0.5 | 0.5 | 6.3 | 6.8 |
| Cod, red | 10.4 | 6.0 | 4.9 | 3.3 | 0.8 | 0.8 | 0.1 | 3.6 | 3.0 | 4.0 | 5.2 | 4.5 | 6.4 | 8.1 | 6.3 | 2.7 | 2.7 | 4.6 | 11.6 | 24.6 | 3.1 |
| Cod, unspec. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dory, john | 0 | 0.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0 | 0 | 0.3 | 0 | 0.1 | 0 | 3.7 | 0 | 0 | 0.1 | 0 | 0.8 | 0.1 | 0.1 | 2.9 |
| Dory, king | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 11.1 | 0 | 3.7 | 1.3 | 0 | 0.4 | 0 | 2.3 |
| Dory, mirror | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.8 | 1.1 | 0.2 | 0.3 | 0 | 0 | 0 |
| Dory, silver | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0.5 | 1.3 | 0.4 | 0 | 0.1 |
| Dory, unspec. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eel | 0 | 0.6 | 0.1 | 0 | 0.2 | 4.2 | 2.3 | 0 | 12.0 | 6.6 | 6.7 | 2.8 | 2.9 | 9.3 | 4.5 | 3.0 | 2.5 | 0.2 | 0.3 | 0.2 | 1.4 |
| Flathead | 11.5 | 78.4 | 49.5 | 31.0 | 92.6 | 37.0 | 27.5 | 62.0 | 74.3 | 149.7 | 72.0 | 61.9 | 50.8 | 23.3 | 10.6 | 52.2 | 33.9 | 50.2 | 149.3 | 110.3 | 100.7 |
| Flounder | 16.2 | 17.5 | 32.9 | 15.4 | 14.8 | 18.1 | 9.6 | 9.5 | 8.8 | 9.4 | 11.4 | 13.0 | 18.6 | 21.4 | 22.8 | 17.7 | 10.7 | 8.7 | 42.8 | 45.0 | 28.3 |
| Garfish | 20.0 | 20.8 | 33.1 | 27.7 | 37.7 | 28.8 | 21.0 | 10.5 | 10.0 | 11.4 | 35.8 | 39.7 | 37.9 | 29.2 | 31.9 | 35.8 | 40.9 | 48.7 | 61.8 | 57.1 | 136.6 |
| Gurnard | 0 | 3.9 | 0.2 | 0.5 | 9.8 | 0.7 | 0.7 | 9.4 | 2.0 | 0.1 | 0 | 0 | 0.4 | 0 | 0 | 2.5 | 2.4 | 2.2 | 9.1 | 2.5 | 9.1 |
| Imperador | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kingfish, yellowtail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.1 | 0.1 | 0.9 | 0.2 | 2.0 | 1.1 | 1.3 | 1.3 | 1.6 | 7.1 |
| Knifejaw | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0.1 | 0 | 0.1 |
| Latchet | 0 | 0 | 0 | 0 | 0 | 0.4 | 0 | 0.8 | 0.5 | 2.4 | 0.5 | 0.4 | 3.1 | 0.4 | 1.9 | 1.6 | 0.6 | 1.4 | 2.5 | 7.5 | 6.8 |
| Leatherjacket | 0.1 | 0.6 | 2.3 | 0 | 0.2 | 0.5 | 0 | 0 | 0.4 | 0.8 | 1.7 | 0.6 | 1.1 | 0.8 | 1.0 | 1.6 | 1.4 | 1.7 | 9.3 | 7.6 | 10.9 |
| Ling | 1.9 | 3.0 | 4.6 | 1.1 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 3.4 | 1.4 | 1.6 | 2.0 | 15.3 | 46.8 | 31.5 | 9.6 | 4.5 | 9.4 | 9.1 | 11.4 |
| Luderick | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0.9 | 0.6 | 0 | 0.1 | 0 | 0.1 | 0 | 0.1 | 0.1 | 1.0 | 3.2 | 5.8 | 3.5 |

**Appendix 2.3.** Continued

| | *Catch (t)* | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *69/70* | *70/71* | *71/72* | *72/73* | *73/74* | *74/75* | *75/76* | *76/77* | *77/78* | *78/79* | *79/80* | *80/81* | *81/82* | *82/83* | *83/84* | *84/85* | *85/86* | *86/87* | *87/88* | *88/89* | *89/90* |
| Mackerel, blue | 5.0 | 1.5 | 20.0 | 9.3 | 130.8 | 465.1 | 0.1 | 0.1 | 0 | 0 | 0 | 0.1 | 0.8 | 1.0 | 0 | 0 | 0 | 0.6 | 0.7 | 0 | 0.7 |
| Mackerel, jack | 0 | 0 | 0 | 0 | 5583 | 0 | 0 | 0.7 | 4.5 | 16.0 | 6.3 | 5.9 | 1.1 | 0.5 | 0.5 | 20.2 | 41.2 | 4.8 | 17.5 | 47.3 | 27.2 |
| Marblefish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 1.6 | 0.2 | 0.3 | 0.6 | 0.4 | 0 | 0.1 | 0 | 0.9 | 0 | 0.3 | 0.6 |
| Morwong, banded | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.1 | 0.6 | 0.4 | 0.3 | 0.4 | 0.7 | 0.1 | 0.3 | 0.8 | 54.9 | 3.2 | 3.5 |
| Morwong, dusky | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 |
| Morwong, jackass | 1.4 | 10.1 | 11.1 | 7.1 | 30.6 | 9.3 | 14.1 | 64.0 | 23.2 | 28.9 | 4.4 | 3.3 | 32.2 | 14.7 | 28.6 | 38.4 | 5.8 | 11.5 | 237.0 | 55.6 | 60.6 |
| Morwong, red | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.1 |
| Morwong, unspec. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mullet | 10.5 | 10.1 | 10.3 | 7.8 | 12.2 | 5.7 | 4.0 | 6.1 | 8.2 | 5.8 | 13.4 | 16.7 | 25.2 | 32.6 | 13.1 | 20.0 | 17.4 | 19.5 | 27.3 | 30.4 | 33.6 |
| Nannygai | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other & Mixed | 2.9 | 3.5 | 11.0 | 5.9 | 167.3 | 1.7 | 4.0 | 4.5 | 21.6 | 7.5 | 27.6 | 5.3 | 9.2 | 9.1 | 13.1 | 19.1 | 13.1 | 38.5 | 98.0 | 94.4 | 121.9 |
| Perch, giant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.6 | 1.7 | 0 | 0.1 | 3.3 | 5.5 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Perch, magpie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0.1 | 0.1 | 0.1 | 3.1 | 6.5 | 4.6 |
| Perch, ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 1.9 | 0.2 | 0.2 | 0 | 1.4 | 0.3 | 11.4 | 5.0 |
| Pike, long-finned | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0 | 0.2 | 0.4 | 0 | 0 | 0 | 0 | 0.6 | 0.2 | 0 |
| Pike, short-finned | 0.2 | 0.4 | 0.2 | 0.3 | 0 | 2.6 | 1.8 | 3.7 | 6.0 | 7.4 | 6.1 | 3.9 | 6.7 | 5.0 | 3.2 | 3.5 | 3.1 | 6.7 | 8.2 | 12.0 | 12.1 |
| Pilchard | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.9 | 0 | 0 | 0 | 0.2 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red bait | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red mullet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 1.4 | 0 | 0.1 | 0.5 | 0.2 | 0.1 | 0.1 | 0.2 |
| Silverfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Rudderfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snapper | 0 | 1.0 | 0.2 | 0 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stargazer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 |
| Sweep | 0 | 0 | 0.3 | 0.2 | 0 | 0 | 0 | 0.3 | 0.9 | 0 | 0.1 | 0 | 0.3 | 0 | 0.1 | 0.1 | 0.1 | 1.1 | 4.1 | 3.6 | 2.9 |
| Tailor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Trevally, silver[11] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30.9 | 6.2 | 2.0 | 21.2 | 36.5 | 70.5 | 84.7 | 87.2 | 104.5 | 119.8 | 184.8 | 96.0 | 272.6 |

[11] It is probable that the bulk of the catch coded as silver trevally was blue warehou, the latter species being commonly referred to as “trevally” by fishers.

**Appendix 2.3.** Continued

| | *Catch (t)* | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *69/70* | *70/71* | *71/72* | *72/73* | *73/74* | *74/75* | *75/76* | *76/77* | *77/78* | *78/79* | *79/80* | *80/81* | *81/82* | *82/83* | *83/84* | *84/85* | *85/86* | *86/87* | *87/88* | *88/89* | *89/90* |
| Trout, rainbow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trumpeter, bastard | 15.6 | 17.8 | 17.5 | 9.8 | 9.5 | 7.1 | 5.8 | 10.2 | 7.4 | 14.1 | 8.3 | 13.9 | 14.0 | 26.7 | 21.0 | 11.8 | 8.3 | 19.2 | 46.9 | 61.6 | 63.5 |
| Trumpeter, striped | 1.6 | 1.3 | 0.1 | 0 | 0.3 | 0 | 0.4 | 0 | 1.7 | 1.1 | 2.0 | 4.5 | 5.5 | 1.8 | 1.4 | 12.4 | 18.4 | 24.8 | 35.7 | 30.9 | 77.6 |
| Warehou, blue | 1.9 | 0 | 0 | 0 | 5.5 | 7.3 | 1.2 | 0 | 0 | 28.0 | 29.1 | 41.2 | 15.3 | 17.8 | 14.4 | 26.8 | 42.8 | 88.7 | 118.0 | 31.4 | 32.2 |
| Warehou, spotted | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 | 35.0 | 32.2 | 43.3 | 14.4 |
| Whiptail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Whiting | 0 | 0 | 0 | 1.4 | 3.3 | 0.5 | 83.5 | 0.5 | 2.2 | 0.8 | 53.7 | 16.9 | 5.5 | 16.9 | 1.6 | 24.4 | 37.8 | 24.7 | 46.0 | 105.5 | 126.5 |
| Wrasse | 0.9 | 0.6 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 1.3 | 0.6 | 0.4 | 0 | 0.4 | 0.2 | 0.3 | 0.4 | 0.3 | 1.1 | 4.1 | 13.6 | 19.4 |
| **Total** | **1476** | **822** | **1429** | **1525** | **7481** | **2532** | **721** | **846** | **1021** | **942** | **830** | **465** | **763** | **827** | **839** | **1091** | **1202** | **1207** | **2249** | **2162** | **1967** |
| **Excl. Aus salmon** | **1414** | **613** | **651** | **802** | **6595** | **1067** | **254** | **274** | **369** | **337** | **317** | **262** | **289** | **332** | **407** | **481** | **473** | **583** | **1308** | **1147** | **1567** |
| **'Commonwealth' species** | | | | | | | | | | | | | | | | | | | | | |
| Blue grenadier | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.3 | 1.6 | 49.4 | 48.6 | 175.6 | 81.7 | 41.9 | 1.9 | 67.3 | 0.4 | 21.6 |
| Gemfish | 1.0 | 2.7 | 7.1 | 7.1 | 4.7 | 7.8 | 7.6 | 9.9 | 14.5 | 5.0 | 5.2 | 1.2 | 10.6 | 14.0 | 32.6 | 20.2 | 12.2 | 5.4 | 66.0 | 6.3 | 22.7 |
| Hapuka | 0 | 0 | 0 | 0.2 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.1 | 0.7 | 0.9 | 2.3 | 0.7 | 1.2 | 2.0 | 7.1 | 4.0 |
| Oreo | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0.1 | 0 | 0 |
| Trevalla, blue eye | 11.2 | 60.7 | 107.1 | 72.6 | 79.6 | 102.7 | 64.8 | 66.8 | 93.6 | 118.7 | 112.0 | 164.0 | 142.9 | 188.1 | 174.0 | 187.9 | 123.3 | 92.7 | 148.5 | 230.1 | 301.4 |
| **Total** | **12.2** | **63.4** | **114.2** | **79.9** | **84.4** | **110.5** | **72.3** | **76.7** | **109.9** | **123.9** | **117.6** | **166.9** | **203.0** | **251.3** | **383.1** | **292.2** | **178.1** | **101.4** | **283.8** | **243.9** | **349.7** |
| **Tunas** | | | | | | | | | | | | | | | | | | | | | |
| Tuna, albacore | 0 | 0 | 0 | 0.5 | 0.4 | 0 | 0.1 | 2.3 | 0.4 | 1.4 | 1.2 | 3.3 | 2.1 | 1.5 | 1.4 | 1.1 | 13.7 | 5.4 | 3.3 | 14.2 | 35.0 |
| Tuna, skipjack | 0.8 | 0.2 | 13.2 | 34.5 | 1326 | 136.0 | 7.8 | 22.5 | 38.4 | 21.6 | 7.9 | 27.6 | 2.2 | 0.2 | 6.9 | 3.8 | 0.5 | 0.1 | 36.2 | 13.6 | 25.5 |
| Tuna, southern bluefin | 4.4 | 4.2 | 22.0 | 2.1 | 8.8 | 5.9 | 63.1 | 31.8 | 8.2 | 40.2 | 30.4 | 10.5 | 11.6 | 0.5 | 0.2 | 0.4 | 1.6 | 1.9 | 5.4 | 14.6 | 29.0 |
| Tuna, yellowfin | 0 | 0 | 0 | 0 | 132.7 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **5.1** | **4.4** | **35.1** | **37.1** | **1468** | **142.0** | **71.0** | **56.6** | **47.0** | **63.3** | **39.5** | **41.4** | **15.9** | **2.2** | **8.5** | **5.3** | **15.9** | **7.3** | **44.9** | **42.4** | **89.5** |

**Appendix 2.3.** Continued

| | *Catch (t)* | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *69/70* | *70/71* | *71/72* | *72/73* | *73/74* | *74/75* | *75/76* | *76/77* | *77/78* | *78/79* | *79/80* | *80/81* | *81/82* | *82/83* | *83/84* | *84/85* | *85/86* | *86/87* | *87/88* | *88/89* | *89/90* |
| **Shark** | | | | | | | | | | | | | | | | | | | | | |
| Shark, angel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Shark, blue whaler | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| Shark, bronze whaler | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0.5 |
| Shark, elephant | 0 | 0 | 0 | 0 | 0 | 0 | 12.5 | 9.5 | 4.6 | 18.8 | 20.6 | 28.9 | 40.6 | 62.3 | 64.9 | 118.1 | 74.0 | 57.2 | 73.8 | 82.2 | 79.1 |
| Shark, gummy | 336.6 | 185.1 | 271.3 | 74.7 | 321.7 | 293.9 | 336.9 | 313.9 | 497.3 | 365.0 | 281.8 | 736.9 | 953.6 | 1105 | 1063 | 1323 | 1148 | 1166 | 1097 | 1168 | 1478 |
| Shark, saw | 0.1 | 0 | 0 | 0.9 | 4.6 | 7.1 | 11.0 | 9.7 | 37.5 | 23.6 | 8.5 | 72.4 | 141.3 | 170.2 | 133.7 | 195.6 | 165.1 | 230.8 | 248.9 | 176.3 | 162.5 |
| Shark, school | 380.7 | 391.5 | 412.3 | 189.3 | 300.4 | 141.8 | 471.9 | 348.0 | 501.5 | 437.7 | 547.1 | 756.2 | 814.4 | 688.6 | 981.3 | 1335 | 1248 | 1122 | 892.9 | 639.6 | 806.9 |
| Shark, seven-gilled | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 10.9 | 3.1 | 1.9 | 1.5 | 0.9 | 0.7 |
| Shark, spurdog | 1.5 | 0 | 0.1 | 0 | 0.2 | 0 | 0 | 0.1 | 0 | 0.5 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0.1 | 0.7 | 0.6 | 0.5 |
| Shark, unspecified | 0.3 | 35.7 | 92.3 | 70.2 | 117.6 | 26.3 | 9.4 | 1.7 | 17.3 | 58.5 | 84.9 | 16.2 | 63.6 | 68.0 | 13.7 | 12.8 | 40.5 | 73.4 | 264.4 | 93.3 | 68.6 |
| Skates & rays | 0.3 | 0 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0.3 | 0.1 | 2.0 | 0.1 | 0.5 | 2.4 | 0.8 | 5.6 | 1.7 | 3.8 |
| **Total shark** | **719.6** | **612.3** | **777.8** | **335.1** | **744.6** | **469.1** | **841.8** | **682.8** | **1058** | **904.2** | **943.0** | **1611** | **2014** | **2097** | **2258** | **2996** | **2681** | **2653** | **2584** | **2163** | **2601** |
| **Excl. sch & gum sh** | **2.3** | **35.7** | **94.2** | **71.1** | **122.5** | **33.4** | **33.0** | **20.9** | **59.5** | **101.5** | **114.1** | **117.8** | **245.6** | **302.5** | **213.9** | **338.0** | **285.1** | **364.2** | **595.0** | **355.0** | **316.1** |
| **Cephalopods** | | | | | | | | | | | | | | | | | | | | | |
| Calamary | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.2 | 13.9 | 5.8 | 2.1 | 0.4 | 23.4 | 18.1 | 18.8 | 10.2 | 8.9 |
| Cuttlefish | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 | 0 | 0 | 1.8 | 0.4 | 0.3 | 0.2 | 0.3 |
| Octopus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 3.4 | 4.1 | 1.7 | 3.5 | 2.5 | 2.9 | 5.9 | 16.2 | 2.9 | 22.1 | 14.9 | 4.6 |
| Squid, arrow | 0.3 | 0.8 | 5.6 | 74.2 | 4.0 | 6.0 | 0.3 | 2.5 | 2.7 | 8.2 | 42.7 | 1.6 | 0.1 | 7.3 | 0.8 | 5.8 | 3.2 | 3.2 | 2.3 | 0.5 | 10.5 |
| **Total cephalopod** | **0.3** | **0.8** | **5.6** | **74.2** | **4.0** | **6.1** | **0.3** | **2.5** | **3.4** | **11.7** | **46.7** | **9.6** | **18.3** | **15.7** | **5.9** | **12.0** | **44.6** | **24.7** | **43.5** | **25.9** | **24.3** |
| **Crustacea** | | | | | | | | | | | | | | | | | | | | | |
| Crab, sand | 0 | 4.0 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 |
| Crab, surf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0.1 | 0.5 | 0.1 | 0.1 | 0 | 0 | 0.3 | 0.1 | 0.5 | 0 | 0 |
| Crab, unspec. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0.5 | 1.0 | 0.3 | 0.8 | 0.1 | 0.2 |
| **Total crust.** | **0** | **4.0** | **0.7** | **0** | **0** | **0** | **0** | **0** | **0** | **0.3** | **0.4** | **0.6** | **0.1** | **0.1** | **0** | **0.5** | **1.3** | **0.5** | **1.3** | **0.1** | **0.2** |
| **Grand total** | **2213** | **1507** | **2362** | **2051** | **9781** | **3259** | **1707** | **1665** | **2239** | **2046** | **1978** | **2294** | **3014** | **3193** | **3494** | **4397** | **4122** | **3994** | **5207** | **4637** | **5032** |

**Appendix 2.4** Biological parameters for striped trumpeter in Tasmania.

| | Growth | | | Longevity | Mortality | | Reproduction | | Recruitment Inshore Fishery | | Length-Weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_{inf}$ | K | $t_0$ | $A_{max}$ | Z | M | Age | Size | Age | Size | a | b | Author |
| Females | 72.9 | 0.89 | -1.258 | | - | - | | | | | 0.034 | 2.77 | unpubl. |
| Males | 72.9 | 0.89 | -1.258 | | - | - | | | | | 0.034 | 2.77 | |
| Females | | | | | | | 5 | 43.8 | | | | | Hutchinson (1993) |
| Males | | | | | | | 8 | 53.4 | | | | | |
| Females | | | | | | | | | 5 | | | | Murphy and Lyle (in prep) |
| Males | | | | | | | | | | | | | |

**Appendix 2.5** Biological parameters for banded morwong in Tasmania

| Growth | | | | Longevity | Mortality | | Reproduction 50% mature | | Recruitment | | Length-Weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_{inf}$ | K | $t_0$ | $A_{max}$ | Z | M | Age | Size | Age | Size | a | b | Author |
| Females | 43.2 | 0.098 | -11.3 | 77 | 0.02-0.04 | 0.059 | 4-5 | 32.4 | | | 0.0318 | 2.91 | Murphy & Lyle (1999) |
| Males | 51.2 | 0.161 | -2.7 | 65 | 0.06-0.07 | 0.071 | | | | | 0.0309 | 2.91 | |
| Females - non spawning | | | | | | | | | | | 0.0371 | 2.847 | |
| Females - spawning | | | | | | | | | | | 0.0329 | 2.902 | |
| Males | | | | | | | | | | | 0.0301 | 2.912 | |
| Females - Bicheno | 43.2 | 0.113 | -10.0 | | | | | | | | | | |
| Females Tasman | 43.1 | 0.082 | -13.7 | | | | | | | | | | |
| Males - Bicheno | 50.9 | 0.178 | -2.5 | | | | | | | | 0.0318 | 2.901 | |
| Males - Tasman | 51.6 | 0.149 | -2.8 | | | | | | | | 0.0309 | 2.901 | |

**Appendix 2.6** Biological parameters for sea garfish in Tasmania

| | Growth | | | Longevity | Mortality | | Reproduction 50% mature | | Recruitment | | Length-Weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_{inf}$ | K | $t_0$ | $A_{max}$ | Z | M | Age | Size | Age | Size | a | b | Author |
| Females | 34.3 | 0.54 | 0.23 | | | | | | 2 | ~25 cm | | | Jordan *et al.* (1998) |
| Males | | | | | | | | | 2 | ~25 cm | | | |
| Females | 37.3 | 0.62 | | | | | 2 | | | | 3.08 | 3.85 | St Hill (1996) |
| Males | 36.4 | 0.59 | | | | | 3 | | | | 3.05 | 3.45 | |

**Appendix 2.7** Biological parameters for purple and blue-throat wrasse in Tasmania

| Growth | | | | Longevity | Mortality | | Reproduction 50% mature | | Recruitment | | Length-Weight | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_{inf}$ | K | $t_0$ | $A_{max}$ | Z | M | Age | Size | Age | Size | a | b | Author |
| **Purple** | | | | | | | | | | | | | |
| Males/Females | 39.9 | 0.12 | 2.36 | 16 | | | 2 | ~15 | | | | | Barrett (1995) |
| Males/Females | | | | | | | | | 7 | 28 | 0.05 | 2.71 | unpubl. |
| **Blue-throat** | | | | | | | | | | | | | |
| Males/Females | 36.1 | 0.20 | -0.35 | 9 | | | 2 | ~15 | | | | | Barrett (1995) |
| Males | | | | | | | 5-9 | 27-32 | | | | | |
| Males/Females | | | | | | | | | 6-7 | 28 | 0.05 | 2.71 | unpubl. |