FISHERY ASSESSMENT REPORT

TASMANIAN SCALEFISH FISHERY ASSESSMENT - 1999

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

The SFAWG met on 28th January, 2000 to consider background documents and provide input into the assessments. The Working Group participants were:

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Scalefish Fishery Assessment 1999

Summary

The scalefish fishery is a multi-species fishery involving a wide variety of fishing methods. In addition, many scalefish species are important to the recreational fishery.

An important element of the Scalefish Management Plan, introduced in 1998, 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 assessment of the scalefish fishery, the fishery is described in terms of catch composition and catch levels. Catch history for the period 1990/91 – 1998/99 is presented, with more detailed analyses of catch and effort by method for the period 1995/96 - 1998/99.

Catch, effort and catch rate (catch per unit effort - CPUE) information are only available for a four year period, the first three years being used as the reference period to define the trigger points. In this regard there is only one year of data available to assess fishery performance.

The most important developments in the fishery have been the significant increases in dropline, handline, dipnet and squid jig effort in 1998/99. For each of these methods effort was more than 40% higher than that for the reference period (Table 1). While indicating that effort triggers have been exceeded, it is noteworthy that all of these methods are available to all holders of scalefish licences. By contrast, effort levels have declined for methods that are regulated through limited entry (eg. purse seine, beach seine) have declined. Graball net effort declined markedly in 1998/99, presumably reflecting the impact of new management arrangements that prescribe and limit the amount of gear that can be used by scalefish licence category.

Table 1 Effort trigger point assessment by fishing method

Y triggered , N not triggered, , * 10-40% increase, ** > 40% increase

	Effort
Method	*>10% peak 95-97*
Beach seine	N
Purse seine	N
Graball net	N
Small mesh	N
Dropline (<200m)	Y **
Handline	Y **
Troll	N
Fish trap	Y *
Octopus trap	N
Spear	N
Dipnet	Y **
Squid jig	Y **

Species assessments

Detailed assessments are provided for striped trumpeter, banded morwong, sea garfish, wrasse and southern calamary. In each case, the 1999 assessment involved an evaluation of catch, effort and CPUE data. Descriptions of these fisheries, including fishing methods, seasonality and spatial distribution of catches were provided in the 1998 assessment.

Striped trumpeter

Annual catch of striped trumpeter increased considerably during 1998/99 for the main fishing methods (dropline, handline and graball), with a combined catch of 97 tonnes. In handline and dropline, this was largely a result of increased effort and not CPUE. Particularly strong recruitment of 1993 and 1994 cohorts appears to have contributed to the increase in the catch. In contrast, graball net CPUE has increased, in part, due to the presence of relatively large numbers of 3 year-old fish, representing the 1996 year-class. The resource status is unknown, but indicators based on catch and effort are likely to be strongly influenced by recruitment variability.

The increase in total catch and handline effort for striped trumpeter resulted in these triggers being exceeded.

Banded morwong

The fishery for banded morwong has expanded over the past eight years with the development of live fish markets for the species. However, the annual catch of banded morwong has declined steadily since 1994/95, falling further in 1998/99 to 43 tonnes due primarily to a large decrease in effort, while CPUE increase slightly. Declines in catch and effort were evident in most east coast fishing blocks (St Helens, Bicheno and Schouten, Tasman Peninsula, Maria Is.).

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 population at small spatial scales (to the level of a particular reef), which suggests that stock assessment needs to be undertaken at this level.

The 1998/99 catch was lower than the recommended catch history reference (1994/95 to 1997/98). This, and the fact that the catch had declined by greater than 30% compared to 1997/98 indicated that the catch triggers had been exceeded. The catch rate indicator, while not exceeded statewide, has been triggered for the Maria and Schouten Island regions.

Sea garfish

Sea garfish catches throughout the state declined in 1998 to 85 tonnes, due largely to a decrease in beach seine effort and CPUE for dipnets. Effort in the dipnet sector increased considerably in the same year. 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. Sea garfish are a schooling species, and as such, catch rates will tend to remain stable even with decreasing stock abundance. Catch rates are not considered to be reliable nor sensitive parameters for indicating trends in abundance. Resource status is unknown.

The increase in dipnet effort in 1998 targeted at sea garfish resulted in this effort trigger being exceeded.

Wrasse

The development of live fish markets for wrasse have resulted in increased catches over the past eight 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 catch declined in 1998/99 to 90 tonnes, reflecting decreases in handline and graball catch and effort. In contrast, trap catch and effort showed increases in 1998/99. CPUE increased for all methods in 1998/99.

Although wrasse are comparatively short-lived, attaining maturity well before they are recruited to the fishery, they demonstrate strong site attachment and therefore, assessment may need to be based at a small 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.

No triggers were exceeded for wrasse in 1998/99.

Southern calamary

There has been a substantial increase in the catch of southern calamary in 1998/99 to 91 tonnes, due largely to increased jig fishing activity. The increase in catch occurred primarily in the Great Oyster Bay and Mercury Passage regions. Catch rates for jigs also increased in 1998/99. Resource status is unknown.

As 1998/99 catch and effort levels for southern calamary have reached historically high levels, both catch (quantity and rate of change) and effort levels have exceeded the trigger points.

Other key species

Catch, effort and CPUE were examined for blue warehou, Australian salmon, bastard trumpeter and arrow squid. These parameters were within the reference criteria for Australian salmon and bastard trumpeter. There was a greater than 30% increase in the catch of blue warehou in 1998/99 compared with the previous year, and catch and effort directed at arrow squid attained an historic high in 1998/99 indicating these triggers have been exceeded.

Trigger point summary

Catch, effort and CPUE trigger point analysis for the key species are summarised in Table 2. Details of effort triggers by methods for key species are detailed in Chapters 3-8.

Table 2 Summary trigger point assessment for key species.
Y triggered; N not triggered; arrows indicate direction of change; * catch history period for comparison is 1994/95 to 1997/98; ** catch history period for comparison is 1995/96 to 1997/98; *** trigger point exceeded in specific fishing blocks; - not considered reliable indicators

	Catch		*Effort*	*CPUE*
Species	*Outside 90-97 range*	*Decline/ increase by >30%*	*Increase by >10% from highest 95-97 level*	*< 80% min. 95-97 range*
Striped trumpeter	Y ↑	N	Y	N
Banded morwong*	Y ↓	Y ↓	N	Y***
Sea garfish	N	N	Y	-
Wrasse**	N	N	N	N
Southern calamary	Y ↑	Y ↑	Y	-
Australian salmon	N	N	N	N
Bastard trumpeter	N	N	N	N
Blue warehou	N	Y ↑	N	N
Arrow squid	Y ↑	Y ↑	Y	-

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1 Management Objectives and Strategies

The Scalefish Management Plan was introduced in 1998 (DPIF 1998) and contains the following objectives, strategies and performance indicators.

1.1 Major objectives

- To maintain fish stocks at sustainable levels b y 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, and
- 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, and
- 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.

2 Fishery Assessment

2.1 The Fishery

The scalefish fishery is a multi-method and multi-species fishery, management of which is complicated by jurisdictional issues, with several key stocks harvested across a number of jurisdictions (Lyle and Jordan 1999).

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 1.

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) (eg. Tilzey 1999).

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, however, the Commonwealth will assume management responsibility for these species. Stock assessment for school and gummy shark is undertaken by the Southern Shark Fishery Assessment Group (SSFAG).

The main cephalopods taken are the southern calamary, arrow squid and octopus. Catches of all three have increased in recent years in response to market developments.

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 gillnet catch (Lyle 2000).

2.2 Data sources

Unless otherwise indicated, catch and effort information is based on Tasmanian General Fishing Returns. 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 effort and catch rate analysis. In early 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 fishing method used.

For the purposes of this assessment, effort and catch rate analyses are restricted to data provided in the new logbook and for the period July 1995 - June 1999. All catch returns available as at December 1999 have been incorporated into these analyses. Data restrictions and manipulations are detailed in Appendix 2.

In generating catch rate statistics for this assessment the geometric mean has been calculated. The geometric mean approach is recommended because catch rate data tend to be log-normally distributed. By contrast, summary catch rate data reported in the 1998 assessment were calculated as total catch divided by total effort.

Catch returns for which effort was unrealistically high or low (either due to data entry error or misinterpretation of information requirements by fishers) have been excluded in effort and catch rate analyses. Effort information for approximately 0.5% of all fishing operations (daily catch records) were considered unreliable.

In terms of reporting annual data, a fishing year from July-June has been adopted, unless otherwise specified. The primary justification being that it better reflects the seasonality in the fishery for most species than using a calender year, with catches (and effort) tending to be concentrated between late spring and early autumn[1].

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, 2000).

2.3 Recent catch trends

Annual catch by species since 1990/91 is presented in Table 2.1. Overall, scalefish catches have declined from over 2000 tonnes in the early 1990s to between 1200 – 1500 tonnes in recent years. The 1998/99 catch of 1320 tonnes represented a decline of just over 10% when compared with the previous year.

Since 1997, an increasing proportion of the catch of ‘Commonwealth’ species, tunas and shark (as defined in Table 2.1) has been reported on Commonwealth logbooks and, as a consequence, catches in recent years are under-represented in the data. The sharp rise in the cephalopod catch in 1998/99 to over 250 tonnes was due to record catches of southern calamary, octopus and arrow squid.

Catch trends for the major species are summarised in Fig. 2.1. Australian salmon have consistently dominated the scalefish catch, with catches in excess of 650 tonnes p.a. prior to 1995/96. More recent landings have remained lower, fluctuating between about 300 - 475 tonnes. These generally lower landings largely reflect a decline in the size of the beach seine catch, itself a response to reduced bait-market demand.

Barracouta catches declined sharply from around 350 tonnes in the early 1990s to around 60 tonnes by 1993/94. Since then landings have remained at low levels, reflecting, in part at least, low market demand. Flounder catches have tended to range between 30 – 40 tonnes, the most recent data indicating a slightly lower catch of around 20 tonnes. The catch history for

[1] An exception is garfish, refer to Section 5.

bastard trumpeter has been characterised by relatively minor fluctuations between years, with catches in the range of 35 – 65 tonnes p.a.

Flathead, jackass morwong and whiting catches all declined from the early 1990's to 1995/96. Subsequent catches have remained relatively stable at levels of below 50 tonnes p.a. A reduction in inshore trawl (otter trawl and Danish seine) activity has largely contributed to these declines (Lyle and Jordan 1999).

Catches of sea garfish and striped trumpeter both increased in 1998/99 to around 100 tonnes, representing levels slightly higher than previously reported for Tasmania.

The development of live fish markets for banded morwong and wrasse during the early 1990's resulted in marked increases in the catch of both species. Subsequent to 1995/96, wrasse catches stabilised at around 90 - 100 tonnes p.a. whereas banded morwong catches have continued to decline, from almost 90 tonnes in 1995/96 to around 50 tonnes in 1998/99.

Blue warehou catches have fluctuated widely, between around 100 – 300 tonnes since the early 1990's, with the most recent catch of around 240 tonnes representing an increase of around 40% on the previous year. This species is also harvested in the Commonwealth managed South East Fishery by both trawl and gillnet methods[2].

Catches of calamary and octopus increased sharply in 1998/99, to around 90 tonnes each. As such they represent the highest catch levels on record.

[2] Assessments of this species is undertaken by the South East Fishery Assessment Group (SEFAG) and data for the Tasmanian component of the fishery is factored into the analyses.

Table 2.1 Annual catch (whole weight) by species for the period 1990/91 to 1998/99 based on General Fishing Returns.

	Catch (t)								
Species	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Alfonsino	0	0	0.1	0	0.1	0.4	1.8	0.8	0
Anchovy	0	0	3.1	12.9	11.8	5.5	4.2	15.4	2.8
Atlantic salmon	0	0	0	1.7	0.1	0	0.2	0	0
Australian salmon	815.9	651.9	867.0	878.8	682.1	412.9	287.3	475.7	384.7
Barracouta	351.5	268.3	205.4	59.6	25.2	20.1	53.8	65.2	27.6
Boarfish	7.2	9.4	7.6	10.1	9.1	7.2	10.0	6.2	3.2
Bream	5.7	3.5	1.4	7.4	7.2	2.5	9.9	1.0	0
Butterfish	0.1	0	0	0	0	0	0	0	0
Cardinal fish	0.3	0	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	0
Cod, bearded rock	0.6	0.4	0.9	2.4	0.6	4.7	3.8	1.8	1.9
Cod, red	0.1	0	1.3	1.3	0.5	0.5	1.5	0.5	0.6
Cod, unspec.	9.3	10.0	4.8	8.4	9.8	14.9	8.6	12.6	7.1
Dory, john	0.3	0	0	0.1	0.1	0.3	0.1	0	0
Dory, king	0.8	0	0	0	0	0	0.1	0	0
Dory, mirror	0	0	0.4	0	0	0	0.2	0.1	0
Dory, silver	0.4	0.5	0	0.4	0.5	0.1	0.3	0.5	0
Dory, unspec.	1.3	0.8	5.6	0.6	0.4	0	0.3	0.6	0.2
Eel	0.2	0.5	0.9	2.2	3.1	2.2	1.4	1.7	2.1
Flathead	165.3	118.1	98.8	121.4	91.1	57.8	51.7	62.7	50.4
Flounder	44.0	36.8	31.8	27.3	27.1	33.4	29.3	26.7	22.7
Garfish	80.9	80.1	82.3	82.9	69.3	58.0	91.6	83.0	101.3
Gurnard	18.6	18.4	13.2	13.1	9.8	9.0	8.2	5.7	2.6
Gurnard perch	0.1	0.2	1.0	0.6	1.9	0.4	0.1	0.9	1.4
Gurnard, red	0.1	0.2	1.0	1.0	1.0	0.9	0.3	0.7	0.9
Hardyheads	0	0	0	0	0	0.2	0.2	0	0
Herring cale	0	0.3	0	0	1.1	1.1	0.5	1.7	0.3
Kingfish	1.3	0.2	2.8	0.1	0.3	1.2	0.3	0.1	1.3
Knifejaw	0.2	0	0.1	0.5	0.2	0	0.1	0.1	0
Latchet	13.9	10.0	6.5	12.4	11.9	6.1	3.3	1.9	1.0
Leatherjacket	12.2	14.0	13.1	23.3	27.7	15.0	12.6	13.3	12.8
Ling	5.1	13.6	30.0	41.6	33.2	20.4	23.5	83.2	4.2
Luderick	0.7	0.6	0.2	1.5	2.4	1.6	0.5	0.3	0.6
Mackerel, blue	3.0	2.1	0.3	8.5	5.7	2.0	1.3	1.0	0.5
Mackerel, jack	6.1	11.1	32.8	48.4	39.7	26.2	19.3	19.7	59.8
Marblefish	0.2	0.9	0.3	1.0	1.8	3.8	5.6	3.0	2.6
Mixed	99.7	66.1	61	52.9	15.0	11.5	13.7	10.4	7.8
Morwong, banded	7.0	6.9	39.2	145.5	105.8	87.9	79.0	71.8	42.9
Morwong, blue	0	0.3	0.3	0	0	0	0	0	0
Morwong, dusky	0.4	0	0	0.1	0.1	0	0	0	0
Morwong, grey	0	0.2	1.9	2.5	2.0	0	0.1	0.1	0.3
Morwong, jackass	136.9	111.9	83.2	117.6	63.1	27.5	18.8	33.2	17.5
Morwong, red	0	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	4.4
Mullet	31.2	22.2	26.2	19.5	23.8	12.0	11.2	16.0	14.5
Nannygai	0	0.3	0	1.1	0.3	0.4	1.0	0.1	0
Perch, magpie	1.2	3.2	0.3	5.7	2.7	1.9	1.5	0.6	1.6
Perch, ocean	1.7	0.2	4.1	4.6	1.3	2.8	3.8	4.1	2.1
Other	0	0	0	0	0.1	0.8	0.5	2.6	0.4

Table 2.1 Continued

	Catch (t)								
Species	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Pike, long-finned	0.1	0	0.1	0.3	0.2	0.3	3.1	3.9	9.5
Pike, short-finned	10.4	9.5	11	12.4	18.6	13.7	15.2	17.7	3.2
Pilchard	0.1	0	0.7	1.7	0.3	0.7	0	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	4.0
Red fish	0.2	0	0	0	0.8	0	0	0.2	0.3
Red mullet	0.4	0	0.2	0.3	0.1	0.2	0.1	0	0
Silverfish	0.4	0	0.2	0	0.3	0	0.4	0.1	0
Snapper	0	0	0	0	0.2	0.2	0.2	0.9	1.4
Stargazer	10.7	3.0	1.2	4.3	1.5	0.2	0	0.3	0
Sweep	1.5	1.4	0.8	0.8	2.0	1.1	0.5	0.6	0.4
Tailor	0	0	0	0	0	0	0.7	0	0
Thetis fish	0	0	0	0	0	1.1	0	0	0
Trevalla, unspec.	1.1	20.9	10.0	0.8	1.4	0	0	3.5	0.0
Trevalla, white	0.6	0	0.1	0	0.2	0	0.1	0	0.9
Trevally, silver	15.0	12.2	2.5	5.9	15.5	5.9	4.2	4.4	6.5
Trevally, unspec.	5.6	1.4	9.5	2.4	6.1	0	0	0	0
Trout	0	0	0.5	0	0	0.4	0.7	3.6	1.1
Trumpeter, bastard	63.3	37.2	34	54.8	50.8	60.7	51.8	40.4	48.0
Trumpeter, striped	74.5	58.2	52.7	56.5	72.4	61.3	79.5	75.4	96.9
Trumpeter, unspec.	0.7	0	0	0.4	0.1	0.2	0.1	0.6	3.5
Warehou, blue	257.6	317.6	187.7	250.1	205.4	94.3	128.5	172.4	241.5
Warehou, spotted	0.7	0.4	4.2	8.8	3.4	14.6	15.6	4.2	0
Whiptail	0	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	30.4
Whiting, King George	0.1	0.4	0.1	0.1	0.2	0.1	0.3	0.2	0.2
Wrasse	57.2	71.7	97.3	142.4	178.0	87.6	110.1	99.2	90.1
Total scalefish	2450.2	2154.3	2134.7	2366.6	1933.9	1230.0	1221.1	1507.9	1321.8
Excl. Aus salmon	1634.3	1502.4	1267.7	1487.8	1251.8	817.1	933.9	1032.3	937.2
‘Commonwealth’ species									
Blue grenadier	3.6	0.1	3.2	5.2	4.2	8.8	12.3	1.4	0
Gemfish	3.4	1.7	1.0	0.4	0.9	5.1	6.1	2.8	0.1
Hapuka	7.2	4.9	19.1	21.4	16.0	2.4	1.3	3.6	0
Oreo	0.5	0	0.1	0	0	0.1	0	0	0
Trevalla, blue eye	206.6	296.5	261.2	288.7	347.7	382.4	515.4	111.4	0.2
Total Comm.	221.3	303.2	284.6	315.6	368.8	398.7	535.1	119.2	0.4
Tunas									
Tuna, albacore	36.7	72.9	43.4	26.9	3.4	1.4	4.8	5.5	2.5
Tuna, skipjack	13.8	14.1	8.2	0.6	0.7	0.3	0.4	0.3	6.8
Tuna, southern bluefin	46.7	24.1	10.8	2.3	1.8	0.6	0.9	0	0
Tuna, unspec.	11.3	10.2	8.9	4.9	1.1	0.2	0.5	0.4	0.9
Total tuna	108.4	121.3	71.3	34.7	7.1	2.4	6.5	6.3	10.2

Table 2.1 Continued.

	Catch (t)								
Species	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Shark									
Shark, angel	0.6	0.2	0.2	0.2	0.3	0.2	0.7	0.2	0
Shark, blue whaler	0.6	0	0.3	0.5	0.5	0.2	0.2	0.7	0.1
Shark, bronze whaler	0.1	0	0	0	0	0	0	0.7	0.1
Shark, elephant	42.4	40.7	48.2	51.4	43.2	55.5	48.7	21.4	14.6
Shark, gummy	770.2	557.7	985.2	904.5	871.6	715.2	538.4	347.6	111.5
Shark, saw	121.4	66.1	121.7	140	148.4	116.6	72.5	29.2	6.6
Shark, school	457.1	395.3	469.6	345.3	333.1	239.5	170.8	72.1	31.4
Shark, seven-gilled	1.7	3.7	2.7	2.1	2.7	6.1	4.9	6.1	1.9
Shark, spurdog	0.1	0	0.2	1.5	3.1	0.3	1.4	2.1	0.3
Shark, unspecified	78.5	50.5	43.2	38.3	24.5	28.4	15.5	10.1	6.3
Skates & rays	2.6	7.4	5.1	6.3	5.9	7.4	2.0	4.6	7.8
Total shark	1475.5	1121.7	1676.5	1490.2	1433.2	1169.5	855.0	494.7	180.7
Excl. school & gummy shark.	248.2	168.7	221.7	240.4	228.5	214.8	145.8	75.1	37.7
Cephalopod									
Calamary	8.2	7.5	5.8	9.7	12.6	32.8	19.0	26.6	90.6
Cuttlefish	0.5	0.7	0	1.1	0.8	0.2	0.3	0.2	0
Octopus	32.2	35.2	47.4	58.2	55.3	77.1	40.8	43.4	85.5
Squid, arrow	35.1	7.2	7.0	7.7	8.6	2.6	2.5	12.9	79.4
Total cephalopod	75.9	50.6	60.1	76.7	77.4	112.3	62.6	83.0	255.5
Crustacean									
Crab	0	0.1	7.1	27.9	4.2	0.3	2.1	5.9	4.7
Grand total	4331.4	3751.2	4234.3	4311.5	3824.6	2913.5	2682.4	2217.1	1773.3

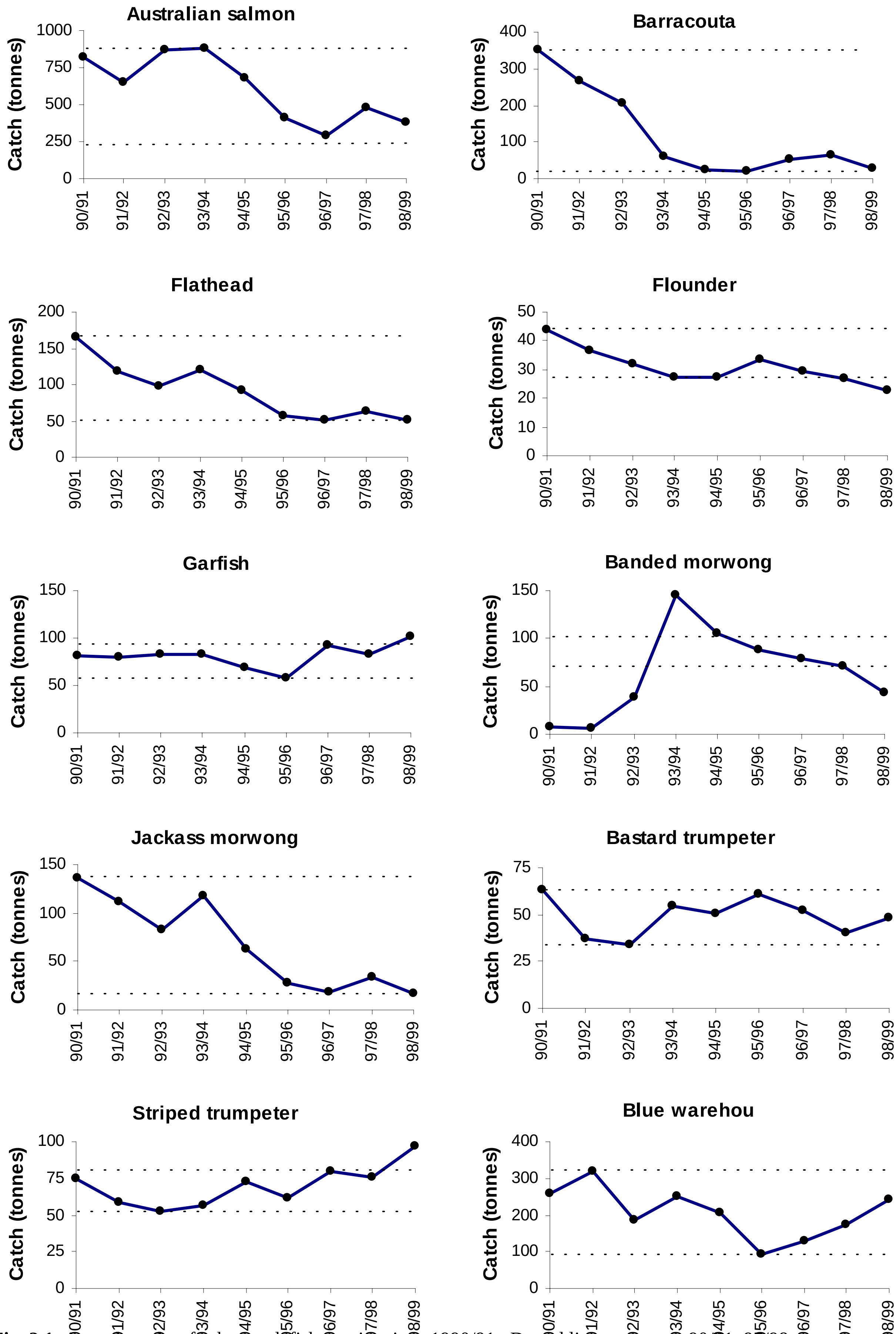

Fig. 2.1. Annual catches for key scalefish species since 1990/91. Dotted lines represent 90/91–97/98 range.

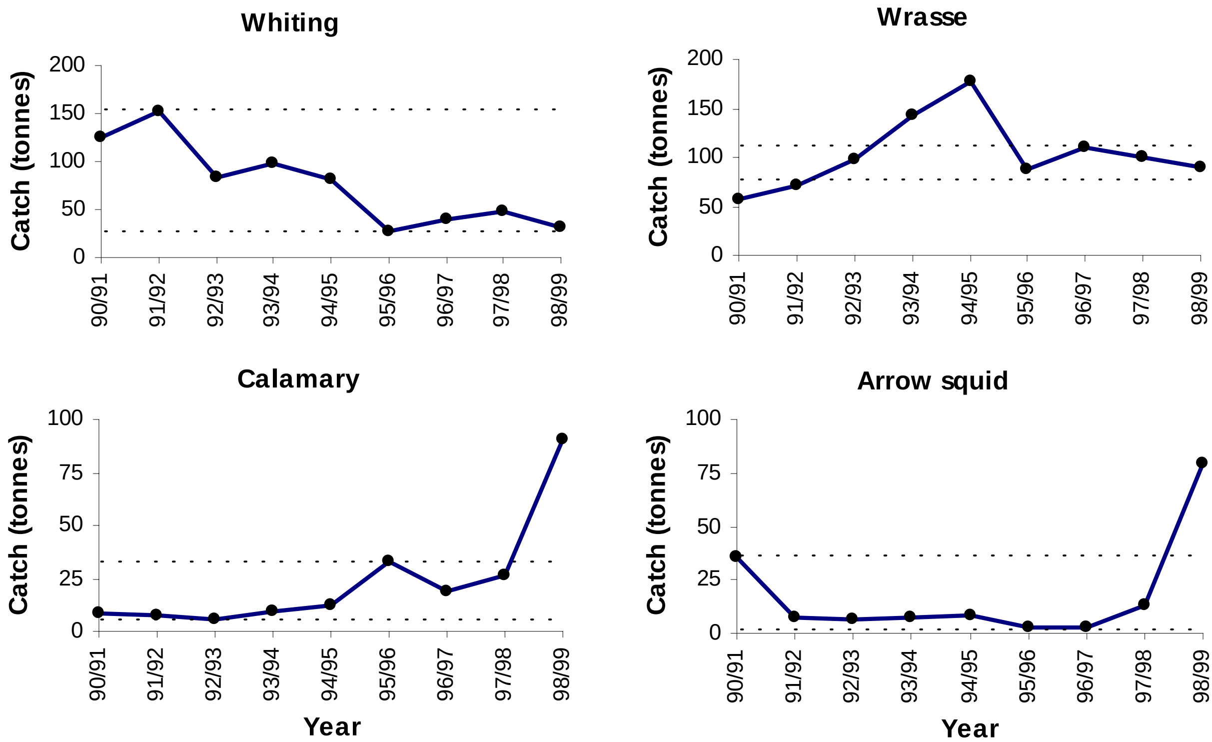

Fig. 2.1. Continued. Note, dotted lines for banded morwong and wrasse represent alternative catch history periods – refer to sections 4 and 6, respectively.

2.4 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.

2.4.1 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 was developed to limit the potential for expansion of fishing effort by defining and limiting access in terms of gear allocations. The impact or performance of these management arrangements may, therefore, be assessed in terms of trends in fishing effort for the main fishing methods.

Catch and effort by the major fishing methods are presented in Table 2.2. Since a range of fishing methods are represented it has been necessary to express effort in units appropriate to the specific fishing method (Table 2.3). Dropline fishing catch and effort has been restricted to depths of less than 200 m to exclude fishing for blue eye trevalla (now managed by the Commonwealth). Since less than 1% of the striped trumpeter catch is reported from depths greater than 200 m, this restriction effectively encompasses the target dropline fishery for striped trumpeter. Catch and effort for shark net and longline methods have been excluded from this analysis as the methods relate specifically to the shark fishery which is assessed by the Southern Shark Fishery Assessment Group.

Few inferences can be made about the status of the fishery and the impacts of recent management changes due to the short time series of available data. In fact, since the new licensing arrangements only took effect part way through the 1998/99 fishing year (November 1998), a full year of data under the new arrangements was not available for this assessment.

Nevertheless, comparisons between 1998/99 effort levels and those for the reference period (1995/96 – 1997/98) indicate that handline, dropline, fish trap, dipnet and squid jig effort has increased, resulting in substantial increases in the dipnet and squid jig catches (Table 2.2). 1998/99 catches for the other methods were within the range reported for the reference period.

Declines in effort were apparent for beach seine, purse seine and graball net methods although catches for the latter two methods tended to be higher than in the reference period. Small mesh net, trolling, spear and octopus pot effort was within the range of the reference years, with only the octopus pot catch exceeding the earlier catch levels.

Trigger point evaluation for the effort based criterion indicates that the 1998/99 effort levels for dropline, handline, fish trap, dipnet and squid jig methods were at least 10% higher than the peak for the reference period (see Table 1). With the exception of fish traps, effort increases were substantial, over 40% greater than the previous peak levels. Effort triggers were not exceeded for the remaining methods. In fact, effort levels in 1998/99 were substantially lower for beach seine, purse seine and graball nets when compared with the preceding three years.

Table 2.2 Total annual catch and effort by fishing method for the period 1995/96-1998/99.
Units of effort are indicated in Table 2.3. * Five or fewer vessels involved, catch and effort data not shown

	Method	*Year*	*Catch (kg)*	*Effort*
Seine	Beach seine	1995/96	469107	1089
		1996/97	364270	1368
		1997/98	520902	1207
		1998/99	447519	899
	Purse seine	1995/96	35185	418
		1996/97	30439	337
		1997/98	41792	322
		1998/99	68064	269
Gillnet	Graball	1995/96	347248	222458
		1996/97	380275	235356
		1997/98	431195	200481
		1998/99	450878	145481
	Small mesh net	1995/96	38687	11039
		1996/97	27138	8000
		1997/98	21886	7992
		1998/99	31348	7863
Hook	Dropline	1995/96	20220	445
	(<200m)	1996/97	30233	437
		1997/98	22918	508
		1998/99	31075	739
	Handline	1995/96	76023	17159
		1996/97	94596	21582
		1997/98	98236	25062
		1998/99	88911	40373
	Troll	1995/96	19565	3497
		1996/97	61971	9719
		1997/98	76175	13460
		1998/99	45855	10105
Traps	Fish trap	1995/96	47888	9830
		1996/97	57260	10712
		1997/98	49866	9876
		1998/99	55083	12283
	Octopus pot	1995/96	57056	882504
		1996/97	28778	442896
		1997/98	32750	544788
		1998/99	60358	552440
Other	Spear	1995/96	14036	1393
		1996/97	19307	1847
		1997/98	16830	1981
		1998/99	19268	1757
	Dipnet	1995/96	*	*
		1996/97	24156	1518
		1997/98	33274	1707
		1998/99	42625	2764
	Squid jig	1995/96	5629	3726
		1996/97	1308	554
		1997/98	17489	7173
		1998/99	138947	128547

Table 2.3 Table of effort and CPUE units by fishing method

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
Squid jig	Jig hours	kg per jig hour

2.4.2 Species based effort

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 Management Plan. Although targeting was not reported in the General Fishing Returns some inferences can be made by considering the relative importance of a species in the catch[3]. 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 fishery assessment, the issue of whether effort is targeted is not addressed. Rather, effort is recorded when a species is reported in the catch (either when targeted or taken as by-catch).

Catch and effort for the key species or species groups by fishing method are presented in Chapters 3-8.

2.5 Catch rates

Trends in catch rate (catch per unit effort-CPUE) for a species are defined as performance indicators. Effectively, a trigger is reached if CPUE values are less than 0.8 times the lowest value for the period 1995/96 to 1997/98. CPUE values by method for key species are presented in Chapters 3-8.

2.6 Recreational fishery

2.6.1 Gillnet fishery

Since the introduction of licences for recreational nets in 1995/96, the number of licensed nets increased steadily from around 8900 to a peak of over 10100 in 1997/98, suggesting an increase in recreational netting effort over the period (Table 2.5).

[3] During 1999 the General Fishing return was modified to allow fishers to identify what species were being targeted.

Table 2.5 Number of recreational gillnet licences issued by licensing year.

Licence type	*1995/96*	*1996/97*	*1997/98*	*1998/99*
Graball Net 1	5615	6290	6685	6421
Graball Net 2	2612	2678	2683	2328
Mullet Net	656	684	738	702
Total net licences	**8883**	**9652**	**10106**	**9451**

Preliminary results from a State-wide survey of recreational gillnetting indicate that between December 1996 – April 1998 a total of 560000 hundred meter net hours of effort was expended for a catch of in excess of 400 tonnes of finfish (Table 2.6). By comparison, commercial graball effort was around 314,000 hundred meter net hours, resulting in a catch of over 560 tonnes for the same period.

Blue warehou dominated the recreational gillnet catch, representing about 45% of the total weight. Species of secondary importance included 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 gillnet catch (Table 2.6), and therefore it is important that the impact of the recreational fishery is also taken into account in stock assessments.

Table 2.6 Comparison of catch and effort for recreational and commercial gillnet fisheries for key species. Based on the period Dec 1996 – April 1998.

	Gillnet catch (tonnes)	
Species	*Recreational*	*Commercial*
Blue warehou	191.6	230.9
Bastard trumpeter	42.0	73.3
Australian salmon	28.3	27.5
Silver trevally	30.3	3.6
Striped trumpeter	22.4	28.6
Cod	14.7	7.9
Leatherjacket	12.4	4.7
Mullet	10.1	6.3
Wrasse	10.0	28.0
Jackass morwong	9.5	20.1
Flounder	8.5	18.7
Jack mackerel	7.1	5.4
Flathead	6.5	4.5
Banded morwong	1.8	105.8
Effort (100 m net hours)	*560160*	*314170*

2.6.2 Other methods

Apart from gillnetting, there has been no comprehensive assessment of the recreational scalefish fishery. However, information about the fishing activity of recreational licence holders has been collected. Although data do not include the activity of non-licensed recreational fishers, it was 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 (Lyle 2000). Based on incomplete fishery coverage (ie. licensed fishers only), the estimated flathead and barracouta catches both exceeded 100 tonnes for the period December 1996 – April 1998, while catches of 10-30 tonnes were estimated for Australian salmon, cod, striped trumpeter and jackass morwong during the same period. These findings clearly demonstrate that recreational catches of several key species are significant, and exceeded commercial catches.

2.7 Uncertainties

While considerable effort has been made to ensure comparability of commercial catch and effort data over time (refer Appendix 2), it is acknowledged that some recent administrative changes 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, four 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.

2.8 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.

3 Striped Trumpeter (*Latris lineata*)

3.1 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). They occur mainly on the continental shelf over rocky bottom to depths of about 300 m, although 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.

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.

There is some evidence for marked recruitment variability in striped trumpeter, with a very strong cohort spawned in 1993 (Murphy and Lyle 1998). The 1994 cohort also appears to be relatively strong, through its size relative to the 1993 cohort is unknown.

Few biological parameters have been defined for striped trumpeter (see Appendix 3). The growth parameters defined are represented by few fish >70 cm and is from unvalidated age estimates in fish > 5 years old.

3.2 Previous Assessment

The 1998 assessment was restricted to analysis of trends in dropline, handline and graball net catch, effort and catch per unit effort (CPUE) for the period 1995/96 to 1997/98 taken in both targeted and non-targeted fishing operations. The 1998 assessment found no significant change in the annual catch of striped trumpeter combined across all fishing gears over the 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 three years. Despite the absence of size composition data from the fishery it was considered unlikely that the increase in 1996/97 resulted from the movement of the strong 1993 year-class from inshore reefs into deeper water where dropline effort is targeted. In contrast, there was a consistent increase in handline catch, effort and CPUE over the same period, with the increase in handline catch driven largely by an increase in effort as CPUE increased only slightly. Catch sampling provided evidence that the strong 1993 year-class was entering the handline fishery in 1997/98, but as they were around 45-50 cm and 1.6-2.0 kg their presence was not expected to strongly influence CPUE.

There was a trend of increased catch and CPUE in graball nets over the three years, although effort decreased in 1997/98. It was suggested that the increase in catch and CPUE was driven largely by the presence of the strong 1993 and 1994 year-classes in the inshore region.

3.3 Current Assessment

3.3.1 The Fishery

Striped trumpeter are currently taken by a wide range of fishing methods, including hook and gillnet. Hook fishing involves the use of multi-hook handlines and droplines which accounted for around 52% of the catch in 1998/99. Fishing operations are conducted over hard bottom, with droplines generally fished in depths of 60-140 m and handlines between 40-80 m and 120-160 m.

Reflecting their more inshore distribution, juvenile striped trumpeter are generally taken in graball nets in inshore reef areas less than 20 m deep, and are often taken along with a number of other scalefish species. In 1998/99, the graball catch represented around 20% of Tasmanian landings. Striped trumpeter are also taken on longlines as a by-catch of fishing for school shark, and in 1998/99 there was a large increase in the catch landed by this method representing around 15% of landings.

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. Relatively small catches are taken from the north-west, west and south-west coasts. There are few indications of any shift in the spatial distribution of catches in 1998/99, although there is evidence of an increase in catches off the west coast.

3.3.2 Recent Developments

Some limited monitoring of the offshore hook fishery for striped trumpeter in the south-east was conducted in 1998/99. The strong 1993 and to a lesser extent, the 1994 year-classes were apparent in the catches. This has several important implications for the interpretation of trends in catch and CPUE in the fishery. While there are limited data to assess the relative strength of the subsequent year-classes, the movement of these two year-classes into the offshore hook fishery are likely to influence future catches in this sector, initially resulting in only a small change in CPUE (based on weight) but there can be expected to be a large increase in the number of fish being landed. There is some evidence to indicate that the 1996 year-class may also be relatively strong and is appearing in inshore graball net catches.

3.3.3 1999 Assessment

There has been a significant increase in the annual catch combined across all fishing gears over the past year, with catches up by 23% to 96.9 tonnes (see Table 2.1). The 1999 assessment is restricted to an analysis of trends in dropline, handline and graball catch, effort and CPUE for the period 1995/96 to 1998/99.

The dropline catch increased by around 5 tonnes, due mainly to increased effort, with CPUE remaining relatively stable (Table 3.1, Fig. 3.1). Similarly, handline catch increased in 1998/99, driven mainly by a significant increase in effort (almost double the 1997/98 level), but there was a slight decline in CPUE (Table 3.1, Fig. 3.2). Graball net catch increased to 21.1 tonnes in 1998/99 despite a decrease in effort (Table 3.1, Fig. 3.3). This trend was driven by a large increase in CPUE, with size composition data indicating that this resulted from the presence of relatively large numbers of 3 year-old fish (representing the 1996 year-class).

Table 3.1 Catch, effort and CPUE by method for striped trumpeter based on General Fish Returns. For units of effort and CPUE refer to Table 2.3.

Method	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Graball	1995/96	10.3	17068	0.75
	1996/97	16.5	23430	1.26
	1997/98	17.7	14899	1.40
	1998/99	21.1	13853	1.71
Handline	1995/96	13.0	3494	2.87
	1996/97	15.1	3823	2.86
	1997/98	24.3	6959	3.49
	1998/99	25.9	12746	2.71
Dropline	1995/96	16.4	545	28.41
	1996/97	27.4	735	35.93
	1997/98	20.2	527	36.18
	1998/99	25.0	677	33.04

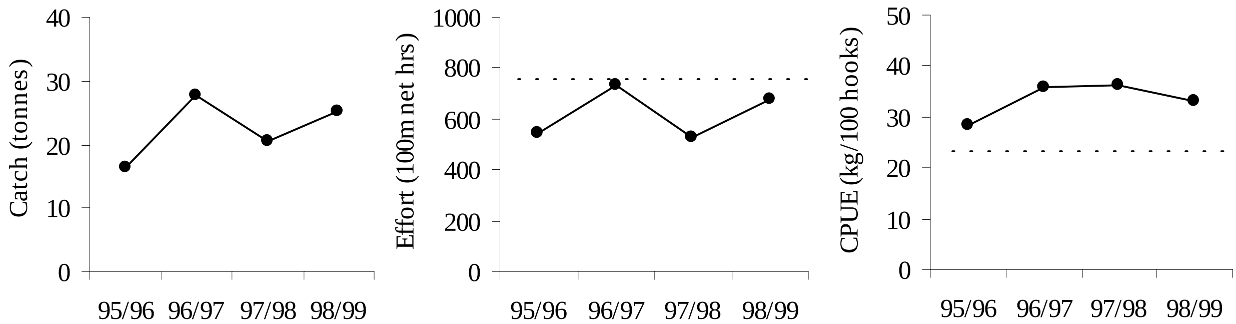

Fig. 3.1 Annual dropline catch, effort and catch per unit effort (CPUE) for striped trumpeter. Dotted lines represent trigger point levels.

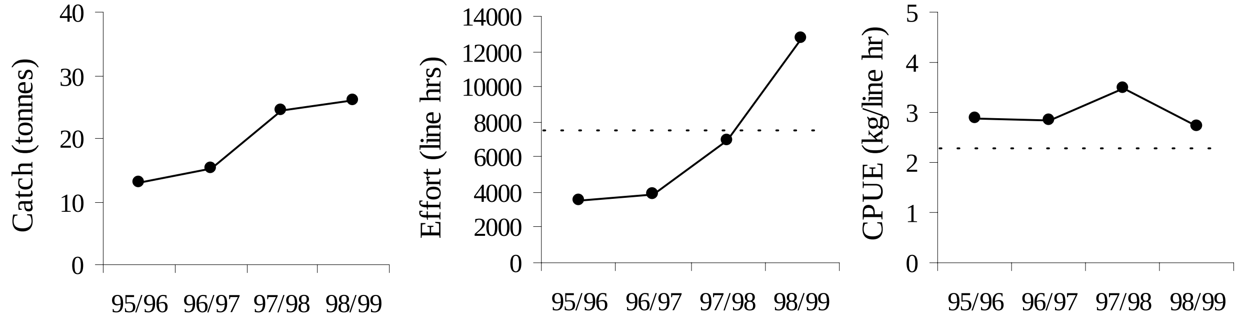

Fig. 3.2 Annual handline catch, effort and catch per unit effort (CPUE) for striped trumpeter. Dotted lines represent trigger point levels.

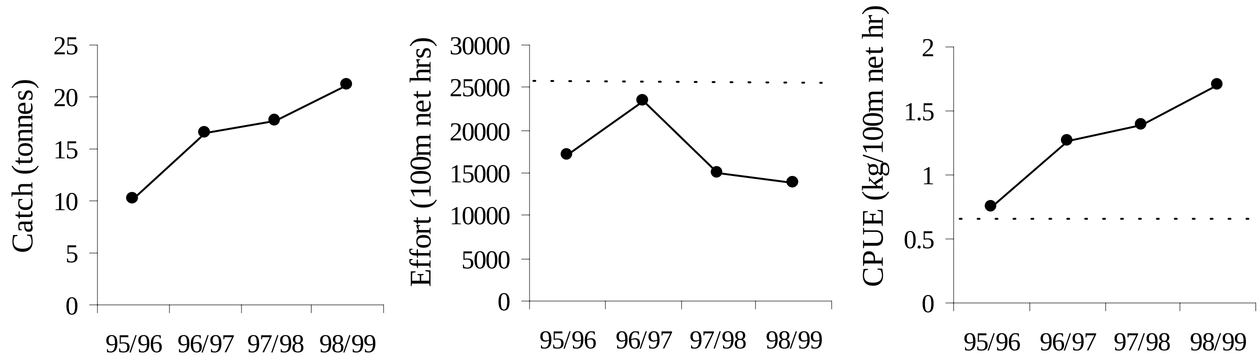

Fig. 3.3 Annual graball net catch, effort and catch per unit effort (CPUE) for striped trumpeter. Dotted lines represent trigger point levels.

3.4 Evaluation of Trigger Points

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 from Tasmanian vessels for the period 1990/91 to 1997/98 ranged from 52.7 to 79.5 tonnes (Table 3.2). The 1998/99 catch was outside this range indicating that this trigger has been reached. However, total catch has not increased by more than 30% from the 1997/98 levels indicating this trigger has not been reached.

Table 3.2 Total annual catch of striped trumpeter (tonnes) between July 1990 and June 1999. Includes catches taken by Tasmanian vessels and Tasmanian and Victorian vessels combined from Tasmanian waters.

Year	*Catch (tonnes) Tasmanian*	*Catch (tonnes) Combined*
1990/91	74.5	111.6
1991/92	58.2	95.0
1992/93	52.7	72.5
1993/94	56.5	72.5
1994/95	72.4	87.0
1995/96	61.3	62.8
1996/97	79.5	82.8
1997/98	75.4	78.8
1998/99	96.9	96.9

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.

While dropline effort increased in 1998/99 it remained lower than the 1996/97 peak (Table 3.1, Fig. 3.1). In contrast, handline effort increased by 83% from the peak level (1997/98), indicating that a trigger has been reached for this gear type. Graball effort declined in 1998/99 to al level slightly lower than that for the reference period.

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.

Both dropline and handline CPUE decreased in 1998/99, but neither level was less than 80% of the lowest value for the 1995-97 period. There was an increase in graball net CPUE in 1998/99.

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 evidence from commercial sampling in 1998/99 of the strong 1993 and 1994 year-classes in the offshore fishery and the 1996 year-class in the inshore graball fishery. No pre-recruit surveys have been conducted since 1996.

3.5 Implications for Management

It is expected that trends in catch and CPUE in the fishery will be influenced for some years by the recruitment of the 1993 and 1994 year-classes. Based on evidence from net catches there is also some indication of the 1996 year-class recruiting to the inshore reefs.

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 yield per recruit is unknown, however, this size limit is well below the size at maturity.

3.6 Research Needs

Stock assessment, recruitment variability and gear interactions of striped trumpeter have 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 that the movement of juveniles from the inshore graball fishery into the hook fishery in deeper water has on both catch and catch rates.

4 Banded Morwong (*Cheilodactylus spectabilis*)

4.1 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 (B.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 with almost 80% of tagging recaptures occurring within 2 km of the site of release and 90% within 5 km (Murphy and Lyle 1999). Less than 4% were recaptured greater than 10 km from the tagging site. There was no obvious relationship between distance moved and time at liberty or 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 structure of the banded morwong population provides some evidence for 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 4.

4.2 Previous Assessments

An assessment was conducted in 1998 that was restricted to analysis of trends in graball net catch, effort and catch per unit effort (CPUE) for the period of 1995/96 to 1997/98 (Lyle and Jordan 1999). Given the considerable differences in the structure of reef habitats off the east coast north of Schouten Is, and evidence of population structuring at a small spatial scale, analysis of catches were conducted at regional and individual fishing block (1/4 degree) levels.

Annual catches of banded morwong have declined since 1995/96 from 88 tonnes in 1995/96 to 72 tonnes in 1996/97 (Table 2.1, Fig. 4.1). Graball catch, effort and CPUE differed between regions, with the south-east characterised by consistently lower catches, higher effort and lower CPUE. There was no clear trend in catches, although a slight decrease occurred in the north-east in 1997/98 with both effort and CPUE relatively stable in both regions over the three years. While CPUE remained relatively stable, it was unclear whether this indicated catch levels were sustainable or that fishing had not impacted significantly on banded morwong populations. It was suggested that catches maybe being maintained at relatively stable levels through the expansion of the fishery into new reef areas. The scale at which catch and effort data are reported is too large to identify serial depletion of individual reef areas.

It was unclear why CPUE differed so markedly between the two regions, although it was suggested that the higher catches in the south-east region in the early years of the fishery compared to the north-east may be significant.

Analysis was also conducted at the level of ¼ degree blocks for 5H1, 5H3 and 6H1, which together accounted for around 60% of all banded morwong landings between 1995/96 and 1997/98. There was a considerable decrease in both catch and effort in block 5H3 (Bicheno) over the three years with little overall change in CPUE. In contrast, there was an increase in catch and effort in block 5H1 (St Helens) and a slight decrease in CPUE over the three years. There was no clear trend in catch, effort or CPUE in block 6H1 (Schouten).

4.3 Current Assessment

4.3.1 The Fishery

Banded morwong are targeted almost exclusively with large mesh gillnets (primarily 130-140 mm stretched mesh) for the live fish market. 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. Fishing operations are conducted over hard bottom, with nets fished primarily in the 10-20 m depth range.

The 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. Smaller catches are made along the south coast and around Flinders Island. There is little evidence of substantial shifts in the distribution of catches at the fishing block level over the past four years.

4.3.2 Recent Developments

There has been no recent research or monitoring of the banded morwong fishery.

4.3.3 1999 Assessment

Given the lack of targeted research in the past year, the 1999 assessment is restricted to an analysis of trends in catch, effort and CPUE. The analysis is conducted both statewide and the level of individual or grouped fishing blocks along the east and south-east coast. The analysis is restricted to targeted and non-targeted graball net fishing operations as it is the primary fishing method used to catch banded morwong.

There was a considerable decline in the statewide catch of banded morwong in 1998/99 to 42.9 tonnes compared to the previous year (Table 2.1, Fig. 4.1). Effort has also declined but there has been little overall change in CPUE throughout the period (Table 4.1, Fig. 4.1).

Table 4.1 Catch, effort and CPUE by method for banded morwong based on General Fish Returns. For units of effort and CPUE refer to Table 2.3.

Method	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Graball	1995/96	85.9	68826	1.17
	1996/97	78.5	64564	1.09
	1997/98	70.4	57941	1.04
	1998/99	41.9	35254	1.10

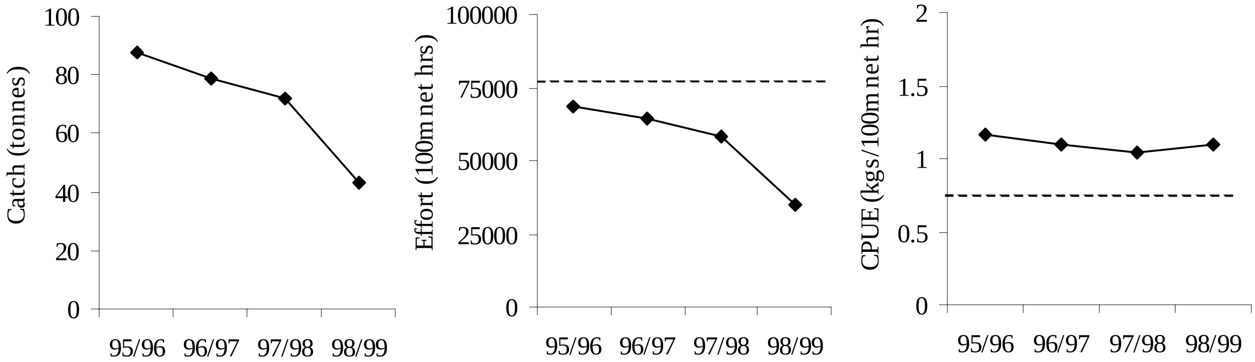

Fig. 4.1 Annual graball net catch, effort and catch per unit effort (CPUE) of banded morwong for all fishing blocks combined. Dotted lines represent trigger point levels.

Since banded morwong appear to be mostly residential on individual reefs, analysis of data at the smallest spatial scale provides a more realistic indication of trends in the fishery. To provide a more consistent assessment of catch rate at this spatial scale, CPUE estimates have been restricted to fishers with a minimum of three years catch history over the period 1995/96 to 1998/99. All three north-east blocks (St Helens, Bicheno and Schouten) showed decreases in both catch and effort in 1998/99 compared with previous years (Fig. 4.2). There has also been a general decline in CPUE in all areas since 1995/96, although catch rates in St Helens and Bicheno blocks were comparable between 1997/98 and 1998/99.

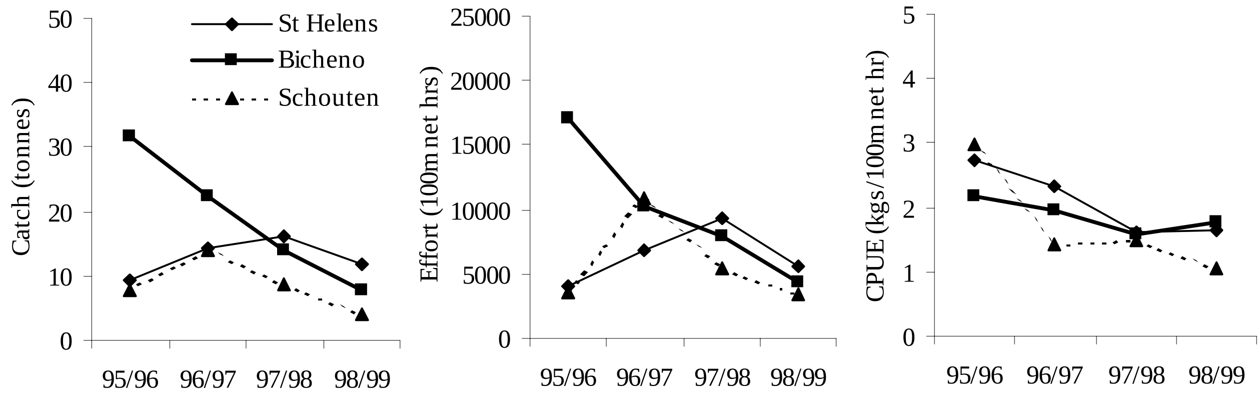

Fig. 4.2 Annual graball net catch, effort and catch per unit effort (CPUE) of banded morwong in fishing areas; St Helens (5H1), Bicheno (5H3) and Schouten (6H1).

There was a marked decline in both effort and CPUE in the Maria area in 1998/99 resulting in a decrease in catch from 13.8 in 1997/98 to just 3.1 tonnes in 1998/99 (Fig. 4.3). A decrease in catch was also evident for the Tasman Peninsula resulting from a decrease in effort only, as CPUE remained relatively stable. Catches have remained low but stable in the Bruny area, with only a slight increase in CPUE.

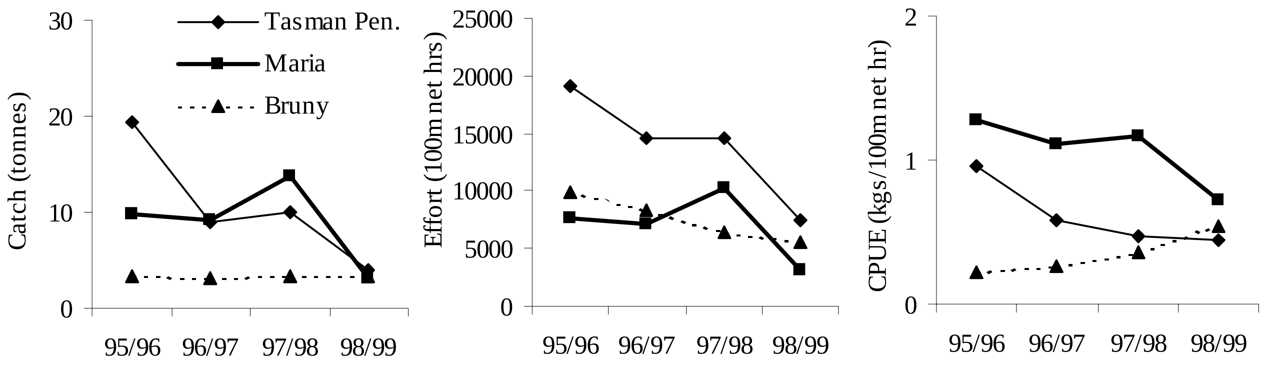

Fig. 4.3 Annual graball net catch, effort and catch per unit effort (CPUE) of banded morwong in fishing blocks; Maria (6H3, 6G4), Tasman Peninsula (7G2, 7H1) and Bruny (7G1, 7G3).

Commercial catch sampling found evidence of seasonal differences in CPUE, which tended to be 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). 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 scales or changes in the dominant mesh size used rather than changes in the abundance of the stock.

4.4 Evaluation of Trigger Points

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 4.2). 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 trends in catch levels. This is particularly the case for data prior to the development of the fishery (pre 1993/94), and for the 1993/94 reported catch, which is believed to be significantly overstated in the light of expectations that the fishery was about to become a limited entry fishery with access based on catch history. Therefore, it is recommended that catches outside the 1994/95 to 1997/98 range be adopted as the reference period when assessing the catch performance indicator.

As the 1998/99 statewide catch was outside this range indicates a trigger point has been reached. Similarly, total statewide catch has decreased by more than 30% from the 1997/98 level indicating a trigger has been reached. Individual block catch has also decreased by more than 30% from the 1997/98 level in the Bicheno, Schouten, Maria and Tasman Peninsula regions indicating triggers have been reached in each of these areas.

Table 4.2 Annual catch of banded morwong statewide in Tasmania between July 1994 and June 1999 and by key fishing blocks between July 1995 and June 1999.

Financial Year				*Catch (tonnes)*			
	Total	*St Helens*	*Bicheno*	*Schouten*	*Maria*	*Bruny*	*Tasman Pen.*
1994/95	105.8						
1995/96	87.9	9.2	31.7	7.8	9.8	3.3	19.4
1996/97	79.0	14.3	22.3	14.1	9.2	3.2	8.9
1997/98	71.8	16.2	14.1	8.8	13.8	3.4	10.0
1998/99	42.9	11.8	7.9	3.9	3.1	3.3	4.0

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.

As fishing effort in the graball fishery has decrease both statewide and in key fishing blocks in 1998/99 a trigger has not been reached (Table 4.3).

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.

Despite changing in catch and effort there has been little variation in the range of the statewide CPUE values between years, the lowest CPUE in fact occurred in 1997/98 (Table 4.1). In contrast, at a regional level the 1998/99 CPUE values in the Schouten and Maria blocks were less than 80% of the lowest value for the reference period indicating for these blocks the triggers had been reached (Table 4.3).

Table 4.3 Annual estimates of graball net effort and catch per unit effort (CPUE) for banded morwong by area.

\+ For units of effort and CPUE refer to Table 2.3.

Region/Block	*Fishing year*	*Effort*	*CPUE*
St Helens/5H1	1995/96	4021	2.73
	1996/97	6792	2.34
	1997/98	9357	1.62
	1998/99	5633	1.64
Bicheno/5H3	1995/96	17082	2.16
	1996/97	10211	1.96
	1997/98	7935	1.60
	1998/99	4348	1.76
Schouten/6H1	1995/96	3591	2.98
	1996/97	10864	1.41
	1997/98	5385	1.49
	1998/99	3446	1.06
Maria/6H3, 6G4	1995/96	7615	1.27
	1996/97	7068	1.10
	1997/98	10198	1.17
	1998/99	3041	0.72
Bruny/7G1, 7G3	1995/96	9946	0.23
	1996/97	8295	0.26
	1997/98	6398	0.37
	1998/99	5556	0.54
Tasman Pen./7G2, 7H1	1995/96	19051	0.96
	1996/97	14666	0.58
	1997/98	14525	0.48
	1998/99	7544	0.45

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.*

No monitoring of the size or age structure of banded morwong populations has been conducted since 1996. 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. The impact of changes in size limits will need to be taken into account in any future analysis.

4.5 Implications for Management

While CPUE over the past four years has declined only slightly in the majority of fishing blocks, it is unclear whether this is indicative that the current catch levels are sustainable or that fishing is simply depleting 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.

In addition, little is known about the dynamics of the fishery, specifically whether catch rates are being maintained through the exploitation of ‘new’ reef areas. Any such serial depletion of individual reefs would be masked in the catch and effort data provided by fishers because of the relatively large spatial scale that operations are reported in catch returns.

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 will be influenced by 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. Modelling undertaken at the time of the new size limits were proposed suggested that there would be a slight decline in catch rates, assuming that there were no changes in mesh size or the size structure of the catch (Murphy and Lyle 1998).

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.

4.6 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 mid-1997, on-board commercial catch sampling of the fishery is a high priority because of inferences that can be made about the effects 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 and justify in a fishery of this size.

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 existing data that form the basis of trigger points.

5 Sea Garfish (*Hyporhamphus melanochir*)

5.1 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 5.

5.2 Previous Assessments

Given the lack of targeted research, the 1998 assessment was restricted to an analysis of trends in catch, effort and catch per unit effort (CPUE) for the calendar years of 1995 to 1997. Analysis has been done on a calender year basis because the major fishery for the species occurs during the winter months. As beach seine and dipnets are the primary fishing methods, examination of trends in these parameters were restricted these methods. The estimate of CPUE relates to the catch rate of sea garfish taken in both targeted and non-targeted fishing operations.

There was a considerable change in the annual catch of sea garfish combined across all fishing gears over the three years, ranging from 55 tonnes in 1995 to 94 tonnes in 1997. Beach seine catch increased over the three years, although this was due in part to some catch data in 1995 being reported in the old logbook but not counted because the fishing method was not defined. The 1995 low effort value was also influenced by the absence of effort data for catches recorded on the old logbook. Therefore, the CPUE data for 1995 may not be representative for the full calendar year.

There was a considerable increase in dipnet catch between 1996 and 1997, from around 10 tonnes in 1996 to over 28 tonnes in 1997. Effort also increased sharply, and while CPUE also increased, the 1995 value was not considered representative as some catch data from early 1995 were not available. It was suggested that the CPUE increase may have reflected an increase in the efficiency of fishers using dipnets to target sea garfish.

5.3 Current Assessment

5.3.1 The Fishery

Sea garfish are taken by a variety of fishing methods, although beach seining and dipnets have generally accounted for around 90% of the catch in recent years. Both beach seine and dip net fishing are conducted close to shore almost exclusively in depths of <10 m. Dip nets are used during the night over shallow areas of sand, seagrass and reef to target surface fish that are attracted to lights.

Sea garfish are taken commercially around the entire Tasmanian coastline (apart from the west coast), with the greatest portion of the catch being taken off Flinders Island and along the length of the east and south-east coasts. The majority of the beach seine catch is taken in the north-east with smaller amounts in the north-west. By contrast, the dipnet catch is largely taken from the south-east. The distribution of catches has been relatively consistent over the 1995-98 period, although there was evidence for an increase in landings in the south-east in 1998.

5.3.2 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). A determination of growth parameters from north-east and south-east Tasmania is currently being undertaken.

5.3.3 1999 Assessment

There has been a small decrease in the annual catch of sea garfish over the past year, with catches down to 84.9 tonnes (Table 5.2). The 1999 assessment is restricted to an analysis of trends in beach seine and dipnet catch, effort and CPUE for the period 1995 to 1998 as they are the primary fishing methods for sea garfish accounting for around 87% of the 1998 catch.

There is evidence of a decrease in both the beach seine catch and effort in 1998 (Table 5.1, Fig. 5.1). As CPUE remained stable, the decrease in catch is driven primarily by the effort decrease over the past year. In contrast, while there was a decrease in dip net catch of around 5.6 tonnes in 1998, it was driven primarily by a decrease in CPUE, as effort increased over the past year (Table 5.1, Fig. 5.2).

Table 5.1 Catch, effort and CPUE by key methods for sea garfish.
For units of effort and CPUE refer to Table 2.3. * data are not shown as the 1995 dipnet data are they represented by 5 or fewer vessels.

Method	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Beach seine	1995	40.0	613	29.2
	1996	49.3	899	36.6
	1997	59.8	954	38.9
	1998	50.6	720	40.7
Dipnet	1995	*	*	7.7
	1996	10.3	657	11.6
	1997	29.1	1662	14.1
	1998	23.5	1920	10.1

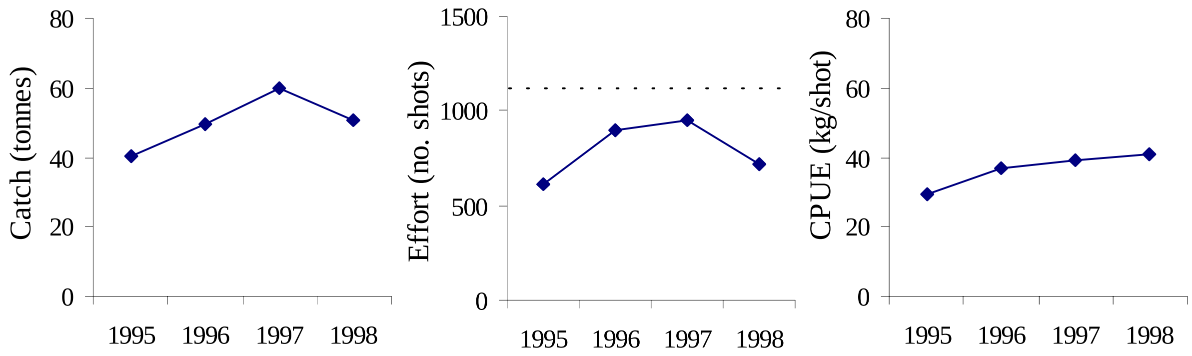

Fig. 5.1 Annual beach seine catch, effort and catch per unit effort (CPUE) of sea garfish (based on new logbook data only). Dotted lines represent trigger point levels.

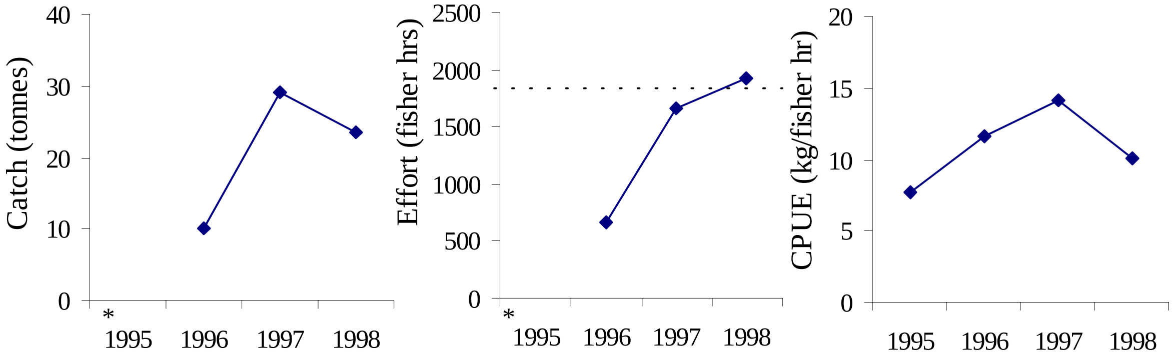

Fig. 5.2 Annual dip net catch, effort and catch per unit effort (CPUE) of sea garfish. *Catch and effort cannot be shown in 1995 as 5 or fewer vessels are involved. Dotted lines represent trigger point levels.

5.4 Evaluation of Trigger Points

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 reference years ranged between 109.0 in 1990 to 55.4 tonnes in 1995 (Table 5.2). As the 1998 catch was within this range indicates that this trigger had not been reached. Likewise, the 1998 catch did not vary by more than 30% from the 1997 level indicating this trigger had not been reached.

Table 5.2 Total annual catch of sea garfish in Tasmania between January 1990 and December 1998.

Year	*Catch (tonnes)*
1990	109.0
1991	78.9
1992	71.6
1993	93.7
1994	74.3
1995	55.4
1996	70.6
1997	95.5
1998	84.9

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.

Fishing effort in the beach seine fishery peaked in 1997, whereas dipnet effort has increased considerably over the past three years to a peak in 1998 (Table 5.1). As dipnet effort has increased by more than 10% from the 1997 level, the effort trigger point has been exceeded for this gear type.

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.*

Sea garfish are a schooling species and as such, catch rates will tend to remain more or less stable even with declines in stock abundance. This stability in CPUE means that it will not be a reliable nor sensitive parameter for indicating trends in abundance and has not been evaluated.

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. Size/age compositions have not been followed through time and no pre-recruit surveys have been conducted.

5.5 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 as it is a method available to all scalefish licence holders. Such increases may result in over-exploitation. 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 sea garfish and therefore the distribution and health of seagrass beds is an important issue for the garfish stock. Recent reports of large reductions in the size of seagrass beds around Tasmania are of concern.

5.6 Research Needs

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

Information indicating the level of fishing pressure that can be sustained on sea 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.

6 Wrasse (Family: Labridae)

6.1 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 down to depths of 25 m while blue-throat wrasse generally occur in deeper water down 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 is set 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 of factors, including social structure and size or age of individuals (Barrett 1995). Functional males with female colour morphology have been found. Length at first maturity of females for both species is about 15 cm, which corresponds to an age of around 2 to 3 years. 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 6). The growth parameters defined are represented by few fish >30 cm and are based on unvalidated age estimates.

6.2 Previous Assessments

Given the lack of targeted assessment research, the 1998 assessment was restricted to an analysis of trends in trap and handline catch, effort and catch per unit effort (CPUE) for the period 1995/96 to 1997/98 taken in both targeted and non-targeted fishing operations.

There was little change in the annual catch of wrasse combined across all fishing gears over the three year period, ranging from 88 tonnes in 1995/96 to110 tonnes in 1996/97.

For traps, catch, effort and CPUE all peaked in 1996/97. The variability in catches between years was generally due to changes in effort over this period. Similarly, the handline component of the fishery showed a peak in catch and effort in 1996/97, with CPUE relatively stable over the three year period.

6.3 Current Assessment

6.3.1 The Fishery

Wrasse are taken primarily by handline and fish traps being the main fishing methods employed by the operators targeting the live fish market. In 1998/99, trap and handline fishing accounted for around 50% and 36% of the catch, respectively. Catches in graball nets are of secondary importance as few graball caught fish are sold on the live fish market. Incidental catches are also regularly taken in rock lobster pots. Wrasse are targeted over shallow hard bottom reefs close to shore with the majority of trap caught fish taken in depths of <10 m, while a higher proportion of the handline catch is taken in depths of 10-20 m.

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. Relatively small catches are taken from the north-west, west and south-west coasts. There have been few indications of a shift in the spatial distribution of catches over the past four years, although there has been an increase in landings around the Flinders Island area since 1996/97.

6.3.2 Recent Developments

A project is currently being conducted examining aspects of age and growth of purple and blue-throat wrasse on the south and east coasts of Tasmania. Multiple mark recapture and selectivity experiments are being undertaken at sites on the east coast which will provide a useful assessment of the possible methods for estimating population abundance and size/age structure in these species. Population modelling is also being conducted on both species. Analysis of data from this research is, however, incomplete and not available for this assessment.

6.3.3 1999 Assessment

There has been a small decrease in the annual catch combined across all fishing gears over the past year, with catches down to 90.1 tonnes (Table 6.2). The 1999 assessment is restricted to an analysis of trends in fish trap and handline catch, effort and CPUE for the period 1995/96 to 1998/99.

In contrast to total catch, the fish trap catch increased by around 8.5 tonnes, reflecting both an increase in effort and CPUE (Table 6.1, Fig. 6.1).

There was a considerable decline in handline catch in 1998/99 driven mainly by a decrease in effort (Table 6.1, Fig. 6.2). There is evidence of an increase in CPUE for handline fishing in 1998/99.

Table 6.1 Catch, effort and CPUE by method and year for wrasse.
For units of effort and CPUE refer to Table 2.3.

Method	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Fish trap	1995/96	32.4	7813	3.42
	1996/97	45.3	10331	3.85
	1997/98	35.0	9380	3.31
	1998/99	43.5	10879	3.89
Handline	1995/96	28.9	7620	3.01
	1996/97	46.8	13232	3.12
	1997/98	41.0	11094	2.95
	1998/99	32.2	8013	3.56

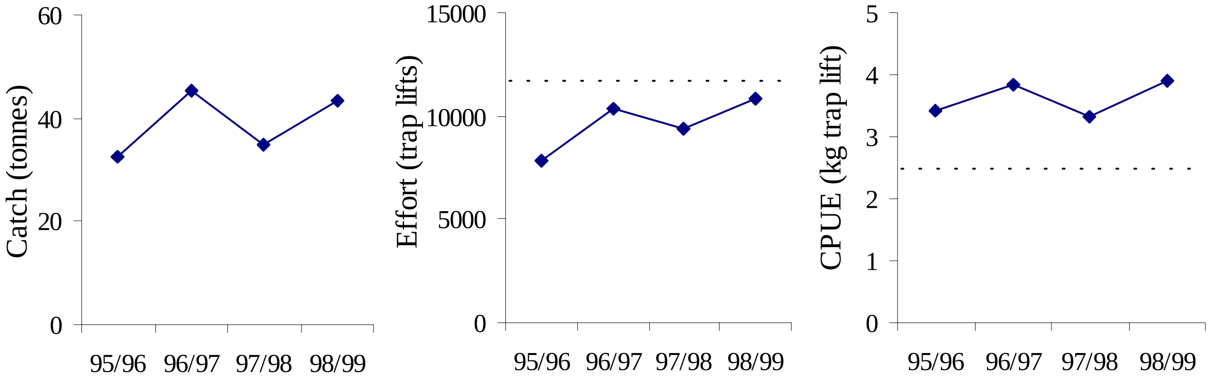

Fig. 6.1 Annual fish trap catch, effort and catch per unit effort (CPUE) of wrasse in Tasmania. Dotted lines represent trigger point levels.

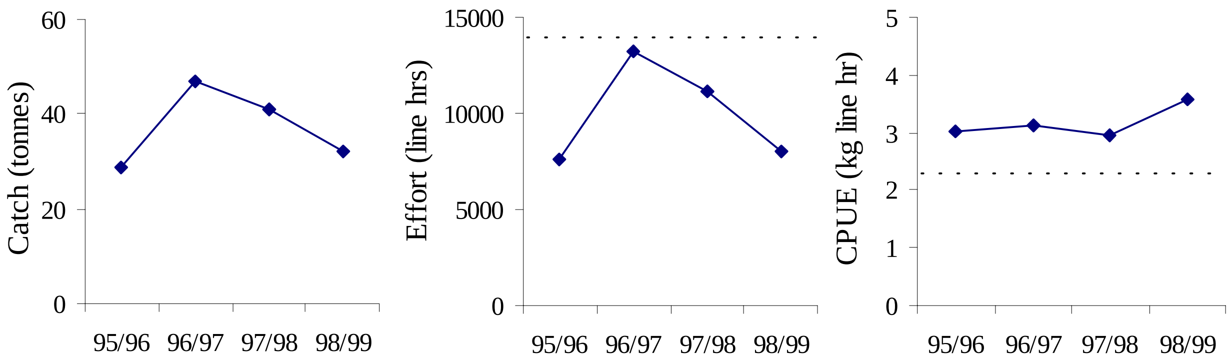

Fig. 6.2 Annual handline catch, effort and catch per unit effort (CPUE) of wrasse in Tasmania. Dotted lines represent trigger point levels.

6.4 Evaluation of Trigger Points

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 6.2). However, given the rapid increase in landings of wrasse over the 1990/91 to 1992/93 period there is little value in the use of this range in establishing a meaningful catch history against which future catch levels can be compared. A further consideration is the suggestion that the 1993/94 and 1994/95 reported catches were significantly overstated in the light of expectations that the fishery was about to become a limited entry fishery with access based on catch history. Therefore, for the purpose of trigger point assessment, it has been recommended that catches for the period 1995/96 to 1997/98 be adopted as the reference period.

As the 1998/99 catch was within the reference range, no catch trigger has been reached. Likewise, total catch varied less than 30% from the 1997/98 levels indicating that the alternative catch trigger was not exceeded.

Table 6.2 Annual catch of wrasse in Tasmania between July 1990 and June 1999.

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	99.2
1998/99	90.1

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.

Fishing effort peaked in both the handline and trap fisheries in 1996/97 indicating that effort triggers were not reached for either method (Table 6.1).

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.

Minimum CPUE levels occurred in the handline and trap components of the fishery in 1997/98 (Table 6.1). As CPUE in 1998/99 was not less than 80% of these values for either gear type then a trigger point has not been reached.

Although no catch, effort or CPUE triggers were reached, these observations should be treated with some caution since analysis is based on the entire State and not at spatial scales appropriate to the life-history of the species. Wrasse are highly residential and tend to be restricted in distribution to individual reefs. Large scale analysis would not be able to detect a serial depletion of individual reefs. Analysis should be conducted at the regional or ¼ degree block level as this might reflect trends in the population more accurately.

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 and species, reflecting possible difference in growth and/or recruitment which will strongly influence the spatial and temporal pattern of future commercial monitoring.

6.5 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.

6.6 Research Needs

Stock assessment, impact of management arrangements and impact of different fishing gear on wrasse have 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 reefs, monitoring of the fishery that aims to detect changes in population structure and catch rates will need to be at the scale of individual reef areas.

7 Southern calamary (*Sepioteuthis australis*)

7.1 Stock structure and life-history

Southern calamary are a shallow water species endemic to southern Australian and northern New Zealand waters. It is one of the most common cephalopods in the coastal waters of southern Australia and is an important component of the coastal ecosystem as a primary consumer of crustaceans and fishes, and as a significant food source for numerous marine animals.

The species is short-lived, probably living for less than one year (Pecl, unpub) although growth is extremely variable. Maximum recorded ages of female and male southern calamary are 263 and 253 days respectively, although males appear to live slightly longer on average than females. Males attain a greater size at age than females. The maximum recorded size of females and males are 1.7 kg & 358 mm and 3.35 kg & 538 mm dorsal mantle length (ML), respectively. The rate of growth is rapid at 7-8% body weight per day (BW day $^{-1}$) in individuals less than 100 days old, decreasing to 4-5% BW day $^{-1}$ in squid older than 200 days. At 200 days of age individual males may vary by as much as 1.5 kg and females by as much as 0.9 kg. Some of this variability in growth is explained by the temperature at hatching, with those individuals hatched in warmer seasons growing faster.

On the east coast of Tasmania around 60% of commercial catch is composed of males and 40% females. In summer and winter, the majority of males taken by the fishery are mature, with immature males very rarely caught. Over 90% of females caught in summer are mature, however, in winter over 50% are either immature or in developing stages of maturity. Minimum recorded age and size at maturity for females is 117 days and 0.12 kg and 147 mm ML. However, immature females as old as 196 days and up 0.62 kg and 237 mm ML have been recorded. Males are mature as young as 92 days and as small as 0.06 kg and 104 mm ML.

Although spring/summer appears to be a major spawning period there is evidence that spawning occurs all year round (Pecl, unpub). The majority of summer caught squid are hatched in winter and vice versa. Southern calamary are multiple spawners although the duration of individual maturity and the frequency of batch deposition are unknown. In summer, females appear to be laying larger batches of eggs than winter spawners. Several females deposit eggs together in collective egg masses, attaching the finger like capsules to the substrate by small stalks. Eggs appear to be most commonly attached to *Amphibolis* seagrass although they are also found attached to macro-algae. Individual egg capsules contain 4-7 eggs, with 50 to several hundred egg strands joined together to form larger egg mops. Development takes between 3-5 weeks, depending on water temperature (Triantafillos 1998).

Newly hatched calamary are 4-7 mm ML and immediately swim to the surface following hatching. Hatchlings remain over the spawning grounds for 20-30 days. The location of individuals between about 20-80 days of age is unknown, however at 80-150 days juveniles are found in deep water adjacent to the spawning grounds. Individuals become available to the fishery at approximately 90-120 days of age. A pilot tagging study suggests that once on the spawning grounds individuals are site-specific, however, movement prior to arrival on the spawning grounds is unknown (Jackson & Pecl, unpub).

The range of biological parameters that have been defined for southern calamary in Tasmania are presented in Appendix 7.

7.2 Previous Assessments

No previous assessments have been conducted on southern calamary in Tasmania.

7.3 Current Assessment

7.3.1 The Fishery

Southern calamary are taken by a variety of methods including purse seine, beach seine, jig, spear and dip net. However, squid jigs and purse seine are the primary methods which accounted for around 80% of the catch in 1998/99. Both purse seine and jig fishing are conducted close to shore almost exclusively in depths of <10 m. Jigs are used during the day over shallow areas of seagrass and macroalgae to target fish concentrated on these beds. Southern calamary are taken commercially along the north and east coast of Tasmania and off Flinders Island, with the greatest portion of the catch taken in the Great Oyster Bay and Mercury Passage regions.

7.3.2 Recent Developments

A recent study of the fishery and biology of southern calamary examined aspects of reproductive biology, early-life-history, size composition and age and growth in Great Oyster Bay (Pecl unpub. data). In October 1999 an additional study was initiated that is further examining these population parameters, with research sampling being conducted on a more intensive temporal basis. The size composition and sex ratio of the commercial catch from both jig and purse-seine gears are being monitored on a monthly basis to determine the biological and population characteristics as a function of season, region and fishing method. The characteristics of the inshore habitats used by southern calamary for spawning, and the distribution and abundance of egg masses within Great Oyster Bay are also being assessed. Analysis of data from this research is, however, incomplete and not available for this assessment.

7.3.3 1999 Assessment

There has been a considerable change in the annual catch of southern calamary combined across all fishing gears over the past four years, ranging from 19.0 tonnes in 1996/97 to 90.6 tonnes in 1998/99 (Table 2.1, Fig. 2.1). This catch increase has been driven almost exclusively by a considerable increase in the squid jig catch and effort in 1998/99 accompanied by an increase in CPUE (Table 7.1).

This 1999 assessment is restricted to analysis of trends in catch, effort and catch per unit effort (CPUE) for the 1995/96 to 1998/99 period. As purse seine and squid jig are the primary fishing methods, examination of trends has been restricted to these methods. CPUE estimates relate to the catch rate of southern calamary taken in both targeted and non-targeted fishing operations.

The purse seine catch has been stable over the past 3 years, with peak catches recorded in 1995/96 (Table 7.1). Despite a considerable decrease in effort in 1998/99, the catches remained stable due to an increase in CPUE.

Table 7.1 Catch, effort and CPUE by key fishing methods for southern calamary.
For units of effort and CPUE refer to Table 2.3.

Method	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Squid jig	1995/96	5.1	360	10.0
	1996/97	0.3	127	2.6
	1997/98	5.3	1407	5.1
	1998/99	63.3	8592	8.9
Purse seine	1995/96	21.0	322	34.6
	1996/97	10.6	226	31.7
	1997/98	10.0	236	30.1
	1998/99	10.6	158	47.8

Trends in catch, effort and CPUE for the three key fishing blocks; eastern Great Oyster Bay (6H1 and ES14), Mercury Passage (6G4 and ES16) and Tasman Peninsula (7G2) which contributed around 80% of both the overall squid jig catch and effort in 1998/99 have been examined in more detail (Fig. 7.1).

All of these areas, but particularly eastern Great Oyster Bay and Mercury Passage indicate a rapid increase in jig catch and effort in 1998/99 due to targeted fishing effort over particular seagrass beds. CPUE increased considerably in eastern Great Oyster Bay and Tasman Peninsula but was fairly stable in Mercury Passage.

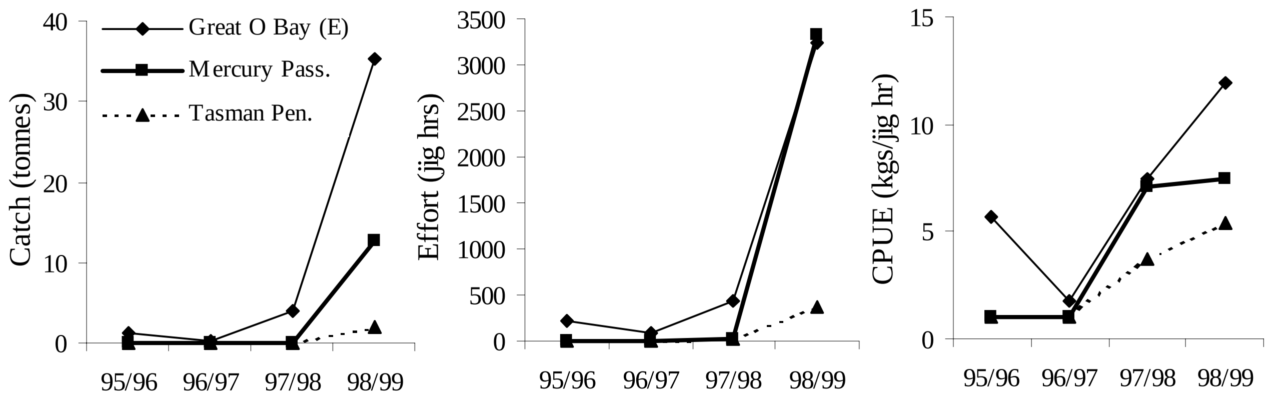

Fig. 7.1 Annual squid jig catch, effort and catch per unit effort (CPUE) of southern calamary in Tasmania.

Purse seine catch and effort was largely concentrated in eastern Great Oyster Bay, where there was a slight increase in catch compared to 1997/98 (Fig. 7.2). Catches for Mercury Passage and Tasman Peninsula were very low, a result of very limited effort. While 1998/99 effort was down considerably, the catch rate was substantially higher in eastern Great Oyster Bay compared to 1997/98.

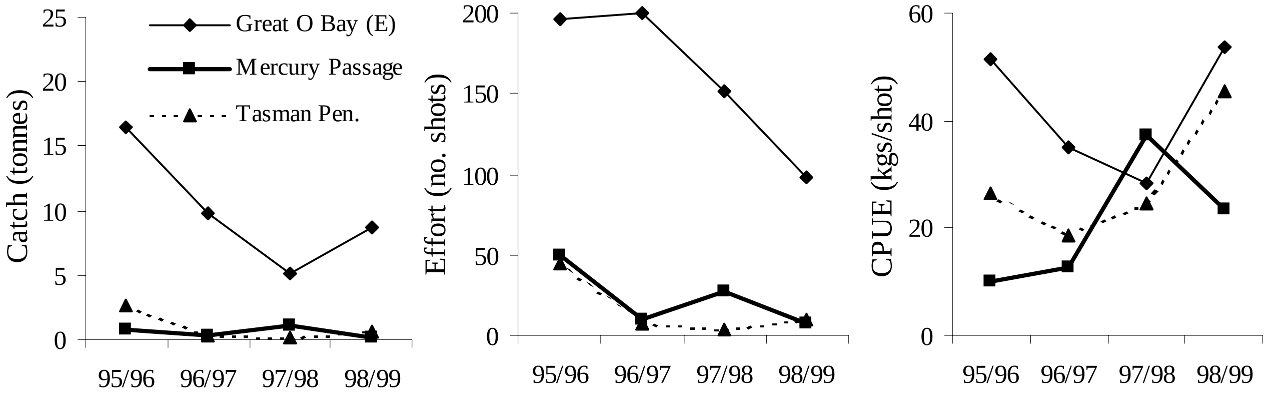

Fig. 7.2 Annual purse seine catch, effort and catch per unit effort (CPUE) of southern calamary in Tasmania.

7.4 Evaluation of Trigger Points

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.

The annual catch of southern calamary for the period 1990/91 to 1997/98 ranged between 5.8 and 26.6 tonnes (Table 7.2). The 1998/99 catch of over 90 tonnes clearly exceeded the previous catch levels and exceeded the 1997/98 catch by over three times. In this regard, both catch triggers have been exceeded for this species.

Table 7.2 Total annual catch of southern calamary in Tasmania between July 1990 and June 1999.

Year	*Catch (tonnes)*
1990/91	8.2
1991/92	7.5
1992/93	5.8
1993/94	9.7
1994/95	12.6
1995/96	32.8
1996/97	19.0
1997/98	26.6
1998/99	90.6

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.

Purse seine fishing effort peaked in 1995/96, the 1998/99 effort being almost half this value indicating a trigger has not been reached for this gear type (Table 7.1). By contrast, jig effort has increased six fold in the past year indicating that the effort trigger has been exceeded for this gear type (Table 7.1).

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.*

Southern calamary are a schooling species and the schools tend to aggregate (often related to spawning) at which time that can be effectively targeted. As such, catch rates may remain relatively stable even with a decreasing stock abundance. It is unclear, however, how representative of changes in abundance catch rates are for this species. Catch rates were either within the previous range (purse seine) or higher (jig) and therefore this trigger point was not exceeded.

Change in size composition

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

iv. *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.*

Commercial and research sampling indicates a considerable range of sizes, and possibly age structure of southern calamary in the commercial fishery. The significance of observed differences between sites and years have yet to be examined.

7.5 Implications for Management

All holders of scalefish fishing licences are entitled to use squid jigs and, therefore, given growing interest in this species, there is potential for further expansion in effort. There is little information available on the stock structure of southern calamary, which is required before the appropriate size of spatial management regions can be developed.

As a consequence of the short life span (<1 yr), annual recruitment to the population is essential since there is no accumulation of recruitment across a number of years to stabilise the population against recruitment fluctuations. The growth and reproductive characteristics of ‘micro-cohorts’ differ substantially, depending upon when individuals hatched and the environmental conditions that were subsequently experienced. Environmental factors may therefore be as important as fishing mortality in driving the population dynamics and determining spatial patterns of abundance.

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

7.6 Research Needs

Stock assessment, critical habitat requirements, impact of management arrangements and gear interactions of southern calamary have all 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 southern calamary is required. Integral to this is the need to analyse statoliths for age in order to determine spawning times and growth rates of seasonal cohorts. The periodicity of increment deposition within the statolith has been validated as one ring per day in juvenile reared squid up to 102 days old, however, validation needs to be conducted on large mature individuals. Our understanding of the variability and plasticity in the life cycle, and the subsequent application of population modelling techniques, would benefit from more detailed research into determining links between environmental factors and growth and reproductive characteristics.

Given the vulnerability to recruitment failure, the impact of fishing activities on the spawning behaviour of the aggregations needs to be addressed. The relationship between reproductive output and age and size of females, in terms of batch size and frequency of batch deposition needs to be quantified.

The significance of seagrass and macroalgal habitats for spawning and feeding of southern calamary will require further sampling in areas along the east coast. Information on the stock structure of southern calamary is required.

8 Other key scalefish species

Catch, effort and CPUE for blue warehou, Australian salmon, bastard trumpeter and arrow squid are presented in Table 8.1 for the period 1995/96 to 1998/99. Reference should also be made to Table 2.1 and Fig. 2.1 for recent catch history trends.

Blue warehou catch by graball has increased steadily over the past four years to peak in 1998/99 (Table 8.1). This trend has been driven largely by an increase in CPUE rather than effort. By contrast, catch, effort and CPUE of blue warehou by small mesh net remained relatively stable in 1998/99 compared to previous years. The total catch for 1998/99 was over 30% greater than for the previous year, indicating that this catch trigger had been exceeded.

Australian salmon beach seine catch decreased in 1998/99 reflecting a large decrease in effort (Table 8.1). The graball catch also declined in 1998/99 consistent with a decrease in effort. No triggers were exceeded for Australian salmon.

Bastard trumpeter graball catch increased by around 5 tonnes in 1998/99 from the previous year driven mainly by an increase in CPUE as effort was slightly down (Table 8.1). No triggers were exceeded for bastard trumpeter.

Arrow squid catch increased considerably in 1998/99, a result of the substantial increase in jig effort (Table 8.1). Catch and effort triggers were exceeded for this species.

Table 8.1 Catch, effort and CPUE by method for key species for the period 1995/96 to 1998/99.
For units of effort and CPUE refer to Table 2.3.

Species	*Method*	*Year*	*Catch (tonnes)*	*Effort*	*CPUE*
Blue warehou	Graball	1995/96	50.7	42046	0.8
		1996/97	111.9	86533	1.1
		1997/98	161.2	83650	1.5
		1998/99	227.3	76314	2.1
	Small mesh net	1995/96	20.7	4092	2.0
		1996/97	9.3	3362	1.6
		1997/98	4.8	3668	0.8
		1998/99	8.9	3053	0.9
Australian salmon	Beach seine	1995/96	387.7	228	221.2
		1996/97	253.8	244	116.6
		1997/98	437.6	359	184.3
		1998/99	352.0	150	244.4
	Graball	1995/96	12.9	11245	0.9
		1996/97	14.1	10982	1.4
		1997/98	16.3	8137	1.9
		1998/99	10.9	7172	1.7
Bastard trumpeter	Graball	1995/96	59.3	76813	0.9
		1996/97	50.3	80425	0.7
		1997/98	39.5	58446	0.7
		1998/99	45.4	49442	0.8
Arrow squid	Squid jig	1995/96	0.4	3282	0.3
		1996/97	0.9	405	2.1
		1997/98	12.0	6483	2.7
		1998/99	74.4	131898	1.5

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Appendix 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. Data restrictions and adjustments

There have been a number of administrative changes that have affected 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*[4].

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. 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.

[4] 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.

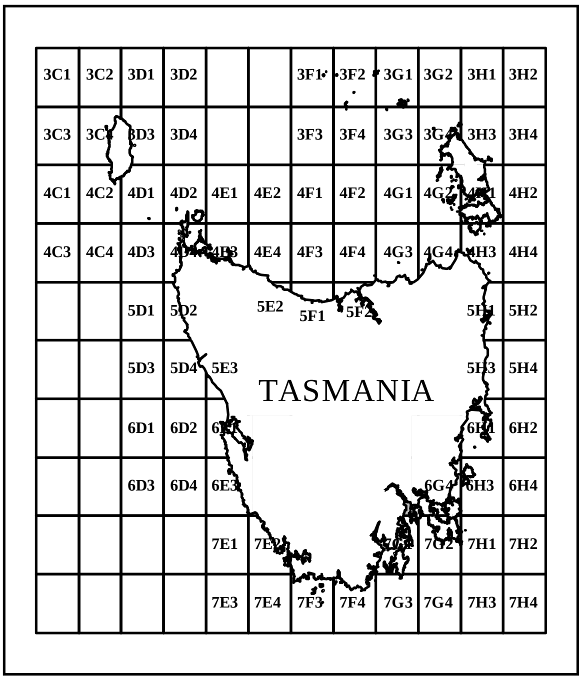

Fig. 1 Block numbers for fishing blocks used in calculation of catch figures.

Appendix 3 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 4 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 5 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 6 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.

Appendix 7 Biological parameters for southern calamary in Tasmania

	Growth			Longevity	Reproduction (minimum age & size)			Recruitment			Length-Weight		
	Maximum Length (ML)	Maximum Weight (g)	% BW day^{-1}	Maximum Age (days)	Age (days)	Length	Weight	Age	Length	Weight	a	b	Author
Females	398	2008	4-8%	263	117	147	120	90-120 days	100-110 mm	60-120g	0.00042	2.56	
Males	530	3350		253	92	114	63				0.00049	2.50	

ML: Dorsal mantle length in mm, %BW day^{-1}: increase in percentage body weight per day.