FISHERY ASSESSMENT REPORT

TASMANIAN SCALEFISH FISHERY - 2008

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

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Tasmanian Scalefish Fishery - 2008

Executive Summary

The Tasmanian scalefish fishery is a multi-species fishery operating in State fishing waters and encompassing a wide variety of capture methods. The Scalefish Management Plan (revised in 2004), provides the management framework for the fishery. An important element of the management plan is the explicit identification of performance indicators and reference points that have two primary functions:

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

Fishery Assessment

In this assessment the scalefish fishery is described in terms of species composition, catch and effort. The commercial catch history for the period 1990/91 to 2007/08 is presented, with more detailed analyses of catch and effort by method for the period 1995/96 to 2007/08. In addition to information provided in Tasmanian catch returns, data from Commonwealth logbooks for dual endorsed operators fishing in Tasmanian waters and for species managed under Tasmanian jurisdiction (*i.e.* striped trumpeter and bastard trumpeter) have been incorporated in the analyses.

Dipnet, dropline and squid jig effort expanded to historically high levels following the introduction of the management plan, whereas effort for other methods tended to remain relatively stable or decline over time. By 2007/08, effort levels for all methods, apart from squid jigs, had fallen to within or below reference levels (Table 1). The dramatic increase in squid jig effort occurred primarily in response to the expansion of the southern calamari fishery.

Although effort performance indicators were not triggered for most methods, there are continuing concerns regarding the level of latent capacity within the fishery from licence-holders who are currently either not active or participating at low levels.

Table 1. Effort performance indicator assessment by major fishing methods for 2007/08
Y triggered, N not triggered.

	Effort >10% peak 1995/96 - 1997/98 levels	
Method	**Gear units**	**Days fished**
Beach seine	N	N
Purse seine	N	N
Graball net	N	N
Small mesh	N	N
Dropline	N	N
Handline	N	N
Troll	N	N
Fish trap	N	N
Spear	N	N
Dip net	N	N
Squid jig	Y	Y

Species assessments

Species assessments evaluate fishery-dependent information against agreed upon reference points for the performance indicators, as detailed in the Scalefish Management Plan (Table 2). Specifically, these reference points relate to catch, effort and catch rates and are exceeded when:

- Commercial catch is outside the range from 1990/91 to 1997/98 (unless otherwise indicated); or catch declines or increases in one year by more than 30% from the previous year;
- Fishing effort is above 10% of the highest levels from 1995/96 to 1997/98;
- Catch rates are less than 80% of the lowest levels from 1995/96 to 1997/98.

The management plan also provides for biological characteristics to be used as performance indicators against which stock status can be evaluated and, where such data are available, they have been updated in this assessment. The fishery has additionally been assessed against an alternative set and reference points which account for recent developments in the fishery (Table 3). These alternative performance indicators are intended to replace the existing indicators over the next few years.

Banded morwong

The total commercial catch in 2007/08 was 51 tonnes.

Exceeded reference points:

- State-wide commercial catches as well as catches in the Tasman, Bicheno and St. Helens fishing regions were below the 1994/95 to 1997/98 range.
- Standardised catch rates were within reference levels with the exception of regional catch rates for Maria which were below the reference point.

Alternative reference points:

- TAC-related reference points were not assessed.
- Catch rates in the Maria region had fallen below 90% of the average catch rate from 2000/01 to 2006/07 triggering the reference point for this region.

Resource status:

- Last year's stock assessment model suggested that exploitation rates in some regions may not be sustainable. Current catch levels are likely to continue to reduce spawning biomass, even though stocks are now more productive (faster individual growth and earlier maturity of females) than at the start of the fishery.
- The fishery is now mainly dependent on recruitment. The model indicated that exploitable and mature biomass had (temporarily) recovered in the Tasman and Maria regions due to strong recruitment in the early 2000s. In the Bicheno and St. Helens regions, exploitable and mature biomass have continued to decline.

Management advice:

- Maintaining the current catch of around 40 tonnes from the east coast is likely to result in a decline in catch rates and spawning biomass. Reductions in fishing mortality are advisable for all regions to enable rebuilding of stocks. Assuming average recruitment, the model predicted a less than 50% probability that mature biomass and catch rates would be maintained at current levels with an east coast catch of 20 tonnes. This is less than half of the 44.5t TAC approved for 2009/10.

Southern calamari

The total commercial catch in 2007/08 was 84 tonnes.

Exceeded reference points:

- State-wide commercial catches was above the reference range.
- State-wide fishing effort was above reference levels.

Alternative reference points:

- Commercial catches were within the reference ranges of 50 tonnes in Great Oyster Bay and Mercury Passage, and 30 tonnes in the south-east. However, they were higher than 25 tonnes outside these areas (29 tonnes).
- Catches increased in 2007/08 and therefore did not exceed the reference point for consistently declining catch over 3 years by >40% in SE and E waters.

Resource status:

- There is considerable uncertainty about stock status due to the dependence of stock size on annual recruitment.

Management advice:

- Extended closure of the major spawning grounds appears to be effective in protecting the main known spawning event. However, any major shift in the fishery to increased effort prior to the closure could adversely impact on the spawning stock prior to the main spawning season. Expansion of catches in space and time should be therefore monitored closely.

Striped trumpeter

The total commercial catch in 2007/08 was 16 tonnes.

Exceeded reference points:

- State-wide commercial catches were below the reference range.
- State-wide catches fell by 46% compared with the previous year.
- Catch rates for dropline (days fished) were below reference levels.

Alternative reference points:

- The 50 tonnes commercial catch reference point was not exceed.
- Catch curve assessment was not assessed.

Resource status:

- Resource status is uncertain though potentially depleted due the combined effects of fishing and apparent poor recruitment in recent years. Major uncertainties surround the lack of information on the recreational catch and the magnitude of the catch taken by Commonwealth operators.

Management Advice:

- Despite the absence of a rigorous assessment, the available data suggest that the stocks are declining and will continue to do so without management action and/or a period of sustained good recruitment. It would be prudent to reduce the combined commercial and recreational fishing mortality, to investigate spawning closures, and to increase the minimum size limit to above the size at maturity.

Bastard trumpeter

The total commercial catch in 2007/08 was 19 tonnes.

Exceeded reference points:

- State-wide commercial catches were below the reference range.

Alternative reference points:

- Pending

Resource status:

- Resource status is uncertain though potentially depleted due to the effects of fishing coupled with apparent poor recruitment in recent years.

Management advice:

- Management options to reduce the total fishing mortality on this species through commercial trip limits, reduction of recreational possession limits and input control restrictions should be explored.

Sea garfish

The total commercial catch in 2007/08 was 30 tonnes.

Exceeded reference points:

- State-wide commercial catches were below the reference range.
- State-wide catches fell by 39% compared with the previous year.

Alternative reference points:

- State-wide catches were below reference levels from 1998/99 to 2006/07.

Resource status:

- Uncertain, but the recent decline in catches appears to be caused by a lack of resource despite high abundance of undersized fish.

Management advice:

- Since it is not known whether present catch levels are sustainable and to clarify effects of dipnetting on the schooling behaviour of garfish, research on the fishery and stock dynamics is required. With the high potential for increased targeted effort, it would be prudent to consider management options that limit further expansion in this fishery and protect the stock during spawning.

Wrasse

The total commercial catch in 2007/08 was 85 tonnes.

Exceeded reference points:

- Effort for fish traps (gear units) was above the reference levels.
- Catch rates for fish traps (gear units) were below the reference levels.

Alternative reference points:

- Catches were within the reference range from 1998/99 to 2006/07.

Resource status:

- The resource status is unknown though the two species are vulnerable to localised economic depletion of legal-size biomass. Interest in the species continued to be strong with increasing catches in previous years, but the declining catch rates could indicate that these catch levels were not sustainable. Minimum size limits provide considerable protection to purple wrasse and female blue-throat wrasse spawner biomass, but not for male blue-throat wrasse which derive from mature females after a sex change, typically at sizes after they have entered the fishery.

Management advice:

- Because there is still a high level of latent effort in the fishery, management options should be considered that limit further expansion in this fishery. The introduction of the new logbook will provide improved spatial information and species-based reporting that should help to reduce the risk of failing to detect serial depletion.

Blue warehou

The total commercial catch in 2007/08 was 25 tonnes.

Exceeded reference points:

- State-wide commercial catches were below the reference range.

Alternative reference points:

- The commercial catch limit of 318 tonnes has not been exceeded.

Resource status:

- Stocks are overfished and availability of blue warehou in Tasmanian waters continues to be low.

Management advice:

- Management action for stock rebuilding of the major component of the blue warehou fishery has been implemented in the Commonwealth fishery.

Australian salmon

The total commercial catch in 2007/08 was 101 tonnes.

Exceeded reference points:

- State-wide commercial catches were below the reference range.

Alternative reference points:

- The commercial catch limit of 435 tonnes for Australian salmon A licences was not exceeded.

Resource status:

- Catch rates may not be good indicators of abundance for schooling species such as Australian salmon and in any case commercial production is known to be strongly influenced by market demand. Resource status is unknown.

Management advice:

- The status quo appears to be acceptable.

Flathead

The total commercial catch in 2007/08 was 74 tonnes. This catch is mainly composed of tiger flathead, as distinct from the sand flathead that forms the bulk of the recreational catch.

Exceeded reference points:

- No reference points were exceeded.

Alternative reference points:

- The regional catches of 46 tonnes in the south-east exceeded the proposed catch reference level of 45 tonnes for this region.

Resource status:

- Resource status is unknown.

Management advice:

- Status quo appears to be acceptable. As further expansion in the commercial fishery is likely, it would be prudent to consider spatial management options that avoid the regional concentration of effort (operators).

Table 2 Summary assessment of existing performance indicators and reference points for key species with risk assessment if no management action (i.e. *status quo*) is taken.

Catch history reference period is *1994/95 to 1997/98 and ** 1995/96 to 1997/98; *** main fishery managed by Commonwealth; Y triggered, N not triggered, arrows indicate direction of change, na not assessed, # applies only to particular methods or regions;
H high risk, M medium risk, L low risk, U uncertain. ## targeted research required. Changes since previous year in bold.

Species	Catch below or above 90-97 range	Catch decline or increase by >30%	Effort >110% of maximum 95-97 range	Catch rate < 80% of minimum 95-97 range	Biological indicators of stock stress	Risk if no management action
Banded morwong*	Y ↓#	N	N	Y #	Y	H
Southern calamari	Y ↑	N	Y	N	N	M
Striped trumpeter	Y ↓	**Y ↓**	N	Y #	Y	H
Bastard trumpeter	Y ↓	N	N	N	na	M
Garfish	Y ↓	Y ↓	N	**N**	na	**M**##
Wrasse**	N	N	**Y ↑**	**Y ↓**	na	L
Blue warehou***	Y ↓	N	N	N	na	-
Australian salmon	Y ↓	**N**	N	**N**	na	L
Flathead	N	**N**	N	N	na	L

Table 3 Summary assessment of alternative performance indicators and reference points for key species.

[##] Main fishery managed by Commonwealth; Y triggered, N not triggered, arrows indicate direction of change, na not assessed, [#] applies only to particular methods or regions.

Reference point	Banded morwong	Southern calamari	Striped trumpeter	Bastard trumpeter	Garfish	Wrasse	Blue warehou[##]	Australian salmon	Flathead
Commercial catch in Region 1 > 30% of TAC Region 2 > 65% of TAC Region 3 > 40% of TAC Outside TAC area >10t	na								
Commercial catch is < 90% of TAC	na								
Catch rates are below 0.9 * average from reference period 2000/01 to 2006/07	Y[#]								
Commercial catch for GOB & MP > 50t Remainder SE > 30t Outside GOB, MP & SE > 25t		N N **Y**[#]							
Declining catch trend over 3 consecutive years by a total of > 40% in south-east Tasmanian waters		N							
Commercial catch is > 50t			N						
Catch curve estimated every 3 years as an index of fishing mortality from all sectors: Target: Fishing mortality $F \leq$ Natural mortality M Limit: $F = 1.5*M$			na						
Pending				-					
Catch outside reference range from 1998/99 to 2006/07 (66-102t)					Y↓				
Catch outside reference range from 1998/99 to 2006/07 (72-99t)						**N**			
Commercial catch limit of 318 tonnes as per Memorandum of understanding (MOU)							N		
Commercial catch limit of 435 tonnes as per Ministerial decision								N	
Catch by Danish Seine > 1.3* the maximum catch from reference period 1998/99 to 2006/07: South-east coast: 45t East coast: 63t									**Y**[#] N
Any indicator of stock stress	Y	N	Y	na	na	na	na	na	na

1 Management objectives and strategies

The Scalefish Management Plan was first introduced in 1998 (DPIF 1998) and was reviewed in 2001 and again in 2004. The primary issues tackled in the latest review related to latent effort in the fishery (addressed by introducing non-transferability for class-C and inactive licences), wastage in gillnets (addressed by a prohibition on night netting for recreational fishers and the requirement for commercial operators to be in attendance whilst night netting[1]), a review of recreational possession and size limits and the closing of further selected waters to gillnetting.

The management plan provides the regulatory framework for the fishery, which covers commercial and recreational components. The plan contains the following objectives, strategies and performance indicators.

1.1 Major objectives

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

[1] Note: some exclusions exist in relation to the gillnet usage changes.

1.3 Performance indicators

In the absence of more quantitatively rigorous stock assessments, the Scalefish Fishery Management Plan identifies a number of performance indicators that are used to define ranges between which the fishery, both in general and for particular species, is deemed to be performing acceptably. If the observed value of a performance indicator falls outside the acceptable range the reference point is said to have been exceeded and this is taken to imply that some management action may be required. Analysis of fishery performance under this (initial) strategy is measured by reference to:

- variations in the total catch from year to year, or between seasons, regions and sectors;
- trends in effort;
- trends in catch rates;
- changes in biological characteristics, such as a changes in size or age structure; and
- other indicators of fish stock stress, for example disease outbreaks.

As part of this strategy, reference or trigger points, or acceptable ranges, have been defined as levels of, or rates of change, 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. Currently, reference points are exceeded when one or more of the following criteria are met:

- total catch of a key target species is outside the range from 1990/91 to 1997/98; 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, is above 10% of the highest levels from 1995/96 to 1997/98;
- catch rates for a key target species are less than 80% of the lowest levels from 1995/96 to 1997/98;
- 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 non-commercial fish relative to 1995/96 to 1997/98 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.

The fishery has also been assessed against an alternative set of reference points which account for recent developments in the fishery. These alternative reference points are intended to replace the existing indicators over the next few years.

2 Fishery assessment

2.1 The fishery

The Tasmanian scalefish fishery is a multi-gear and multi-species fishery. The main gear types include gillnet, hooks and seine nets, harvesting a diverse range of scalefish, shark and cephalopod species. Other fishing gears in use include traps, Danish seine, dip nets and spears. A listing of common and scientific names of species reported in catches is presented in Appendix 1.

In many respects the scalefish fishery is dynamic, with fishers readily adapting and changing their operations in response to changes in fish availability and in response to market requirements and opportunities. As a consequence, only a small proportion of the fleet has specialised in a single activity or targeting a primary species. For many operators, scalefish represent an adjunct to other activities, for instance rock lobster fishing.

This report covers the assessment of key scalefish and cephalopod fisheries under Tasmanian jurisdiction. Other species, such as tiger flathead, blue warehou, jackass morwong, ocean perch, blue eye trevalla, blue grenadier, school and gummy shark, are managed under Commonwealth jurisdiction. Formal assessments for these species are undertaken by the Southern and Eastern Scalefish and Shark Fishery Assessment Group (SESSFAG; *e.g.* Tuck 2006) and are summarised in fishery status reports produced by the Bureau of Rural Sciences (e.g. Larcombe and McLoughlin 2007).

This report continues the series of annual assessments of the scalefish fishery and incorporates catch and effort information available up to and including June 2008. Copies of previous assessment reports are available on the TAFI web page - http://www.utas.edu.au/tafi/TAFI_Download.htm.

2.2 Data sources

Commercial catch and effort data are based on Tasmanian General Fishing Returns, and Commonwealth non-trawl (GN01 and GN01A) and Southern Squid Jig Fishery (SSFJ) logbook returns. Unless noted otherwise, catch and effort data reported in this assessment relate to the commercial sector. Catch and effort information are not routinely collected for the recreational sector.

2.2.1 General fishing returns

General Fishing Returns prior to 1995 provided only monthly summaries of landed catches and limited effort information that was of little value for effort and catch rate analyses (Lennon 1998).

During 1995, a revised General Fishing Return was introduced, replacing the monthly return with catch and effort information reported on a daily basis for each fishing method used. The revised returns provide greater detail about fishing operations, including more explicit specification of fishing method, greater spatial resolution (30nm or ½ degree rather than 1 degree blocks), plus details about effort and depths fished. Amendments in 1999 included provision to nominate target species and an option to indicate interference to fishing operations from marine mammals (*e.g.* seals or

killer whales). During late 2007, a new logbook was introduced providing finer spatial and operational detail. In analysing General Fishing Returns some data manipulation has been undertaken, details of which are provided in Appendix 2.

2.2.2 Commonwealth catch returns

Following the introduction of the Commonwealth non-trawl logbook (GN01 and subsequent versions) in late 1997, dual endorsed Tasmanian and Commonwealth (South East Non-Trawl and Southern Shark) operators generally commenced recording all of their catch and effort data, including fishing in State waters, in the Commonwealth logbooks. In addition, several dual endorsed squid operators reported some or all of their state waters fishing activity in the Southern Squid Jig Fishery (SSJF) logbook. As most of these operators did not explicitly indicate whether fishing occurred in State or Commonwealth waters, it has been necessary to incorporate all activity reported from coastal fishing blocks in the analyses. For details of data restrictions and manipulations involving Commonwealth logbook data see Appendix 2.

During 2001, dual endorsed fishers were instructed to report all fishing activities under State jurisdiction in the Tasmanian General Fishing Returns. This should have removed the necessity to include subsequent Commonwealth catch and effort data into analyses but it became apparent that there was some confusion amongst fishers about reporting requirements. For example, catches of species such as striped trumpeter taken by Commonwealth operators were not routinely reported in the Tasmania catch returns. Commonwealth logbook data since 2001 have been available for the current assessment. Data were checked for possible double reporting (*i.e.* on both the Tasmanian and Commonwealth catch returns) and where this was not the case, the catch and effort database used in this assessment was updated.

2.2.3 Data analysis

For the purposes of this assessment, effort and catch rate analyses are restricted to commercial data provided for the period July 1995 to June 2008. All catch returns from within this period and available as at October 2008 have been incorporated in the analyses.

A fishing year from 1st July to 30th June in the following year has been adopted for annual reporting. This period reflects the seasonality of the fisheries for most species better than the calendar year, with catches (and effort) generally concentrated between late spring and early autumn. In addition, it better encompasses the biological processes of recruitment and growth for most species.

If not stated otherwise, catches have been analysed State-wide and by region. Five broad assessment regions have been identified, *viz*. south-east coast (SEC), east coast (EC), north-east coast including Flinders Island (NEC), north-west coast including King Island (NWC), and west coast (WC) (Fig. 2.1).

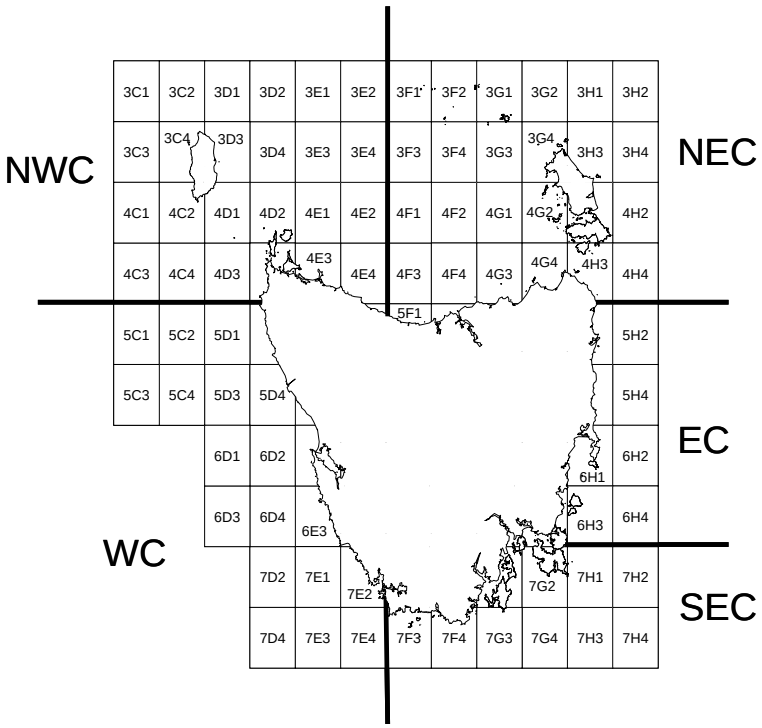

Fig. 2.1: Map of Tasmania with 30 nm fishing blocks and the assessment regions. SEC is south-east coast, EC is east coast, NEC is north-east coast, NWC is north-west coast, and WC is west coast.

Two measures of effort have been examined in past assessments: (i) days fished (*i.e.* number of days on which a method/gear type was reported); and (ii) quantities of gear/time fished using the method. Since a diverse range of gear types are utilised in the fishery, appropriate measures of effort differ with gear type. For instance, gillnet effort has been calculated as a function of the quantity of net set and fishing duration, dropline and longline effort is expressed in terms of number of hooks set, while handline fishing is reported as the product of the number of lines fished and fishing duration. Measures of effort by fishing method are presented in Table 2.1. However, because effort reporting has changed for some gears with the introduction of a new logbook during 2007, some gear related effort measures in 2007/08 are not directly comparable to those in the previous years. Also, confusion about the new reporting requirements may have biased some effort measures.

Table 2.1. Table of effort gear units by fishing method

Method	Effort gear units
Beach seine/purse seine	No. of shots
Graball/small mesh net	100 m net hours
Dropline	100 hook lifts
Handline	Line hours
Fish trap	No. trap or pot lifts
Squid jig	Jig hours
Spear	Fisher hours
Dip net	Dip net hours

Catch returns for which effort information was incomplete or unrealistically high or low (either due to data entry error or misinterpretation of information requirements by fishers) were flagged and excluded when calculating effort levels based on gear units or catch rates based on catch per unit of gear. Only a small number of fishing records for 2007/08 needed to be excluded in this manner. All records were, however, included for reporting catch, days fished and catch per day.

In generating catch rate statistics, the geometric mean rather than the arithmetic mean of all valid individual daily catch records has been calculated, since catch rate data are typically log-normally distributed. The geometric mean is calculated as the n^{th} root of the product of the individual rates (y_i)

$$GM_{\bar{y}} = \sqrt[n]{\prod y_i}$$

This is equivalent to computing the arithmetic mean of the natural logarithm of each number, and then taking the exponent:

$$GM_{\bar{y}} = \exp\left[\frac{1}{n}\left(\sum \ln\left(y_n\right)\right)\right]$$

It should be noted that catch rates calculated in this manner may differ slightly from the more simplistic approach of dividing total catch by total effort or using the arithmetic mean. The geometric mean has the advantage of being less affected by the few observations that are skewed very high, as often happens with log-normally distributed data.

2.2.4 Recreational fishery

The only detailed analysis of the Tasmanian recreational fishery available is based on the 2000/01 National Survey (Lyle 2005). Apart from recreational net licence numbers, there are no additional data relevant to the recreational scalefish fishery in Tasmania. However, a State-wide recreational fishing survey was undertaken during 2007/08 and data will be incorporated in the next assessment report.

2.3 Commercial fishing licences

The number of fishing Scalefish licences A, B and C has slowly declined from a peak in 2000 to 185 active and 355 total licences in 2007 (Table 2.2). The decline was mainly due to a reduction in Scalefish C fishing licences, while the numbers of Scalefish A and B licences have remained reasonably stable. Scalefish C licences were also the licence type that was least often fished, with just 26% of all C licences active in 2007 (down from 35% in 2000). In contrast, around 70% of Scalefish A and B licences were actively fished in 2007 with only minor fluctuations over the years.

In addition to these fishing licences, separate fishing licences allow the use of beach seine (a total of 51 licences in two categories A and B) and small mesh gillnet (10 licences). Fishers with a rock lobster licence (but without Scalefish A or B licence) are also allowed to take scalefish with a limited amount of fishing gear.

Table 2.2. Number of active and total fishing licences (FL) by licence type (A, B or C) from 2000 to 2007 (licence years from March to February of the following year)

2008 data is incomplete and not presented here.

No of active licences	2000	2001	2002	2003	2004	2005	2006	2007
FLA	50	44	51	48	46	38	43	47
FLB	109	104	111	110	109	101	105	105
FLC	79	62	63	52	47	34	36	33
Total	238	210	225	210	202	173	184	185

No of total licences	2000	2001	2002	2003	2004	2005	2006	2007
FLA	69	67	70	70	70	66	66	66
FLB	166	165	164	165	165	162	162	160
FLC	226	214	205	185	173	152	137	129
Total	461	446	439	420	408	380	365	355

2.4 Commercial catch trends

Annual commercial catches have been variable since 1990/91 (Table 2.3) and since the early 1990s, catch trends for the major species have generally been declining (Fig. 2.2). Overall, total scalefish catches declined from over 2000 tonnes in the early 1990s to around 1000 tonnes in recent years.

The 2007/08 scalefish catch of 1048 tonnes was substantially higher compared to 2006/07, primarily due to about 500 tonnes of jack mackerel and redbait caught by purse seine in State waters. For most other species, downward catch trends continued. Catches of Australian salmon (-14 tonnes), barracouta (-13 tonnes), garfish (-20 tonnes) and striped trumpeter (-7 tonnes) were at record low levels in 2007/08. Catches also declined for wrasse (-27 tonnes), while only flathead (+14 tonnes), jack mackerel (+199 tonnes) and redbait (+298 tonnes) experienced significant increases. Catches of most other scalefish species were within ± 10 tonnes of 2006/07 levels (Table 2.2 and Fig. 2.2). Cephalopod production was stable for southern calamari and octopus, but declined strongly for the sporadically occurring Gould's squid (-648 tonnes).

When assessing trends within the scalefish fishery it is important to recognise that some species occur seasonally in Tasmanian waters and that availability can differ markedly between years. Such variability does therefore not necessarily reflect changes in stock condition. Species in this category include blue warehou, barracouta and Gould's squid. By contrast, species such as banded morwong, garfish, wrasse, the trumpeters and calamari are resident species, and variability in catches can reflect a combination of factors, including market forces, management intervention, stock status and intrinsic variability in life history.

Catch trends for the key species including banded morwong, southern calamari, striped trumpeter, bastard trumpeter, garfish, wrasse, blue warehou, Australian salmon, and flathead will be discussed in separate chapters.

Table 2.3. Annual 'Tasmanian' scalefish and cephalopod production (whole weight in tonnes) by fishing year since 1990/91 based on General Fishing Returns and Commonwealth (GN01, GN01A and SSJF) logbook returns.

Species	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08
Scalefish																		
Australian salmon	815.9	651.9	867.0	878.8	682.1	413.2	287.3	476.0	384.7	363.7	485.0	462.1	407.2	167.2	336.5	254.2	115.0	101.4
Barracouta	351.5	268.3	205.4	59.6	25.2	19.3	53.8	65.2	27.6	25.0	15.1	132.1	65.5	85.2	97.3	60.1	26.8	13.3
Boarfish	7.2	9.4	7.6	10.1	9.1	7.3	10.4	9.4	7.0	7.2	8.0	5.5	3.6	4.3	3.6	5.0	5.2	4.6
Cod	10.0	11.3	11.6	14.5	12.7	18.6	12.8	9.5	9.8	9.0	3.8	3.0	2.2	2.1	1.6	2.0	2.9	5.2
Flathead	165.3	118.1	98.8	121.4	91.1	57.9	51.8	62.9	50.6	60.3	63.4	52.1	40.8	31.2	74.7	91.9	60.0	74.2
Flounder	44.0	36.8	31.8	27.3	27.1	33.4	29.4	29.7	25.2	18.6	12.4	13.0	12.1	15.1	14.7	10.9	13.0	7.5
Garfish	80.9	80.1	82.3	82.9	69.3	56.2	91.6	83.0	101.7	91.2	81.4	87.8	92.5	66.2	85.5	89.3	50.0	30.3
Gurnard	20.5	19.0	19.3	19.3	14.0	13.5	10.4	9.1	7.1	9.9	7.8	5.3	9.7	6.8	6.1	5.1	5.7	5.0
Leatherjacket	12.2	14.0	13.1	23.3	27.7	14.5	12.6	13.3	12.9	16.5	16.7	16.6	13.7	14.8	10.4	8.5	9.1	6.6
Ling	5.1	13.6	30.0	41.6	33.2	15.0	13.4	9.0	4.9	2.2	5.1	0.9	0.4	0.8	0.7	0.4	0.4	0.4
Mackerel, jack	6.1	11.1	32.8	48.4	39.7	26.2	19.3	19.7	59.8	13.7	8.6	19.4	19.4	41.1	12.8	6.8	2.6	201.5
Mackerel, other	3.0	2.1	0.3	8.5	5.7	2.0	1.3	1.0	0.5	2.1	0.1	0.0	0.1	0.0	0.5	0.5	0.2	10.3
Marblefish	0.2	0.9	0.3	1.0	1.8	3.5	5.6	3.0	2.6	4.2	4.0	4.4	3.1	0.6	1.1	0.5	2.2	2.3
Morwong, banded	7.0	6.9	39.2	145.5	105.8	86.7	79.0	72.6	42.4	33.8	39.2	53.7	56.0	46.4	45.6	54.3	50.3	50.9
Morwong, jackass	136.9	111.9	83.2	117.6	63.1	27.1	19.0	34.1	18.2	16.6	13.7	14.8	14.4	16.3	17.5	13.1	11.7	4.4
Morwong, other	3.8	5.6	5.2	13.9	8.1	5.4	7.4	7.4	6.3	1.5	0.6	1.4	1.9	1.2	1.8	1.3	1.3	2.5
Mullet	31.2	22.2	26.2	19.5	23.8	10.8	11.2	16.0	14.5	21.0	13.7	12.1	7.3	7.5	5.1	7.5	4.5	2.4
Other	140.2	110.4	97.4	102.0	62.0	31.9	28.5	40.3	24.6	16.2	14.7	11.3	30.1	25.0	26.9	28.2	14.2	12.3
Pike	10.5	9.5	11.1	12.7	18.8	14.0	18.3	21.6	12.6	14.0	12.5	18.8	17.3	17.7	8.9	13.9	16.6	15.5
Pilchard/anchovy	0.1	0.0	3.8	14.6	12.1	6.6	4.3	15.4	2.8	1.7	3.2	0.7	0.0	0.3	0.8	0.0	0.0	13.2
Redbait	0.0	0.7	0.0	0.8	0.1	0.1	0.0	0.0	4.0	0.0	0.0	0.0	0.0	3.4	1.0	1.4	0.3	298.3
Trevally	20.6	13.6	12.0	8.3	21.6	5.9	4.5	7.8	8.1	3.2	1.6	4.6	5.5	3.4	3.7	6.3	3.6	8.8
Trumpeter, bastard	63.3	37.2	34.0	54.8	50.8	60.1	51.8	40.7	47.7	36.4	26.1	23.9	21.0	23.2	18.5	23.4	21.3	18.9
Trumpeter, striped	74.5	58.2	52.7	56.5	72.4	60.3	80.4	81.1	107.4	101.8	49.6	44.8	40.0	40.5	26.2	23.8	22.3	15.5
Trumpeter, unspec.	0.7	0.0	0.0	0.4	0.1	0.2	0.1	0.6	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Warehou, blue	257.6	317.6	187.7	250.1	205.4	82.3	128.7	189.5	274.3	187.6	36.0	66.4	49.3	27.5	19.7	20.0	29.3	24.9
Warehou, other	0.7	0.4	4.2	8.8	3.4	14.6	15.6	4.8	1.0	0.0	0.0	0.1	0.2	0.1	0.8	0.1	0.0	0.1
Whiting	124.2	152.3	84.3	97.9	81.4	25.5	39.6	48.3	30.6	31.7	42.7	40.1	39.9	55.5	38.3	28.3	40.2	39.6
Wrasse	57.2	71.7	97.3	142.4	178.0	83.4	110.1	100.0	90.7	85.4	88.4	92.3	72.0	75.1	99.4	92.9	113.2	85.8
Total scalefish	**2450**	**2154**	**2135**	**2367**	**1933**	**1195**	**1198**	**1471**	**1383**	**1174**	**1053**	**1187**	**1025**	**779**	**960**	**850**	**622**	**1056**

Table 2.3. cont. Whole weight in tonnes by fishing year

Species	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08
Cephalopod																		
Calamari, southern	8.2	7.5	5.8	9.7	12.6	33.0	19.0	26.6	94.5	84.6	76.6	104.8	108.8	86.8	114.2	44.6	85.4	83.7
Cuttlefish	0.5	0.7	0.0	1.1	0.8	0.2	0.3	0.2	0.0	0.0	0.0	0.7	2.4	1.0	0.2	0.4	0.1	0.3
Octopus	32.2	35.2	47.4	58.2	55.3	76.9	40.8	43.4	85.5	61.5	62.0	63.1	67.7	71.1	81.4	98.6	105.4	105.3
Squid, Gould's	35.1	7.2	7.0	7.7	8.6	5.7	7.8	12.9	79.7	480.5	39.7	2.4	1.9	2.1	2.6	1.8	694.3	45.9
Total cephalopod	**76**	**51**	**60**	**77**	**77**	**116**	**68**	**83**	**260**	**627**	**178**	**171**	**181**	**161**	**198**	**145**	**885**	**235**
Sharks[2]																		
Elephant shark						58.0	50.1	33.1	29.5	42.7	40.0	18.4	16.5	10.2	7.6	5.7	9.0	1.9
Gummy shark						750.5	626.6	714.7	798.3	1021.2	1148.2	23.5	14.2	24.7	41.7	12.4	13.6	13.9
Draughtboard shark						0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.7	1.0	0.8	1.3	1.4	3.4
Sawshark						127.4	88.8	113.4	86.8	109.7	127.9	21.4	20.4	20.6	23.5	5.9	3.4	0.3
School shark						252.1	196.4	216.1	150.5	136.3	72.1	2.2	1.4	7.0	2.6	0.6	1.8	1.0
Seven-gilled shark						6.1	7.9	15.6	17.6	33.5	44.5	18.8	7.4	11.5	8.4	3.8	3.9	0.6
Other shark						32.8	18.9	23.1	19.0	22.3	15.3	7.9	10.8	7.2	1.8	1.1	2.6	2.7
Total sharks						**1227**	**989**	**1116**	**1102**	**1366**	**1448**	**94**	**71**	**82**	**86**	**31**	**36**	**24**

[2] Since 2001/02, shark catches have been reported in Commonwealth logbooks. Tasmania has jurisdiction of all shark species inside 3nm except gummy and school shark, and fishers are on bycatch possession limits for all species. Includes bycatch from the rock lobster fishery (separate reporting since 2007/08).

Fig. 2.2. Annual catches for key scalefish species since 1990/91.

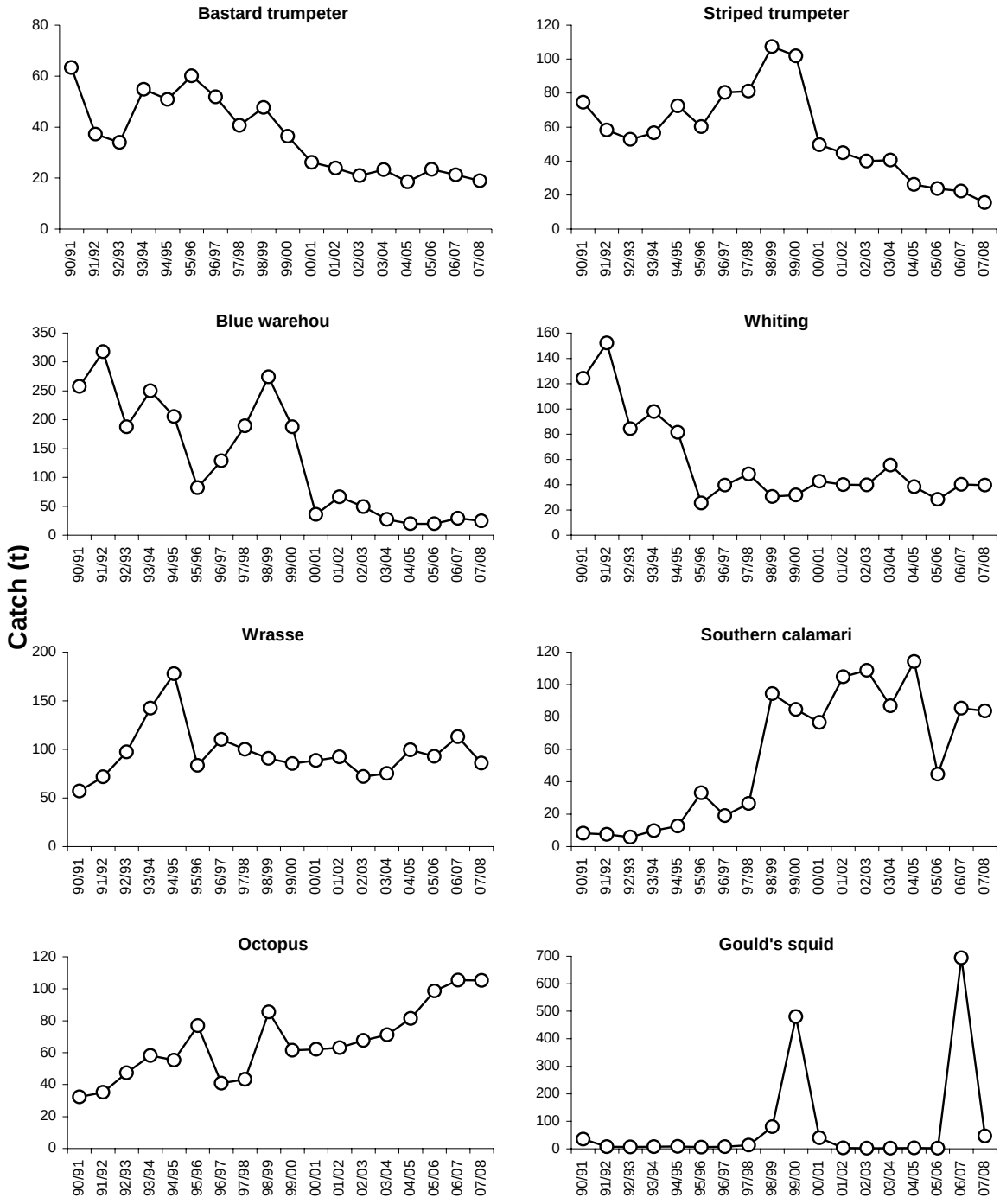

Fig. 2.2. Continued.

2.5 Commercial effort trends

The Scalefish Management Plan contains two trigger points that pertain to fishing effort, one based on effort relating to a particular gear type and the other based on effort directed towards a species or species group. A trigger point is reached when effort exceeds the peak level for the period 1995-1997 by at least 10% (for the present analysis the reference period is taken as 1995/96 to 1997/98).

Catch and effort by the main fishing gear types are presented in Table 2.4. Since a variety of gear types are represented, it has been necessary to express effort in units appropriate to each specific fishing method (Table 2.1). Effort has also been expressed in terms of number of days fished using the specified gear type, irrespective of the amount of gear utilised each day. Although days fished represents a less sensitive measure of effort, it has become apparent that some fishers have misinterpreted reporting requirements for effort. This problem has been exacerbated with the introduction of the new logbook in 2007. Days fished overcomes any uncertainty about the accuracy of reporting effort units.

For the purpose of analysis, dropline catch and effort up to 1998 was restricted to records that indicated a fishing depth of less than 200 m. This restriction effectively excluded reports of dropline fishing for blue-eye trevalla (since 1998 fishing for blue-eye has been covered in Commonwealth catch returns) but effectively encompassed the target fishery for striped trumpeter (less than 1% of the striped trumpeter catch has been reported from depths greater than 200 m). In addition, shark net and bottom longline catch and effort methods have been excluded since these methods relate specifically to the shark fishery, now managed by the Commonwealth.

Since the mid 1990s effort for the major gear types either declined (beach seine, purse seine, graball and small mesh nets), increased or remained stable initially but has then undergone declines (dipnet, dropline, spear and fish trap), or increased over time (handline and squid jig; Table 2.4 and Fig. 2.3). Following the introduction of the new management arrangements in November 1998, effort based on beach seine, purse seine, graball and handline all fell whereas effort based on dropline, squid jig and dipnet all increased sharply. While a range of factors, including availability of target species and market developments, have had an influence, there is little doubt that management changes have had a direct impact on effort levels. Specifically, methods for which gear allocations or access became more regulated (beach seine, purse seine and gillnets) demonstrated declines in effort whereas there was a shift to and increase in effort for less regulated methods (hooks, jigs and dipnets; i.e. gear that is equally available to all licence-holders).

Effort levels during 2007/08 were generally similar to or lower than in 2006/07 for most gear types, except for squid jig, handline and spear which all increased. The effort performance indicator of 110% from the highest of the 1995 to 1997 levels was only exceeded for squid jig. Notwithstanding this, there are continuing concerns, regarding the level of latent effort from licence-holders who are currently either not active in the fishery or participating at low levels but with access to gear such as gillnets, hooks, dipnets and jigs. The 2004 management plan review has attempted to address this issue through several strategies including non-transferability of C-class licences.

Considering effort by gear type alone can mask important dynamics within the fishery itself, such as shifts in species targeting. This is particularly pertinent where individual

species may be targeted using a variety of gear types and where a given gear type can be used to target a number of different species. For instance, beach seines are used primarily to target Australian salmon or garfish (Fig. 2.3). While effort for Australian salmon has remained relatively stable since 1995/96, fluctuations in effort for garfish have had the greatest influence on overall beach seine effort. The decline in purse seine effort (Table 2.3) was driven largely by falls in effort directed at calamari, whereas there has been only minor variation in purse seine effort for garfish in recent years (not shown).

Lyle (1998) noted that there are effectively three main sub-fisheries within the graball fishery, targeting blue warehou, banded morwong and flounder (Fig. 2.3). A variety of other species are also commonly taken as by-product of these sub-fisheries. By analysing graball effort based on the occurrence of these species in the catches, an initial increase in effort for blue warehou was evident. The effort peaked in 1997/98 (gear units) and 1998/99 (days fished) and then rapidly declined especially between 1999/00 and 2000/01. Effort directed at banded morwong declined up until the late 1990s, but then expanded slightly between 2000/01 and 2002/03 and stabilised at a lower level in recent years. By comparison, effort directed at flounder has decreased steadily of over time and is now at a low level.

Striped trumpeter and wrasse are the two main species targeted by handline and these fisheries demonstrate different trends in effort (Fig. 2.3). Handline effort for striped trumpeter increased up until 1999/00 but has gradually fallen since that time. This contrasts the pattern for wrasse, where effort rose to an initial peak in 1996/97, declined to 1998/99 and then climbed gradually to levels higher than the peak reported in the mid 1990s.

Garfish and calamari are the two main species captured by dipnet (Fig. 2.3). The overall dipnet effort closely follows that for garfish, indicating garfish was captured during most dipnet operations. In contrast, the low dipnet catches for calamari (see Section 4) suggest that calamari was mainly caught opportunistically or as a bycatch.

A significant expansion in jig effort (particularly evident in days fished; Table 2.4) commenced in 1998/99 and was initially directed at calamari, but in 1999/00 there was also a dramatic increase in effort targeted at Gould's squid (graph not shown). Effort for calamari continued to rise up until 2004/05, fell sharply in 2006/07 and increased again to high levels in the most recent year. Concurrently, increased squid jig (and automated jig) effort was directed at Gould's squid, after very low levels of effort for this species since the 1999/00 peak.

The remaining methods are used primarily to target single species and as such effort trends tend to reflect the dynamics of the fishery for the target species, i.e. dropline for striped trumpeter, spear for flounder and fish traps for wrasse. Species-based effort trends are also considered in more detail in Chapters 3 to 9.

Table 2.4. Total annual catch, effort and number of vessels by fishing methods - 1995/96-2007/08
Effort units are defined in Table 2.1. * Catch data not shown where five or fewer vessels involved.

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
Beach seine	95/96	469.2	1086	559	53
	96/97	351.7	1355	685	50
	97/98	520.9	1206	582	44
	98/99	441.7	872	398	40
	99/00	422.9	901	430	33
	00/01	528.4	789	373	31
	01/02	572.2	1070	495	30
	02/03	490.7	1063	511	35
	03/04	238.1	1282	458	31
	04/05	397.0	975	368	27
	05/06	308.4	653	304	25
	06/07	140.6	528	234	25
	07/08	109.9	617	248	17
Purse seine	95/96	35.2	418	185	11
	96/97	30.4	336	153	10
	97/98	41.8	319	154	7
	98/99	76.9	246	150	8
	99/00	33.7	244	123	10
	00/01	*	224	104	4
	01/02	*	216	91	5
	02/03	*	139	76	4
	03/04	*	68	45	3
	04/05	*	130	70	5
	05/06	*	122	60	4
	06/07	*	86	41	4
	07/08	526.1	113	119	6
Graball net	95/96	348.0	223553	5437	257
	96/97	383.3	231140	5186	232
	97/98	446.3	231412	5249	216
	98/99	493.3	166505	4689	204
	99/00	359.7	152144	4169	203
	00/01	173.4	86838	3187	186
	01/02	196.0	71109	3303	180
	02/03	231.0	85628	3395	168
	03/04	189.8	69189	2904	160
	04/05	154.6	53965	2491	137
	05/06	170.3	51591	2402	123
	06/07	170.0	56482	2544	132
	07/08	157.4	57155	2351	118
Small mesh net	95/96	38.7	10971	285	19
	96/97	27.0	7965	260	14
	97/98	21.8	7875	246	17
	98/99	31.2	7772	282	14
	99/00	22.7	6232	210	15
	00/01	20.8	8170	256	14
	01/02	24.7	9863	259	11
	02/03	22.9	10297	284	11
	03/04	23.0	7254	228	11
	04/05	15.9	5982	220	13
	05/06	21.7	5890	191	11
	06/07	16.4	7144	202	11
	07/08	15.2	6426	182	11
Dip net	95/96	*	320	83	5
	96/97	24.2	1518	364	10
	97/98	37.9	1903	449	21
	98/99	43.6	2784	579	29
	99/00	29.4	2319	505	35
	00/01	22.8	1430	371	27
	01/02	24.8	1561	387	27
	02/03	18.7	1259	337	20
	03/04	25.6	1557	374	19
	04/05	27.4	1521	305	16
	05/06	39.1	2167	376	18
	06/07	22.6	1308	244	18
	07/08	14.8	1038	223	17

Table 2.4. Continued

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
Fish trap	95/96	41.8	8264	1401	66
	96/97	57.2	10710	1796	66
	97/98	49.9	9870	1875	71
	98/99	53.7	10657	1559	56
	99/00	56.1	11030	1637	62
	00/01	54.3	9356	1548	68
	01/02	49.0	6098	1278	62
	02/03	38.2	6177	1246	58
	03/04	48.0	6308	1414	58
	04/05	46.7	7409	1222	54
	05/06	44.6	12302	1421	54
	06/07	44.2	11001	1328	47
	07/08	27.5	9493	894	45
Drop line	95/96	19.9	438	158	31
	96/97	30.0	433	203	27
	97/98	24.7	539	222	42
	98/99	31.8	666	309	38
	99/00	30.8	385	291	48
	00/01	15.8	382	248	36
	01/02	12.8	220	258	35
	02/03	18.8	264	350	43
	03/04	19.4	378	281	51
	04/05	14.1	351	219	31
	05/06	9.3	185	204	33
	06/07	7.1	259	137	28
	07/08	2.9	38	53	19
Hand line	95/96	74.3	16964	1612	147
	96/97	94.3	21542	1893	135
	97/98	97.5	21076	1702	145
	98/99	88.2	17668	1278	127
	99/00	87.8	16688	1439	134
	00/01	74.2	13585	1541	130
	01/02	87.3	15527	1603	138
	02/03	72.2	15025	1552	125
	03/04	76.4	15610	1411	127
	04/05	99.8	19950	1799	123
	05/06	82.7	20247	1884	116
	06/07	107.3	22745	2139	128
	07/08	88.7	19465	1974	122
Squid jig	95/96	10.2	5389	125	23
	96/97	5.7	640	77	14
	97/98	15.2	4381	211	18
	98/99	89.8	10200	613	53
	99/00	150.3	39240	989	64
	00/01	66.5	13173	793	53
	01/02	85.2	12544	925	65
	02/03	91.8	19220	1228	68
	03/04	69.8	15764	1223	73
	04/05	104.8	22362	1424	79
	05/06	35.4	11223	767	59
	06/07	74.4	14105	1204	67
	07/08	72.6	15585	1358	54
Spear	95/96	14.1	1403	368	21
	96/97	19.3	1853	464	27
	97/98	16.8	1981	483	40
	98/99	19.8	1812	452	38
	99/00	19.3	2233	475	25
	00/01	14.4	1586	355	22
	01/02	13.1	1296	279	19
	02/03	10.3	1366	247	22
	03/04	10.5	1446	289	22
	04/05	13.5	1609	357	24
	05/06	7.9	1009	271	22
	06/07	15.4	1414	363	20
	07/08	9.5	939	250	21

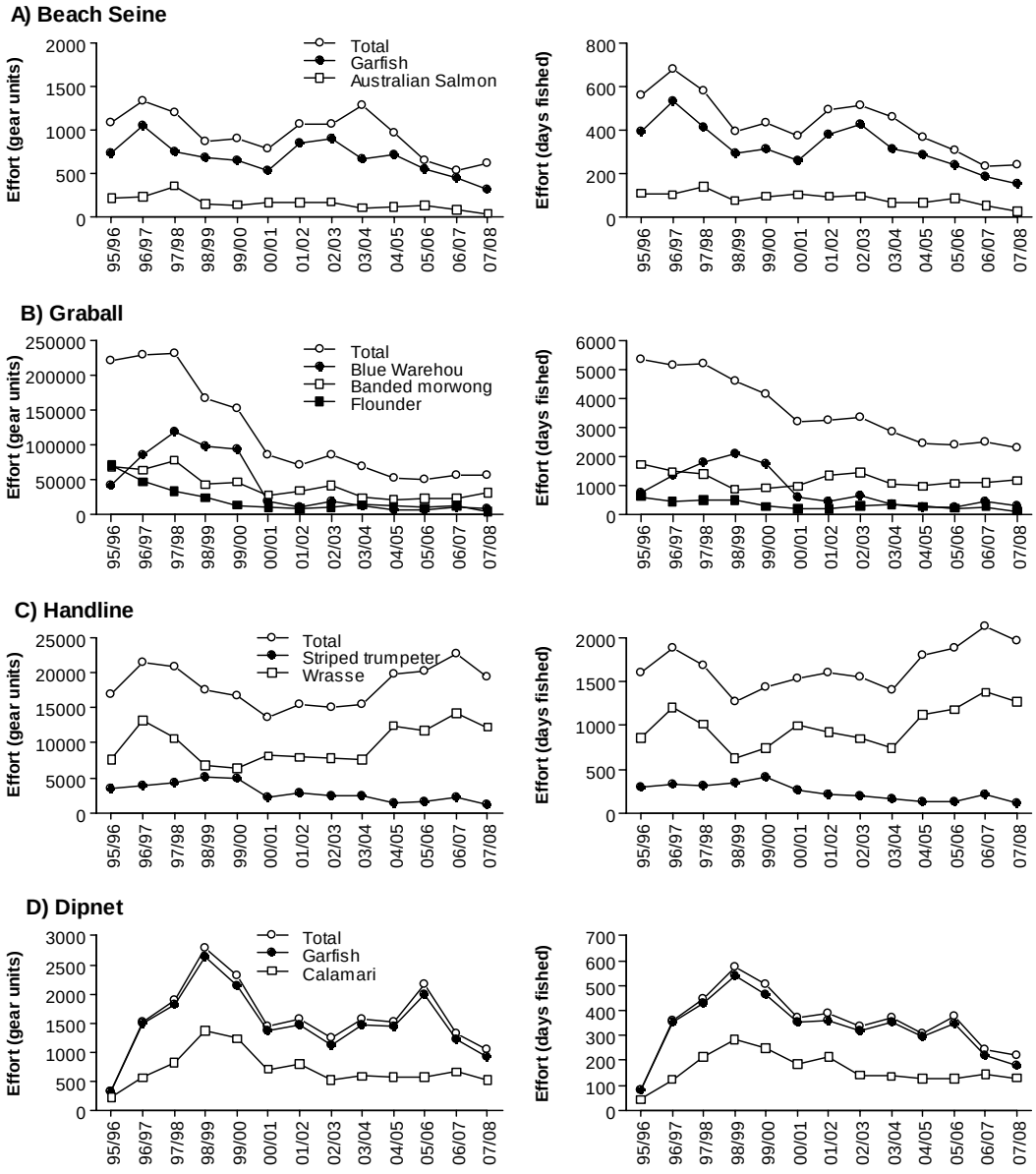

Fig 2.3. Annual effort by selected methods for key species, expressed as gear units (refer Table 2.1) and days fished.

2.6 Catch rates

Catch rate or catch per unit effort (CPUE) is often used in fisheries assessment as a relative index of stock abundance. In the context of the scalefish management plan, a catch rate performance indicator is triggered when catch rates fall below 80% of the lowest value for the reference period (i.e. 1995/96 to 1997/98 unless otherwise specified). Catch rate trends for key species and species groups are considered in some detail in Chapters 3 to 9.

2.7 Recreational fishery

2.7.1 Catch and effort

Catch and effort information are not routinely available for the recreational fishery. A survey of the recreational fishery conducted in 2000/01 provides the only comprehensive snapshot of the Tasmanian recreational fishery (Henry and Lyle 2003, Lyle 2005). A repeat of the recreational survey is underway and will cover fishing activity during the period December 2007 and November 2008. Results will be incorporated in the 2009 fishery assessment.

The 2000/01 survey demonstrated that the recreational catch represented a significant component of the total harvest for many species, either as a proportion of the total harvest or in absolute quantities taken. For instance, recreational catches exceeded commercial catches for flathead, barracouta, jackass morwong, bastard trumpeter, cod, flounder and silver trevally in 2000/01 (Lyle 2005). By contrast, the commercial sector dominated the catches of Australian salmon, southern calamari, arrow squid, wrasse, garfish, whiting and banded morwong. The striped trumpeter catch was shared more or less equally between the two sectors.

In the absence of more recent data few inferences can be made in relation to the relative impacts of recreational catches on the finfish stocks. However, there is no reason to believe that the recreational catch has reduced in importance for those species that are popular recreational targets.

2.7.2 Recreational net licences

Since 1995, the use of recreational nets in Tasmania has been subject to licensing, with fishers able to licence up to two graball nets prior to 2003/04, plus one mullet net and a beach seine. From November 2002 the number of graball nets was reduced to one per person.

Following the introduction of net licences in 1995, the number of licences issued rose rapidly from around 8900 to a peak of over 11000 in 1999/00 (Table 2.5). Licences stabilised at around 8-9000 in recent years but climbed again over 10000 in 2007/08. However, as indicated by the number of Graball Net 1 licences issued, the actual number of gillnet licence-holders varied only slightly between the late 1990s and 2003/04. Since then licence numbers have increased steadily, to about 9200 graball net licences. It is significant that night netting was banned for recreational fishers (with the exception of Macquarie Harbour) in late 2004. Night netting was a common and popular practice amongst recreational fishers (Lyle 2000) but its ban would appear to have had no discernable impact on licence numbers.

Table 2.5. Number of recreational gillnet licences issued by licensing year since 1995/96

na not applicable

Licence type	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08
Graball Net 1	5615	6290	6685	6709	7477	7401	6960	7695	7313	7408	8054	8677	9185
Graball Net 2	2612	2678	2683	2426	2652	2515	1841	na	na	na	na	na	na
Mullet Net	656	684	738	739	879	845	608	754	753	754	816	877	995
Total	**8883**	**9652**	**10106**	**9874**	**11008**	**10761**	**9409**	**8449**	**8066**	**8162**	**8870**	**9554**	**10180**

Although not a direct index of recreational net fishing effort (not all licence holders fish each year and in any case the level of individual fishing effort is highly variable), licence numbers suggest that netting effort may have increased in the last couple of years. With the exception of surveys conducted between 1996-98 (Lyle 2000) and the national survey in 2000/01 (Lyle 2005) there have been no recent assessments of recreational net catch or effort in Tasmania.

2.8 Uncertainties

While considerable attention has been directed at ensuring comparability of commercial data over time (refer Appendix 2), it is acknowledged that some recent administrative changes relating to the reporting of catches may have, nonetheless, exerted some influence on observed catch and effort trends.

Other uncertainties in this assessment relate to limitations in catch and effort data, both in terms of the limited time series available and the level of detail provided. In addition, since the General Fishing Return was designed to accommodate a diverse range of fishing activities, compromises have been necessary, with data collection on a daily rather than operational (set or shot) basis.

It has also become apparent that some fishers have experienced problems in correctly interpreting or complying with reporting requirements, especially in terms of how effort information is reported. The introduction of a new logbook during the 2007/08 season has helped to clarify reporting, but there continues to be an ongoing need to educate fishers in this regard. Further, the lack of catch verification remains a major issue in relation to data quality. Anecdotal reports suggest that some catch and effort data may be unreliable, particularly prior to the implementation of the management plan in 1998. Recent industry workshops have identified the need to improve the quality of catch reporting, including provision for catch verification. The inclusion of catch disposal records in the new logbook may also improve the accuracy of catch reporting.

Catch and effort are influenced by a combination of factors which include fishers matching their fishing operations to changing market requirements and/or resource availability, as well as responses to changing management arrangements. The latter adds further uncertainty regarding the underlying causes of any observed trends in catch and effort. There is, therefore, a need to take account of industry perceptions and information when interpreting fishery dependent information.

Limited information about the recreational fishery remains a major uncertainty and is especially significant in the scalefish assessment given the scale of the recreational relative to commercial catches. While the 2000/01 survey represents an important baseline about this sector, there is a need to develop an on-going monitoring program for the recreational fishery, since without such information attempts to assess the status of those species with significant recreational catches will be flawed.

Fish mortality due to predation and fishery interactions with Australian and New Zealand fur seals is largely unknown but represents another source of uncertainty. Seals can cause substantial mortality to some of the fish species assessed in this report as well as causing gear damage and influencing the fisher behaviour, factors that impact on catches and catch rates. This tends to be caused predominantly by individual ‘rogue’ seals which learn to target particular fisheries or fishing methods (e.g. the banded

morwong gillnet fishery), while the typical diet of seals includes mainly pelagic fish species (Goldsworthy et al. 2003).

2.9 Implications for management

In the short to medium term, uncertainty will continue to be associated with the scalefish fishery primarily because of the uncertain data quality (lack of verification) and lack of information about recreational catches. There is also a need to review the present 'generic' performance indicators to ensure that they are appropriate for each species and that the fishery is managed in accordance with the principles of ecologically sustainable development. For this purpose alternative performance indicators are suggested in this report.

3 Banded morwong (*Cheilodactylus spectabilis*)

3.1 Life-history and stock structure

Banded morwong is a highly sedentary rocky reef species with an unusual combination of high longevity and fast growth:

<table>
<tr><th>Parameter</th><th>Estimates</th><th>Source</th></tr>
<tr><td>Habitat</td><td>Rocky reef down to about 50 m, with females and juveniles inhabiting the relatively shallow sections of the reef and males tending to dominate deeper reef regions. Highly territorial adult males. Depth stratification of populations in southern Tasmania may be less pronounced than in NZ due to large depth changes occurring over short distances.</td><td>McCormick 1989a
McCormick 1989b</td></tr>
<tr><td>Distribution</td><td>From around Sydney south to eastern Victoria and around Tasmania, New Zealand.</td><td>Gomon et al. 1994</td></tr>
<tr><td>Movement and Stock structure</td><td>In tagging studies, movement of juvenile and adult banded morwong was limited and generally restricted to within 5 km of the release site.
No known information on the stock structure of banded morwong and thus the relationships of populations throughout the range.</td><td>Murphy and Lyle 1999
Ziegler et al. 2006</td></tr>
<tr><td>Natural mortality</td><td>Low
Estimated at $M = 0.05$</td><td>Murphy and Lyle 1999</td></tr>
<tr><td>Maximum age</td><td>Females: 93 years
Males: 96 years</td><td>Ewing et al. 2007</td></tr>
<tr><td>Growth</td><td>Males grow to larger sizes than females
Growth accelerated between 1996 and 2007
Schnute & Richards (1990) growth parameters:
<table>
<tr><th></th><th colspan="6">Females</th><th colspan="6">Males</th></tr>
<tr><th></th><th>$L\infty$</th><th>a</th><th>b</th><th>c</th><th>α</th><th>σ</th><th>$L\infty$</th><th>a</th><th>b</th><th>c</th><th>α</th><th>σ</th></tr>
<tr><td>1996</td><td>429</td><td>11.9</td><td>3.8E-08</td><td>0.08</td><td>0.01</td><td>18.0</td><td>525</td><td>2.4</td><td>0.022</td><td>0.28</td><td>0.4</td><td>20.3</td></tr>
<tr><td>1997</td><td>446</td><td>19.7</td><td>4.7E-08</td><td>0.04</td><td>18.9</td><td>20.5</td><td>522</td><td>2.7</td><td>0.044</td><td>0.27</td><td>1.0</td><td>22.7</td></tr>
<tr><td>2001</td><td>418</td><td>13.8</td><td>1.2E-05</td><td>0.08</td><td>11.2</td><td>19.2</td><td>520</td><td>10.3</td><td>0.0002</td><td>0.08</td><td>8.2</td><td>20.5</td></tr>
<tr><td>2002</td><td>433</td><td>20.4</td><td>1.1E-07</td><td>0.05</td><td>75.3</td><td>17.6</td><td>538</td><td>11.3</td><td>0.0001</td><td>0.07</td><td>11.0</td><td>18.2</td></tr>
<tr><td>2003</td><td>427</td><td>20.1</td><td>1.3E-07</td><td>0.05</td><td>69.2</td><td>19.3</td><td>522</td><td>7.3</td><td>0.0037</td><td>0.11</td><td>6.8</td><td>18.2</td></tr>
<tr><td>2004</td><td>438</td><td>20.1</td><td>1.3E-07</td><td>0.05</td><td>68.2</td><td>19.5</td><td>526</td><td>5.9</td><td>0.0097</td><td>0.15</td><td>4.4</td><td>21.2</td></tr>
<tr><td>2005</td><td>452</td><td>22.7</td><td>1.3E-08</td><td>0.04</td><td>93.0</td><td>17.9</td><td>547</td><td>7.9</td><td>0.0022</td><td>0.10</td><td>8.1</td><td>17.2</td></tr>
<tr><td>2007</td><td>442</td><td>18.8</td><td>3.3E-07</td><td>0.05</td><td>51.4</td><td>16.2</td><td>516</td><td>2.3</td><td>0.0088</td><td>0.33</td><td>0.1</td><td>19.4</td></tr>
</table></td><td>Ziegler et al. 2007a</td></tr>
<tr><td>Maturity</td><td>Early age and small size at onset of maturity
Onset of maturity in 2005 at smaller sizes and younger ages than in 1996
Age at maturity modelled by logistic function:
<table>
<tr><th></th><th>B_0</th><th>B_1</th><th>50% maturity</th></tr>
<tr><td>F1996-97</td><td>-3.09</td><td>0.78</td><td>4 years</td></tr>
<tr><td>F2001</td><td>-2.93</td><td>1.08</td><td>2-3 years</td></tr>
<tr><td>F2002-03</td><td>-5.11</td><td>1.94</td><td>2-3 years</td></tr>
<tr><td>F2005</td><td>-5.26</td><td>1.94</td><td>2-3 years</td></tr>
</table></td><td>Ziegler et al. 2007a</td></tr>
<tr><td>Spawning</td><td>In a spawning condition between mid to late February to early May, with the size distribution of oocytes in the ovaries indicating they are serial spawners</td><td>Murphy and Lyle 1999</td></tr>
<tr><td>Larval phase</td><td>Eggs and larvae are concentrated on the surface. Considerable numbers of Cheilodactylus spp. larvae have been caught some distance off the shelf break of eastern Tasmania, suggesting that banded morwong have a pelagic stage that is distributed in offshore waters.</td><td>B. Bruce pers. comm.</td></tr>
<tr><td></td><td>Juveniles appear in shallow water on rocky reefs and tide-pools between September and December after a pelagic phase of around 4-6 months.</td><td>Wolf 1998</td></tr>
</table>

3.2 The fishery

The 'live fish' fishery for banded morwong began in the early 1990s. All holders of a fishing licence (vessel) were able to take this species and, as a result, there was a dramatic increase in effort directed at the species. Reported landings increased from 7 tonnes in 1991/92 to over 145 tonnes in 1993/94, though the latter figure is considered to be highly unreliable (Ziegler *et al.* 2006). Between 1994/95 and 1999/00, catches declined steadily from over 100 tonnes to just 34 tonnes, before increasing to over 50 tonnes in 2001/02 (Fig. 3.1). Since then, catches have stabilised around 40-50 tonnes.

Banded morwong are targeted almost exclusively for the live fish market with large mesh gillnets, primarily 130-140 mm stretched mesh. The fishery is centred mainly along the east coast of Tasmania, between St. Helens in the north and the Tasman Peninsula in the south, with the largest catches traditionally coming from around Bicheno (Fig. 3.2). Smaller catches have been taken along the south coast and around Flinders Island. Fishing operations are conducted over inshore reefs, with gear set primarily in the 10-20 m depth range. In addition to targeted fishing, the species occurs as a by-product of netting operations primarily targeted at blue warehou.

3.3 Management background

On 31 May 1994, a Ministerial warning was issued explaining that any catches of banded morwong and wrasse taken after that date would not be used toward catch history, should previous catches be used to determine future access to the live fishery. In the same year, minimum and maximum size limits (330 and 430 mm fork length) were introduced for banded morwong in an attempt to maintain adequate egg production by protecting large adults and to reflect market requirements by restricting the size range to that of highest value. Subsequent research indicated that these size limits offered minimal protection to mature females, since few females actually exceeded the upper size limit and the lower size limit was set close to the size at 50% maturity (Murphy and Lyle 1999). For these reasons, the size limits were revised in 1998 and minimum and maximum sizes were both increased by 30 mm to 360 and 460 mm fork length.

From 1995 onwards, a closed season (March and April inclusive) was introduced to coincide with the peak spawning period. The primary objectives of the closure were to protect spawning fish and to minimise wastage of fish at a time when they are most vulnerable to mortality in captivity.

In addition to the closed season, an interim live fish endorsement to take banded morwong and wrasse was introduced in 1996. Eligibility was based on a demonstrated history of taking one or both of these species (at least 50 kg between 1 January 1993 and 31 May 1994) and around 90 endorsements were issued. These arrangements continued until the scalefish fishery management plan was implemented in late 1998. Under the plan, a specific licence was introduced for the banded morwong fishery (live or dead) in State waters. To qualify for a banded morwong fishing licence, a more stringent catch history requirement was applied (minimum of two tonnes of banded morwong during the period 1 January 1993 to 31 May 1994) that resulted in 29 fishing licences for banded morwong. As the result of concerns about a potential unsustainable expansion of the fishery, a quota management system with a Total Allowable Catch (TAC) along the east coast from Whale Head in the south to Low Head on the north coast (excluding the Furneaux Group) was introduced in October 2008.

In November 2001, largely as a result of concerns about stock status, a daily bag limit of two fish was introduced for recreational fishers. This was amended in 2004 to a possession limit of two fish.

3.4 Management objectives and strategies

The generic management objectives for the Tasmanian scalefish fisheries apply, although with reference period 1994/95 to 1997/98 for catch and effort.

The species is currently managed by a combination of limited licences, gear limitations (maximum of 1000 m graball nets), size limits (360-460 mm fork length) spawning closure (March-April), and limits on recreational catch (2 fish possession limit).

3.5 Relative vulnerability to fishing

Banded morwong show an unusual combination of high longevity, fast initial growth and early maturity. The high plasticity in growth and onset of maturity, if proven to be a response to high levels of exploitation (Ziegler *et al.* 2007a), would indicate a resilience of the fish stocks to overfishing. However, such significant changes also strongly indicate that stocks have experienced heavy fishing pressure and potentially unsustainable fishing mortality levels. This is all the more important because the species remains site attached after settlement and so is highly vulnerable to localized overfishing and serial depletion.

3.6 Current assessment

Since juvenile and adult banded morwong are largely site attached, populations on individual reefs will remain relatively discrete and therefore catch and catch rate trends should ideally be evaluated at this spatial scale. However, for practical reasons, primarily the spatial resolution of the data (½ degree fishing blocks), analyses have been undertaken at the regional or block level for the main fishing areas. Regions have been defined as north-east coast including Flinders Island (blocks 3F2, 3F4, 3G1, 3G2, 3G3, 3G4, 3H3, 4G2, 4G4, 4H1, 4H2, 4H3 and 4H4), St Helens (5H1), Bicheno (5H3 and 6H1), Maria (6H3 and 6G4) and Tasman (7G2 and 7H1). Collectively, catches from these regions have averaged over 90% of the total banded morwong production each year since the mid-1990s (Fig. 3.2).

This report presents catch and effort analysis and catch rate standardisation. Sampling of biological information during the fishing season is conducted only every second year. The most recent biological information and a summary of results from the stock assessment model are presented in last year's report (Ziegler et al. 2008).

The data presented for this assessment derive from the commercial catch and effort logbook returns and have been evaluated against performance indicators specified in the scalefish management plan and detailed in Section 1.3. They are also evaluated against a new set of alternative performance indicators which are intended to replace the existing ones over the next few years.

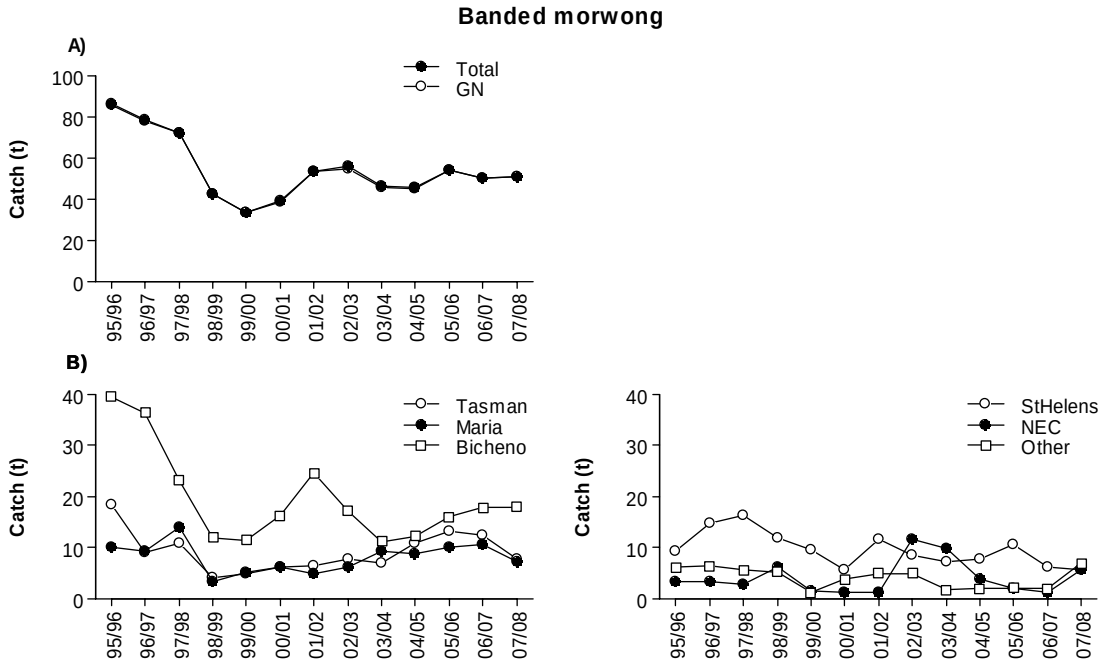

Fig 3.1. Banded morwong graball catches (tonnes) since 1995/96: A) state-wide catches; and B) catches in the Tasman, Maria and Bicheno (Bich) regions (left), and in the St. Helens (StH), north-east coast (NEC) and remaining (Other) regions (right).

3.6.1 Catch, effort and catch rates

State-wide reported catches have stabilised and the 2007/08 catch of 51 tonnes is very similar compared to that from the previous year (Fig. 3.1A). At the regional scale, catches have continued to increase in Bicheno and the north-east, whereas catches have dropped in Maria and Tasman (Figs. 3.1B and Fig. 3.2).

Within the designated TAC area from Low Head on the north coast along the East coast to Whale Head in the south, the reported catch was 46.8 tonnes (Fig. 3.3, Table 3.1). Assessment area 2 between Scamander River and the northern end of Marion Beach dominated the catches with just over 50% taken. Catches from outside the proposed TAC areas were low at 4.1 tonnes.

Results of the National Survey indicated that the recreational catch of banded morwong in 2000/01 was low at around one tonne (Henry and Lyle 2003), representing only about 2.5% of the commercial catch. This is consistent with estimated recreational gillnet catch levels from the latter part of the 1990s (Lyle 2000) and confirms that the recreational take relative to the commercial fishery is small.

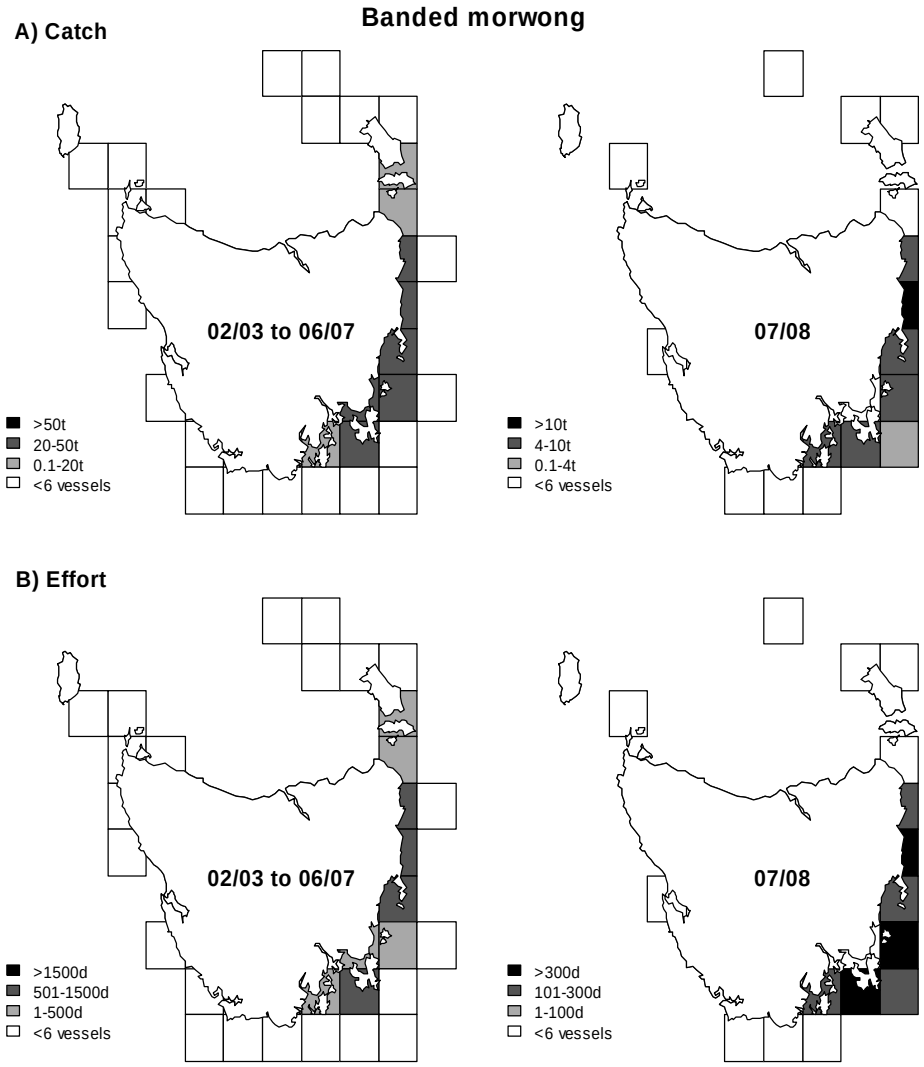

Fig 3.2. (A) Banded morwong catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

Total effort expressed as days fished or gear units (100m net hour) has slightly increased in 2007/08 (Fig 3.4A). Fishers have progressively reduced their fishing activity and deployed less gear on average for each day fished over the last 10 years, indicated by a stronger decline of effort by days fished compared to gear units. There are also numerous industry reports of increasing levels of seal interference over time that have meant that affected fishers have often resorted to fishing with less gear or doing fewer sets each day to reduce losses to seals (Ziegler *et al.* 2006).

Regionally, the most conspicuous trends in effort (days fished) have been relative stability of effort in the Bicheno, Maria and Tasman regions, and the sharp drop of effort in the St Helens region. The effort in the north-east coast region and remaining areas has increased again (Figs. 3.2 and 3.4B).

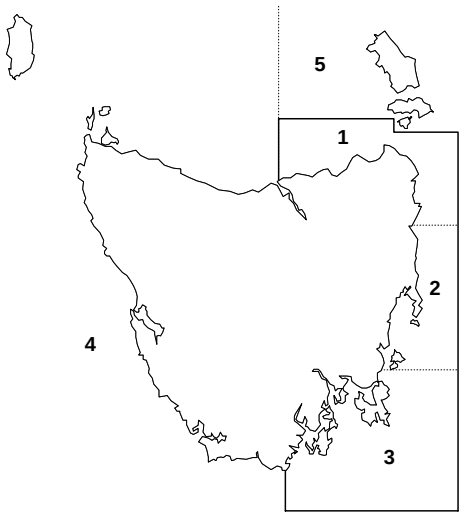

Fig 3.3. Designated TAC area for banded morwong (bold box) from Low Head on the north coast to Whale head in the south, and the five assessment regions separated by the dotted lines.

Table 3.1: Catches in tonnes for 2007/08 inside and outside the designated TAC area.

Assessment Region		Description	Catch	Proportion within TAC area
Within designated TAC area	1	North-East: Low Head to Scamander River	7.2	15%
	2	East: Scamander River to Marion Bay	24.1	51%
	3	South-East: Marion Bay to Whale Head	15.5	33%
	Total		**46.8**	
Outside designated TAC area	4	West coast & North cost west of Low Head	0.1	
	5	Furneaux Group	4.0	
	Total		**4.1**	

Catch rates of banded morwong have been standardised using generalized linear models (GLM) to reduce the impact of obscuring effects such as block, depth, season or skipper on the underlying trends (Kimura 1981, 1988). However, while standardised catch rates are preferred over the simple geometric mean, there remains no guarantee that a direct relation exists between the standardised catch rates and stock size, as other factors may have effects on changes in biomass that are unaccounted for by the statistical model.

Standardisation of catch rates was conducted for an annual time scale, at both the east coast-wide scale and for four separate fishing regions along the east coast (Table 3.2). The data was selected with respect to skippers who had reported catches for at least two years and who had caught a median catch of at least one tonne of banded morwong across all years present in the fishery. These restrictions selected data that accounted for 83% of the total catch reported since 1995/96.

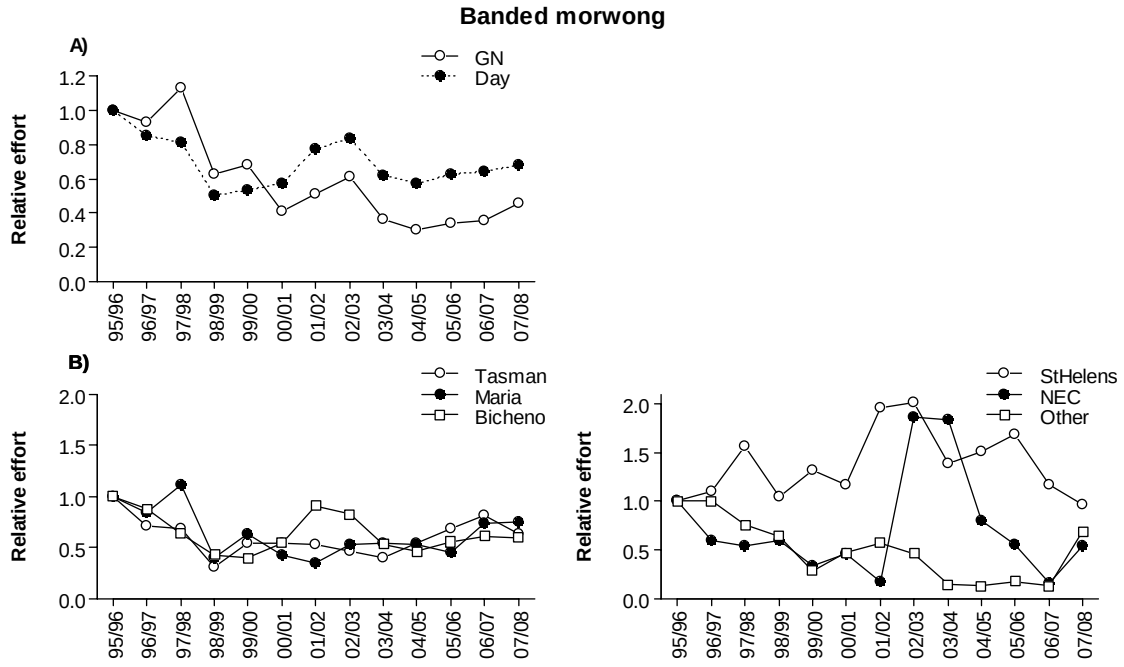

Fig 3.4. Banded morwong graball effort relative to 1995/96 levels: A) state-wide relative effort based on gear units (GN) and days fished (Day); and B) relative effort (days fished) in the Tasman, Maria and Bicheno regions (left), and the St. Helens , north-east coast (NEC) and remaining (Other) regions (right).

The generalized linear models of catch rate were fitted to different combinations of various factors for which information were available, viz. skipper, vessel, fishing block, depth zone fished (<10 m, 10-20 m, 20-30 m, and >30 m), bimonthly period, and reported seal interference. A bimonthly period rather than month was included as a temporal factor because there would have been too few records each month to give reliable results. Due to the annual spawning season closure in March and April, only five bimonthly categories were investigated. Seal interference was included into the analysis, but it rarely turned out to be an influential factor. Reporting of seal interference (in the catch returns seal interference is reported as 'occurrence') appeared to be very inconsistent, and fishing trips with seal interference and very low catch are often not reported at all. In any case, a report of seal interference did not in any way allow quantification of the severity of the interaction in terms of lost catch or impact on fishing activity.

Standardised catch rates for banded morwong were fitted to natural log-transformed catch rate data (assuming a lognormal distribution), using a normal distribution family with an identity link. All models were fitted using a forward approach by manual stepwise addition of each factor starting with the time-step. Some interaction terms between various factors were also considered, but these were limited to combinations for which sensible interpretations could be ascribed. The optimal model was chosen based on minimization of the Akaike's Information Criterion (AIC; Burnham and Anderson 1998).

Table 3.2: Generalized linear models (GLM) for the catch rates of banded morwong across the whole east coast of Tasmania, and in the separate St. Helens, Bicheno, Maria and Tasman regions. The adjusted R^2 has been used for the Variation described.

Region		Model	Variation described
Whole East Coast	Ln cpue =	Constant + year + vessel + bimonth + seals + depth + block + skipper + vessel*bimonth	39.0%
Tasman	Ln cpue =	Constant + year + bimonth + vessel + block + seals + depth + vessel*bimonth	36.8%
Maria	Ln cpue =	Constant + year + vessel + bimonth + depth + block + seals + vessel*bimonth	52.9%
Bicheno	Ln cpue =	Constant + year + vessel + bimonth + depth + seals + block + skipper + vessel*depth	39.0%
St. Helens	Ln cpue =	Constant + year + vessel + seals + bimonth + depth + vessel*bimonth	46.6%

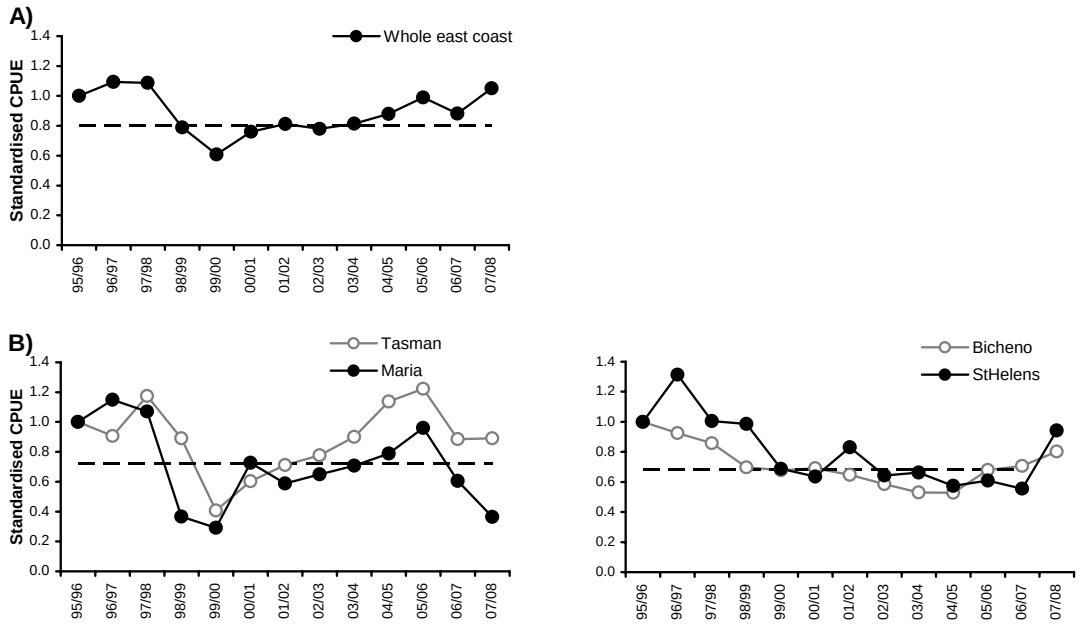

Fig 3.5. Banded morwong standardised graball catch per unit effort (CPUE by days fished) relative to 1995/96 levels from the whole east coast, and from the Tasman, Maria, Bicheno and St. Helens regions. Dotted lines mark the reference limits.

Overall standardised catch rates from the east coast fell steadily between 1995/96 and 1999/2000, accompanying the declines in catch and effort (Fig. 3.5). Since 1999/2000 overall catch rates have risen back to 1995/96 levels. Regionally, catch rates in the Tasman and Maria regions have shown reasonably similar trends with initial decreases up to 1999/2000 and subsequent increases to above 1995/96 levels by 2005/06. Catch rates have since stabilised at a lower level in Tasman, but continued to drop in Maria. Fishers indicated that increasing seal interactions could have contributed to this decline. In the Bicheno and St. Helens regions, catch rates have fallen continuously since the mid 1990s, but recently shown signs of recovery. The sharp increase in St. Helens may be in reaction to decreasing catches and effort in this region.

3.7 Stock assessment model

The stock assessment model was not updated and reference should be made to the 2007 assessment for details (Ziegler *et al.* 2008).

3.8 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1994/95 to 1997/98 range (73t-106t)	Yes: Statewide ↓ Yes: Regionally in Tasman, Bicheno and St Helens ↓	Commercial catch in Region 1 > 30% of TAC Region 2 > 65% of TAC Region 3 > 40% of TAC Outside TAC area > 10t	Not assessed
Catch increase or decline by over 30% from previous year	No	Commercial catch is less than 90% of TAC	Not assessed
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	Yes: Regionally in Maria	Catch rates are below 0.9 * average from reference period 2000/01 to 2006/07	Yes: Regionally in Maria
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Yes: Significant changes of age/size composition, acceleration of growth & earlier maturity (see Ziegler et al. 2008)	Any indicator of stock stress	Yes: Significant changes of age/size composition, acceleration of growth & earlier maturity (see Ziegler et al. 2008)

3.9 Implications for management

The 2007 assessment model for banded morwong indicated that mature and exploitable biomass had remained high in both southern stocks, mainly due to strong recruitment pulses. In the northern stocks, recruitment had been only slightly elevated in the 2000s and mature and exploitable biomass had continued to decrease.

Stabilising current biomass levels and rebuilding populations of old fish, particularly females, appears to be a desirable strategy in the northern stocks of Bicheno and St. Helens. Continued harvest rates above the internationally recognised reference points for mature biomass of $H_{40\%}$ or $H_{30\%}$ (the harvest rate that reduces spawning biomass-per-recruit to 40% or 30% of the unfished level) had decreased the mature and exploitable biomass to about 30% of the initial levels in 1990, although there was some uncertainty around these values and the levels could have been closer to 50% in one of these stocks.

In the southern stocks, mature and exploitable biomass levels were predicted to be substantially higher with a minimum of 43% in Maria and 61% in Tasman. Recent stock rebuilding in the southern stocks was based on strong recruitment pulses in the 2000s coupled with higher productivity through increased growth rates and earlier maturity (Ziegler et al. 2007a). As a result, the fishery in the south and north is now largely recruitment-driven with only a small proportion of the catch made up by older females. While the fishery in the southern stocks has profited from strong recruitment in recent years, even a relatively short period of low recruitment could lead to serious declines in catch rates and mature biomass. Therefore, a reduction of fishing mortality to rebuild populations of old fish is advisable also for the southern stocks.

The higher dependence on new recruitment in all stocks was reflected in the risk assessment. For a total East coast catch of 40t or more, the model predicted a decline of biomass and catch rate in all stocks. For 30t, the probability of sustaining current levels was less than 10% for mature biomass and 6%-28% for catch rates in the four stocks. Only with a catch of 20t, the model predicted overall about a 50% chance that the current mature biomass and catch rates could be sustained over a 5-year period. However, this catch level is less than half of the 44.5t TAC approved for 2009/10.

The current catch of 38t in the four East coast regions was still too high to stabilise catch rates and spawning biomass, but the decline from last year's catch by 9t should have relieved the pressure on the fish stocks to some degree. However, this was not obvious in catch rate data, where catch rates fell in Maria and remained stable in Tasman despite lower catches in both regions. In the northern regions, catches remained stable but catch rates increased suggesting possible higher recruitment.

3.10 Research needs

The Scalefish Fishery Research Advisory Group has accorded stock assessment of banded morwong a high priority. Bi-annual spawning season surveys and stock assessments will continue in 2009 and should provide further insights into the impact of fishing on the size, age and sex structure. However, given the level of spatial structuring, sampling needs to be focussed regionally, even at the scale of discrete reef areas. This degree of sampling intensity is in practice difficult to achieve and justify in a fishery of this size.

Information about the character or relative abundance of populations in the deeper reef areas or potential mixing rates with the shallower areas is still missing. Fishing surveys of such areas and an understanding of the size and distribution of suitable deep reef habitat relative to the shallow fished reef areas could prove informative in evaluating the potential importance of depth refuges.

4 Southern calamari (*Sepioteuthis australis*)

4.1 Life-history and stock structure

Southern calamari is a very short-lived, fast-growing cephalopod species with spawning aggregations in inshore waters:

Parameter	Estimates	Source
Habitat	One of the most common cephalopods in coastal shallow waters of southern Australia.	
	Important component of the coastal ecosystem as primary consumer of crustaceans and fishes, and as a significant food source for numerous marine animals.	Gales *et al.* 2003
Distribution	Endemic to southern Australian and northern New Zealand waters	Gomon *et al*. 1994
Movement	Differential habitat use by the sexes during spawning with males accumulating on the beds, as opposed to more frequent small-scale movement on and off the beds by females. Sex-ratio is more even both before and after the closure, however, during the closure spawning activity in aggregations males out-numbered females 10:1. Therefore, although the fishery removes a representative sample of what squid are on the spawning beds at any point in time (squid jigs do not appear to be sex-selective), the fishery is effectively selective for males and will therefore impact both the apparent size of individuals and sex-ratio of the population.	Pecl *et al.* 2006 Hibberd 2005
Natural mortality	High	Pecl *et al.* 2004
Maximum age	The species is short-lived, probably living for less than one year: Maximum recorded ages: males: 275 days, females: 263 days.	Pecl *et al.* 2004
Growth	Rapid rate of growth 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. Extremely variable growth: At 200 days of age individual males may vary in size by as much as 1.5 kg and females by as much as 0.9 kg. Some of this variability in growth may be explained by temperature or food availability at hatching, with those individuals hatched in warmer seasons or years generally growing faster. Males attain greater size and weight than females: - Maximum recorded length: males 550 mm, females: 480mm dorsal mantle length (ML). - Maximum recorded weight: males 3.6 kg, females: 2.3 kg.	Pecl *et al.* 2004
Maturity	On the east coast of Tasmania, over 90% of females caught in summer are mature, whereas in winter over 50% of the females are either immature or in early stages of maturity.	Pecl 2001
	Minimum recorded age and size at maturity for females is approximately 117 days, 0.12 kg and 147 mm ML. Immature females were found to be as old as 196 days and up 0.62 kg and 237 mm ML. Males mature as young as 92 days and as small as 0.06 kg and 104 mm ML.	Pecl 2001
Spawning	Major spawning period in spring/summer in Tasmania, with low levels of spawning occurring all year round. The majority of summer caught squid are hatched in winter and vice versa.	Moltschaniwskyj *et al.* 2003
	Multiple spawners with individual spawning activity occurring over several months (acoustically-tagged mature females moved on and off the spawning grounds for up to 3½ months). Frequency of batch deposition is unknown.	Pecl *et al* 2006

Spawning (cont.)	Summer spawners can lay larger batches of eggs than winter spawners Younger females may lay more eggs than older females. Spawning aggregations are male-biased. Female calamari have multiple mates with up to 85% of individual egg capsules from the one female sired by multiple fathers. Mating occurs either in temporary pairs with a large dominant male that guards the female, or in extra-pair copulations with a 'sneaker male'. Genetic studies demonstrated that both small and large males sire similar proportions of offspring. 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 other seagrasses and macro-algae, or embedded directly into sand. Individual egg strands contain 4-7 eggs, with 50 to several hundred egg strands joined together to form larger egg mops. Development takes between 4-8 weeks, depending on water temperature, bringing the total life span close to annual.	Pecl 2001 van Camp *et al.* 2005 Jantzen and Havenhand 2002 van Camp *et al.* 2004 Moltschaniwskyj *et al.* 2003 Steer *et al.* 2002
Early life history	Newly hatched calamari are 2.4-7 mm ML and immediately swim to the surface following hatching. Hatchlings can be found near the spawning grounds for 20-30 days. The habitat and ecology of individuals between about 20-80 days of age is unknown, however at 80-150 days, juveniles have been found in deeper water adjacent to the spawning grounds. Individuals become available to the fishery at approximately 90-120 days of age.	Steer *et al.* 2002 Pecl 2000 Pecl 2004
Recruitment	Highly variable	This report

4.2 The fishery

During the latter half of the 1990s there was a marked expansion in the fishery for calamari in Tasmania, with catches rising from less than about 20 tonnes p.a. prior to 1995/96 to about 90 tonnes in 1998/99, accompanied by a trebling of effort. Southern calamari are taken by a variety of methods including purse seine, beach seine, squid jig, spear and dipnet, with squid jigs the primary method in recent years. Although some night fishing occurs, fishing is generally conducted during the day over shallow areas of seagrass and macro-algae where squid aggregate to spawn.

4.3 Management background

The dramatic rise in southern calamari catches prompted a ministerial warning in August 1999 that management arrangements were under review and restrictions on catch, effort and numbers of operators accessing the resource may be introduced in the future. In addition, Great Oyster Bay was closed to fishing for southern calamari for 2 weeks twice between October and December 1999 as a precautionary measure to protect egg production. Similar short-term closures were implemented again in 2000 and 2001, while in 2002 closures were extended to include adjacent fishing grounds in Mercury Passage. In each year from 2003 to 2006, the commercial fishery in Great Oyster Bay and Mercury Passage was closed for a three month period to reduce catches from the spawning population.

In 2003 and 2004, the area was closed from September to November inclusive. Recreational fishers were permitted to fish for calamari during this period but with a reduced daily bag limit of five calamari, and there was some limited research fishing by commercial fishers, operating under permit. The movements of acoustically-tagged

squid monitored throughout the closed areas and periods suggests that squid were unlikely to have left the protection of the Great Oyster Bay closed area for the boundaries that were in place for 2003. However, tracking data indicate that some leakage out of the protected area probably occurred during the 2004 closed season where the boundaries were reduced (Pecl *et al.* 2006).

In 2005, the closed area was expanded to include all waters between Wineglass Bay and the northern end of Marion Bay and the closure period lasted from mid-September to mid-December. The closure also included recreational fishers, thereby providing effective protection to the spawning stock during the peak of the spawning season. A similar closure was implemented in 2006.

Growing markets for the species coupled with increasing use of squid jigs, a method available to all holders of scalefish and rock lobster licences to target the species, have contributed to the recent expansion of the fishery. In an effort to limit further expansion of the fishery in November 2001, a combined possession limit of 30 calamari and arrow squid was introduced for all holders of scalefish C licences (but excluding those also holding beach seine or purse seine licences). Also in November 2001, a daily bag limit of 20 'squid' (southern calamari and/or arrow squid) and a possession limit of 30 squid were introduced for recreational fishers. Recreational bag limits for squid were replaced in 2004 with a possession limit of 15 calamari and 15 arrow squid.

Recent deliberations regarding the long-term management of calamari have included consideration of zoning the fishery into "developed" region on the east and south-east coasts and "undeveloped" regions for the rest of Tasmania, along with the introduction of a specific calamari licence for the developed region.

4.4 Management objectives and strategies

The generic management objectives for the Tasmanian scalefish fisheries apply (with reference period 1995/96 to 1997/98).

The species is currently managed by a combination of spawning season closure for commercial and recreational fishers in all waters between Wineglass Bay and the northern end of Marion Bay from mid-September to mid-December, a combined possession limit of 30 calamari and arrow squid for all holders of scalefish C licences (excluding those also holding beach seine or purse seine licences), and a possession limit of 15 fish limits on recreational catch.

4.5 Relative vulnerability to fishing

Vulnerability of calamari to fishing pressure is unclear but probably high because spawning aggregations can be targeted and the species has an annual or sub-annual life span that renders the stock susceptible to spawning and/or recruitment failure. However, if the population is allowed to spawn (during the fishing closures) prior to the main harvest, the population may be able to sustain high fishing mortality rates without detrimental effects on future recruitment.

4.6 Previous assessments

Previous assessments have involved analyses of catch, effort and catch rate trends. Rising effort and declining catch rates in the main fishing regions were noted and flagged as potential indicators that the fishery had impacted on the calamari stocks. Preliminary analysis of catch and effort data using surplus production modelling for the major fishing areas of Great Oyster Bay and Mercury Passage was investigated for the 2003 and 2004 assessments. Analyses suggested that the unfished, mid-season exploitable biomass was between about 200-275 tonnes but had been reduced to below 50% of this level, implying that harvest rates were very high and not sustainable. Three month closures were implemented as a direct management response to reduce the harvest rates as well as protect the stocks whilst spawning. These closures, however, resulted in a substantial change in the temporal distribution of catch and effort, thereby violating a key model assumption that the distribution of catch and effort is consistent over time. This meant that the surplus production modelling was no longer valid or useful.

4.7 Current assessment

The extended fishery closures had large impacts on monthly catches in Great Oyster Bay and Mercury Passage each year since 2003 (Fig. 4.1). Fishing activity has effectively shifted from an August - December focus (1998/99 - 2002/03) to being heavily concentrated into the single month of December (2003/04 - now).

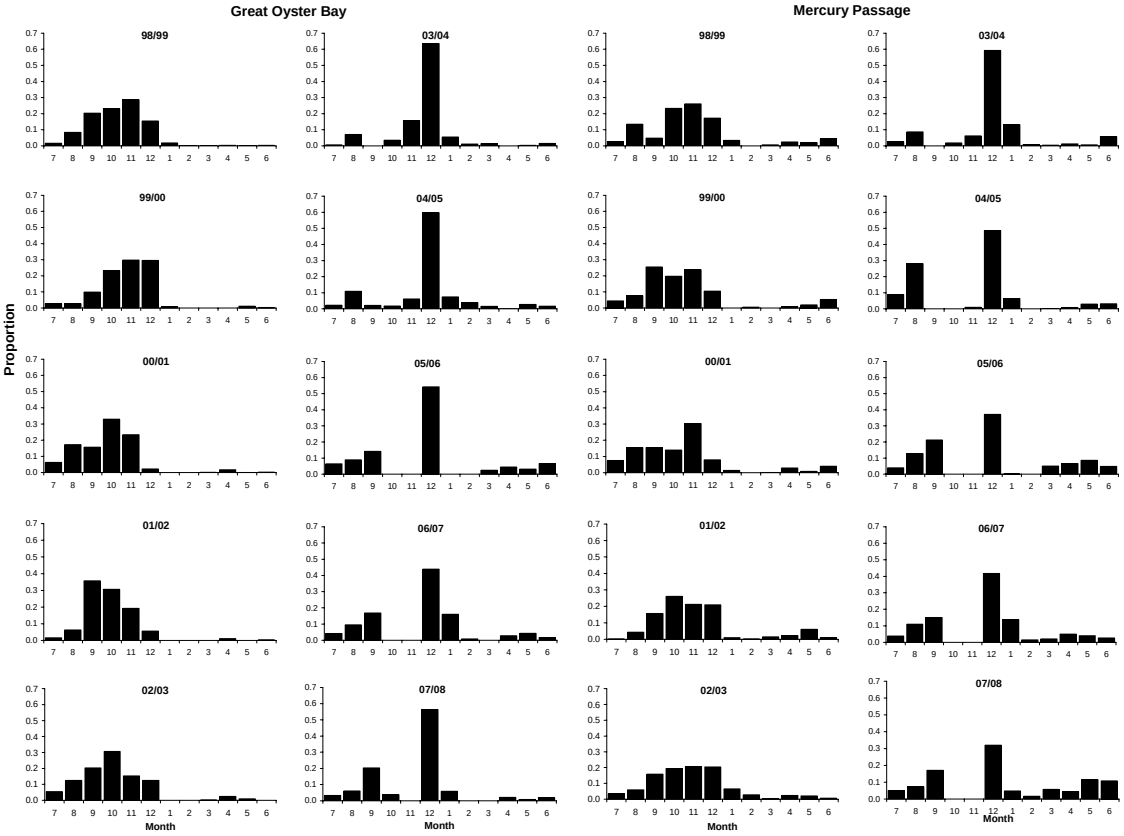

Fig. 4.1 Monthly catch distribution (as proportion of the total catch within the fishing year) for Great Oyster Bay (ES13 and ES14) and Mercury Passage (ES16).

4.7.1 Catch, effort and catch rates

Since 1998/99, a significant fishery for southern calamari has developed in Tasmania, with catches expanding rapidly from less than about 30 tonnes p.a. prior to 1998/99 to over 100 tonnes (Fig. 4.2A). While calamari catches have been reported from all areas apart from the west coast, the fishery is concentrated off the central east and south-east coasts (Fig. 4.3). The fishery developed initially in the mid-1990s in Great Oyster Bay and then expanded to the south to include Mercury Passage, Maria Island and Tasman Peninsula (Fig. 4.2B). Over recent years moderate catches of calamari have also been taken from Flinders Island.

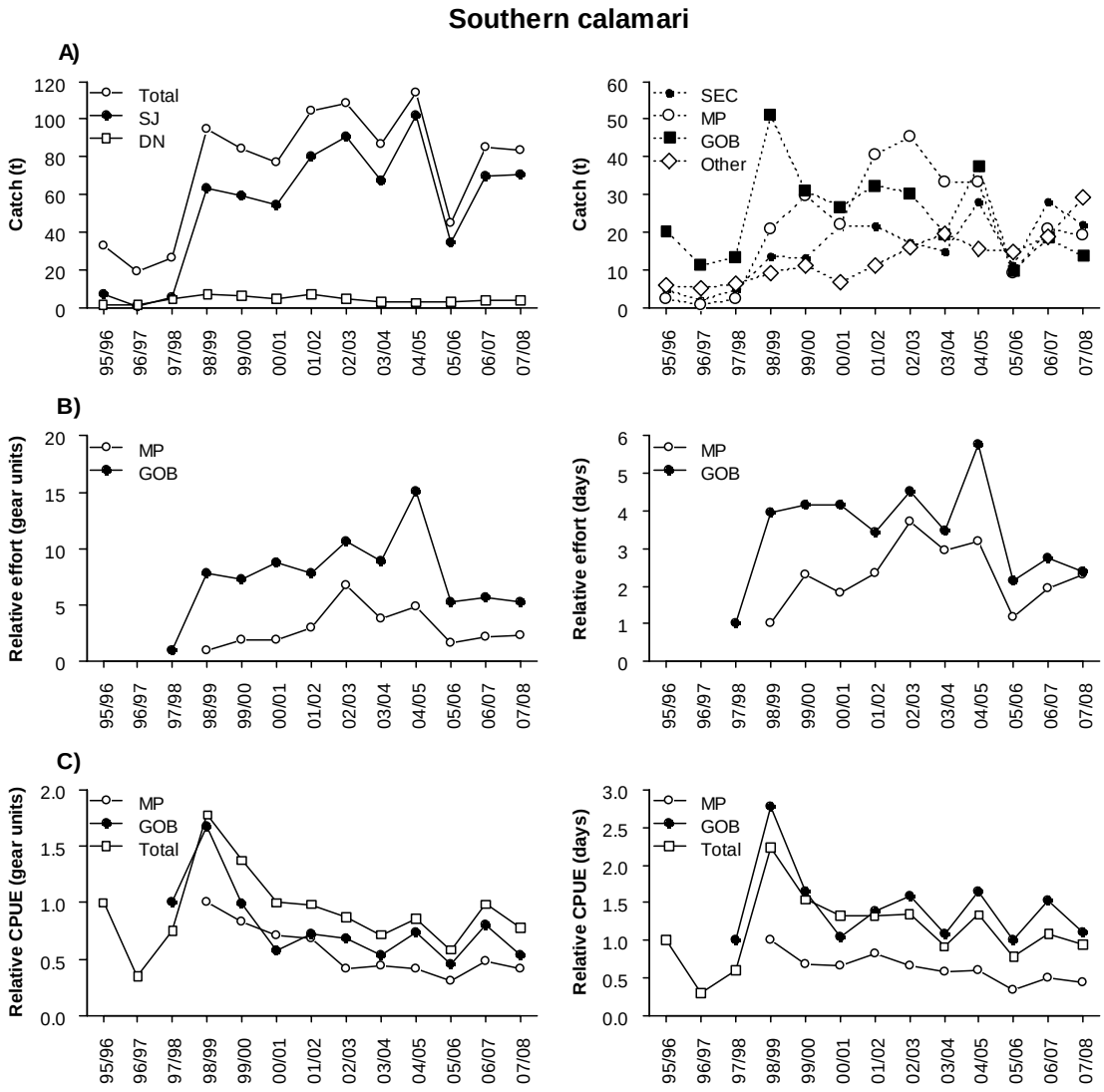

Fig. 4.2 A) Annual catch (tonnes) of calamari by method (left) and by region (right) since 1995/96; B) squid jig effort based on gear units (left) and days fished (right) relative to 1998/99 for MP and 1997/98 for GOB; and C) squid jig catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day (right) relative to 1998/99 for MP, 1997/98 for GOB and 1995/96 for Tasmania (Total). SJ is squid jig, DN is dipnet; SEC is south-east coast, MP is Mercury Passage, GOB is Great Oyster Bay, and Other is all remaining areas. Only years with >5 operators are shown.

The expansion of the fishery was almost exclusively due to increased squid jig catches (Fig. 4.2A). The 2007/08 catch of 84 tonnes was similar to last year's catches, although catches have shifted away from Great Oyster Bay and the south-east to other areas. Expansion of the fishery in Great Oyster Bay (blocks 6H1, ES13 & ES14) and Mercury Passage (6H3, 6G4 & ES16) was primarily responsible for the initial growth of the fishery (Fig. 4.2B). The 3-month spawning season closure, introduced in 2004/05 for Great Oyster Bay and Mercury Passage and recently extended over a larger area, appears to be successful in reducing pressure on these main spawning grounds and encourage industry to spread the effort into other regions such the central east coast and the north coast (Other in Fig. 4.2A, Fig 4.3).

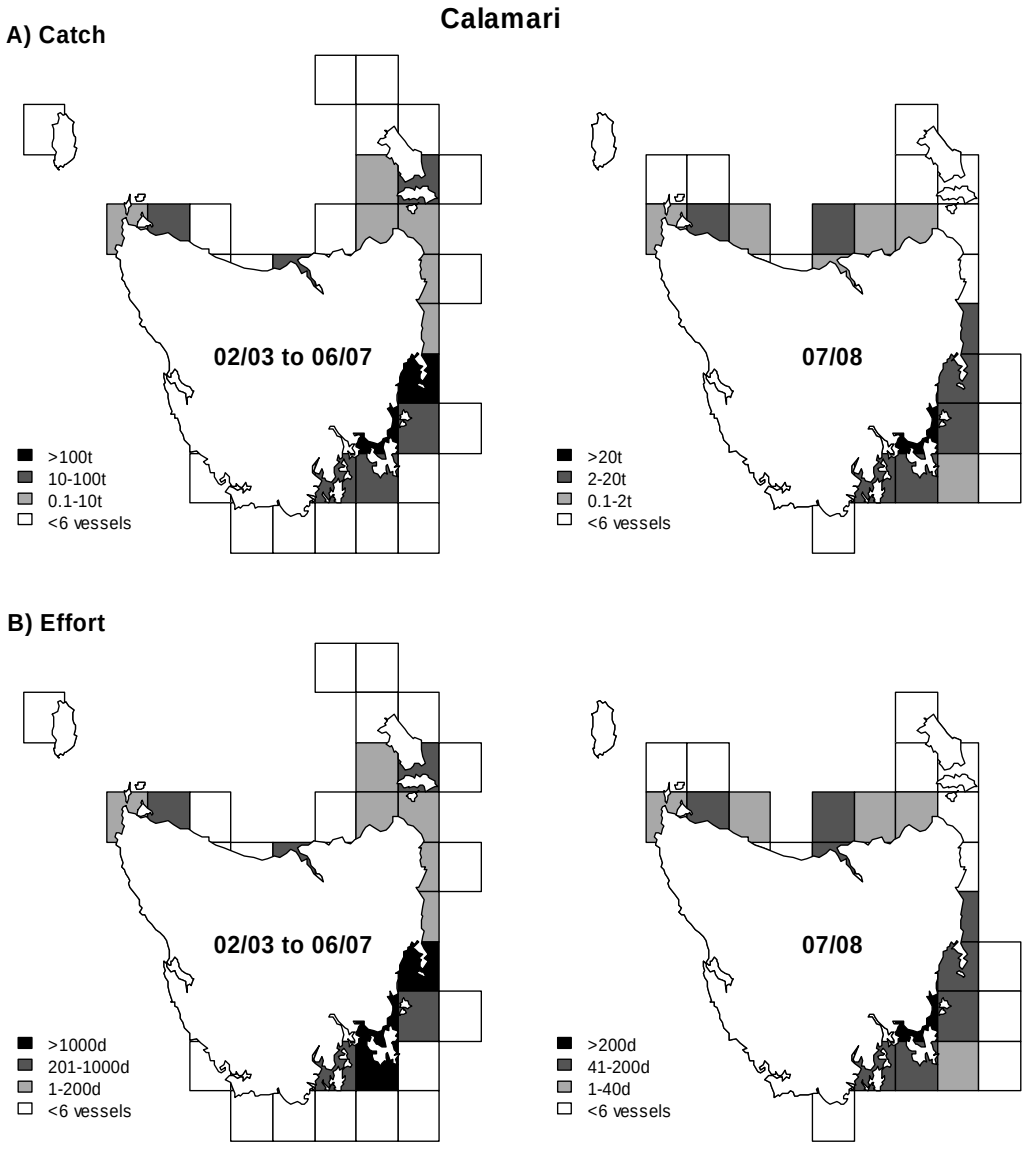

Fig 4.3. (A) Calamari catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

The only available estimate of the recreational catch of calamari (18 tonnes in 2000/01) indicates that this sector has the potential to contribute significantly to the overall fishing pressure on the species.

The regional distribution of the fishery in terms of effort is, not surprisingly, consistent with the pattern observed for catches (Fig. 4.3). Effort is focussed on Great Oyster Bay, Mercury Passage, the south-east and Tamar in the north. Jig effort in 2007/08 remained low in Great Oyster Bay and Mercury Passage after the sharp fall in the 2005/06, largely influenced by 3-month seasonal closure (Fig. 4.2B).

State-wide, catch rates (gear and daily) for jigs decreased in 2007/08 compared with 2006/07 (Fig. 4.2C). In the context of catch and effort, these data imply that the lower catches for calamari in Great Oyster Bay during 2007/08 was in response to generally worse catch rates outside the period of the seasonal closure.

4.7.2 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1990/91 to 1997/98 range (6t-33t)	Yes: Statewide ↑ (84t)	Commercial catch in: GOB & MP > 50t Remainder SE > 30t Outside GOB, MP & SE > 25t	 No No Yes: 29t
Catch increase or decline by over 30% from previous year	No	Declining catch trend over 3 consecutive years by a total of > 40% in south-east Tasmanian waters	No
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	Yes	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	No	Any indicator of stock stress	No

4.8 Management implications

The alternative reference points for calamari should finally overcome the shortfalls of the existing reference ranges for catch and effort. The existing ranges derived from a period well before the fishery developed and thus compared the fishery between an under-developed (pre-1998/99) and developed state. As a result, catch and effort indicators have been continuously triggered in the past.

Preliminary modelling using surplus production models (2003 and 2004 assessments) implied that, within the main area of the fishery, harvest rates were very high. Closures have been applied to reduce fishing pressure as well as provide protection to the spawning stock. The extension of the closure to three months since 2003 has, not surprisingly, resulted in substantial changes in the fishery dynamics and compromised the validity of several model assumptions. Hence the model could no longer be used.

Based on cumulative egg production (Ziegler et al. 2007b), closures that encompass the September to November (or early December) period are likely to provide effective protection to the bulk of the spring spawning event. Moreover, since calamari have a life span of generally less than one year, intense fishing pressure immediately after the fishery is opened will often have a limited impact on subsequent recruitment, since most calamari caught would have already spawned and would die anyway within in a short period of time. In this context, the current management strategy of spawning closures should have considerable stock benefits. Impacts on the economic viability of operators and markets arising from the resultant pulse fishery are likely but whether management options are available or desirable to modify this behaviour is beyond the scope of this present assessment.

As the spawning dynamics and relationships between egg production and subsequent recruitment are better understood, there may be potential to use egg surveys in a real-time monitoring capability, whereby consideration could be given to shortening or extending closures depending on the level of accumulated egg production at a given point in time. However, since growth and reproductive characteristics of individual calamari appear to differ substantially depending upon the timing of hatching and subsequent environmental conditions, environmental factors may ultimately prove as important as fishing mortality in driving the population structure and dynamics.

Because stable isotope analyses indicated that most adult calamari caught on the east and south-east coasts are probably spawned in Great Oyster Bay (Ziegler et al. 2007b), this area exhibits a high degree of self-recruitment as well as supplying other parts of the south-east coast with the bulk of recruits. These findings reinforce the value and effectiveness of management arrangements that involve the closure of this region during the main spawning period.

Interest in calamari continues at a high level and there is substantial capacity within the Tasmanian scalefish industry to increase effort levels, an issue that is being tackled as part of the current management review through consideration of licensing and limited entry. As for the recreational sector, interest in the species is also high and effort directed at the species is likely to increase. Areas such as the D'Entrecasteaux Channel, Norfolk and Frederick Henry Bay and Great Oyster Bay are recognised hotspots.

The extended closure of the major spawning grounds (implemented again in 2007/08) appears to be effective in protecting the main known spawning event and ensuring relatively high egg production. Major catches can still be taken even after the spawning closure. However, any major shift in the fishery to increased effort prior to the closure could adversely impact on the spawning stock prior to the main spawning season. Expansion of catches in space and time should be therefore monitored closely and restricted if need be.

4.9 Research needs

The Scalefish Fishery Research Advisory Group has recognised stock assessment, evaluation of critical habitat requirements, impact of management arrangements and gear interactions on calamari populations as high priority research areas. The continued lack of information concerning the recreational catch, especially from Great Oyster Bay, remains a significant hole in the assessment of calamari.

Information on the stock structure and level of fishing pressure that can be sustained on southern calamari is required. Integral to this is the need to quantify the relationships between reproductive output, spawning stock size and subsequent recruitment. Critically the source and sink populations supporting the Tasmanian calamari fishing industry need to be identified to ensure sustainable use of this resource. While recent research has progressed in this area, it is important to note that calamari is a highly variable species and the observed patterns may not be valid in all years. Our understanding of the variability and plasticity in the life cycle, and the subsequent application of population modelling techniques, would also benefit from more detailed research into determining links between environmental factors and growth, reproductive, and survival characteristics. Given the vulnerability to recruitment failure, the impact of fishing activities on the spawning behaviour of the aggregations needs to be addressed.

5 Striped trumpeter (*Latris lineata*)

5.1 Life-history and stock structure

Parameter	Estimates	Source
Habitat	Mainly on the continental shelf over rocky bottom to depths of about 300 m, with juveniles associated with shallow inshore reefs.	
Distribution	Distributed throughout southern Australia, from Sydney around to Kangaroo Island in South Australia and including Tasmania. The species is also found in New Zealand, the St. Paul and Amsterdam Islands in the southern Indian Ocean, and the Tristan da Cunha Group and Gough Island in the southern Atlantic Ocean.	Gomon *et al*. 1994
Movement and Stock structure	Uniform stock structure in Tasmanian waters (no significant genetic separation of populations).	Tracey et al 2007b
	Tagging studies suggest that juveniles tend to remain around shallow reefs for several years, with only limited movement, before moving into deeper offshore reefs. This pattern is supported by data from the commercial fishery that shows fish do not recruit to the offshore hook fishery until about 45 cm fork length (FL).	Lyle and Jordan 1999 Tracey and Lyle 2005
	In 2001, a striped trumpeter tagged off the Tasman Peninsula in 1996 was recaptured off St. Paul Island in the Indian Ocean indicating a capacity to undergo wide-scale movements.	Lyle and Murphy 2001
Natural mortality	Estimated as $M = 0.1$	Tracey and Lyle 2005
Maximum age	Maximum age is estimated to be 43 years (while this has yet to be fully validated, the incremental structure in sectioned otoliths is clear and unambiguous)	Tracey and Lyle 2005
Growth	Growth up to 1.2 m in length and 25 kg in weight	Gomon *et al*. 1994
	Rapid growth of juveniles, reaching a mean length of around 28 cm FL after two years and 42 cm FL after four years, with most growth occurring during summer and autumn. Older fish grow significantly more slowly, with a large range in size-at-age for fish over about 50 cm FL.	Murphy and Lyle 1999 Tracey and Lyle 2005
Maturity	Females reach maturity at a smaller size and age (44 cm FL and 5 years) than males (53 cm FL and 8 years).	Hutchinson 1994
	However, more recent data suggest that size at 50% maturity in females is somewhat larger, around 54 cm FL (6.8 years), with male attaining 50% maturity at 53 cm FL (6.2 years).	Tracey *et al*. 2007a
Spawning	Spawning occurs from July to early October, depending on geographical location, with earlier start and finish at lower latitudes.	Ruwald et al. 1991
	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 1992 Hutchinson 1993
Early life history	Larval rearing trials indicate a complex and extended larval phase, with a post-larval 'paperfish' stage of up to nine months prior to settlement.	Ruwald et al. 1991
	The distribution of larvae and recruitment processes have not been studied.	Ruwald 1992
	While no information is available on the size and timing of settlement, juveniles of around 18 cm FL have been caught on shallow reefs off the south-east coast in January.	Murphy and Lyle 1999
Recruitment	Recruitment is highly variable, with evidence of a particularly strong year class spawned in 1993 and indications of good recruitment from the 1994 and 1996 cohorts. Recruitment in intervening years has apparently been poor (based on anecdotal reports of low numbers or absence of juvenile fish observed associated with inshore reefs).	Murphy and Lyle 1999 Tracey and Lyle 2005
	Otolith microchemistry supports the hypothesis that inshore reefs represent an important juvenile habitat, with the bulk of the offshore adult population derived that individuals that spent their juvenile phase inshore.	Tracey, unpubl. data

5.2 The fishery

Striped trumpeter has had a long history of commercial exploitation in Tasmania, being highly esteemed for its eating qualities. There is also a high and apparently increasing level of interest in the species from recreational fishers and charter boat operators.

The species is taken by a variety of fishing methods, with hooks and gillnets being the primary methods. Juvenile striped trumpeter are taken predominantly by graball net in inshore waters (within 3 nautical miles) and usually in depths <50 m, whereas adult fish are taken in deeper offshore waters by hook methods (dropline, handline, bottom longline, trotline) and as by-product in large mesh gillnets (shark nets). Catches are concentrated off the east coast, including Flinders Island, as well as off the south and south-west coasts of Tasmania. Limited catches are taken off the west coast.

5.3 Management background

Responsibility for the management of striped trumpeter was passed to Tasmania in 1996 through an Offshore Constitutional Settlement (OCS) arrangement with the Commonwealth. A memorandum of understanding accompanied the OCS, specifying trip limits for Commonwealth only fishers to 100 kg for South East Non-Trawl (SENT) permit holders and 20 kg for all other permit holders.

When the Tasmanian scalefish fishery management plan was implemented in 1998, gear restrictions were introduced for all commercial scalefish fishers operating in State waters. However, after the introduction of the management plan, those fishers who held a Tasmanian licence and a Commonwealth permit to fish in the southern shark or SENT fisheries were effectively allowed to target unrestricted quantities of striped trumpeter in offshore waters using their Commonwealth gear allocations (this was a significant change to their original 20 kg or 100 kg restrictions). In addition, Tasmanian rock lobster fishers were also allowed to take unrestricted quantities of striped trumpeter in offshore waters using their State scalefish gear allocations.

In August 2000, the State Government introduced a combined 250 kg trip limit for striped trumpeter, yellowtail kingfish and red snapper for all fishers (Commonwealth and State) in inshore and offshore waters relevant to Tasmania. This measure was introduced to limit the potential for expansion of effort directed at these species. A daily bag limit of five and possession limit of eight striped trumpeter was also introduced for recreational fishers.

The legal minimum size limit for striped trumpeter was raised from 35 to 45 cm total length (TL, equivalent to about 42 cm FL) in November 2004 in recognition that the smaller size limit was substantially below the size at maturity (54 cm FL for females and 53 cm FL for males). The recreational bag limit was also dropped (effectively replaced by the possession limit of eight fish).

5.4 Management objectives and strategies

The generic management objectives for the Tasmanian scalefish fisheries apply (with reference period 1995/96 to 1997/98).

The species is currently managed by a combination of trip limit (250 kg) for commercial operators, a minimum size (450 mm total length) and recreational possession limit of eight fish.

5.5 Relative vulnerability to fishing

The spawning potential of striped trumpeter is severely impacted by the current legal size limits that are still well below the size of maturity. Juveniles are also particularly vulnerable to inshore gillnetting and, although the recent size limit increase will offer increased protection of juvenile fish, it is possible that incidental capture of sub-legal striped trumpeter in gillnets may result in significant post release mortality.

Marked recruitment variability appears to be a feature of striped trumpeter, and although the species is long-lived, prolonged periods of poor recruitment combined with the impacts of fishing and natural mortality have the capacity to severely deplete the size of the mature adult stock.

5.6 Previous assessments

Previous assessments have been largely limited to the examination of catch, effort and catch rate trends, and reporting against performance indicators. Yield-per-recruit analyses have been conducted and refined since the 2003 assessment. Size and age composition data and a spawner biomass-per-recruit analysis in 2005 indicated that striped trumpeter recruitment had been generally poor over the past decade and a further increase in the minimum size limit was required to reduce the risk of recruitment and growth overfishing.

5.7 Current assessment

The current assessment examines trends in catch, effort and catch rate for the primary fishing methods, namely dropline, handline and graball net and includes Commonwealth data up to 2007/08. Opportunistic catch sampling was undertaken between 2005/06 and 2007/08 and age composition data are compared with similar data collected during the 1990s.

Data presented for this assessment have been evaluated against the reference levels of performance indicators specified in the scalefish management plan and detailed in Section 1.3.

5.7.1 Catch, effort and catch rates

The recent catch history in waters south of latitude 39° 12'S (i.e. waters incorporated within the OCS agreement for striped trumpeter), including catches reported in Victorian and Commonwealth logbooks, is presented in Table 5.1. In the early 1990s catches by Victorian vessels were significant, peaking at around 37 tonnes. Since the mid 1990s, data from this sector have been unavailable, though it is assumed that subsequent catches have been reported in Commonwealth logbooks. Apart from 1999/00 when over 14 tonnes was taken, reported Commonwealth catches have been relatively low since that time.

Annual production was high at over 110 tonnes in the early 1990s with Victorian vessels taking between 17-39% of the reported catch, but then fluctuated generally between 70-80 tonnes through the early to mid 1990s before increasing again to over 100 tonnes by the late 1990s (Table 5.1). Catches almost halved in 2000/01 to less than

50 tonnes and have remained low since that time. The reported catch of 16 tonnes for 2007/08 was substantially lower that in the previous year and represented the lowest catch reported since the mid 1980s. However, Commonwealth catches are believed to be substantially underreported and, together with an unknown level of recreational catch, represent a major source of uncertainty in estimating the total mortality.

Striped trumpeter catches have been reported from all areas apart from the north coast, with catches from around the state, particularly off the south-east and east coasts (Figs. 5.1A and 5.2). With the decline in catches over recent years the fishery area appears to have contracted and catches are now concentrated off the south-east coast.

The most conspicuous trend in catches was the initial increase in production for all methods up until 1999/00, followed by general declines in catches for all methods (Fig. 5.1A). In 2007/08, catches declined by all methods. Regionally, expansion of the fishery during the late 1990s was the result of increased catches from all areas. Catches strongly then strongly declined by 2000/01. South-east coast catches have since remained relatively stable at around 6-10 tonnes per annum, while catches from the other regions have fallen further with less than 2 tonnes taken from each of the east, north-east and west coasts during 2007/08.

The observed catch trends mainly reflect the influence of especially strong year classes (1993 and 1994) that entered the fishery between 1995/96 and 1997/98 (see also Section 5.7.2). Larger graball catches in 1998/99 followed by a decline suggest that the 1996 year-class, which would have recruited to the inshore gillnet fishery in 1998/99, was also relatively strong. The subsequent decline in graball catches presumably reflects the movement of the relatively strong year-classes offshore but also suggests that there has been limited recruitment in recent years. Industry representatives also suggest that the trip limit of 250 kg introduced in 2000 has represented a strong disincentive for some operators to fish for the species and may have contributed to the fall in dropline and handline catches since 2000/01.

Table 5.1. Annual commercial catches of striped trumpeter (tonnes) south of latitude 39° 12'S.
Based on Tasmanian (General Fishing Return), Victorian and Commonwealth catch returns. Commonwealth catches are likely to be underreported.

	Catch (tonnes)			
Year	Tasmanian	Victoria	Commonwealth	Combined
1990/91	74.5	37.1		111.6
1991/92	58.2	36.8		95.0
1992/93	52.7	19.8		72.5
1993/94	56.5	16.0		72.5
1994/95	72.4	14.6		87.0
1995/96	60.3			60.3
1996/97	79.7		0.7	80.4
1997/98	75.4		5.7	81.1
1998/99	98.4		8.9	107.4
1999/00	86.3		14.5	101.8
2000/01	41.2		7.5	49.6
2001/02	40.0		4.8	44.8
2002/03	36.8		3.2	40.0
2003/04	36.8		3.7	40.5
2004/05	24.0		2.2	26.2
2005/06	19.1		4.7	23.8
2006/07	18.7		3.5	22.2
2007/08	12.5		3.0	15.5

Striped trumpeter have also been heavily targeted by the recreational fishery. An estimate of the recreational take of striped trumpeter (38 tonnes in 2000/01) indicates that the recreational catch may well be larger than the commercial catch and, therefore, a significant component of the overall fishery. While more recent estimates of recreational catches are not available, recreational fishing activity targeting the species has almost certainly increased in recent years. Catches taken by recreational fishers and from chartered boats are now likely to be the dominant source of fishing mortality.

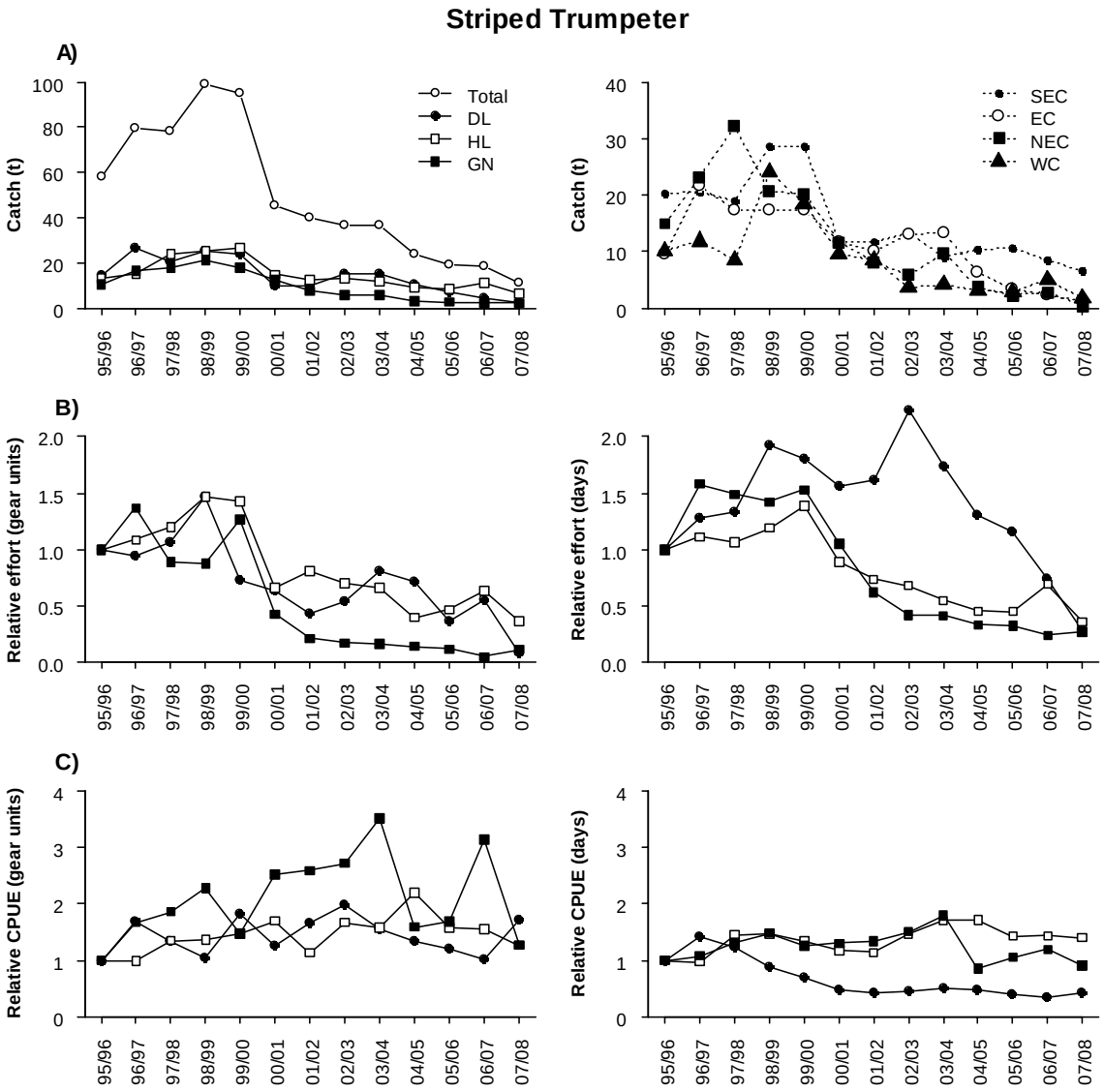

Fig. 5.1. A) Annual catch (tonnes) of striped trumpeter by method (left) and region (right) since 1995/96 reported in Tasmanian logbooks; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. DL is dropline, HL is handline and GN is graball; SEC is south-east coast, EC is east coast, NEC is north-east coast, and WC is west coast.

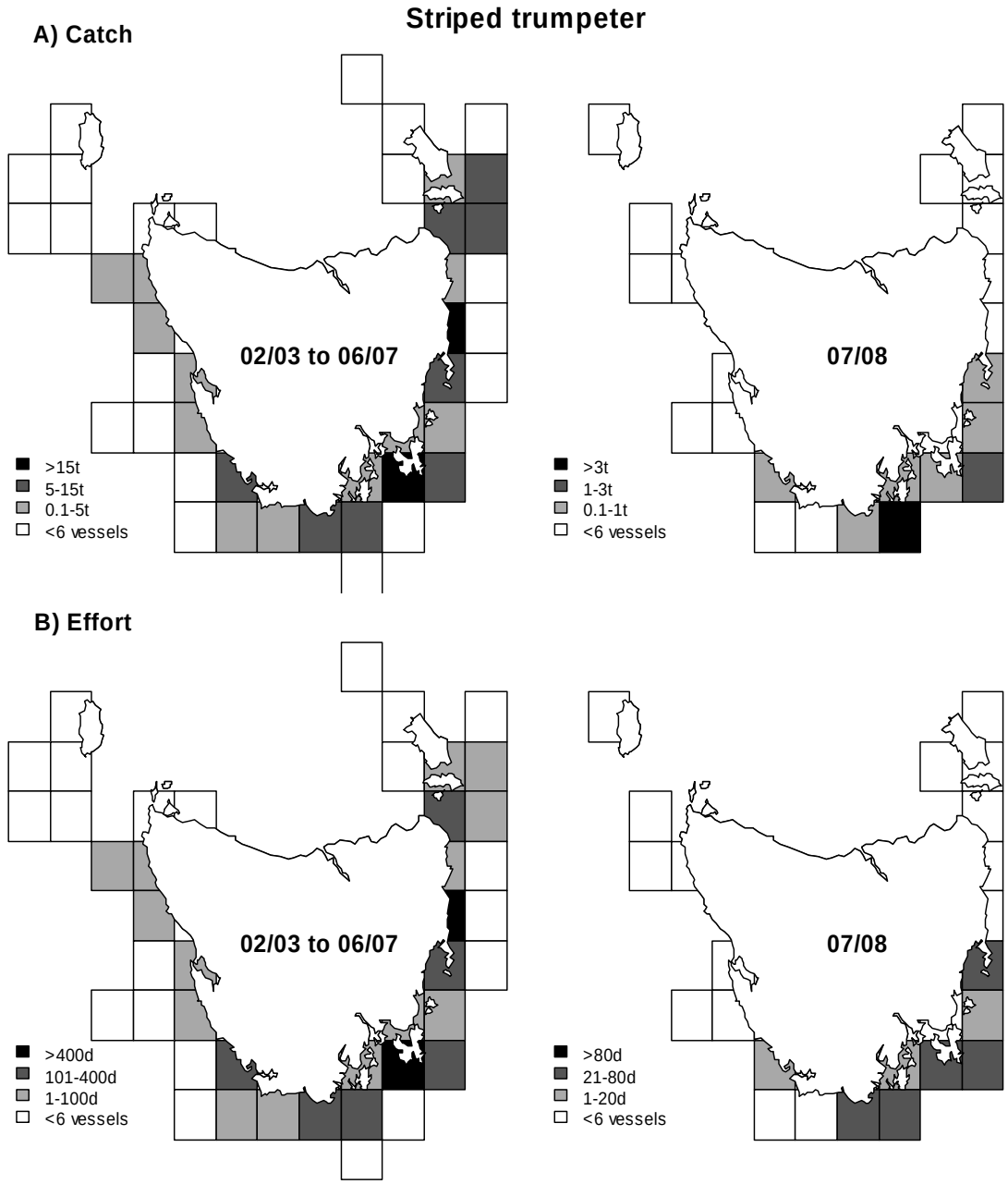

Fig. 5.2. (A) Striped trumpeter catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

Fishing effort increased during the latter part of the 1990s, presumably linked to the increased availability of striped trumpeter (Fig. 5.1B). Subsequently, effort for graball and handline declined. Dropline effort has fallen in recent years and continued the trend of more deployed gear on fewer fishing days in 2007/08. Fishing effort has been focussed mainly on the east coast and to a lesser extent off the north-east, south and south-west during the past few years (Fig. 5.2B).

Graball catch rates increased steadily up until 2003/04, despite declining catches during the latter half of the period (Fig. 5.1C). The sharp fall in graball catch rates since 2004/05 may have been influenced in part at least by the minimum size limit increase that took effect during 2004. Increased catch rates in 2006/07 were based on very small catches and are thus unlikely to be informative about availability. Handline catch rates increased slightly through time but trended downwards in recent years. Dropline catch rates, based on catch per hook-lift, have fallen slightly over the past four years but were still within the range of reference values. Daily catch rates have changed little since 2000/01, remaining at about half of the minimum reference level.

5.7.2. Age composition

The 1993 year class has been prominent in age composition samples obtained from research fishing and commercial catches undertaken since 1999 (5 year olds in 1999, 6 year olds in 2000 etc.; Fig. 5.5). Since sample sizes for most years were low and based on opportunistic sampling, age samples may not fully represent the population age structure. However, it is significant that this cohort, as 13 year olds, was the dominant age class in the 2007 sample with little evidence of strong recruitment in subsequent years. The age structure for 2008 was relatively flat between ages 4 (recruitment to the offshore fishery) and 16 years, again providing no clear indication that there had been any strong year classes over the past decade. The fact that 14 year olds in 2008 (i.e. from the 1993 year class) were almost as common in the sample as 5 year olds is an indicator that recruitment in most recent years has remained low. With poor recruitment, adult biomass is expected to continue to decline and the average size of fish will continue to increase in the short-term, at least until such time as there is a period of sustained good recruitment.

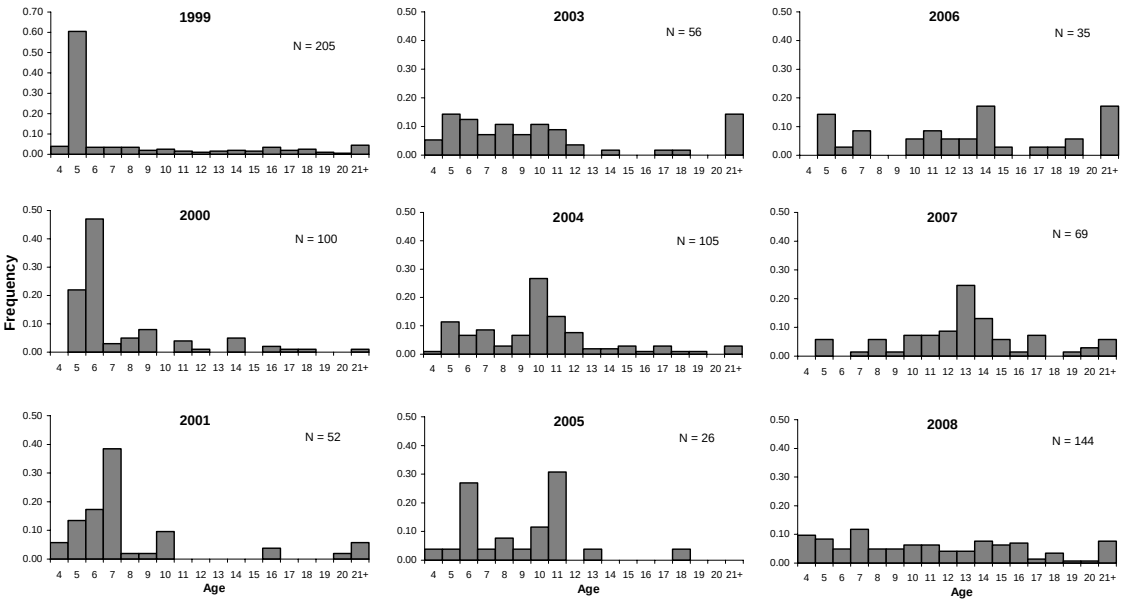

Fig. 5.5. Age composition of striped trumpeter samples by year. N is sample size.

5.7.3 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1990/91 to 1997/98 range (52t- 81t)	Yes: Statewide ↓ (15t)	Commercial catch is > 50t	No
Catch increase or decline by over 30% from previous year	Yes: ↓ (42%)	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	Yes: Droplines (days fished)	-	
		Catch curve estimated every 3 years as an index of fishing mortality from all sectors: Target range: Fishing mortality $F \leq$ Natural mortality M Limit RP: $F = 1.5*M$	Not assessed
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Yes (lack of strong new recruitment)	Any indicator of stock stress	Yes (lack of strong new recruitment)

5.8 Implications for management

The sharp decline in catches since 2000/01 gives rise to concern about the current status of striped trumpeter stocks. As suggested in previous assessments, strong recruitment variability could result in marked variation in population size, especially if there is a prolonged period of poor recruitment, with the fishery becoming dependent upon relatively few year classes. Age composition data imply that this may in fact be the case for striped trumpeter, with no evidence of strong recruitment for over a decade and the prevalence of the strong 1993 cohort in the adult population. Based on this assessment, the average size of hook-caught fish will continue to increase as recruited cohorts grow but spawner biomass will decline as a consequence of natural and fishing mortality acting on the adult population. Furthermore, if catch declines do in fact reflect falling abundance, then it is likely that fishing mortality is too high and may lead to recruit overfishing, a situation exacerbated by the minimum size limit still being set smaller than the size at maturity.

However, as noted in previous assessments the impact of recent management changes cannot be discounted as a contributing factor to the downturn in catches. Reduced incentives for fishers to target striped trumpeter due to the 250 kg trip limit appear to have been reflected in reduced line fishing effort over the past three years.

Catches reported in Commonwealth returns in recent years have averaged about 3 tonnes per annum, though industry reports suggest that these figures may be significantly underestimated. There is an urgent need to ensure that catch and effort information are comprehensive and approaches have been made to the Commonwealth to this end.

Growing interest from the recreational sector coupled with declining commercial catches suggest that recreational catches has become the dominant component of the total fishing mortality and thus should be explicitly factored into the future assessment and management of this fishery.

The low graball catch observed for some years may be linked to a combination of low numbers of striped trumpeter in inshore waters and/or size structuring within the population (immature fish inshore/mature fish offshore) that means that few if any fish captured in the inshore gillnet catch will be of legal size. Spawner biomass-per-recruit analyses (Tracey et al. 2007a) imply that either fishing mortality needs to be reduced or that the minimum size limit should be increased further, noting that the current limit of 45 cm is still below the size at maturity at about 53-54 cm. Spawning season closures could also improve the spawning potential of the species.

Reduction of fishing pressure on spawning fish at a time when they are particularly vulnerable to capture (September/October) would also have benefits in terms of spawning success. There is little obvious seasonality in catches throughout the year but commercial catch rates do peak in September possibly reflecting increased catchability as the species aggregate to spawn. A spawning closure during September/October would impact on 10-25% of annual commercial production which are typically taken during this period.

Although a more rigorous assessment is required to assess the sustainability of the fishery, the apparent lack of recent recruitment means that the stock will continue to decline. Management action is required to reduce the total fishing mortality, including review of catch limits for recreational fishers, recognising that this sector is likely to have expanded over the past five years.

5.9 Research needs

The Scalefish Fishery Research Advisory Group has identified the need for research into stock assessment, recruitment variability and gear interactions as areas of high research priority for striped trumpeter. In addition, there is a need to estimate the recreational catch and reduce uncertainty in the magnitude of the catch by Commonwealth operators.

There is an urgent need to characterize the commercial and recreational fisheries for this species in terms of size composition and age-structure. Quantification of the recreational harvest remains a major uncertainty and hence a priority for the fishery assessment. There is a need to further examine the impacts of present and alternative harvest strategies.

6 Bastard trumpeter (*Latridopsis forsteri*)

6.1 Catch, effort and catch rates

Bastard trumpeter catches declined steadily from the mid 1990s. They have remained stable at around 20 tonnes for the past five years with a catch of 19 tonnes in 2007/08 (Fig. 6.1A). Bastard trumpeter are taken almost exclusively by graball from inshore waters off the east, south and west coasts (Fig. 6.2). The species has also significance to recreational fishers. The estimated 43 tonnes taken in 2000/01 was almost double the size of the commercial catch for the corresponding period.

Graball effort for bastard trumpeter has followed a similar downward trend to catches since the mid-1990s (Figs. 6.1B and 6.2).

Catch rates have remained relatively stable over time (Fig. 6.1C). This lack of an obvious trend, despite the sharp decrease in catches, presumably reflects the fact that bastard trumpeter are taken primarily as by-product, rather than as a target species.

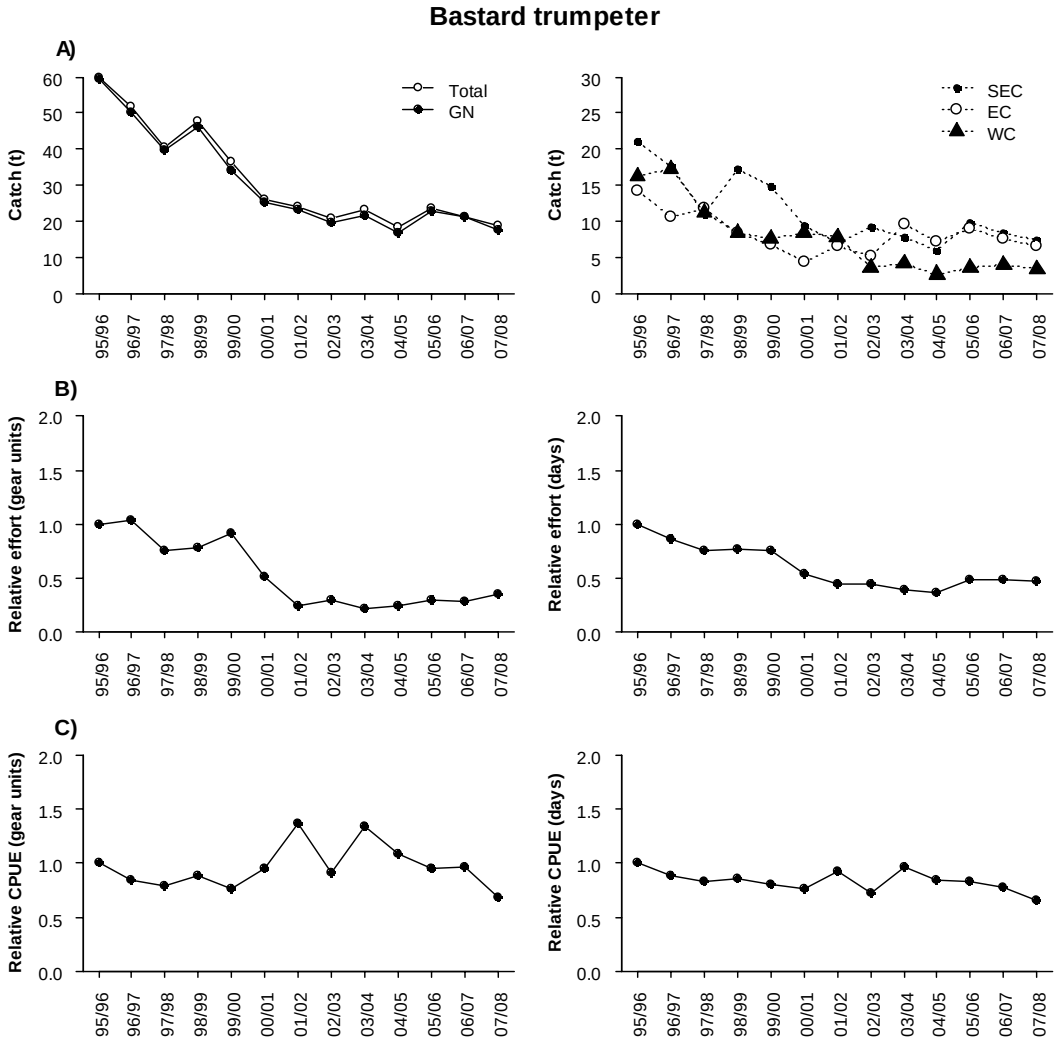

Fig. 6.1. A) Annual catch (tonnes) of bastard trumpeter by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. GN is graball; SEC is south-east coast, EC is east coast and WC is west coast.

6.2 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1990/91 to 1997/98 range (34t-63t)	Yes: Statewide ↓ (19t)	Pending	
Catch increase or decline by over 30% from previous year	No		
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No		
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No		
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed		

6.3 Implications for management

Total catch rather than catch rates may be a better indicator of abundance/availability for bastard trumpeter and as such, the trend in commercial production suggests that current inshore populations are at historically low levels. In accordance with this observation, industry and recreational representatives have expressed concerns about the scarcity of the species in recent years.

Two aspects of bastard trumpeter life history have direct relevance when assessing the status of the fishery. Firstly, the fishery is based almost entirely on juveniles. As the fish grow they appear to move offshore and are rarely caught. Secondly, the species exhibits strong recruitment variability that can result in short-term variability in catches and such variability has been a feature of the fishery over the past century (Harries and Croome 1989). Anecdotal reports and low inshore catches suggest that recruitment levels have been low in recent years, although higher numbers have been reported from the Tasman Peninsula in 2007 and 2008.

Whilst juvenile biomass may vary widely due to recruitment variability and fishing pressure, no information regarding the adult segment of the population is available. However, it is clear that low levels of fishing pressure are exerted on those adults that evade the inshore fishery. Since commercial and recreational fisheries are based on juveniles, recruitment as well as growth overfishing are possibilities. Increasing the minimum size limit to above the size at maturity, which appears to be greater than 50 cm FL, would be beneficial to the stock but would also effectively close down the current commercial and recreational fisheries for the species. Limiting effort and reducing possession limits for the recreational fishery, and discouraging targeting by the commercial fishery through the introduction of trip limits may be possible management measures to reduce mortality, although commercial beach prices for bastard trumpeter have been low for some time.

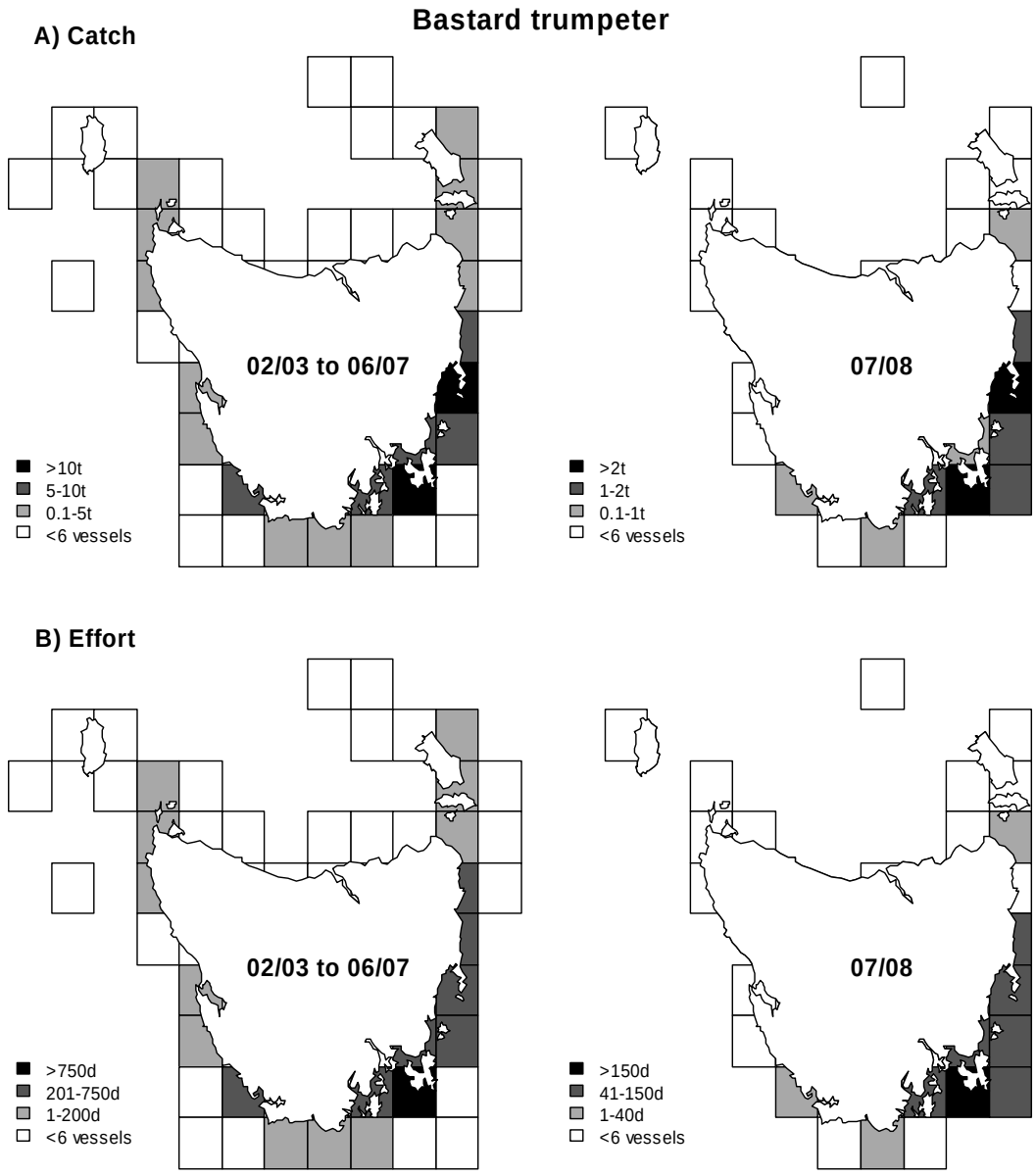

Fig. 6.2. (A) Bastard trumpeter catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

7 Sea garfish (*Hyporhamphus melanochir*)

7.1 Catch, effort and catch rates

The southern sea garfish is caught in Tasmania almost exclusively taken by beach seine on the north-east coast, but mainly by dipnets off the south-east and east coasts. In these regions, dipnetting accounts for around 85% and 70%, respectively to the total catches.

After years of relative stability in garfish catches at between 80-90 tonnes in most years since the early 1990s, catches have strongly fallen over the last two years from 89 tonnes in 2005/06 to 50 tonnes in 2006/07 (-46%) and 30 tonnes in 20007/08 (-39%, Fig. 7.1A). Decreases were experienced by the two main fishing methods beach seine and dipnets, and in all major fishing regions. Despite strong catch declines in all regions, the north-east coast including Flinders Island still dominated catches. The east coast had only recovered recently from several years of low catches, while catches from the south-east coast have decreased constantly since 2001/02.

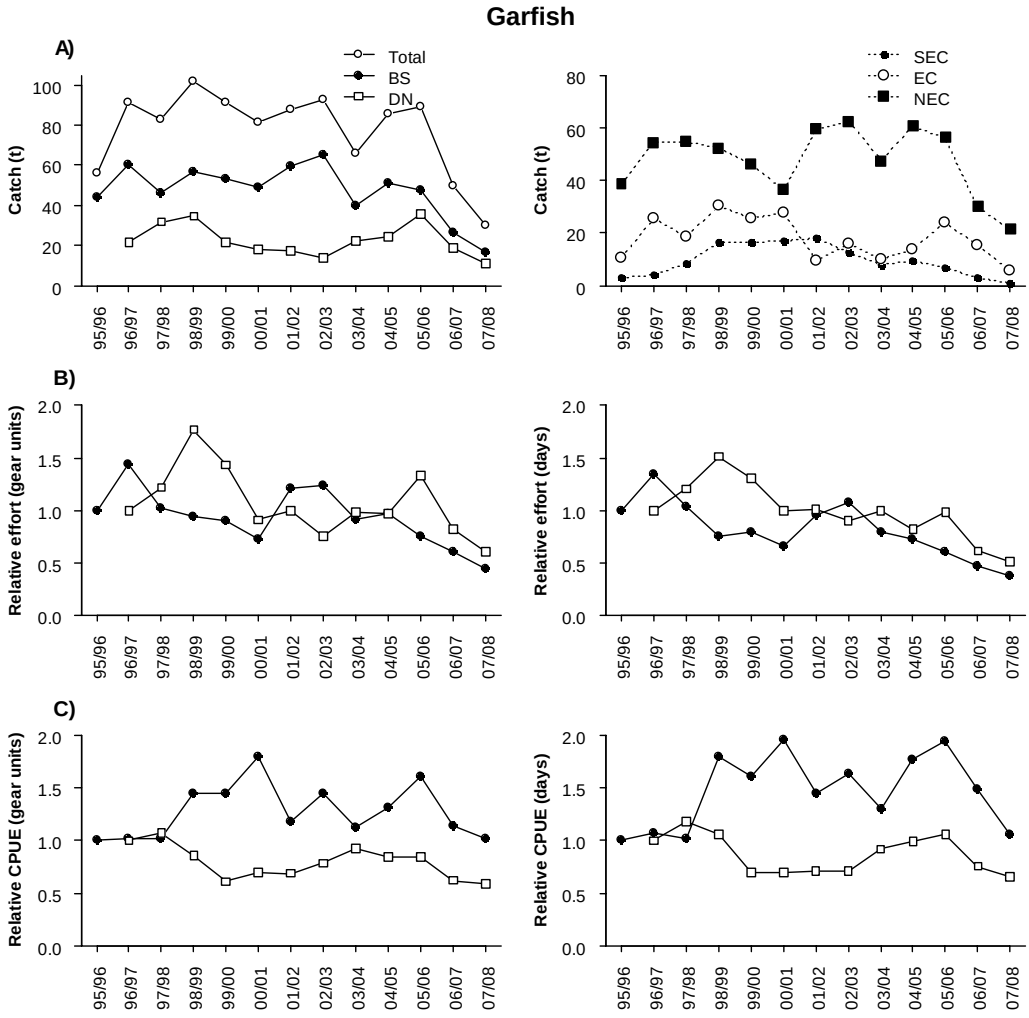

Fig. 7.1. A) Annual catch (tonnes) of garfish by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96 (BS) and 1996/97 (DN). BS is beach seine and DN is dip net; SEC is south-east coast, EC is east coast, and NEC is north-east coast.

Effort has fallen markedly compared to 2006/07 and five or fewer fishers now operate in most fishing blocks (Fig. 7.2). Dipnet effort increased initially to a peak during 1998/99 but has subsequently decreased to a lower level (Fig. 7.1B, days fished). Beach seine effort experienced a more recent decline, and is now at the lowest levels since 1995/96.

Catch rates for beach seine have experienced much stronger fluctuations over time than those for dipnet, with both falling markedly in 2007/08. Beach seine catch rates generally rose during the late 1990s and early 2000s and have fluctuated at a high level since that time (Fig. 7.1C). By contrast, dipnet catch rates underwent an initial decline but had since recovered. However, in the context of schooling species such as garfish, catch rates may be relatively insensitive to changes in abundance.

7.2 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1990/91 to 1997/98 range (56t-92t)	Yes: Statewide ↓ (30t)	Catch outside reference range from 1998/99 to 2006/07 (66-102t)	Yes: ↓ (30t)
Catch increase or decline by over 30% from previous year	Yes: Statewide ↓ (39%)	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed	Any indicator of stock stress	Not assessed

7.3 Implications for management

Industry members indicated that the catch declines in all major fishing regions and experienced by both major fishing methods during the 2007/08 fishing year were caused by a lack of resource despite high abundance of undersized fish. The reason for this, after a long period of apparent stability in the fishery and underlying fish stocks, remains unclear. Since it is not known whether present catch levels are sustainable, close monitoring of the fishery and fish stock including collection of biological samples has commenced to increase the understanding about the fishery and stock dynamics. In addition, it would be prudent to consider management options that limit further expansion in this fishery until more is known about the stock dynamics.

Some industry members have expressed concern about the effects of dipnets on the schooling behaviour of garfish. Specifically, it has been suggested that intensive dipnet activity tends to cause schools to break up reducing opportunities to use beach seines to target the species and possibly affecting catch rates. Since such interactions tend to be localised, analyses at the spatial resolution of fishing blocks are unlikely to be sensitive enough to detect such impacts.

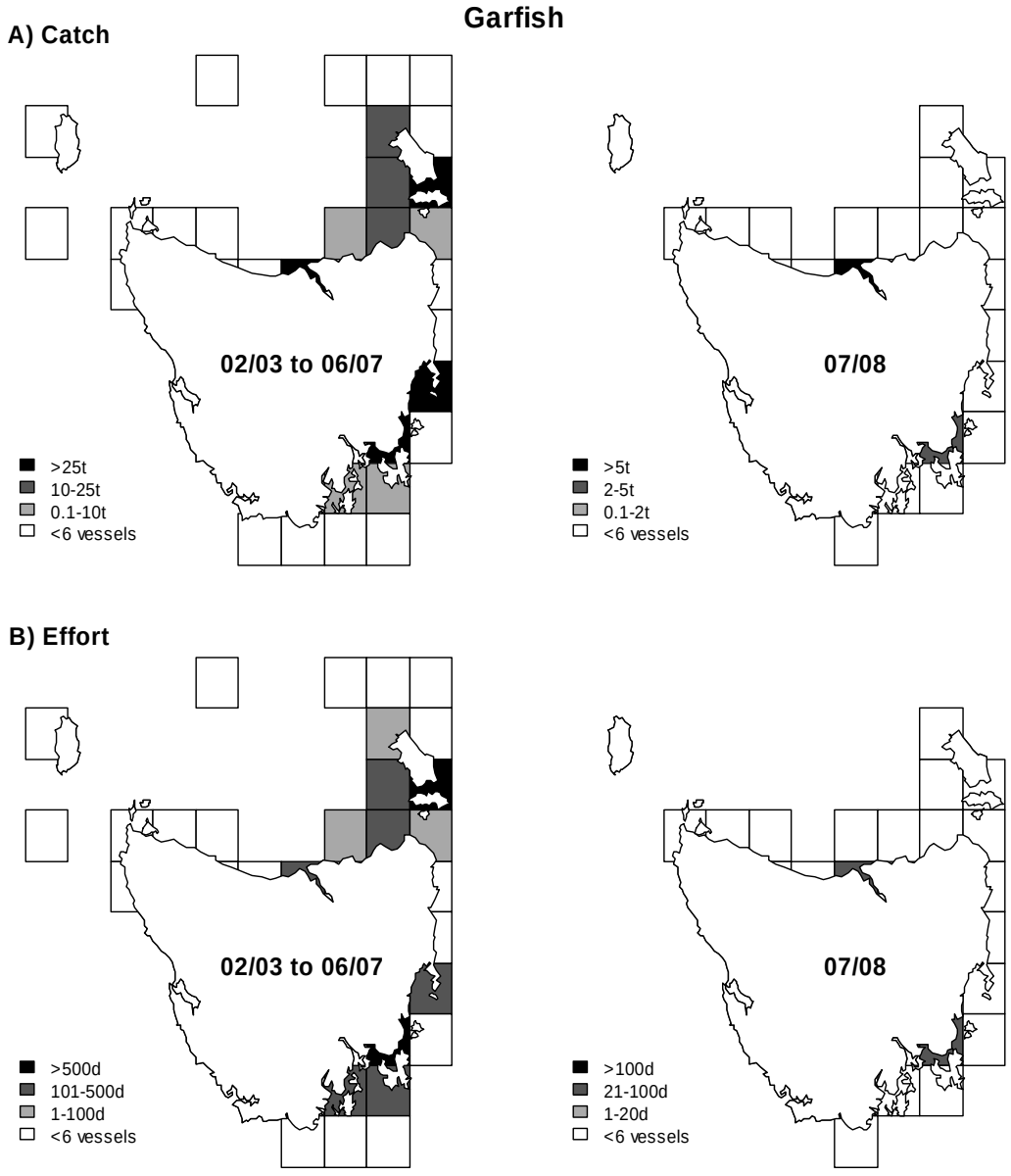

Fig 7.2. (A) Garfish catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

8 Wrasse (Fam. Labridae)

8.1 Catch, effort and catch rates

Of the several species of wrasse occurring in Tasmanian waters, purple wrasse (*Notolabrus fucicola*) and blue-throat wrasse (*N. tetricus*) are the main species taken commercially. Wrasse are targeted for the live fish markets as well as being sold as dead product and utilised as bait for rock lobster (bait usage is possibly under-reported). Fish marketed live are distinguished in the logbooks, and live wrasse have accounted for over 90% of the total reported catch since 2001/02. Thus, trends in the live-fish fishery will ultimately be reflected in overall production levels. The two species of wrasse have only been recently distinguished in catch returns. While there is an apparent market preference for blue-throat wrasse, purple wrasse are more robust for live handling.

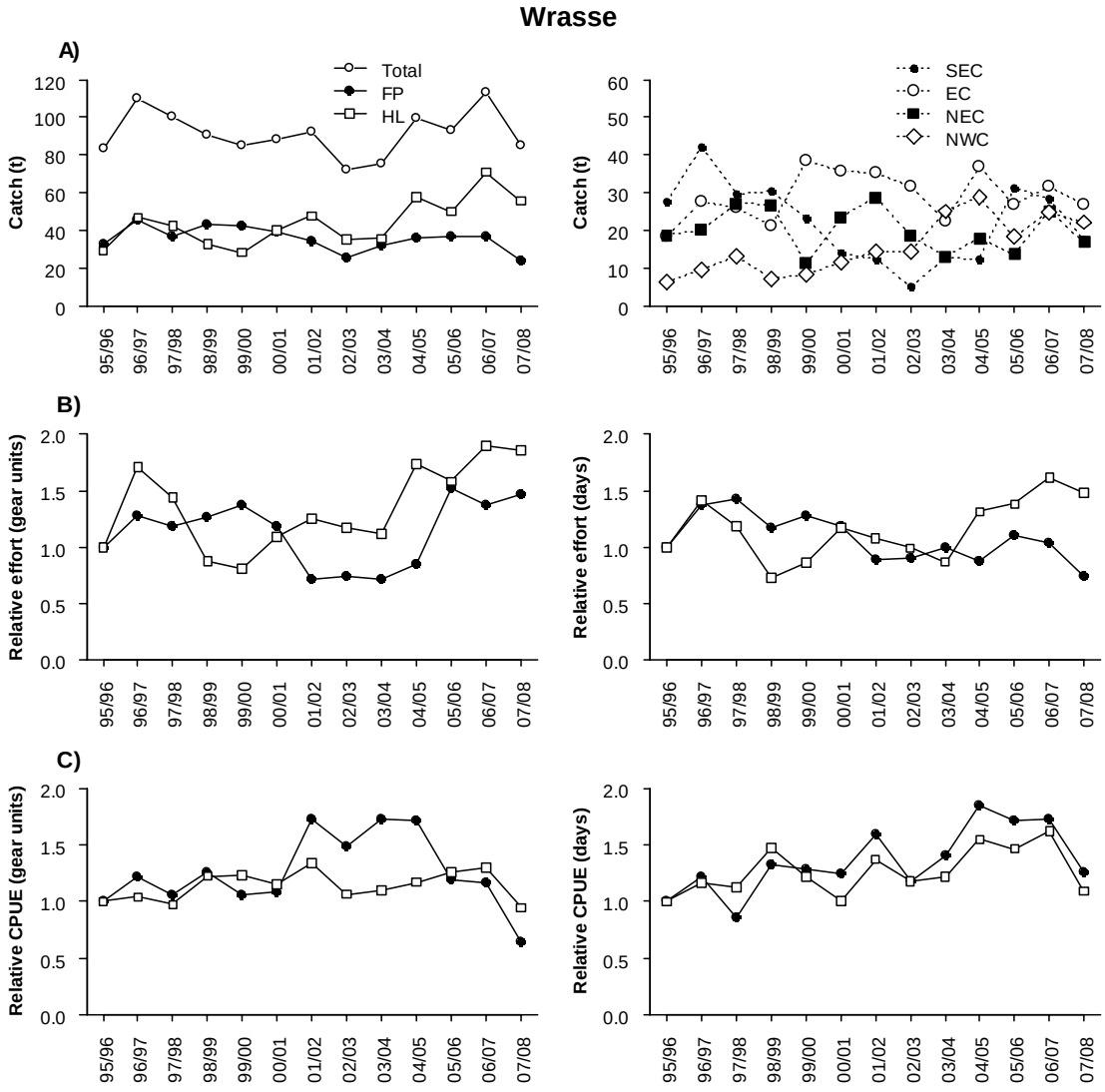

Fig. 8.1. A) Annual catch (tonnes) of wrasse by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. FP is fish trap and HL is hand line; SEC is south-east coast, EC is east coast, NEC is north-east coast, and NWC is north-west coast.

Since 1995/96, wrasse catches were relatively stable and consistently over 70 tonnes (Fig. 8.1A). After reaching 113 tonnes in 2006/07, reported catches decreased to 85 tonnes in 2007/08. Lower catches by both main methods handline and fish trap contributed to the decline. With blue-throat wrasse being more susceptible to line methods and purple wrasse more vulnerable to trap capture, blue-throat wrasse appear to be taken in larger quantities in the live fishery. Gillnets account for the bulk of the remaining catch (< 5 tonnes) but because survival in nets is poor, graball caught wrasse are rarely marketed live.

Catches decreased mainly in the south-east, east and north-east, but remained relatively stable in the north-west (Fig. 8.1A and 8.2). The underlying drivers for the regional shifts in the fishery have not been investigated but may relate to fishers entering and exiting the fishery and/or species availability and market influence.

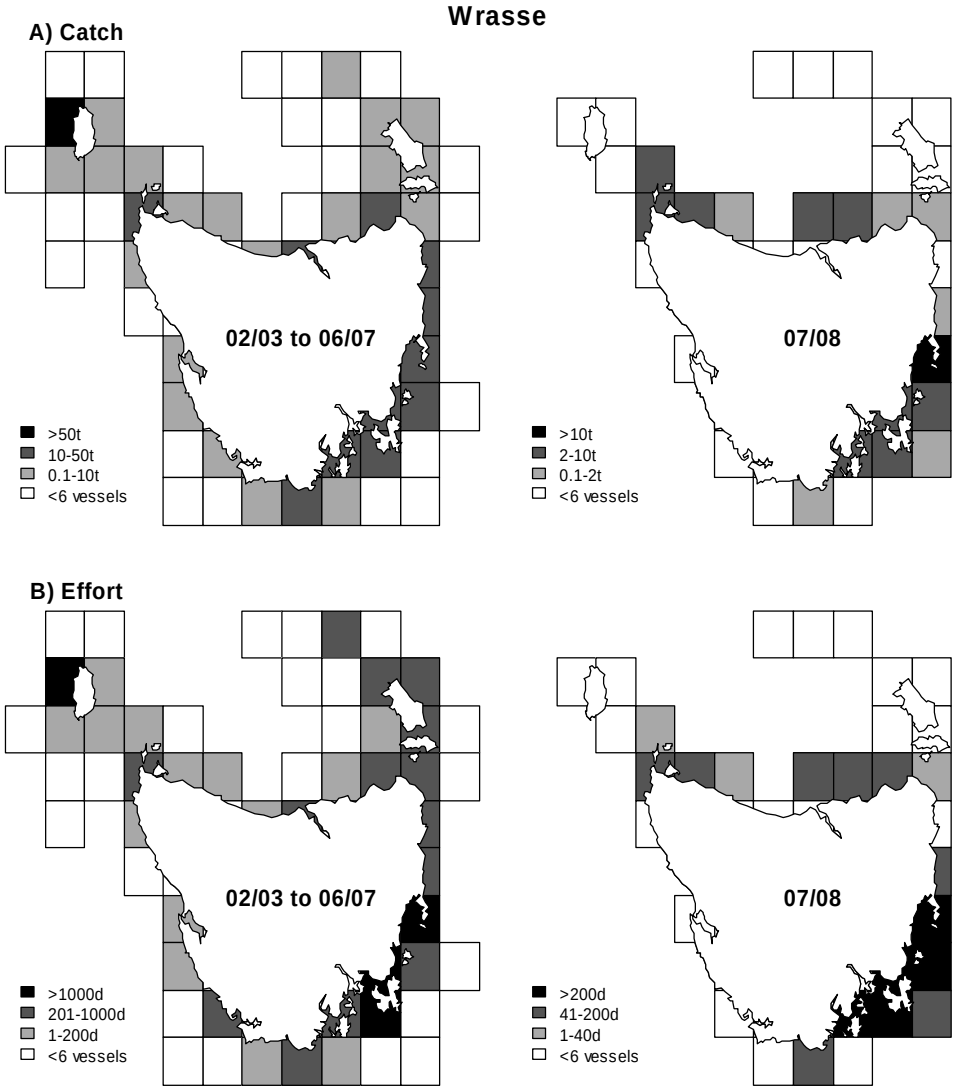

Fig. 8.2. (A) Wrasse catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

Trends in handline effort generally reflected those of catches. Trap effort indicated a increase in gear units (trap-lifts), but decreased in terms of days fished (Fig. 8.1B).

Catch rates by both methods and measured dropped substantially in 2007/08 (Fig. 8.1C). Previously, catch rates for handline based on gear units (kg per line hour) had remained stable since the mid 1990s, while trap catch rates (kg per trap lift) fell further after peaking in 2004/05 during the 1990s. Daily catch rates for both handline and trap methods had increased gradually since the mid-1990s.

Catch rate trends imply that wrasse stocks have not been impacted significantly by the fishery until recently. However, these broad-scale analyses are insensitive to changes in abundance at the level of individual reefs at which the fishery impacts the populations. In fact, there is evidence on some east-coast reefs that exploitation rates of legal-sized purple wrasse are extremely high (Ewing 2004). The marked regional shifts that have occurred in the fishery may also mask localised depletions, with fishers moving to new or lightly fished areas to maintain catches. As a consequence, caution needs to be exercised when making inferences about the status of the wrasse stocks though key fishery indicators do not suggest significant fishery impacts.

8.2 Reference points

Existing reference points	Exceeded?	Alternative RP	Exceeded?
State-wide or regional catches outside the 1995/96 to 1997/98 range (83t-110t)	No (85t)	Catch outside reference range from 1998/99 to 2006/07 (72-99t)	No (85t)
Catch increase or decline by over 30% from previous year	No	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	Yes: Fish traps (gear units)	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	Yes: Fish traps (gear units)	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed	Any indicator of stock stress	Not assessed

8.3 Implications for management

While input controls (limited entry) have capped participation in the live wrasse fishery, there is still a substantial level of latent effort. Increasing catches in previous years indicated continued strong interest in the species, but the decrease in catch rates could indicate that those catch levels were not sustainable. Under present arrangements, there is potential for localised depletions of legal-sized wrasse, especially if effort becomes concentrated in particular regions. There is already evidence for a concentration of effort off the east coast.

The minimum size limit provides good protection (several years post size at maturity) for the spawning stock of purple wrasse and for populations of female blue-throat wrasse. The limit does not, however, provide the same level of protection for male blue-throat wrasse because males are derived through sex change from mature females, typically at sizes after they have entered the fishery. This coupled with the fact that males are strongly site attached and have higher catchability (being more aggressive than females) suggests that they are vulnerable to over-fishing. In extreme situations it is possible that localised heavy fishing pressure could result in 'sperm shortage' that would affect spawning success even though there may be a robust population of mature (sub-legal size) females present. The removal of the maximum size limit may have exacerbated this potential problem. However, neither in Tasmania nor in Victoria, where the blue-throat wrasse fishery has been larger, are there any clear indications of spawning stock shortages.

9 Key scalefish fisheries shared with Commonwealth / other States

9.1 Blue warehou (*Seriolella brama*)

9.1.1 Catch, effort and catch rates

Two stocks of blue warehou occur in southern Australian waters, east and west of Bass Strait (Bruce *et al.* 2001). The fishery for blue warehou in Tasmanian waters is mainly centred off the south-east and east coast and thus probably targets the eastern stock (Figs. 9.1A and 9.2). Catches are also taken off the north-east and north-west coasts, the latter potentially involving the western stock.

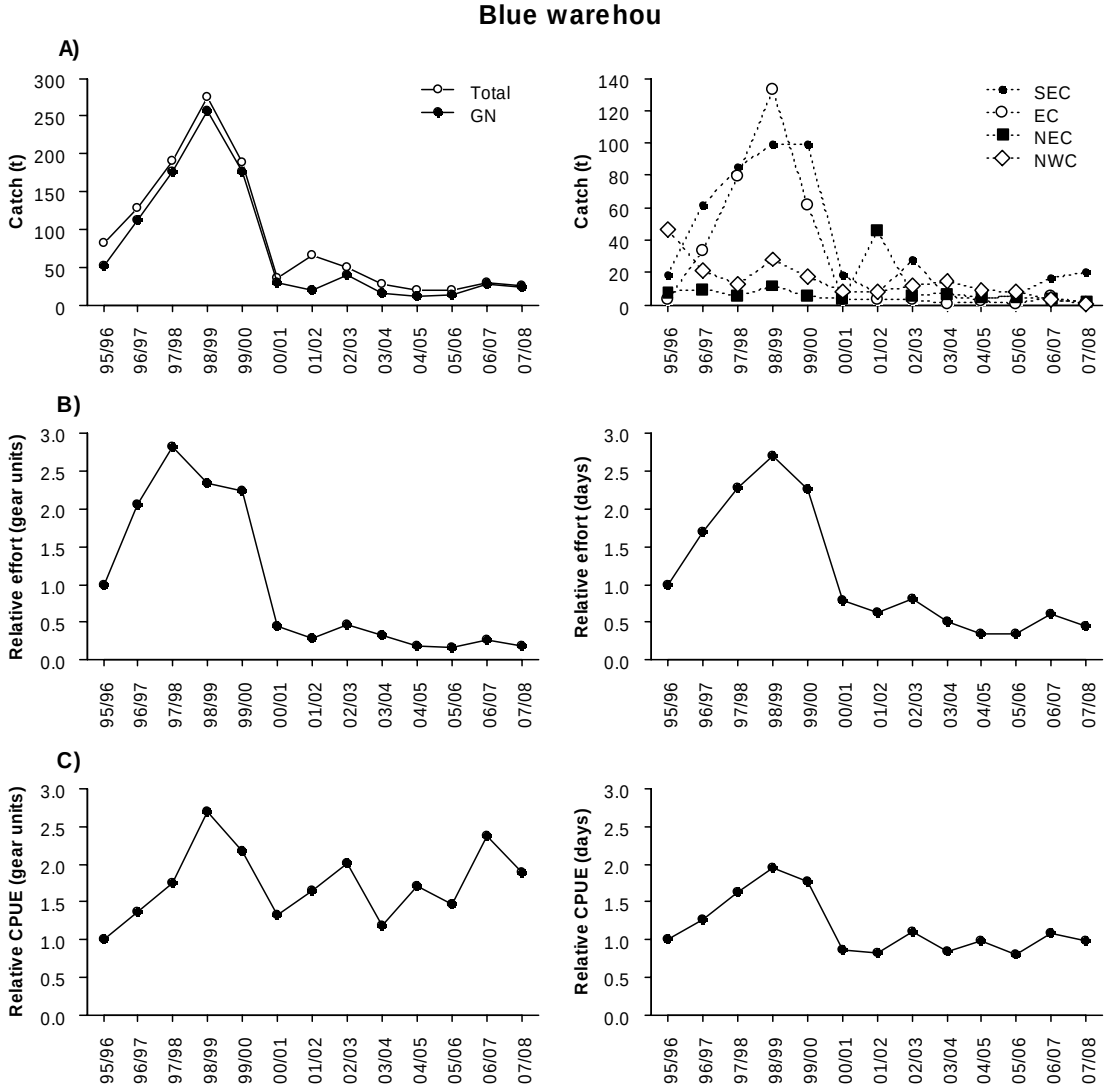

Fig. 9.1. A) Annual catch (tonnes) of blue warehou by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. GN is graball; SEC is south-east coast, EC is east coast, NEC is north-east coast, and NWC is north-west coast.

Blue warehou occur seasonally in Tasmanian inshore waters, the region representing the southern-most extent of the species' distribution. Traditionally, the availability of blue warehou in coastal waters has been assumed to be influenced by prevailing oceanographic conditions and availability of prey species. These factors produce marked inter-annual variability in abundance and hence catches taken from State waters as demonstrated in Fig. 9.1A. Due to low availability since the early 2000s, the species has been rarely targeted. The current catch of 25 tonnes is similar to that for the previous year and low compared to the catches reported during the 1990s.

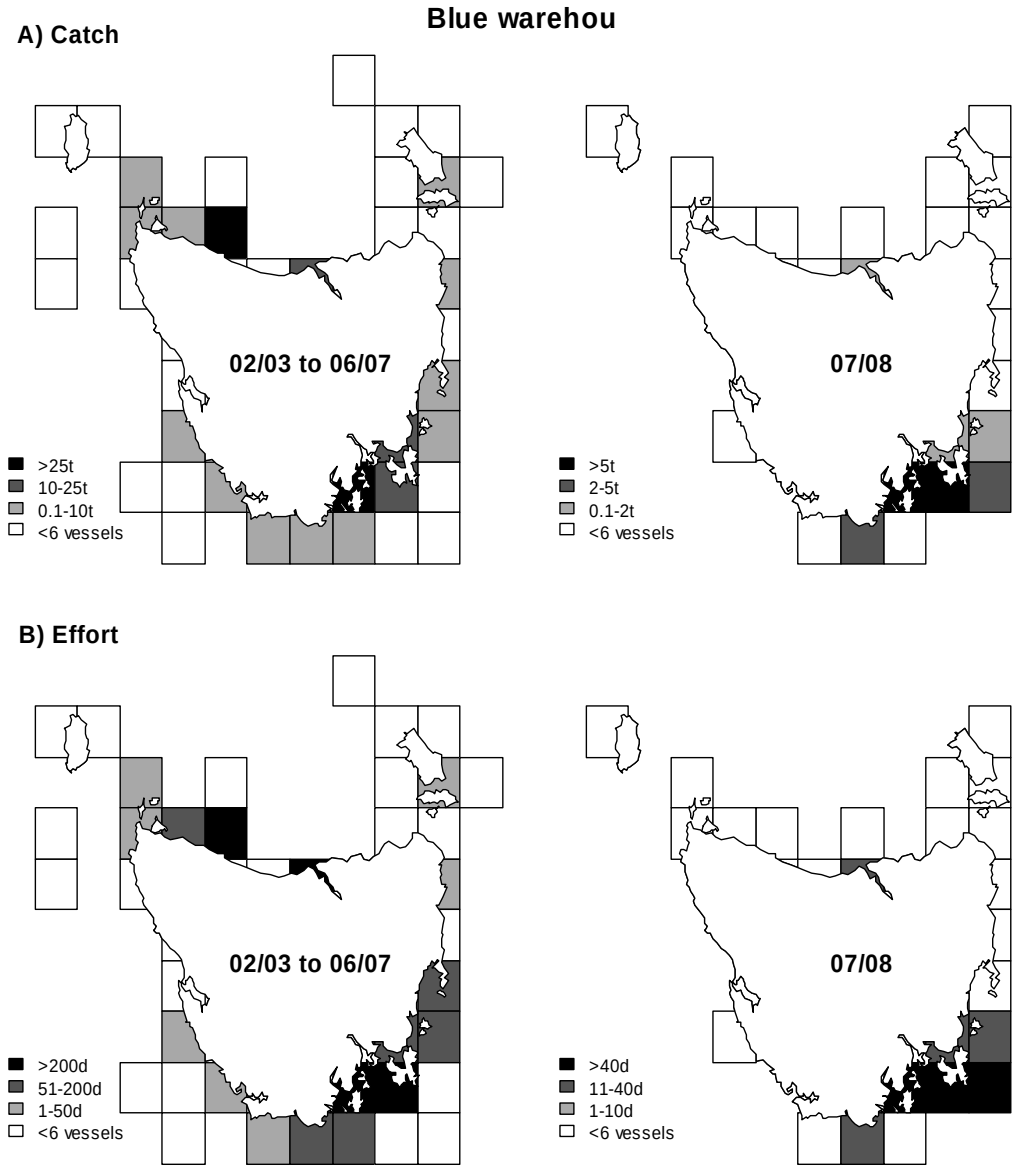

Fig. 9.2. (A) Blue warehou catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

The species is taken primarily in graball nets (Fig. 9.1A), with a range of other capture methods used including other gillnet categories (small mesh and shark net) and seine nets. In 2001/02 about half the catch was taken by beach seine off the north-east coast and in many respects this was unusual, with fishers reporting the presence of large schools of fish off some beaches at that time.

Recreational fishers also target the species using gillnets and to a lesser extent line fishing. The estimated recreational harvest in 2000/01 was just 16 tonnes (Lyle 2005), substantially lower than recreational catches taken in 1997 and 1998 (Lyle 2000) but consistent with the depressed state of the commercial catches.

Following an increase in graball effort between 1995/96 and 1998/99 that resulted in increased catches, effort has since fallen to a substantially lower level (Fig. 9.1B). Low effort is largely in response to the reduced availability of the target species.

Graball catch rates increased markedly between 1995/96 and 1998/99 reflecting increased availability and targeting of warehou around Tasmania at the time (Fig. 9.1C). Since then catch rates have declined fluctuated around levels similar to the mid-1990s.

9.1.2 Reference points

Existing reference points	**Exceeded?**	**Alternative RP**	**Exceeded?**
State-wide or regional catches outside the 1990/91 to 1997/98 range (82t-318t)	Yes: ↓ (25t)	Commercial catch limit of 318 tonnes as per Memorandum Of Understanding (MOU)	No
Catch increase or decline by over 30% from previous year	No	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed	Any indicator of stock stress	Not assessed

9.1.3 Implications for management

Blue warehou is a Commonwealth managed species and a Memorandum of Understanding (MOU) exists to cover catches from Tasmanian State Fishing Waters. Within the context of this MOU, State catches of blue warehou are to be managed within historic levels.

The availability of blue warehou in Tasmanian inshore waters is influenced by a range of environmental factors as well as stock size. Recent depressed catches are almost certainly linked to reduced biomass, the result of overfishing by Commonwealth and State fisheries during the 1990s. In 2003, the total allowable catch (TAC) for the Commonwealth fishery had been set at 300 tonnes per year, down from over 2,000 tonnes in late 1990s, because catches of blue warehou were expected to be poor for the foreseeable future due to overfishing in combination with a lack of good recruitment. The 2004/05 stock assessment of the Commonwealth fishery concluded that the blue warehou stocks required a stock rebuilding strategy (Tuck 2006), however the TAC was increased to 650 tonnes in 2006 (100 tonnes for eastern stock, 550 tonnes for western stock) due to some signs of stock recovery in the west.

9.2 Australian salmon (*Arripis trutta and A. truttaceus*)

9.2.1 Catch, effort and catch rates

The commercial catch of Australian salmon dropped further to 101 tonnes in 2007/08 and was the lowest on record (Fig. 9.3A). Industry suggested that unusually warm waters in winter reduced availability of the species. Beach seines account for the vast majority of the catch. While Australian salmon were caught predominantly in the north-east coast until 1998/99, more recent catches have been spread more evenly between the south-east, east, north-east and north-west coasts (Figs. 9.3A and 9.4).

Australian salmon also represent the second most commonly caught species in the recreational fishery, with an estimated harvest of 111 tonnes in 2000/01 (Lyle 2005).

Beach seine effort also decreased to a record low level since the late 1990s (Figs. 9.3B and 9.4).

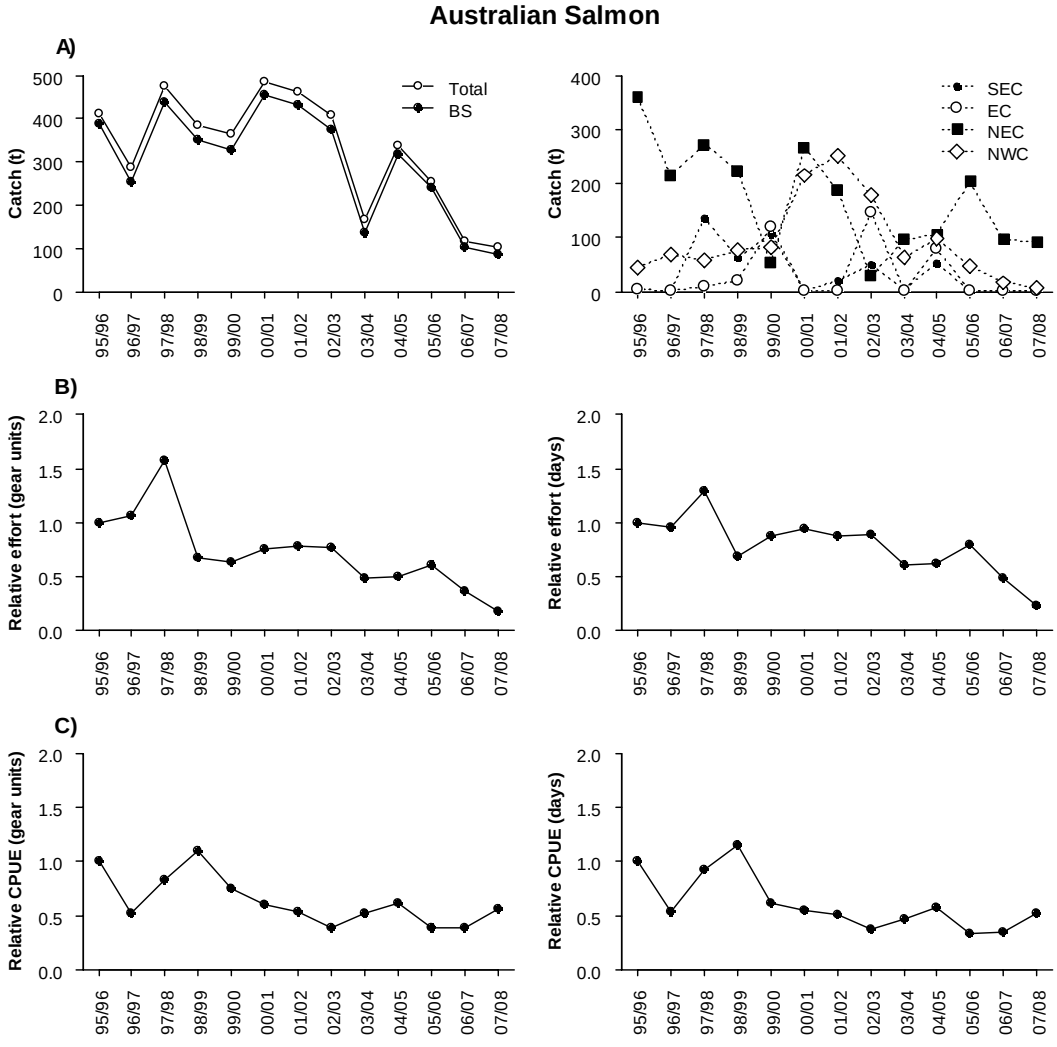

Fig. 9.3. A) Annual catch (tonnes) of Australian salmon by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS is beach seine; SEC is south-east coast, EC is east coast, NEC is north-east coast, and NWC is north-west coast.

Beach seine catch rates by gear units and days fished increased during 2007/08 (Fig. 9.3C). It should be noted however, that catch rate estimation is influenced by the extremely skewed nature of the data, *i.e.* the majority of catches are small but the total catch is influenced by only a small number of extremely large catches. In this respect, even the geometric mean approach to calculating catch rates may provide biased estimates. Notwithstanding this, for schooling species such as Australian salmon catch rates will not be particularly sensitive indicator of stock condition especially if search time is not taken into account.

9.2.2 Reference points

Existing reference points	**Exceeded?**	**Alternative RP**	**Exceeded?**
State-wide or regional catches outside the 1990/91 to 1997/98 range (287t-879t)	Yes: ↓ (101t)	Commercial catch limit of 435 tonnes for Australian salmon A licences (120% of 10-year average for the period 1996/97 to 2006/07) as per Ministerial decision	No
Catch increase or decline by over 30% from previous year	No	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed	-	

9.2.3 Implications for management

Although Australian salmon stocks appear to fluctuate throughout the year in relation to environmental conditions, annual catches are to a large extent linked to market demand, specifically the bait market, and thus not a good indicator of stock status. There is capacity for industry to expand production to the commercial catch limit should new markets be found. While stock status is unknown, the species has sustained substantially higher catches in the past and current commercial and recreational catches would appear sustainable.

Australian salmon also have commercial and recreational significance across several other southern states and thus a coordinated approach to management of stocks across jurisdictions would have the advantage to minimising potential conflicts, especially if there is a change in the market situation.

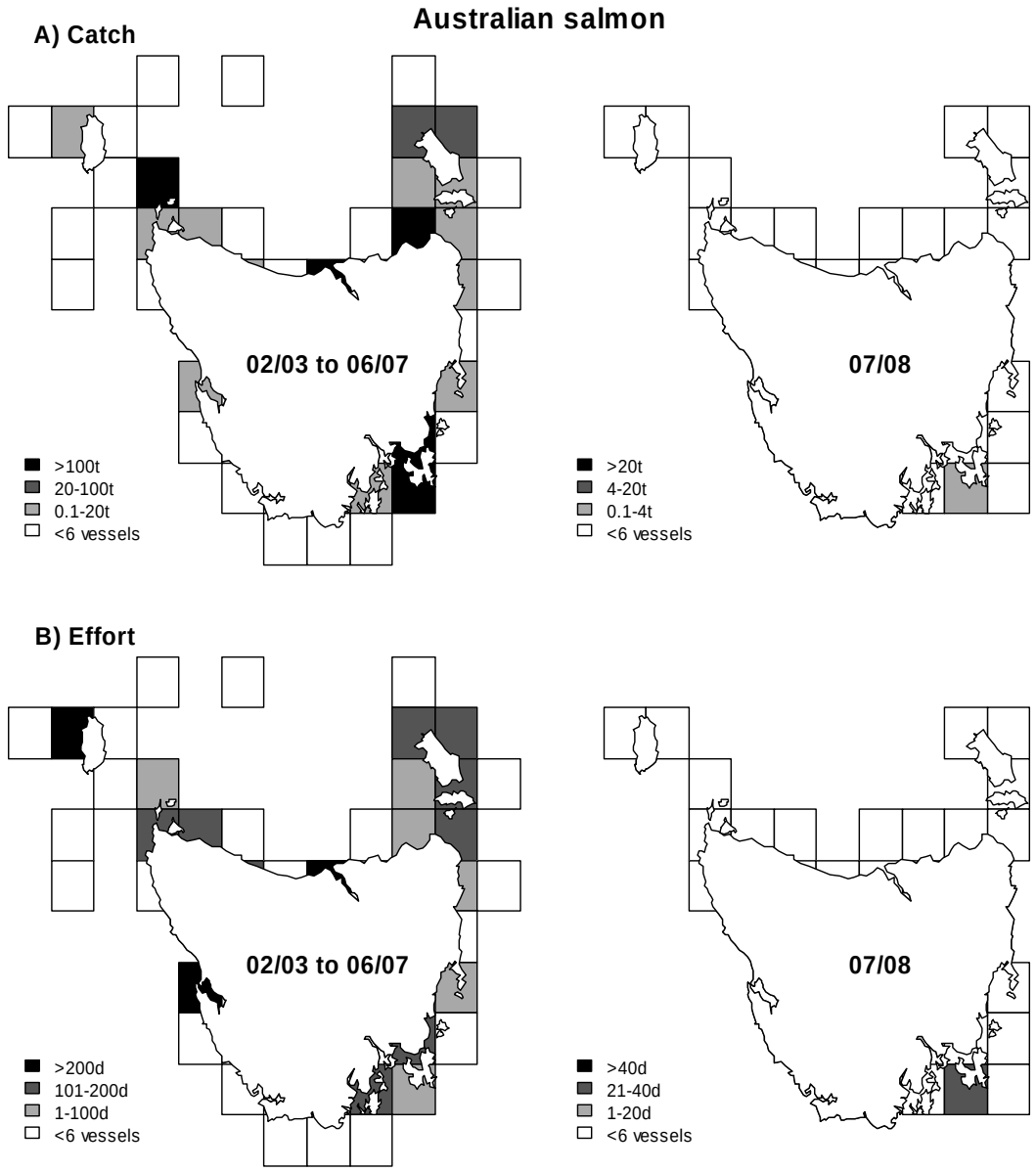

Fig. 9.4. (A) Australian salmon catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

9.3 Flathead (Fam. Platycephalidae)

9.3.1 Catch, effort and catch rates

Several species of flathead occur in Tasmanian waters, but commercial catches are dominated by tiger flathead (*Neoplatycephalus richardsoni*) taken by Danish seine. Sand flathead (*Platycephalus bassensis*) are caught to a lesser extent by handline. However, the two species are not routinely distinguished in catch returns and catches by species are inferred by the gear taking the catch.

Flathead catches declined steadily between 2000/01 and 2003/04 but had more than doubled to 91 tonnes by 2005/06 (Fig. 9.5 and Fig. 9.6). After a drop in the previous year, catches increased again by 24% to 74 tonnes in 2007/08. These fluctuations were mainly caused by tiger flathead taken by Danish seine catches (not shown due to 5-vessel rule), while handline catches, mainly targeting sand flathead, have remained stable since the mid 1990s.

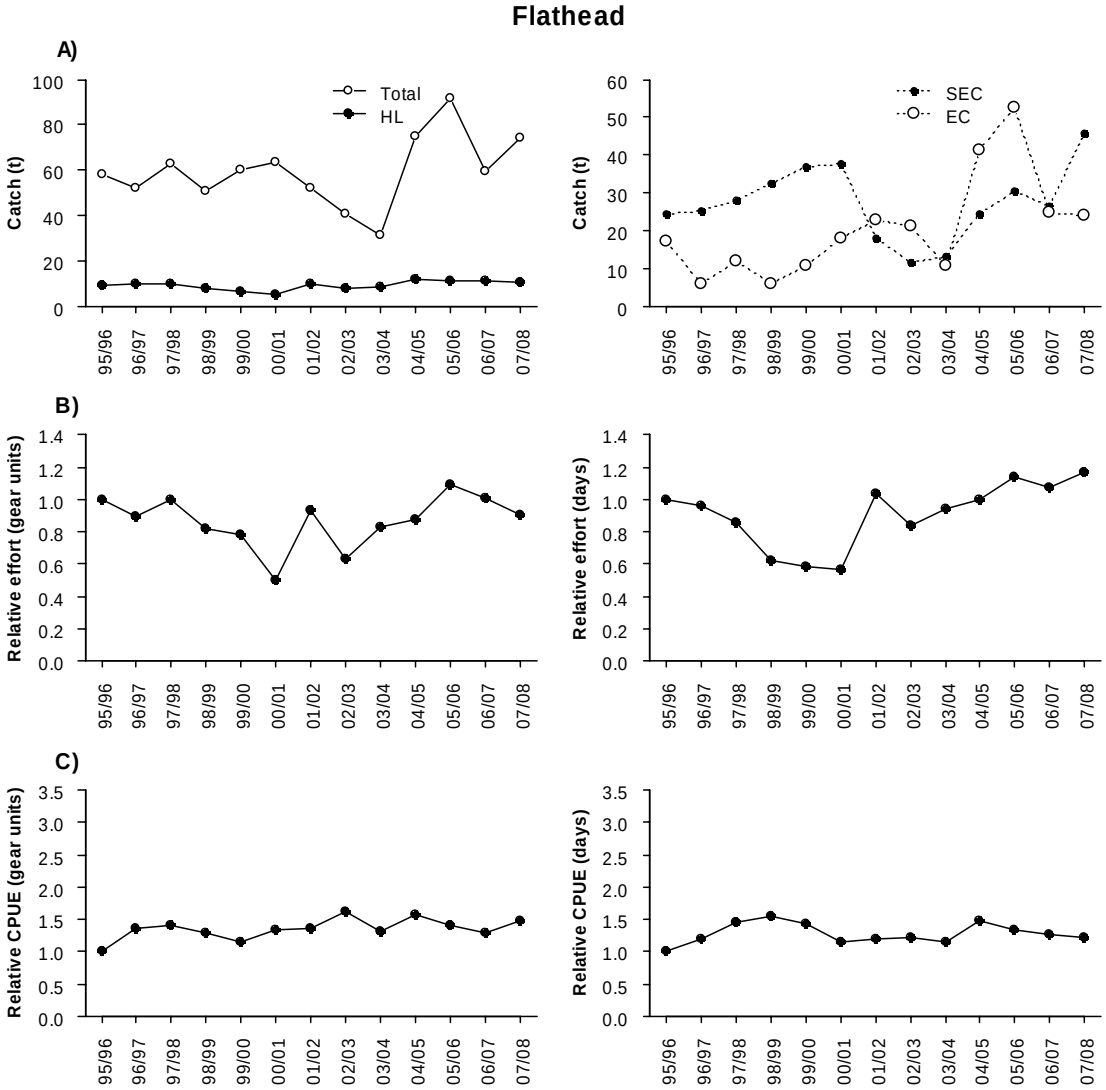

Fig. 9.5. A) Annual catch (tonnes) of flathead by method (left) and region (right) since 1995/96; B) effort by method based on gear units (left) and by days fished (right) relative to 1995/96; and C) catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. HL is hand line; SEC is south-east coast and EC is east coast.

Catches were derived mainly from the south-east and east coasts, with smaller quantities also taken from the north-east (including around Flinders Island) and north-west coasts (Figs. 9.5A and 9.6). The increased production of the past years has been mainly focussed in the south-east of the state.

Although the estimated recreational catch of flathead in 2000/01 was 361 tonnes, recreational catches are dominated by sand flathead, with tiger flathead only comprising a minor component of the harvest (Lyle 2005).

Effort for both gear types has fluctuated without obvious trend and, overall, has remained relatively stable since the mid 1990s (only handline shown, 9.5B). The regional distribution of effort has changed little from previous years, with commercial effort particularly concentrated off the south-east, east and north-east coasts (Fig. 9.6).

Hand line catch rates have remained stable over time (Fig. 9.5C). Danish seine catch rates dropped again after two years of elevated levels and presumably reflect the impact of initially increased and now decreased targeting for the species.

9.3.2 Reference points

Existing reference points	**Exceeded?**	**Alternative RP**	**Exceeded?**
State-wide or regional catches outside the 1990/91 to 1997/98 range (52t-165t)	No (74t)	Catch by Danish Seine above 1.3* the maximum catch from the reference period 1998/99 to 2006/07: South-east coast: 45t East coast: 63t	 Yes (46t) No
Catch increase or decline by over 30% from previous year	No	-	
State-wide or regional effort over 10% of the highest for the period 1995/96 to 1997/98	No	-	
State-wide or regional catch rates less than 80% of the lowest annual value for the period 1995/96 to 1997/98	No	-	
Others: - Significant change in size/age composition of catch - Change in catches of non-commercial fish relative to 1990/91 to 1997/98 or high incidental / undersized mortality - Significant catch of unhealthy fish - Any other indicator of stock stress	Not assessed	Any indicator of stock stress	Not assessed

9.3.3 Implications for management

Recent increases in Danish seine catches are mainly due to a switch in targeting from whiting to flathead (refer Table 2.2 and Fig. 2.2). While stock status of both key flathead species in state waters is unknown, commercial catches of tiger flathead have been maintained at higher levels in past. There are however, additional and significant trawl catches of flathead (almost exclusively tiger flathead) that are taken from Commonwealth waters as part of the South East Fishery, with the tiger flathead stock classified as not overfished (Tuck 2006). Sand flathead stock status is not known, though clearly the main impact on stocks is from the recreational sector.

Increased interest from commercial operators is likely, as evidenced in the recent Danish seine catches, with rising market prices and reduced access to and availability of other scalefish species. Future catch trends should be monitored closely along with those taken by recreational fishers. Given the possibility that Danish seine effort may increase it would be prudent to consider spatial management options that avoid the regional concentration of effort (operators).

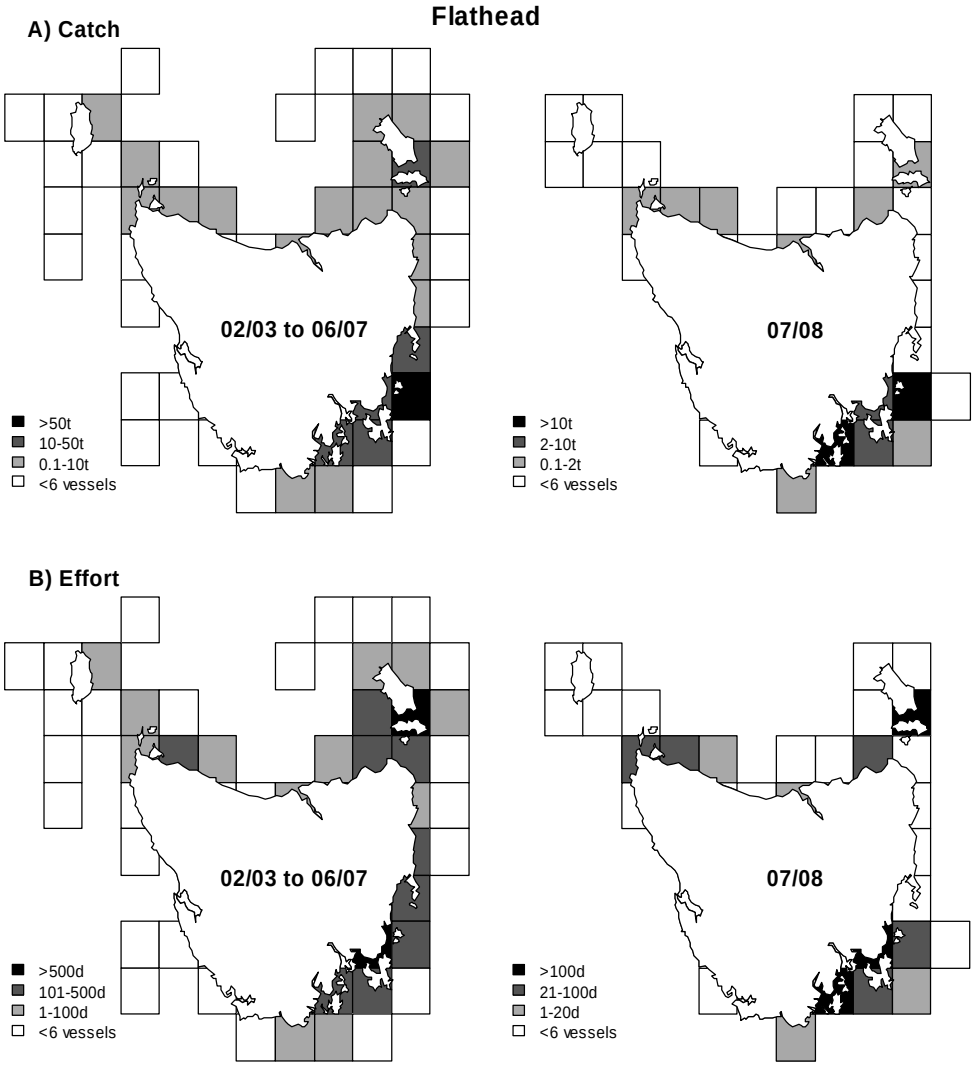

Fig. 9.6. (A) Flathead catches (tonnes) and (B) effort (days) by fishing block pooled from 2001/02 to 2006/07 (left) and during 2007/08 (right). The levels in the right graphs are 1/5 of those in the left graphs where data from 5 years have been pooled. Blocks with less than 6 vessels reporting catch are shown as empty.

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Appendices

Appendix 1. Common and scientific names for species reported in catch returns.

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

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.

Tasmanian logbook data

i) Correction of old logbook landed catch weights

Prior to 1995, catch returns were reported as monthly summaries of landings. With the introduction of a revised logbook in 1995, catch and effort was recorded on a daily basis for each method used. Since catch data reported in the old general fishing return represent landed catch, it has been 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 revised logbook all catches are reported in terms of weight and product form (whole, gilled and gutted, trunk, fillet, bait or live). 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[3].

Without correcting for product form, old logbook and revised 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 revised 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) Effort Problems

Records where effort (based on gear units, Table 2.1) was zero or null, or appeared to be recorded incorrectly (implausible), were flagged. The catch was included in catch summaries but the records were not included in gear unit effort and catch rate calculations. These records were, however, used in calculating days fished and daily catches.

iii) 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 were known to have fished consistently in Commonwealth waters and their catches of species such as blue warehou and ling tended to significantly distort catch trends. In fact, all four Victorian vessels and one of the Tasmanian vessels ceased reporting on the General Fishing Returns in 1994. With the introduction of the South East Fishery Non-Trawl logbook (GN01) in 1997, the remaining Tasmanian vessel ceased reporting fishing activity in the Tasmanian logbook.

[3] 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.

Commonwealth logbook data:

Commonwealth logbook data from Australian Fisheries Management Authority was included in the analyses so that the assessment reflected all catches from Tasmanian waters.

(i) Area restrictions

Commonwealth logbook records were only included if the catch was taken in fishing blocks adjacent to Tasmania and the maximum depth of the fishing operation was less than 200 m. These conditions were applied to all records except where striped or bastard trumpeter were caught. All records that included catches of these species were included for analysis, because these species are managed under Tasmanian jurisdiction in all waters adjacent to Tasmania.

Fishing blocks adjacent to land and used in the analyses (refer Fig. A1) include:

3C2, 3D1, 3F1, 3F2, 3G1, 3G2, 3C4, 3D3, 3F4, 3G3, 3G4, 3H3, 3H4, 4C2, 4D1, 4D2, 4E1, 4G2, 4H1, 4H2, 4D4, 4E3, 4E4, 4F4, 4G3, 4G4, 4H3, 4H4, 5D2, 5E2, 5F1, 5F2, 5H1, 5D4, 5E3, 5H3, 6E1, 6H1, 6E3, 6G4, 6H3, 7E1, 7E2, 7G1, 7G2, 7H1, 7E4, 7F3, 7F4, 7G3.

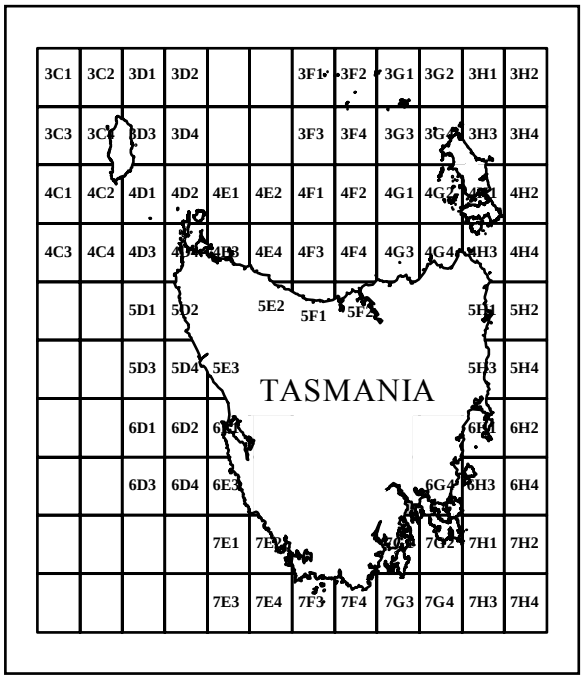

Fig. A1. Numbers for fishing blocks used in calculation of catch figures.

(ii) Duplicate records

A number of records in Commonwealth logbooks had matching records (fisher, date, gear type) in the Tasmanian database. Such records were examined individually and decisions made as to whether it was more appropriate to keep the Tasmanian record, the Commonwealth record or both. In most situations the Tasmanian logbook entry was kept and the Commonwealth record excluded. The only exceptions were records with extra information in the Commonwealth record, e.g. catch of a Commonwealth species that was not recorded in the Tasmanian logbook.