TASMANIAN SCALEFISH FISHERY ASSESSMENT 2014/15

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This assessment of the Tasmanian Scalefish Fishery is produced by the Institute for Marine and Antarctic Studies (IMAS) using data downloaded from the Department of Primary Industries, Parks, Water and the Environment (DPIPWE) Tasmanian Scalefish Database. The information presented here includes all logbook returns for 2014/15 season that were entered prior to 12 October 2015.

IMAS uses input from the Scalefish Fishery Advisory Committee (SFAC). The SFAC met on the 26 November 2015 to consider draft results of the 2014/15 Scalefish assessment. Meeting participants were:

Stephen Bartels	Industry member
Shane Bevis	Industry member
Dave Blake	Industry member
Todd Francis	Industry member
Craig Garland	Industry member
Tim Mirabella	Industry member
Jon Bryan	Environment member
Julian Harrington	TSIC representative
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Ashley Kent	Marine Police
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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 (amended in 2015), provides the management framework for the fishery. A policy document includes the explicit identification of performance indicators and reference points that have two primary functions: (1) monitor performance of the fishery in relation to catch and effort, and (2) provide reference points against which the status of fish stocks can be assessed.

Fishery assessment

Since the early 1990s, annual commercial catches of the major species have generally declined. Total scalefish production (excluding small pelagics) declined from over 2,000 t in the early 1990s to around 500 t in recent years, due in part to changed targeting practices, the transfer of shark fishery to the Commonwealth and introduction of a State management plan in 1998.

There has been a continuous decline in the number of vessels participating in the scalefish fishery and in the number of scalefish fishing licences since 2000. Although effort performance indicators were not triggered for any fishing method, there are on-going concerns regarding the level of latent capacity within the fishery from licence holders who are currently either participating at low levels or not active (only 20-50% of licences are active depending on the type).

Catch and effort information for the recreational fishery are available periodically and have demonstrated that the recreational catch now represents a significant component of the total Tasmanian harvest for species such as Flathead, Striped Trumpeter, Bastard Trumpeter, Blue Warehou, Flounder, Mullet, Barracouta, Jackass Morwong, Cod, Leatherjacket, and Silver Trevally.

Species assessment

The scalefish policy document is currently undergoing a review, including a review of performance indicators and reference points. For this assessment, a hierarchical approach based on the available information for individual species is applied in determining proposed reference points. Both existing and proposed reference points are, however, presented for each species.

The current assessment report should be viewed as transitional, both in terms of the development and implementation of reference points and the adoption of stock status reporting based on the recently implemented national stock status reporting framework.

Species/Species group	Status	Comment	Page
Australian Salmon *Arripis trutta*	SUSTAINABLE	Species has a long history of exploitation across south-eastern Australian. Low commercial landings in Tasmania in 2014/15 are driven by market demand not abundance. The current level of fishing pressure in Tasmania is well below historical levels and unlikely to cause the biological stock to become recruitment overfished.	47
Banded Morwong *Cheilodactylus spectabilis*	TRANSITIONAL DEPLETING	Mature biomass has declined steady since the early 2000s. Modelling indicates fishing pressure at 2014/15 levels will continue to deplete the stock resulting in it becoming recruitment overfished. Reductions in catch quotas have been	54

		progressively applied but positive increases in biomass have not yet been observed.	
Barracouta *Thyrsites atun*	**NOT ASSESSED**	Catches of Barracouta have been declining steadily since the mid-2000s due to a decrease in targeted effort as a result of a lack of market opportunities. Catch rates are not considered indicative of stock status and the status of the stock is uncertain.	66
Bastard Trumpeter *Latridopsis forsteri*	**OVERFISHED**	Trends in commercial catch suggest record low population levels and that the species is recruitment overfished. The current minimum legal size limit is below the size of maturity. Species is considered medium risk in the ERA. Current low levels of fishing pressure may be too high to allow stock to recover.	71
Blue Warehou *Seriolella brama*	**OVERFISHED**	This is a Commonwealth-assessed species that is classified as overfished (see: http://www.afma.gov.au/portfolio-item/blue-warehou/). It is sporadically abundant in Tasmanian waters. Despite a reduction in Total Allowable Catch (TAC) for the Commonwealth fishery to 118 t and the initiation of a rebuilding strategy, stocks have shown little evidence of recovery.	78
Tiger Flathead *Platycephalus richardsoni*	**SUSTAINABLE**	This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/tiger-flathead/). In Tasmania, Tiger Flathead are caught predominately by the commercial sector and in recent years, catches have declined to around 20 – 30 tonnes, equivalent to less than 1% of Commonwealth trawl landings.	85
Sand Flathead *Platycephalus bassensis*	**TRANSITIONAL DEPLETING**	Both Flathead species are caught by commercial and recreational fishers, however, Sand Flathead dominates the recreational catch (> 90%). Fishery independent surveys suggest relatively low abundances of legal sized fish, particularly in south-eastern Tasmania, with populations subject to heavy fishing pressure, especially relative to historic levels. Fishing pressure in 2014/15 is likely to cause the stock to become recruitment overfished.	92
Flounder *Pleuronectidae* family	**NOT ASSESSED**	Greenback Flounder constitute the majority of the commercial catches, which remains small due to the ban on overnight gillnetting and lack of market demand. Catch is an unreliable estimate of abundance and the status of the stock remains uncertain.	102
Gould's Squid *Nototodarus gouldi*	**SUSTAINABLE**	This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/goulds-squid/). Dual-endorsed	108

		vessels fish in Tasmanian waters especially in years of peak abundance. Species is characterised by high inter-annual variability in abundance in State waters with low catches in the last two fishing seasons suggesting that the recent focus of the fishery was in Commonwealth waters.	
Jack Mackerel *Trachurus declivis*	SUSTAINABLE	This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/). Only minor catches of this species in recent years due to one operator leaving the fishery and do not reflect the stock status.	115
Jackass Morwong *Nemadactylus macropterus*	SUSTAINABLE	This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/) with very low commercial catches in Tasmania.	122
Leatherjacket *Monacanthidae* family	UNDEFINED	Various species of Leatherjackets are found inshore around Tasmania's coastline and are not differentiated in logbooks. Leatherjackets are a by-product species and are not actively targeted due to a lack of market demand. Catch is therefore not a good indicator of abundance and there is little biological information to confidently classify the status of Leatherjacket stocks.	129
Longsnout Boarfish *Pentaceropsis recurvirostris*	NOT ASSESSED	Boarfish are a by-product species with low catches due to the large minimum legal size. There is too little information available to confidently assign a stock status for this species.	134
Yelloweye Mullet *Aldrichetta forsteri*	SUSTAINABLE	Catches are at low levels but this is unlikely to be indicative of abundance. Yelloweye Mullet are most abundant in estuarine habitats, where netting is prohibited or restricted, thereby providing a high degree of protection throughout most of their range. It's therefore unlikely that the stock is recruitment overfished or that current fishing pressure is too high as to cause recruitment overfishing.	139
Snook *Sphyraena novaehollandiae*	UNDEFINED	The catch of Snook has been relatively stable in recent years around 6 – 9 tonnes. Catch rates are an unreliable estimate of abundance and a lack of information as to the biological vulnerability of this species to fishing means there is insufficient information to confidently classify the status of the stock.	146
Eastern School Whiting *Sillago flindersi*	SUSTAINABLE	This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/eastern-school-whiting/). Catches fluctuate due to the interstate market and are (generally) based on a single operator and the species targeted (Tiger Flathead	151

		or School Whiting). Tasmanian commercial catches are a fraction of the Commonwealth commercial catch.	
Southern Calamari *Sepioteuthis australis*	**SUSTAINABLE**	Both commercial and recreational fishing effort in the northern areas of the State have increased to a historic high. Despite this, catch rates in the northern areas have continued to rise in recent years, while remaining stable in southern areas of the State. Vulnerability of Southern Calamari to fishing pressure is unclear but probably high, with the ERA considering the species to be at medium risk. There are no indications as yet that the fishing mortality is excessive and likely to cause the stock to become recruitment overfished.	157
Southern Garfish *Hyporhamphus melanochir*	**TRANSITIONAL DEPLETING**	After a strong decline in catches in 2006/07 and 2007/08 coupled with changes in population structure, which prompted management actions, this species showed signs of recovery. However, a lack of recent length and age frequency data has prevented any further assessment of population recovery. Over the last two fishing seasons there have been significant reductions in the catch rates of both fishing methods, particularly beach seine (which is the main catching method), suggesting that fishing mortality may be too high and likely to cause the stock to become recruitment overfished.	167
Striped Trumpeter *Latris lineata*	**UNDEFINED**	A lack of length and age frequency data in recent years has prevented an assessment of the extent of population recovery in Striped Trumpeter. Consequently, the justification for the previous stock status is no longer appropriate as there is not enough biological information to confidently classify the stock.	177
Wrasse *Notolabrus tetricus* (Bluethroat Wrasse) *Notolabrus fuciola* (Purple Wrasse)	**SUSTAINABLE**	Catches, effort and catch rates have remained relatively stable for almost a decade providing no indicators that recent fishing mortality is too high. There is, however, some uncertainty over the size of the catch taken by rock lobster fishers and used for bait.	191

1. Fisheries Assessment

Management objectives and strategies

The Scalefish Fishery Management Plan [*Fisheries (Scalefish) Rules 1998*] was first introduced in 1998 (DPIF 1998) and was reviewed in 2001, 2004, 2009 and most recently in 2015. The management plan provides the regulatory framework for the fishery, which covers commercial and recreational components. While the plan contains the overarching legislation under which the fishery operates, the following objectives, strategies and performance indicators are contained in a policy document currently under review.

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.

Primary strategies

- Limit total commercial 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.

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 (Ziegler 2012). For many operators, scalefish represent an adjunct to other activities, for instance rock lobster fishing.

This report covers the assessment of selected scalefish and cephalopod fisheries under Tasmanian jurisdiction, as well as selected species under Commonwealth jurisdiction which are also taken in state waters by state-endorsed operators. Formal assessments of species under Commonwealth jurisdiction (e.g. Tiger Flathead, Blue Warehou, Jackass Morwong, Ocean Perch, School Whiting, Blue-eye Trevalla, Blue Grenadier, School and Gummy Shark) are undertaken by the Southern and Eastern Scalefish and Shark Fishery Assessment Group (SESSFAG, e.g. Morison et al. 2012) and are summarised in fishery status reports produced by the Australian Bureau of Agricultural and Resource Economics and Sciences (e.g. Woodhams et al. 2012).

Data sources

Commercial catch and effort data are collected through compulsory Tasmanian Commercial Catch, Effort and Disposal 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 for the recreational sector are collected from surveys that are conducted periodically.

Tasmanian Scalefish Fishing Returns

The catch and effort logbooks have been amended several times (1995, 1999, 2007, 2010 and 2013) in an effort to report at finer spatial scales and provide greater operational detail. While the offshore fishing blocks are still at the 30nm (1/2 degree) spatial resolution, the logbooks introduced in 2010 have redefined the scale of the coastal blocks (Fig. 1.1). In analysing catch and effort information some data manipulation has been undertaken, details of which are provided in Appendix 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.

Commonwealth logbook data since 2001 have been available for the current assessment and have been 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.

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 2015.

A fishing year from 1st July to 30th June in the following year has been adopted for annual reporting. This better reflects the seasonality of the fisheries for most species rather than reporting based on calendar year, with catch (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. Unless otherwise stated, data have been analysed at state-wide and regional levels. Five broad assessment regions are used: southeast coast (SEC), east coast (EC), northeast coast including Flinders Island (NEC), northwest coast including King Island (NWC), and west coast (WC) (Fig. 1.1).

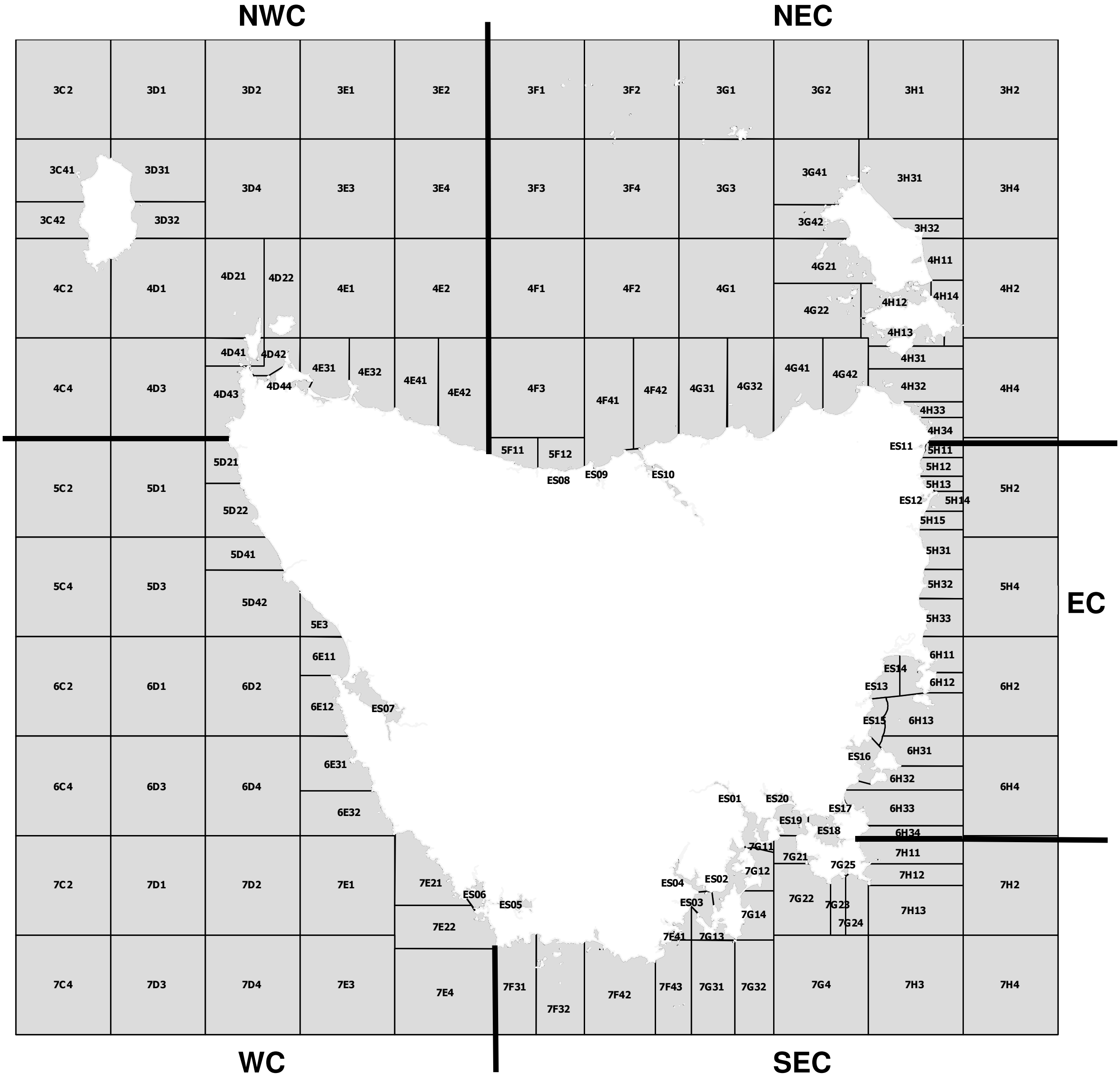

Figure 1.1 Map of Tasmania with the fishing blocks and the assessment regions. SEC is southeast coast, EC is east coast, NEC is northeast coast, NWC is northwest coast, and WC is west coast.

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. Measures of effort by fishing method are presented in Table 1.1. However, because effort reporting has changed for some gears with the introduction of a new logbook during 2007, some gear related effort measures since 2007/08 are not directly comparable to those in the previous years. Additionally, fishing block reporting changed in 2007 and some of the new block subdivisions do not exactly match the old block boundaries. Consequently, confusion about the new reporting requirements may have biased some effort measures.

Table 1.1 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
Drop-line	100 hook lifts
Hand-line	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 2013/14 needed to be excluded in this manner. All records were, however, included for reporting catch, days fished and catch per day.

Since catch rate data are typically log-normally distributed, the geometric rather than arithmetic mean of all valid individual daily catch records has been calculated when generating catch rate statistics. 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.

Recreational fishery

Information on recreational fisheries in Tasmania is relatively sparse in comparison to commercial data. Detailed analyses of the Tasmanian recreational fishery available are based on the 2000/01 National Survey (Lyle 2005), the 2007/08 state-wide fishing survey (Lyle et al. 2009) and the 2012/13 state-wide survey (Lyle et al. 2014b). Additional data are provided by targeted surveys of the offshore recreational fishery (Tracey et al. 2013), recreational gillnet fishery (Lyle and Tracey 2012) and fishing practices (Lyle et al. 2014a), along with recreational net licence numbers.

Current assessment categories

In the absence of rigorous quantitative 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 (DPIF 1998). If the observed value of a performance indicator falls outside the acceptable range the reference point is said to have been exceeded implying that 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 for a species are exceeded when one or more of the following criteria are met:

Performance indicators	Reference points
Catch	• Total catch outside the 1990/91 to 1997/98 range • Total catch declines or increases by > 30% from previous year
Effort trend	• Effort (related to species) >10% higher than the maximum level from 1995/96 to 1997/98 • Effort (related to gear) >10% higher than the maximum level from 1995/96 to 1997/98
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98
Change in biological characteristics	• Significant change in the size composition of commercial catches • Significant change in the abundance of a year class (or year classes) from size/age structure monitoring, with particular importance on pre-recruit year classes
Change in catch composition	• Change in the catch of non-commercial fish relative to 1995/96 to 1997/98 • Unacceptably high incidental mortality of non-commercial species or undersized commercial species
Stress	• Significant numbers of fish landed in a diseased or clearly unhealthy condition • Occurrence of a pollution event that may cause risks to fish stocks, the health of fish habitats or to human health

	• Any other indication of fish stock stress

Banded Morwong is the only scalefish species where management includes the use of a Total Allowable Catch (TAC), and therefore has its own set of performance indicators and reference points (see Banded Morwong section).

The fishery has also been assessed against an alternative set of performance indicators and reference points which account for recent developments in the fishery. These alternative assessment categories (presented below) are expected to be further refined and could replace the existing indicators over the next few years.

Proposed assessment categories

The proposed assessment categories take into account the species' importance and the quantity of data available to inform the appropriate reference points for each species, with the intention to assign a stock status to each species based on the presented criteria.

Species' importance

There are over 90 species reported in commercial catches. Harvested species in Tasmania have variable social and economic values, meaning that all species cannot be given the same priority for assessment. In assessing the importance of a species, a combination of factors was taken into account, which includes:

- Whether the species is a target, secondary target or by-product;
- The economic importance of the species;
- The annual landings for the species (i.e. annual catch >5 t for 50% of the time between 1995 and present);
- The number of operators targeting the species and;
- The "conservation" value of the species.

Species are consequently classified as "Key species" or "Minor species". The remaining species reported in commercial catches are considered of minor significance and not at threat from current fishing practices. As such, these species are not included in the assessment.

Reporting levels definitions

Each species in the assessment is associated with a level of reporting (Full, Medium or Minor), which stems from the available data for the species/species group. The aim is, in time, to have full reporting for all key species and medium reporting for all minor species. The attributes of the reporting categories are defined in Table 1.2. Table 1.3 summarises the species selected for the assessment, their importance and level of reporting.

Table 1.2. Summary of the attribute for the reporting categories

Attribute	Reporting level Full	Medium	Minor
Time series estimate of biomass from dynamic models	•		
Time series estimate of total, natural and fishing mortality from dynamic models	•		
Quantitative risk analysis of future harvesting using dynamic models	•		
Time series of age and/or length composition data	•		
Estimates of total, natural and fishing mortality (from catch curves)	•		
Local (TAS) information for growth, mortality, selectivity and maturity	•	•	
Representative time-series of commercial catch	•	•	•
Single biological species or stock	•	•	•
Sporadic age and/or length composition data		•	
Non-local (non-TAS) information for growth, mortality, selectivity and maturity		•	•
Complex of related species		•	•

Table 1.3. Summary of importance and reporting level for all retained species

Species/Species group	Importance	Reporting level
Banded Morwong	Key	Full
Australian Salmon	Key	Medium
Bastard Trumpeter	Key	Medium
Blue Warehou	Key	Medium
Flathead	Key	Medium
Southern Calamari	Key	Medium
Southern Garfish	Key	Medium
Striped Trumpeter	Key	Medium
Wrasse	Key	Medium
Barracouta	Minor	Minor
Flounder	Minor	Minor
Gould's Squid	Minor	Minor
Jack Mackerel	Minor	Minor
Jackass Morwong	Minor	Minor
Leatherjacket	Minor	Minor
Longsnout Boarfish	Minor	Minor
Mullet	Minor	Minor
Pike	Minor	Minor
School Whiting	Minor	Minor

Stock status definitions

In order to assess the fisheries in a manner consistent with the national approach (and other jurisdictions) we have adopted the national stock status categories (Flood et al. 2012). These categories define the assessed state of the stock in terms of recruitment overfishing, which is often treated as a limit reference point. Recruitment overfishing occurs when the mature adult (spawning biomass) population is depleted to a level where it no longer has the reproductive capacity to replenish itself. Hence, recruitment overfished stocks have not necessarily collapsed but they do have reduced productivity. This is different to growth overfishing where fish are harvested at an average size that is smaller than the size that would produce the maximum yield per recruit. Fisheries are ideally also managed towards targets that maximise benefits from the harvesting, such as economic yield or provision of food. The scheme used here does not attempt to assess the fishery against any target outcomes.

Table 1.4 Stock status classification summary

Stock status	Description	Potential implications for management of the stock
SUSTAINABLE	Stock for which biomass (or biomass proxy) is at a level sufficient to ensure that, on average, future levels of recruitment are adequate (i.e. not recruitment overfished) and for which fishing pressure is adequately controlled to avoid the stock becoming recruitment overfished	Appropriate management is in place
TRANSITIONAL-RECOVERING ↑	Recovering stock—biomass is recruitment overfished, but management measures are in place to promote stock recovery, and recovery is occurring	Appropriate management is in place, and the stock biomass is recovering
TRANSITIONAL-DEPLETING ↓	Deteriorating stock—biomass is not yet recruitment overfished, but fishing pressure is too high and moving the stock in the direction of becoming recruitment overfished	Management is needed to reduce fishing pressure and ensure that the biomass does not deplete to an overfished state
OVERFISHED	Stock is recruitment overfished, and current management is not adequate to recover the stock; or adequate management measures have been put in place but have not yet resulted in measurable improvements	Management is needed to recover this stock; if adequate management measures are already in place, more time may be required for them to take effect
UNDEFINED	Not enough information exists to determine stock status	Data required to assess stock status are needed
NOT ASSESSED	No attempt has been made to assess stock status	Resources required to assess stock status

Performance indicators and reference points definitions

The determination of stock status is based on the consideration of model outputs (for species with full reporting) and the commercial catch and effort data, which are assessed by calculating fishery performance indicators and comparing them with reference points.

The proposed performance indicators are biomass and fishing mortality. For medium and minor reporting, proxies (commercial catch and CPUE) are used instead as there are insufficient data to calculate biomass or fishing mortality. These are compared to a reference period (1995/96[1] to 2006/07 unless stated otherwise) for each species. The reference points for more generic and full reporting are species-specific while the reference points for medium and minor reporting are applicable for all species. Reference points are illustrated in Fig. 1.2.

Table 1.5 Summary of the performance indicators and reference points for each reporting standard
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Reporting	Performance indicators	Reference points
Full	Fishing mortality	• Maintain an appropriate spatial distribution of catch
	Biomass	• High probability of staying above a certain level of mature biomass
		• High probability of staying above a certain CPUE
Medium	Fishing mortality	• Catch > 3rd highest catch value from the reference period
		• Catch < 3rd lowest catch value from the reference period
		• Catch variation from the previous year above the greatest inter-annual increase from the reference period
		• Catch variation from the previous year above the greatest inter-annual decrease from the reference period
		• Latest recreational catch estimate > recreational catch estimate from the reference period
		• Proportion of recreational catch to total catch > previous proportion estimate
	Biomass	• CPUE< 3rd lowest CPUE value from the reference period
		• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period
Minor	Fishing mortality	• Catch > 3rd highest catch value from the reference period
		• Catch < 3rd lowest catch value from the reference period
		• Latest recreational catch estimate > recreational catch estimate from the reference period
		• Proportion of recreational catch to total catch > previous proportion estimate
	Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period

[1] 1995/96 to 2006/07 was selected as the reference period, corresponding to the first twelve years since the introduction of daily catch and effort reporting in the Tasmanian General Fishing Returns.

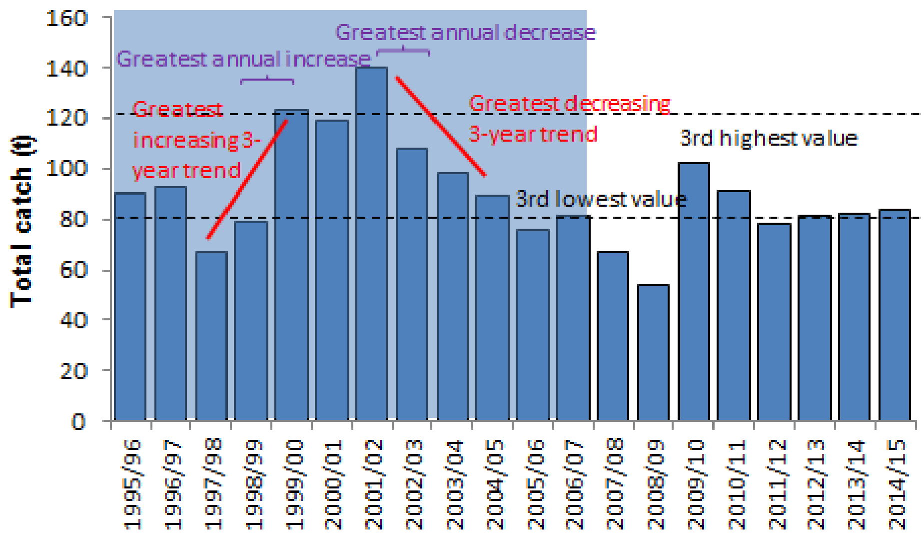


Figure 1.2 Schematic illustration of the application of fishing mortality reference points for medium and minor reporting based on trends in catch. The shaded blue area represents the reference period. Note this figure is for illustrative purposes only.

As per the current assessment categories, other measures are also taken into consideration in the determination of stock status, such as changes in biological characteristics of the stock, indicators of stock stress, significant changes in the catch of non-commercial species or undersize commercial-species, and significant external factors related to fishing activity.

Reporting	Performance indicators	Reference points
All	Stock stress	• Significant change in the size/age composition of commercial catches • Significant numbers of unhealthy fish landed

As this is the fourth transitional report, stock status was only assessed for a few species (Australian Salmon, Banded Morwong, Bastard Trumpeter, Blue Warehou, Tiger Flathead, Gould's Squid, Jack Mackerel, Jackass Morwong, Leatherjacket, Sand Flathead, School Whiting, Southern Calamari, Southern Garfish, Striped Trumpeter, Wrasse and Yelloweye Mullet) based on the current reference points. Proposed new reference points are presented for comparison.

Ecological risk assessment

The current assessment incorporates, for the first time, an evaluation of the potential ecological risks posed by the Tasmanian Scalefish Fishery. Two recognised ecological risk assessment (ERA) frameworks were used in this process: the first involved a qualitative approach suited to fisheries with limited data and is closely aligned with the standard risk assessment approach utilised in occupational health and safety; the second was a semi-quantitative approach that is suited to fisheries for which data relating to catch, discards, post release survival and technical aspects of the fishery are available. Risk analysis considers the source of risk, the possible consequences of the risk and how likely it is that the consequences will occur. Consequences and likelihood are assessed against specific objectives, which differ according to the component of the risk assessment. Consequence and likelihood are combined to produce an estimated level of risk associated with the particular hazardous event in question.

The ERA was conducted as a snapshot in time, capturing the risk profile of the fishery in 2012/13, full details are provided in Bell et al. (2016).

2. General fishing trends

Commercial fishing licences

The number of scalefish licences A, B and C have slowly declined since 2001 to 286 total licences in 2014, of which 123 were active (Table 2.1). The decline was mainly due to a reduction in scalefish C licences (which are non-transferable), while the numbers of scalefish A and B licences have remained stable. Scalefish C licences were also the licence type that was least often fished, with just 25% of C licences active in 2013 (down from 29% in 2001). The proportion of actively fished scalefish A and B licences dropped from around 70% in 2007 to 54% for Scalefish A and 47% for Scalefish B licences in 2014.

In addition to the general scalefish licences, separate fishing licences allow the use of beach seine (a total of 50 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 2.1 Number of active and total fishing licences (FL) by licence type (A, B or C) since 2001 (licence years run from March to February of the following year, hence the 2014 licencing year is the last complete year covered by this assessment).

No of active licences	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
FLA	44	51	48	46	38	43	47	37	33	32	35	28	35	34
FLB	104	111	110	109	101	105	105	93	88	84	76	80	67	71
FLC	62	63	52	47	34	36	33	23	16	17	17	13	16	18
Total	210	225	210	202	173	184	185	153	137	133	128	121	118	123

No of total licences	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
FLA	67	70	70	70	66	66	66	66	65	65	65	65	65	63
FLB	165	164	165	165	162	162	160	159	159	158	158	154	154	151
FLC	214	205	185	173	152	137	129	120	112	92	86	81	77	72
Total	446	439	420	408	380	365	355	345	336	315	309	300	296	286

Commercial catch trends

General production

Since the early 1990s, annual commercial catch of the major species has generally declined (Fig. 2.1). Overall, total scalefish production (excluding small pelagics and Gould's Squid) declined from over 2,000 t in the early 1990s to around 500 t in recent years (Appendix 3, Table A1).

The total scalefish catch increased by >100t between 2011/12 (495.8 t) and 2012/13 (608.8 t) but declined by just over 50% in 2013/14 (291.6 t) before falling by 20 tonnes in 2014/15 (271.3 t). These large fluctuations are largely driven by variability in the landings of Australian Salmon, which has the potential to mask changes in other species that are landed in much lesser quantities.

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 may not, therefore, necessarily reflect changes in stock status. Species in this category include Australian Salmon, Blue Warehou, Barracouta and Gould's Squid. By contrast, species such as Banded Morwong, Wrasse, Striped Trumpeter, Bastard Trumpeter, Southern Calamari and Octopus are more 'resident' species, and variability in catches can reflect a combination of factors, including market demand, management intervention, stock status and intrinsic variability in life history.

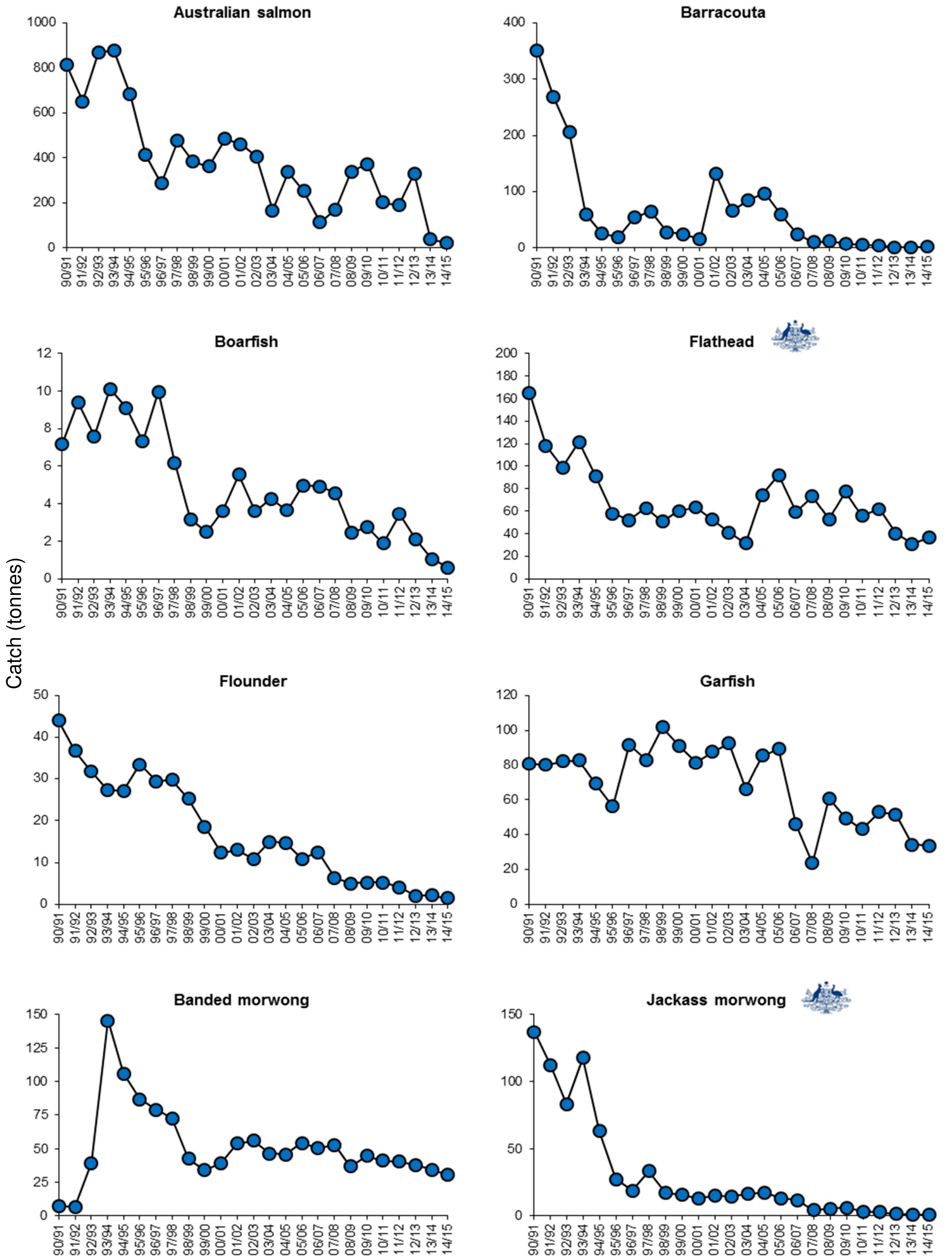


Figure 2.1 Annual catches (t) for selected scalefish species since 1990/91. Note Tiger and Sand Flathead are combined in this figure.

= Part Commonwealth-managed fisheries

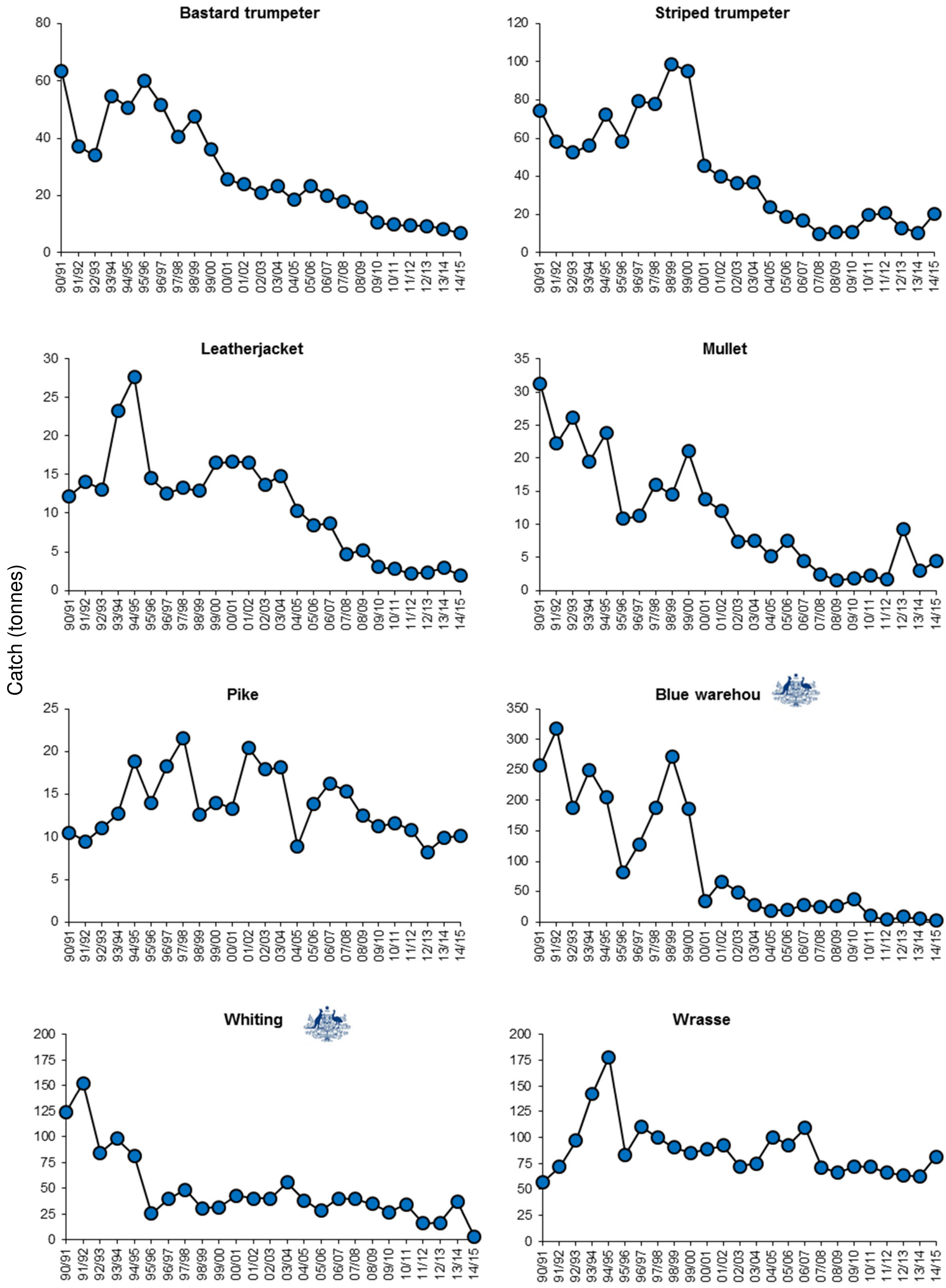


Figure 2.1 Continued.

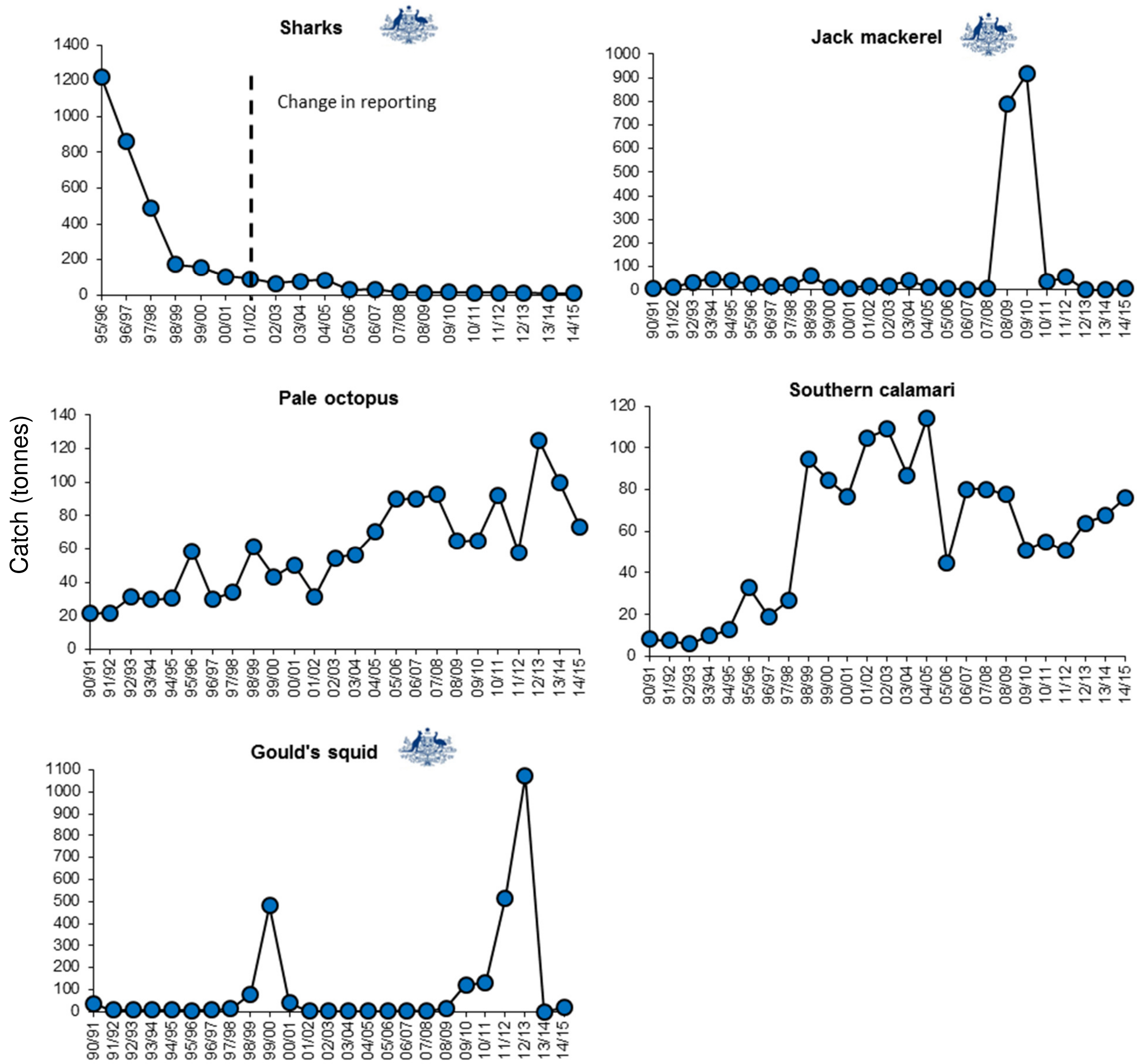


Figure 2.1 Continued.

Estuarine production

Estuarine production (a subset of the whole general fishery) totalled 26.3 t in 2014/15, which is a decrease from the previous year (Table 2.2). Catches came mainly from the southern estuaries including the Derwent River (ES1), Blackman Bay (ES17), Norfolk Bay (ES18), Frederick Henry Bay (ES19), and from the Tamar River (ES10) in the north of the state. Whiting, Southern Calamari, Australian Salmon and Mullet were the main species captured. Port Davey (ES06) and Mersey River (ES08) are restricted to hand-line fishing, which accounts for the very low production. Georges Bay (ES12) and Ansons Bay (ES11) have been closed to commercial scalefishing since 2004 and 2009 respectively.

Table 2.2 Total commercial catches (t) in estuaries around Tasmania (a) by fishing year and (b) by species in 2014/15

a) By fishing year	ES01	ES06	ES07	ES08	ES09	ES10	ES11	ES12	ES17	ES18	ES19	ES20	Total
95/96	30.8	0.8	4.4	0.2	0.7	11.4		0.4	2.9	26.4	16.1	3.2	97.3
96/97	37.7	0.3	2.6		0.6	16.6		0.9	6.4	12.3	7.0	1.8	86.2
97/98	59.5	0.2	1.4	<0.05	1.0	18.9		2.5	13.4	20.9	15.2	1.4	134.4
98/99	20.4		1.4		1.2	22.3		1.6	11.0	36.5	23.5	4.9	122.8
99/00	11.4		1.0		0.5	16.6	0.1	1.9	21.5	28.5	16.8	2.8	101.1
00/01	20.4		0.2		0.1	18.0	<0.05	1.2	16.0	28.0	28.4	1.9	114.2
01/02	14.0		2.2		0.2	81.9		1.2	9.2	64.6	32.6	2.0	207.9
02/03	30.4		8.1		0.2	29.8	0.5	0.8	14.6	35.4	23.4	1.6	144.8
03/04	44.0		6.2		1.0	26.3			5.6	59.5	21.8	0.8	165.2
04/05	29.9		4.9		1.8	35.9			9.6	25.9	23.1	0.7	131.8
05/06	4.1	0.1	23.2		0.9	34.2	1.3		8.4	14.4	19.6	0.8	107
06/07	31.0	0.3	9.9		2.0	26.3	0.2		8.7	20.3	19.7	1.4	119.8
07/08	38.8		3.2			17.9			13.0	26.9	12.3	0.9	113
08/09	33.7		1.1		0.2	22.2			8.4	15.7	10.5	2.1	93.9
09/10	26.9		0.7		0.5	17.5	<0.05		3.9	15.6	4.4	2.1	71.6
10/11	27.8	0.1	0.4		0.6	11.1			6.3	5.4	13.7	1.7	67.2
11/12	13.9		0.3			8.1			6.1	7.2	6.7	1.9	44.2
12/13	12.3	0.1	0.1		<0.05	12.6	0.2		7.9	13.2	4.1	0.8	51.4
13/14	32.3		1.1		0.3	9.9			3.0	6.7	8.7	1.1	63.1
14/15	1.8	<0.05	<0.05		0.4	9.2		0.1	4.8	8.4	0.9	0.7	26.3
b) By species	**ES01**	**ES06**	**ES07**	**ES08**	**ES09**	**ES10**	**ES11**	**ES12**	**ES17**	**ES18**	**ES19**	**ES20**	**Total**
Australian Salmon					0.4	1.7			0.9	<0.05			3.0
Blue Warehou													0.0
Calamari						1.0			1.4	3.2	0.7		6.3
Flathead						<0.05			<0.05	0.1	<0.05	<0.05	0.2
Flounder			<0.05			0.2			0.1	0.3	<0.05	0.7	1.3
Garfish						1.3			<0.05	0.1			1.4
Jack Mackerel						0.2							0.2
Mullet						0.3			1.5				1.8
Octopus						<0.05			<0.05	3.4			3.4
Pilchard/Anchovy													0.0
Redbait													0.0
Trevally						<0.05			0.8	<0.05			0.8
Whiting	1.8					<0.05							1.8
Wrasse		<0.05				2.4		0.1		0.3	0.1		2.9
Total	1.8	<0.05	<0.05	0.0	0.4	7.1		0.1	4.7	7.5	0.8	0.7	23.1

ES	Description
ES01	Derwent River
ES06	Port Davey
ES07	Macquarie Harbour
ES08	Mersey River
ES09	Port Sorrell
ES10	Tamar River
ES11	Ansons Bay
ES12	Georges Bay
ES17	Blackman Bay
ES18	Norfolk Bay
ES19	Frederick Henry Bay
ES20	Pitt Water

Recreational fishery

Catch and effort

Surveys of the recreational fishery conducted in 2000/01, 2007/08 and 2012/13 provide comprehensive snapshots of the Tasmanian recreational fishery (Henry and Lyle 2003, Lyle 2005, Lyle et al. 2009, Lyle and Tracey 2012, Lyle et al. 2014b). In addition there have been targeted surveys of recreational gillnetting in 1996-98 and 2010 (Lyle 1999, Lyle and Tracey 2012) and offshore boat fishing in 2011/12 (Tracey et al. 2013).

The most recent recreational fishing survey indicates that there has been a general decline in participation, in both absolute and relative terms (i.e. percentage of the population) (Lyle et al. 2014b). Nevertheless, recreational landings represent a significant component of the total harvest for many species, either as a proportion of the total harvest or in absolute quantities taken (Table 2.3). For instance, recreational catches likely exceed commercial catches of Australian salmon, Blue Warehou, Striped Trumpeter, Bastard Trumpeter, Sand Flathead, Jackass Morwong, Barracouta and Flounder. By contrast, the commercial sector dominates the catches of Tiger Flathead, Banded Morwong, Southern Calamari, Southern Garfish, Pike, Wrasse and School Whiting.

A particularly conspicuous change in the recreational fishery has been the more than threefold increase in the landings of Southern Calamari since 2000/01, such that the recreational harvest is now comparable to that of the commercial sector. Another is the significant recreational catch of Blue Warehou in 2012/13, which exceeds the Tasmanian commercial catch and recent estimates of Commonwealth commercial catches. Blue Warehou is classified as overfished in the latest stock status reports (Flood et al. 2012, Woodhams et al. 2013, Flood et al. 2014) and is subject to a rebuilding strategy at the Commonwealth level.

Table 2.3 Estimated recreational harvest (numbers and weight) for key scalefish species taken by Tasmanian residents, commercial landings (weight) and proportion of the total (recreational plus commercial) catch represented by the recreational harvest (refer Lyle et al. (2014b)). Note: the survey periods do not correspond with fishing years; 2000/01 represented the period May 2000 to Apr 2001, 2007/08 represented the period Dec 2007 to Nov 2008 and 2012/13 represented the period Nov 2012 to Oct 2013.* estimated from the 2011/12 offshore recreational fishing (Tracey et al. 2013); ** estimated from the 2010 recreational gillnetting survey (Lyle and Tracey 2012).

	2000/01				2007/08				2012/13			
	Rec harvest		Com.	Rec.	Rec harvest		Com.	Rec.	Rec harvest		Com.	Rec.
Species	No.	(t)	(t)	%	No.	(t)	(t)	%	No.	(t)	(t)	%
Flathead	1,236,675	322.0	63.4	*83.5*	1,066,293	293.0	73.2	*80.0*	924,932	235.9	39.9	*85.5*
Australian Salmon	300,456	105.0	485.0	*17.8*	110,312	48.1	299.8	*13.8*	144,712	63.7	270.8	*19.0*
Mullet	111,025	30.0	13.7	*68.6*	24,152	6.6	2.4	*73.3*	26,265	7.1	7.9	*47.3*
Flounder	50,582	15.2	10.5	*59.1*	32,436	10.1	7.8	*56.3*	23,238	7.2	2.1	*77.4*
Cod	65,115	30.6	4.0	*88.4*	14,263	8.2	2.5	*76.7*	10,464	6.1	2.2	*73.5*
Jackass Morwong	27,041	31.9	13.7	*70.0*	9,979	6.8	3.8	*64.2*	23,732	16.1	2.1	*88.5*
Garfish	15,669	1.9	81.4	*2.3*	14,568	2.0	51.0	*3.7*	15,260	2.0	50.6	*3.8*
Whiting	7,480	0.8	42.5	*1.9*	14,992	3.4	35.4	*8.7*	9,412	2.1	35.8	*5.5*
Black Bream	34,336	22.0	-	*100.0*	13,134	11.4	-	*100.0*	19,153	16.7	-	
Barracouta	24,320	46.9	15.1	*75.7*	11,577	10.8	13.9	*43.8*	32,954	31.0	1.1	*96.6*
Wrasse	23,083	13.6	88.4	*13.3*	11,640	10.3	68.5	*13.1*	7,223	6.4	65.2	*8.9*
Blue Warehou	16,359	14.6	36.3	*28.6*	8,723	7.0	26.6	*20.8*	10,757	15.4	8.8	*63.6*
Jack Mackerel	15,770	3.2	8.6	*26.8*	5,216	1.0	225.7	*0.4*	30,907	5.2	0.2	*96.3*
Striped Trumpeter	13,450	29.6	49.6	*37.4*	7,274*	31.9*	19.8	*61.7*	3,476	15.2	10.5	*59.1*
Bastard Trumpeter	29,130	37.0	26.2	*58.5*	27,527**	27.3**	10.5	*72.2*	7,573	7.5	9.8	*43.4*
Leatherjackets	18,706	8.2	16.7	*33.0*	7,619	2.6	4.2	*38.0*	5,389	1.8	2.5	*41.9*
Silver Trevally	16,812	4.7	1.6	*74.6*	10,636	4.2	2.0	*67.9*	4,826	1.9	2.8	*40.4*
Southern Calamari	29,473	17.7	76.6	*18.8*	40,525	44.6	102.6	*30.3*	57,728	63.5	60.2	*51.3*
Gould's Squid	9,903	5.0	39.7	*11.1*	73,236	36.6	45.8	*44.4*	42,853	21.4	1054.7	*2.0*

Recreational gillnet fishery

The use of recreational nets in Tasmania has been subject to licensing since 1995, with fishers able to licence up to two graball nets prior to 2002, along with one mullet net and a beach seine. From November 2002 the number of graball nets that could be licensed was reduced to one per person. The number of recreational net licences issued rose rapidly from around 8 900 in 1995 to over 11 000 in 1999/2000, licence numbers then stabilised at between 8 000–9 000 for several years. Licence numbers climbed again to around 10 000 in 2007/08 before trending downward to 8 742 by 2014/15 (Table 2.4). It is possible that the reduction in licence numbers since 2009/10 occurred in response to the introduction of maximum soak times for gillnets in 2009. Night netting, which was a common and popular practice amongst recreational fishers (Lyle 2000), was banned for recreational fishers (with the exception of Macquarie Harbour) in late 2004. While this appeared to have little discernible impact on licence numbers, a targeted survey of recreational gillnetting in 2010 revealed a concomitant reduction in overall gillnet effort (effort in 2010 was about 60% of the level in 1997 despite there being 40% more gillnet licence-holders, Lyle and Tracey 2012). Furthermore, only 73% of recreational licences were used during 2010 (Lyle and Tracey 2012).

The 2010 survey revealed that almost 65% of the gillnet catch (by number) was kept (Lyle and Tracey 2012). Bastard Trumpeter and Blue Warehou together represented 45% of the total retained catch, Atlantic salmon contributed a further 10%, with Australian Salmon, Jackass Morwong, Mullet and Wrasse of secondary importance. Wrasse was the most significant by-catch. Recreational gillnet catches of Bastard Trumpeter, Mullet, Jackass Morwong, Leatherjacket and Cod were higher when compared to the commercial catches, while Blue Warehou catches were similar between the two sectors. Recreational gillnet catch rates have fallen from an average of >6 fish retained per net set in 1997 to just over 4 fish per set throughout the past decade. While variability in the abundance of target species has contributed to this trend (especially Blue Warehou), changes in fishing practices (no night netting, shorter average set durations, reduction in the length of mullet nets, larger minimum size limits for some species influencing release/discarding rates, etc.) have also been contributing factors.

Table 2.4 The 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
Graball 1	5615	6290	6685	6709	7477	7401	6960	7695	7313	7408	8054
Graball 2	2612	2678	2683	2426	2652	2515	1841	na	na	na	na
Mullet Net	656	684	738	739	879	845	608	754	753	754	816
Total	**8883**	**9652**	**10106**	**9874**	**11008**	**10761**	**9409**	**8449**	**8066**	**8162**	**8870**

Licence type	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15
Graball 1	8677	9185	9172	8960	8162	8248	7995	7765	7887
Graball 2	na	na	na	na	na	na	na	na	na
Mullet Net	877	995	1080	922	886	888	890	841	855
Total	**9554**	**10180**	**10252**	**9882**	**9048**	**9136**	**8885**	**8606**	**8742**

Uncertainties and implications for management

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, mainly in terms of the level of detail provided and the lack of independent verification. Since the Commercial Catch, Effort & Disposal logbook (formerly 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 new logbooks during the 2007/08 season has helped to clarify reporting, but there continues to be an on-going 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.

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 recreational catches relative to commercial catches for some species. While the 2000/01, 2007/08 and 2012/13 surveys provide important information about this sector, there is a need for an on-going monitoring program for key species in the recreational fishery. Without such information attempts to assess the status of those species with significant recreational catches may be compromised.

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 fishers' 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 (Goldworthy et al. 2003).

3. Gears in the commercial fishery

There are 14 main fishing methods used in the commercial Tasmanian Scalefish Fishery. Catch and effort by gear types are presented in Table A2 in Appendix 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 1.1). 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. Attempts have been made to reduce this problem by updating the logbook; however misreporting effort continues to be prevalent and due to logbook changes is inconsistent through time. Days fished overcomes any uncertainty about the reporting of effort units and provides consistency assuming there have been no major changes to fishing practices throughout the time series.

For the purpose of analysis, shark net and bottom longline catch and effort have been excluded since these methods relate specifically to the school and gummy shark fishery, which is managed by the Commonwealth.

General effort trends

Following the introduction of the new management arrangements in November 1998, effort based on beach seine, purse seine, gillnets and hand-line all fell, whereas effort based on drop-line, squid-jig and dip-net 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, there was a decline in the effort of fishing methods for which gear allocations, or access, became more regulated (beach seine, purse seine and gillnets), whereas there was an initial shift to or increase in effort for less regulated methods (hooks, jigs and dip-nets; i.e. gear that is equally available to all licence-holders).

Since the early 2000s effort levels for most fishing methods declined, exceptions being hand-line, which has remained relatively stable, and automatic squid-jig which has peaked sporadically with the periodic occurrence of Gould's Squid in Tasmanian waters. For example, catches were at a record high level during 2012/13 whereas little fishing was reported for the automatic jig fishery in Tasmanian waters during 2013/14 and 2014/15.

For the other gear types, levels of effort during 2014/15 were generally similar to, or lower than, those in 2013/14. Exceptions included beach seine, hand-line, squid jig and trolling methods for which effort was higher in the current year (Figures 3.1–3.27; more detailed data available in Table A2, Appendix 4). There is potential for future effort increases due to the levels of latent effort from licence-holders who are currently inactive in the fishery or participating at low levels. The 2004 management plan review in particular attempted to address this issue through several strategies including non-transferability of C-class licences.

The following section presents an overview of the catch composition, as well as the overall catch, effort, and number of vessels for each fishing method.

Automatic squid-jig

Automatic squid-jig users target exclusively Gould's Squid, and have practically no by-catch.

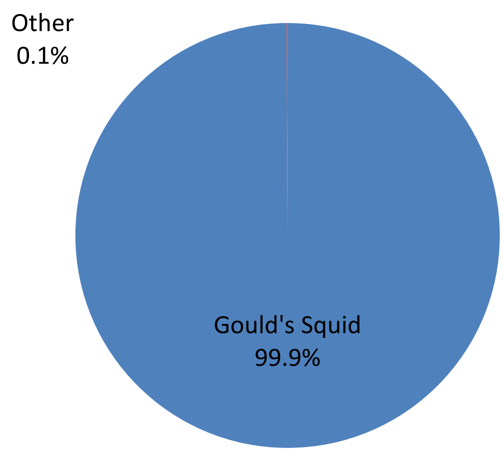


Figure 3.1 Automatic squid jig catch composition for 2014/15.

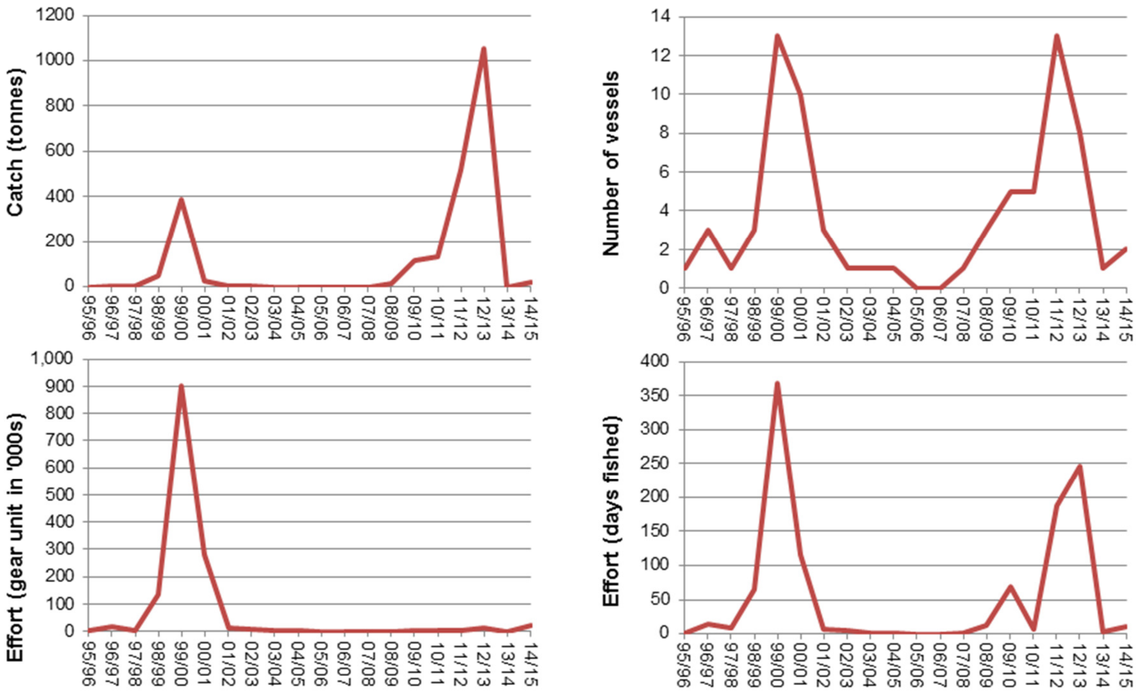


Figure 3.2 Overall catch, number of vessels using the gear, and effort (in gear unit and days fished) for automatic squid-jig.

Beach seine

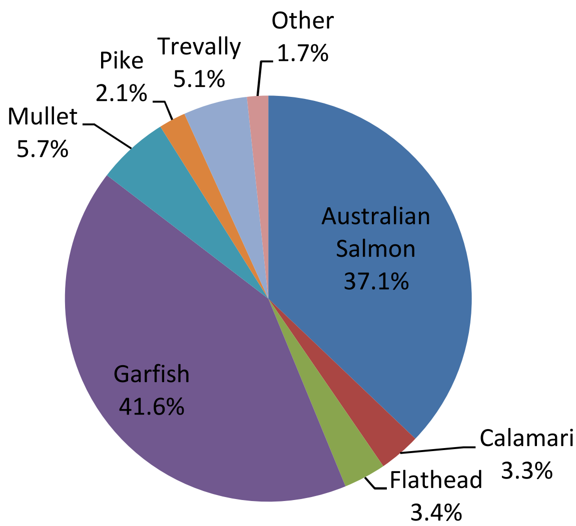


Figure 3.3 Beach seine catch composition for 2014/15.

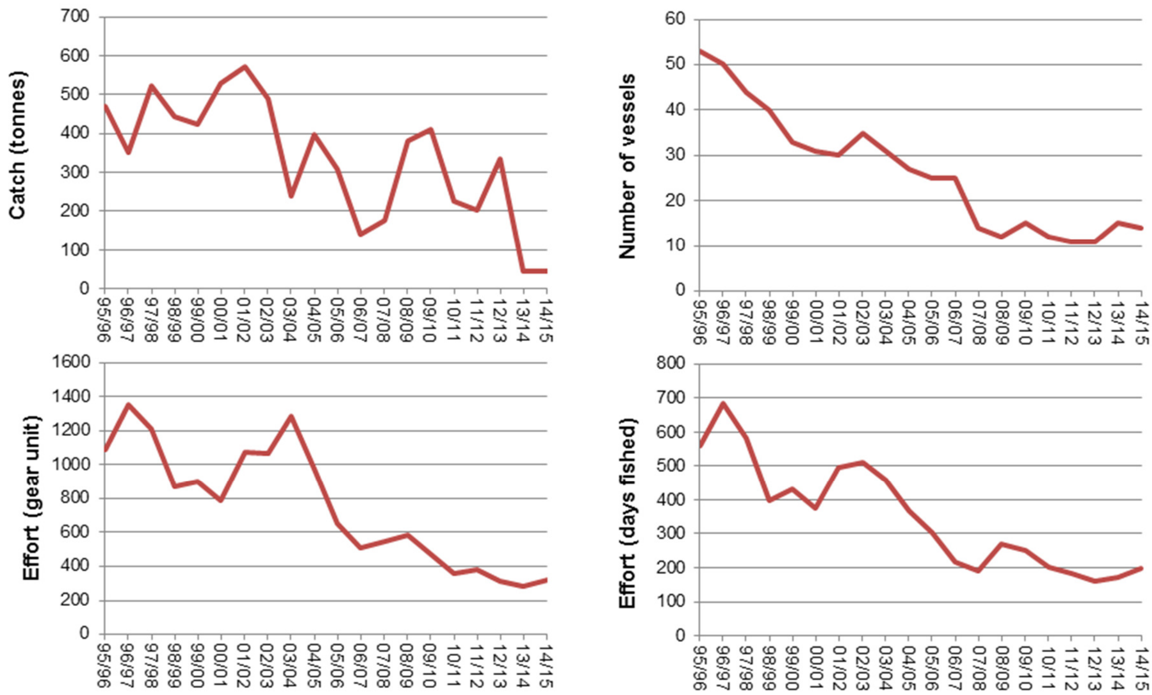


Figure 3.4 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for beach seine.

Drop-line

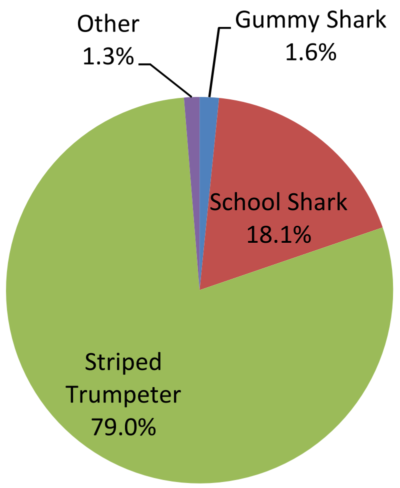


Figure 3.5 Drop-line catch composition for 2014/15.

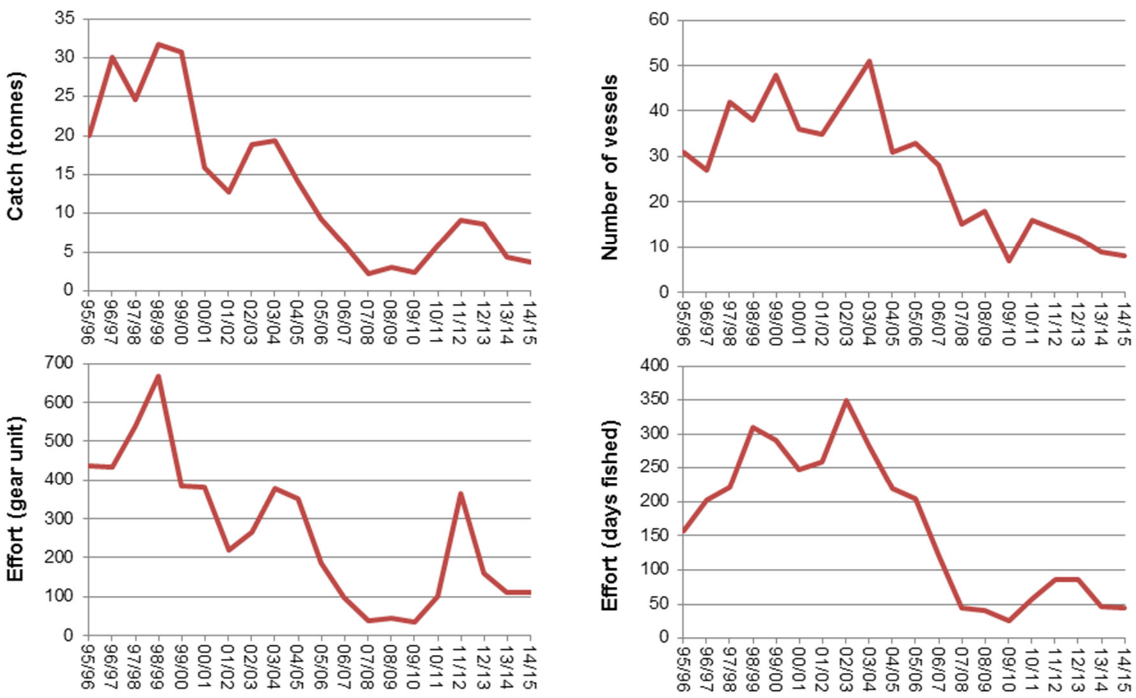


Figure 3.6 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for drop-line. For the purpose of analysis, drop-line catch and effort up to 1998 was restricted to records that indicated a fishing depth of less than 200 m, effectively excluding effort targeting Blue-eye Trevalla but encompassing the target fishery for Striped Trumpeter (less than 1% of the Striped Trumpeter catch has been reported from depths greater than 200 m; since 1998 fishing for Blue-eye has been covered in Commonwealth catch returns).

Dip-net

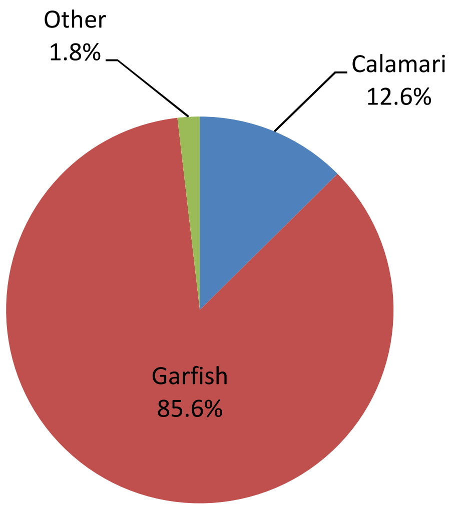


Figure 3.7 Dip-net catch composition for 2014/15.

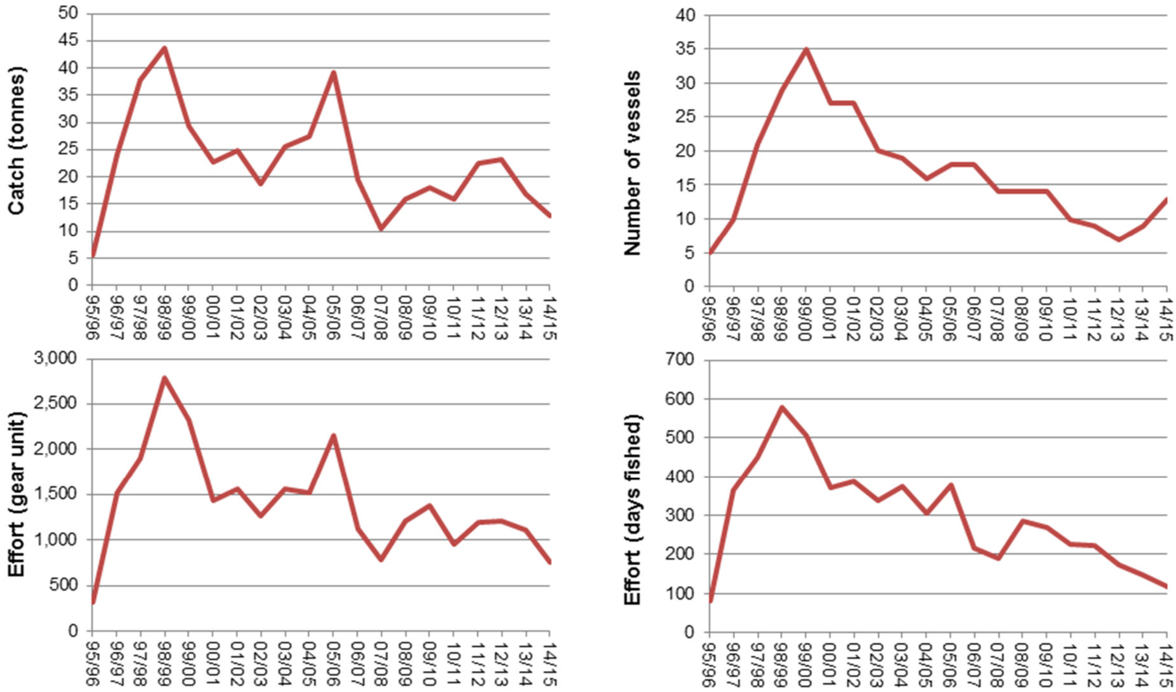


Figure 3.8 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for dip-net.

Danish seine

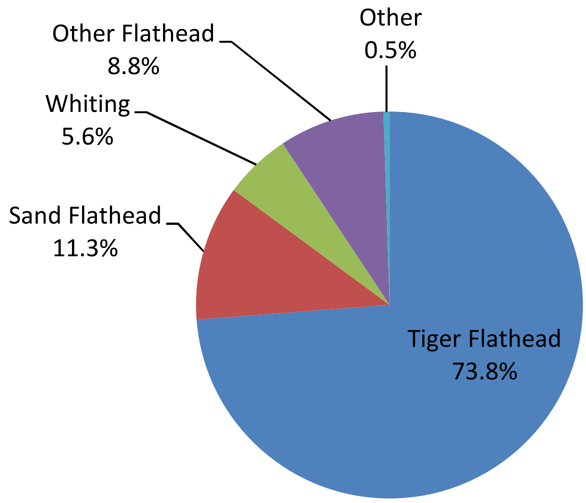


Figure 3.9 Danish seine catch composition for 2014/15.

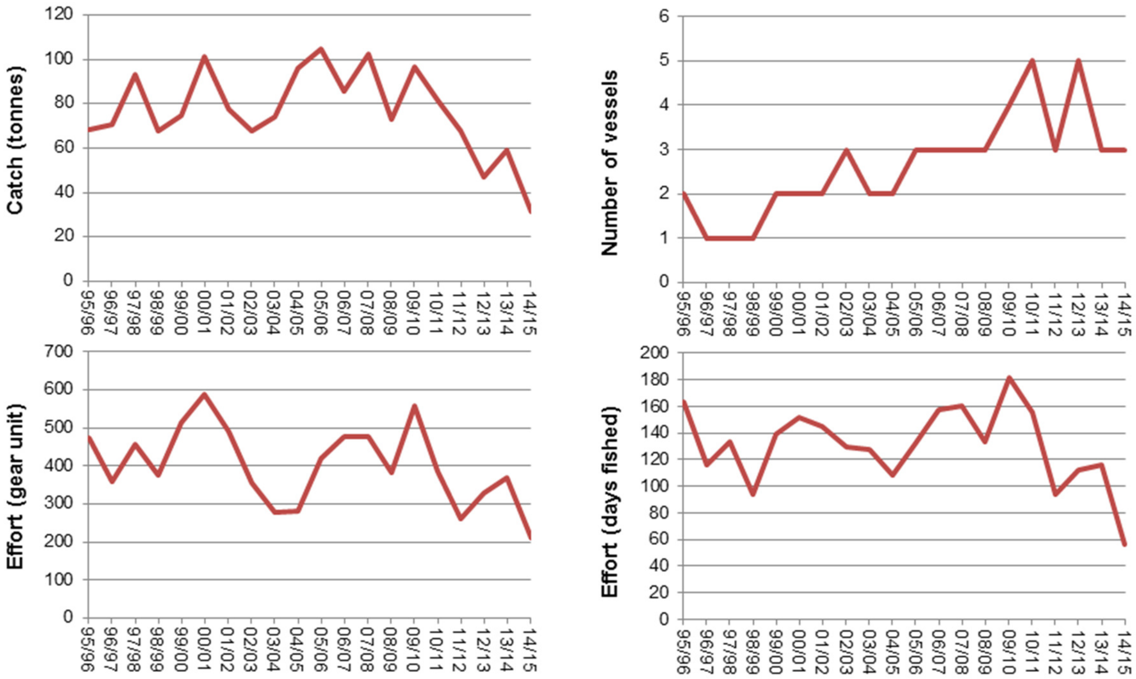


Figure 3.10 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for Danish seine.

Fish trap

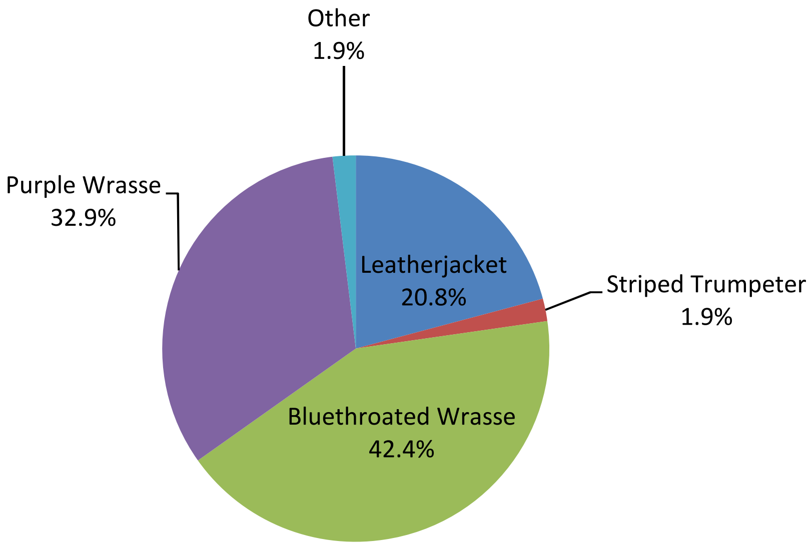


Figure 3.11 Fish trap catch composition for 2014/15.

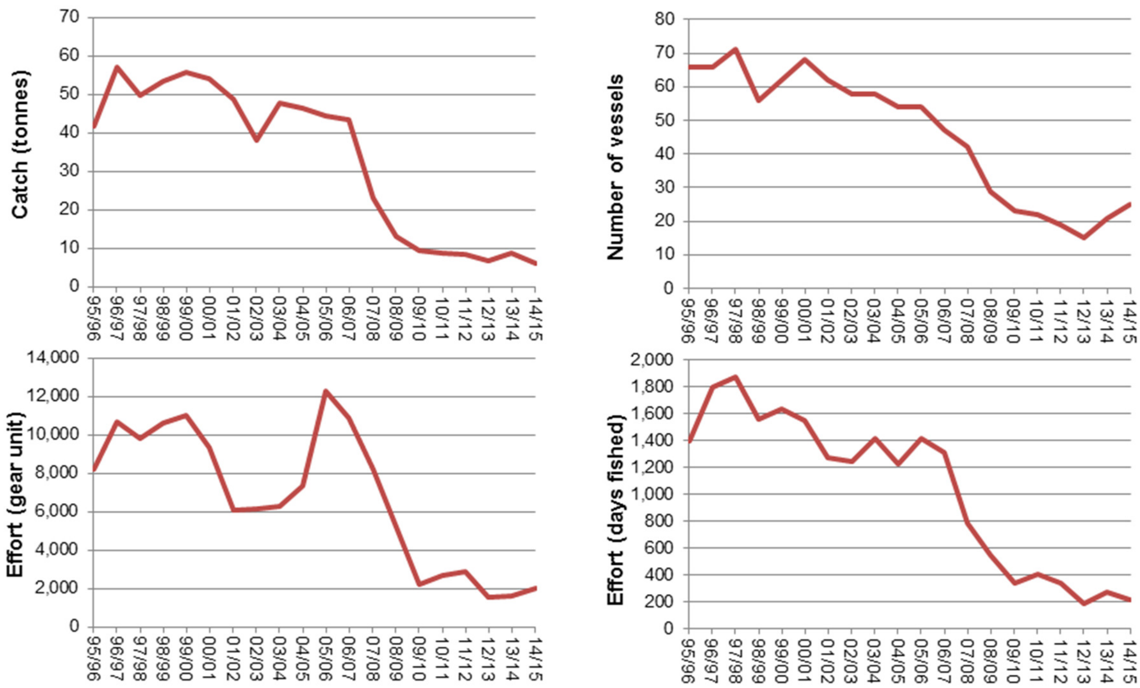


Figure 3.12 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for fish trap.

Graball net

Graball nets in this analysis include both the traditional graball net (110 mm mesh size) and the Banded Morwong net (140 mm mesh size).

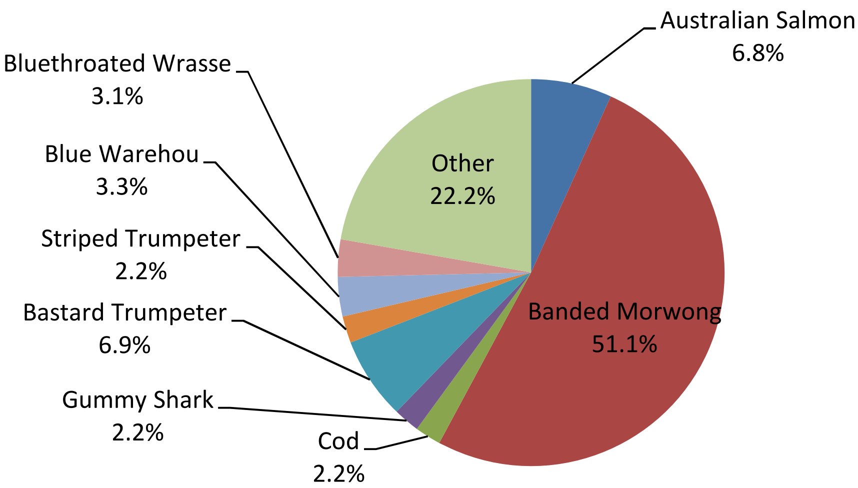


Figure 3.13 Graball net catch composition for 2014/15.

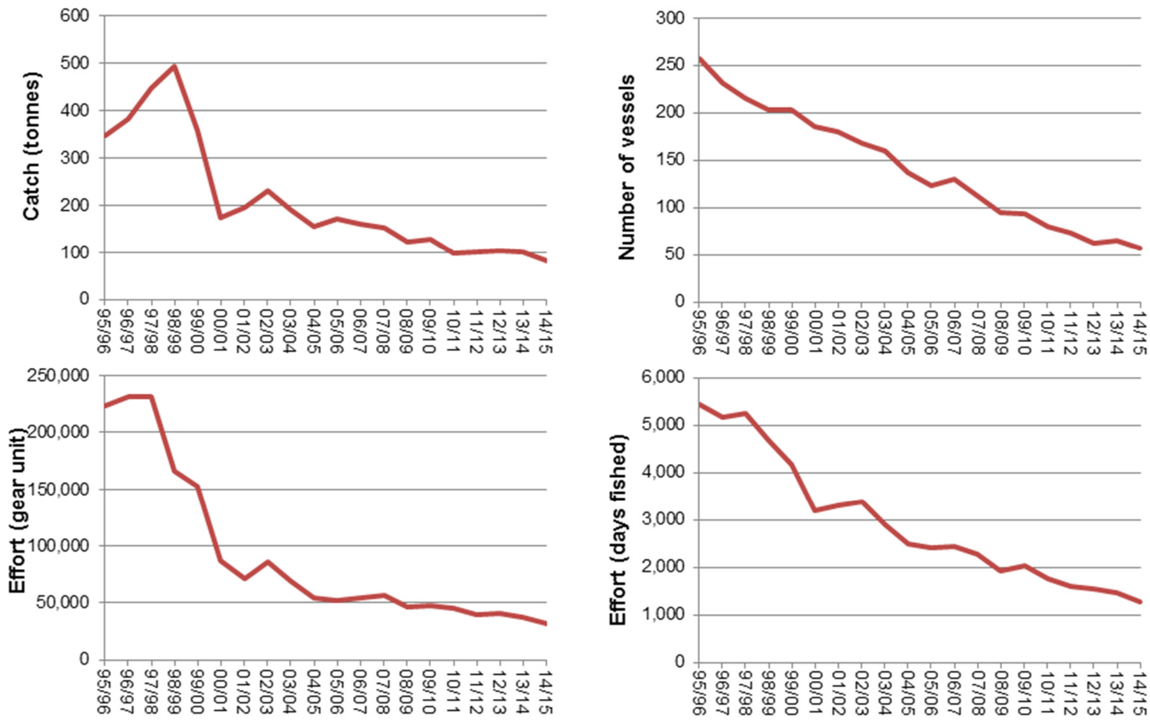


Figure 3.14 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for graball net.

Hand-line

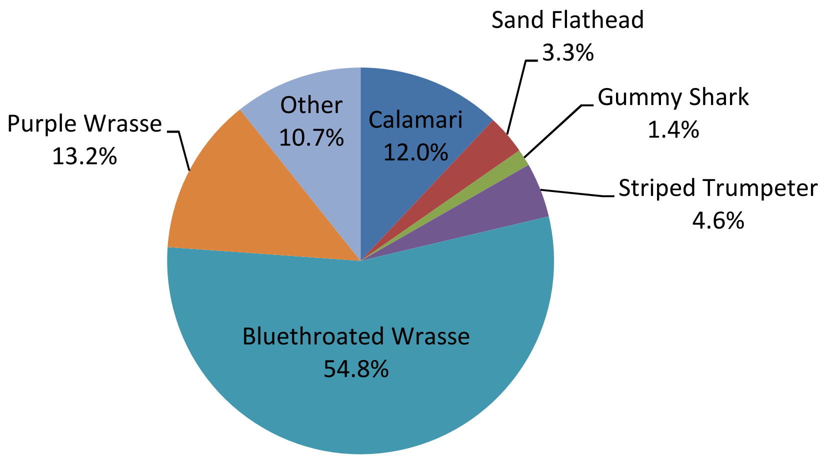


Figure 3.15 Hand-line catch composition for 2014/15.

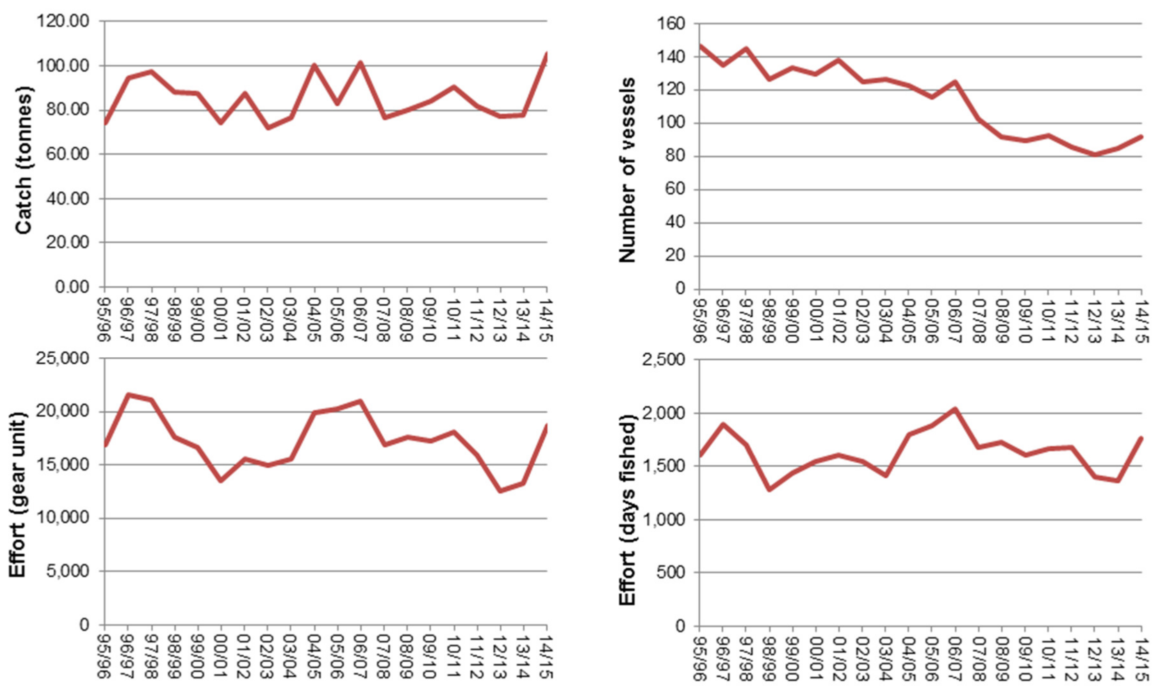


Figure 3.16 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for hand-line.

Small mesh net

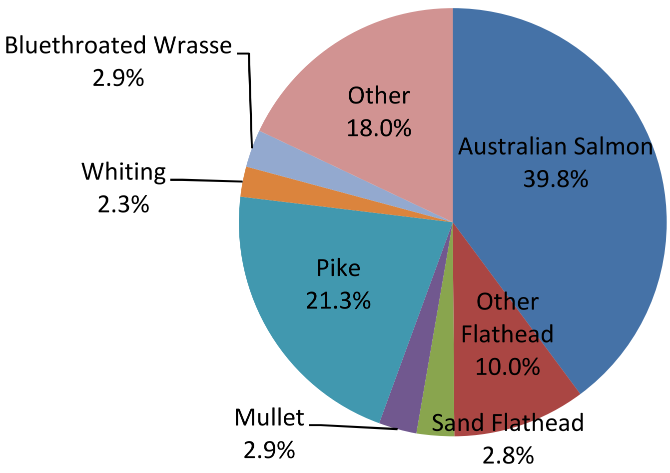


Figure 3.17 Small mesh net catch composition for 2014/15.

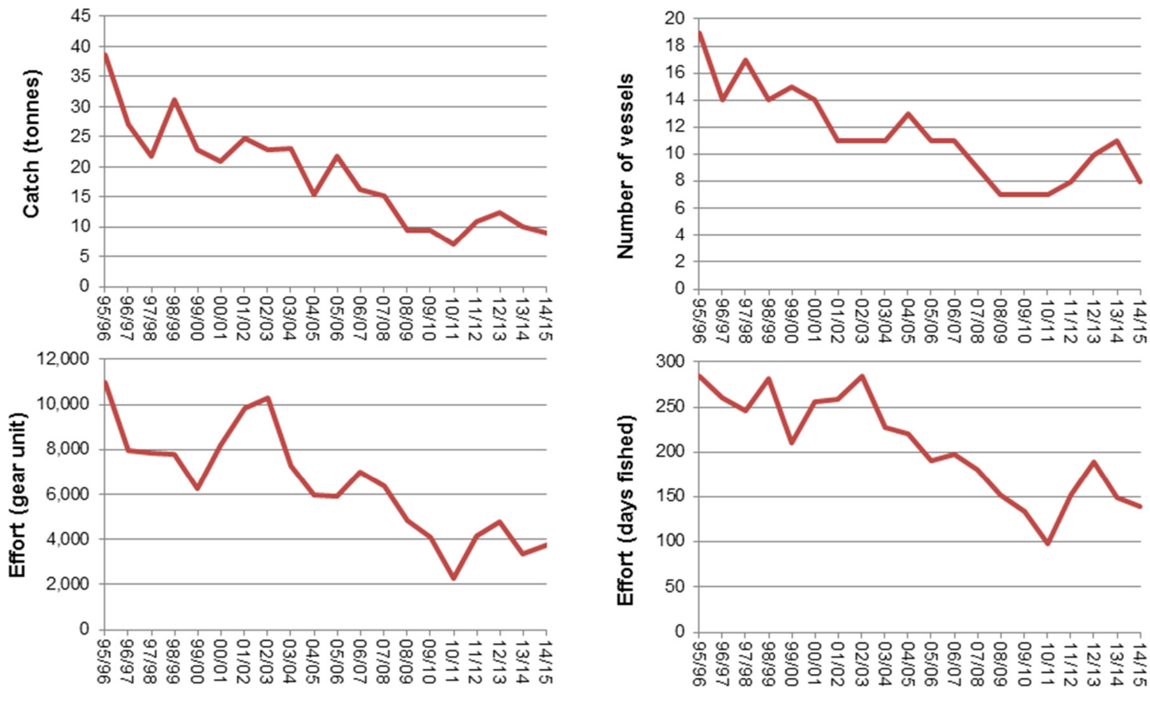


Figure 3.18 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for small mesh net. Note: the low effort in 2010/11 is due to a significant amount of incorrect records for that fishing year.

Purse seine

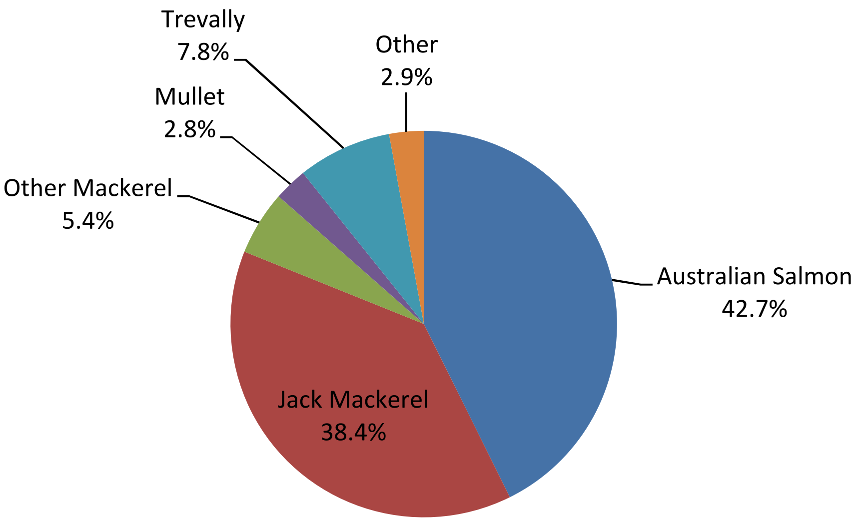


Figure 3.19 Purse seine catch composition for 2014/15.

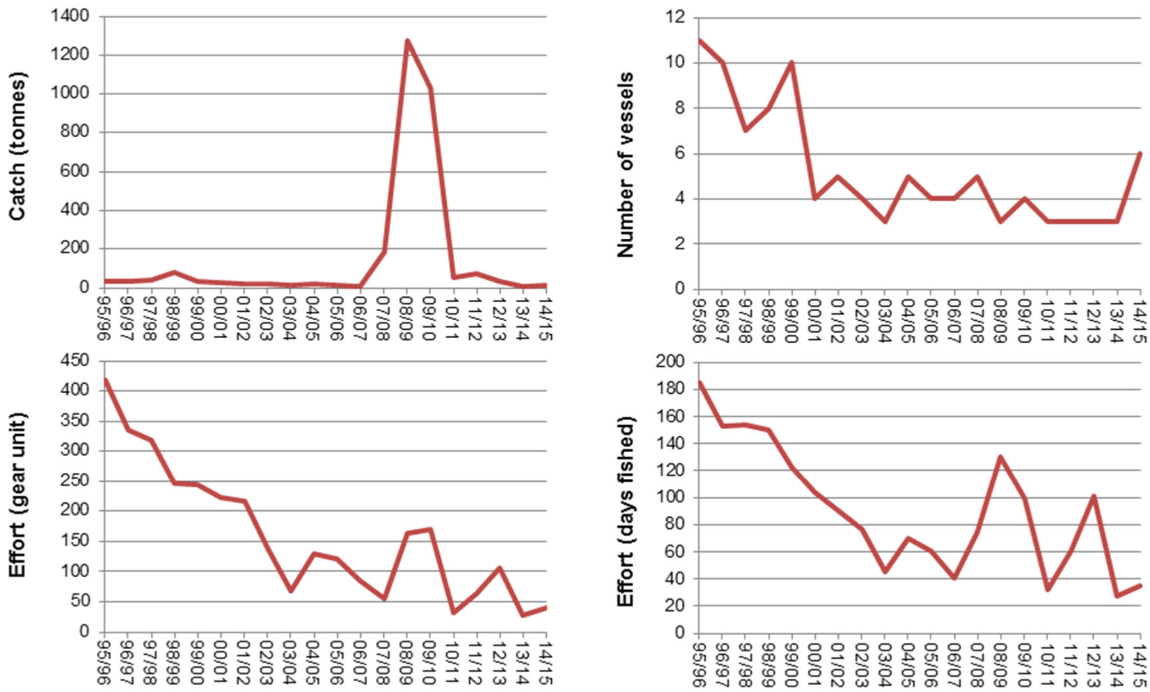


Figure 3.20 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for purse seine.

Squid-jig

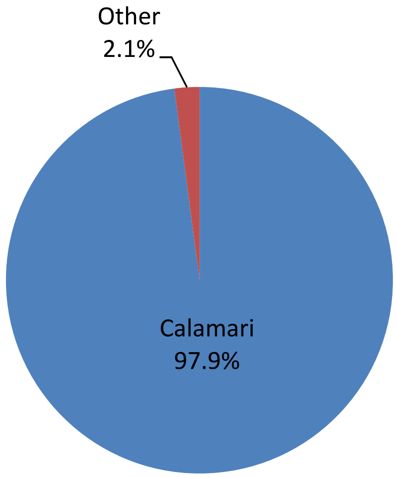


Figure 3.21 Squid-jig catch composition for 2014/15.

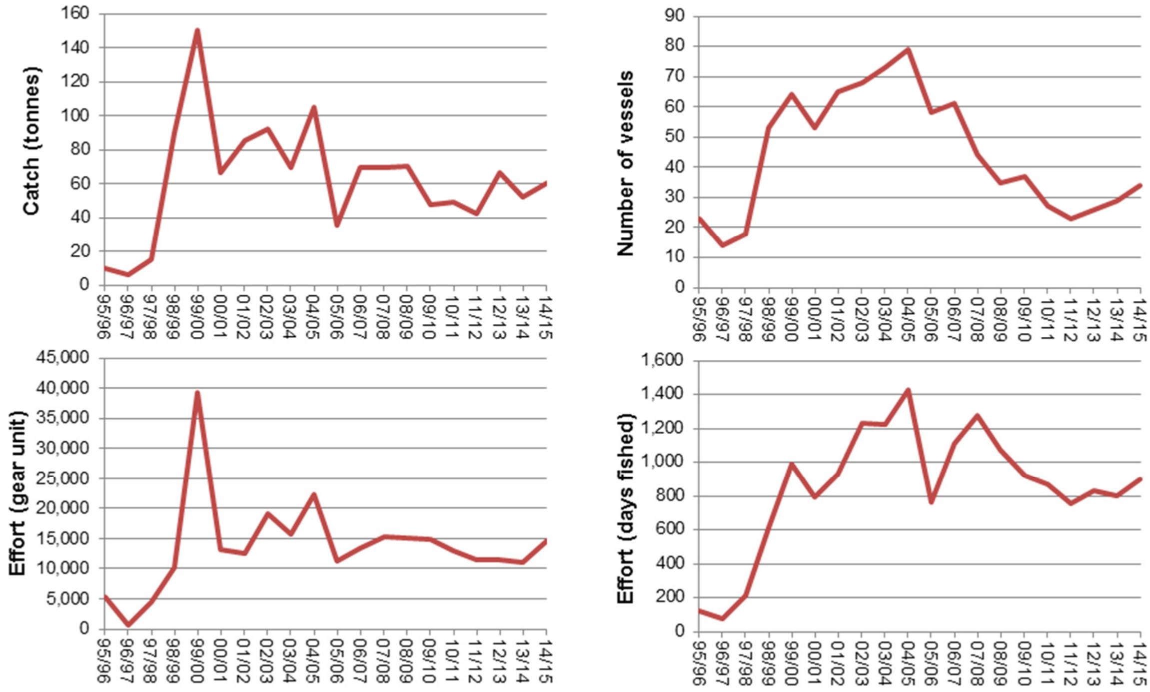


Figure 3.22 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for squid-jig.

Spear

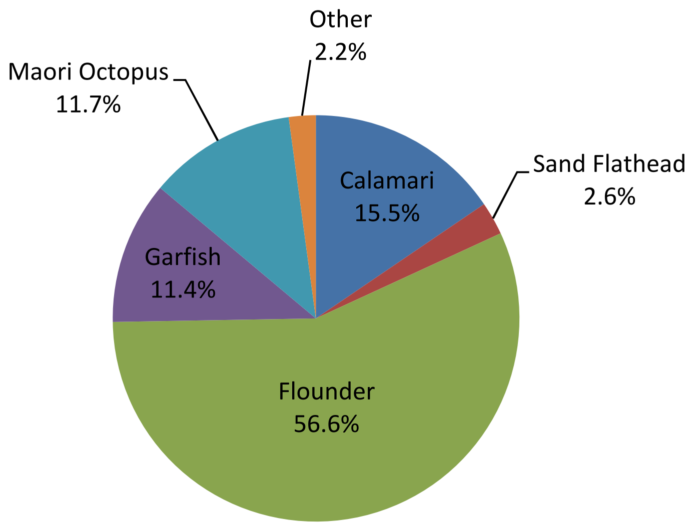


Figure 3.23 Spear catch composition for 2014/15.

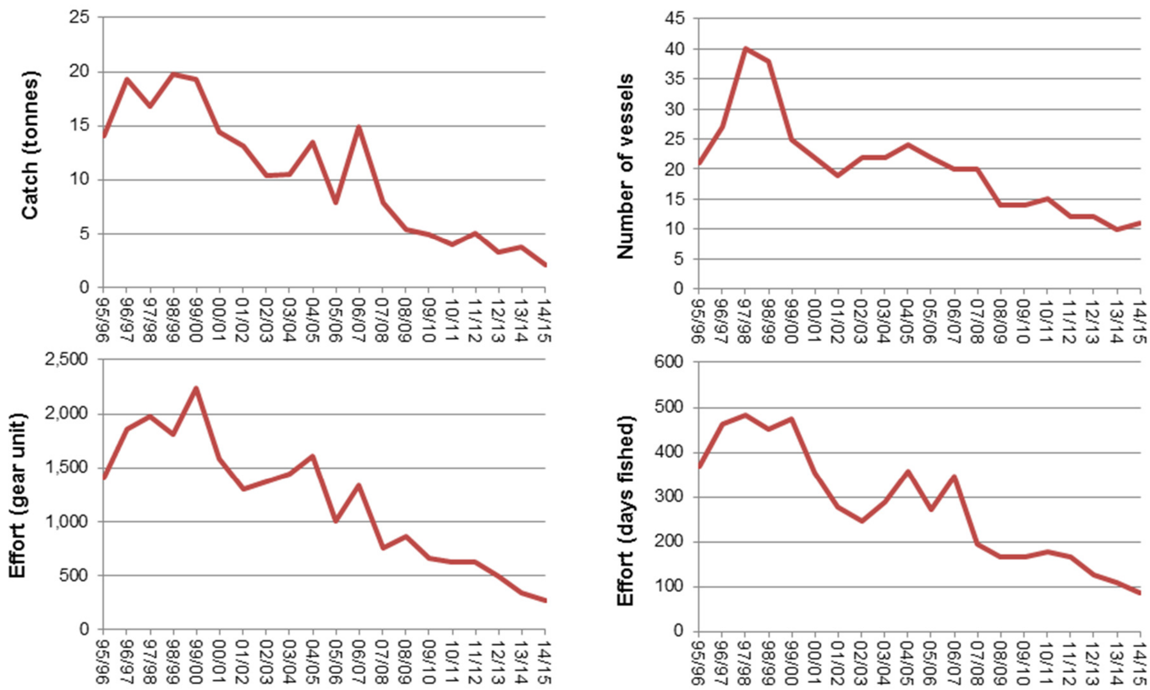


Figure 3.24 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for spear.

Trolling

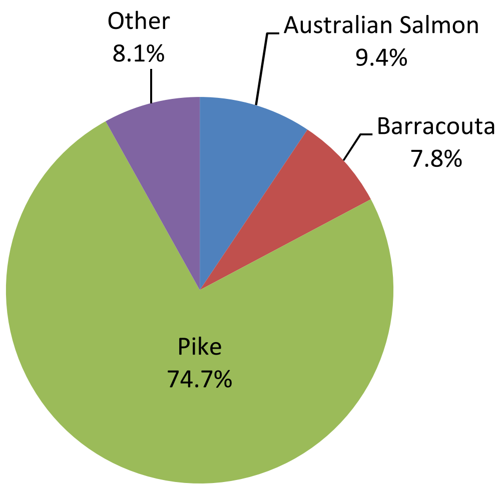


Figure 3.25 Trolling catch composition for 2014/15.

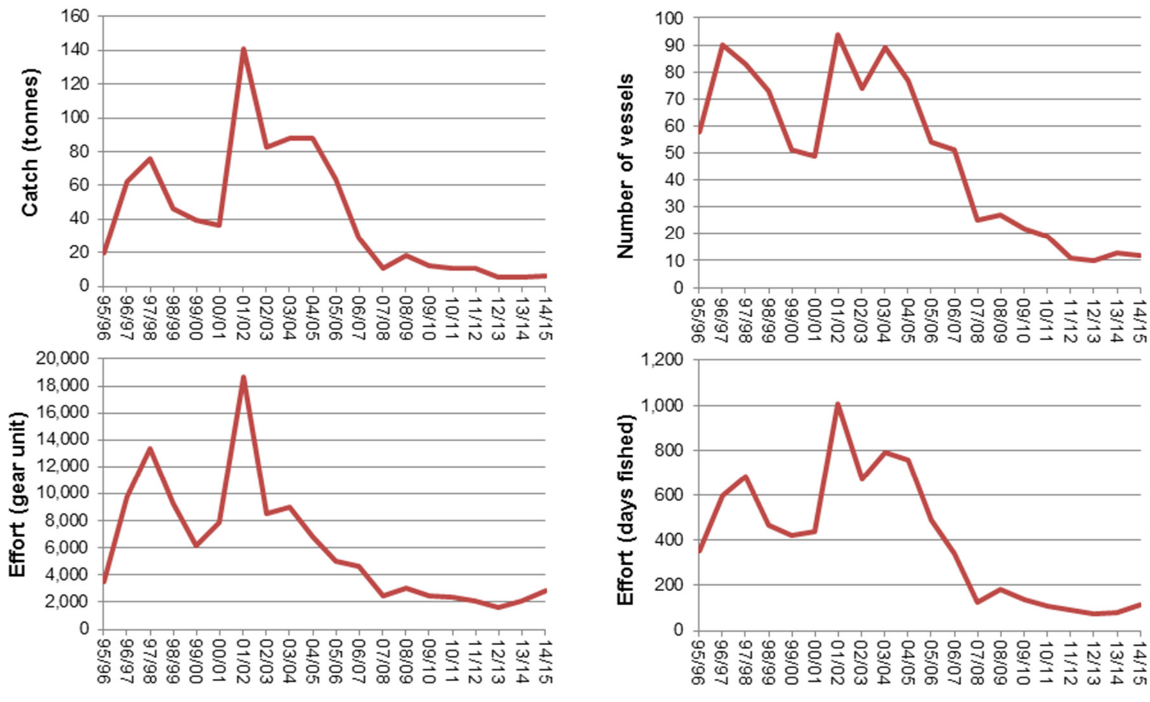


Figure 3.26 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for trolling.

Hand collection

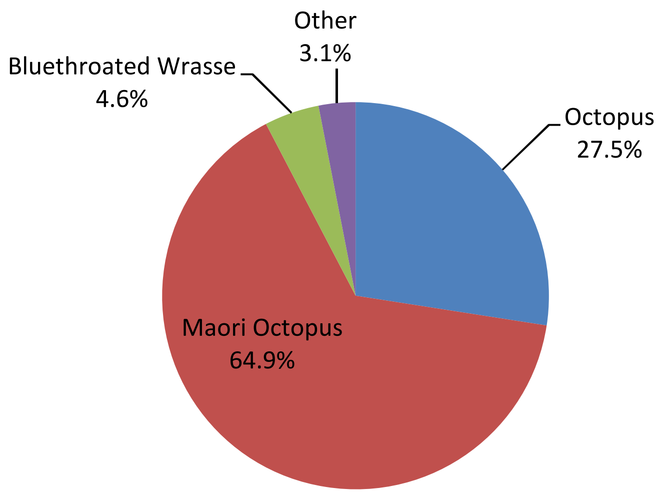


Figure 3.27 Hand collection catch composition for 2014/15.

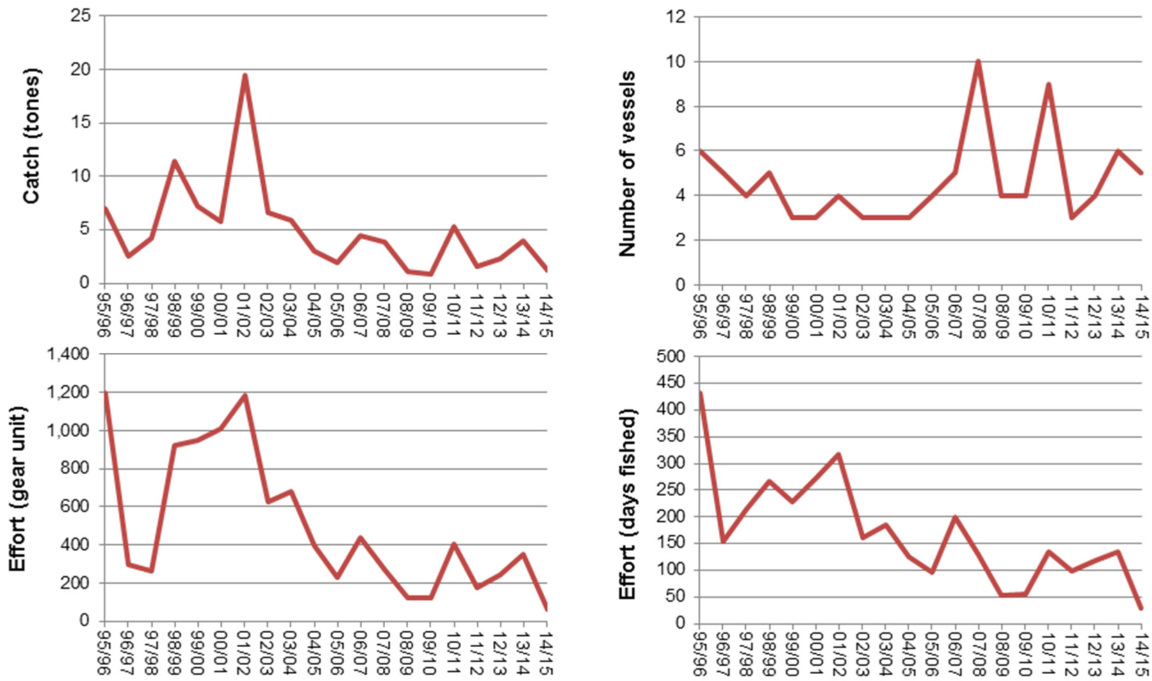
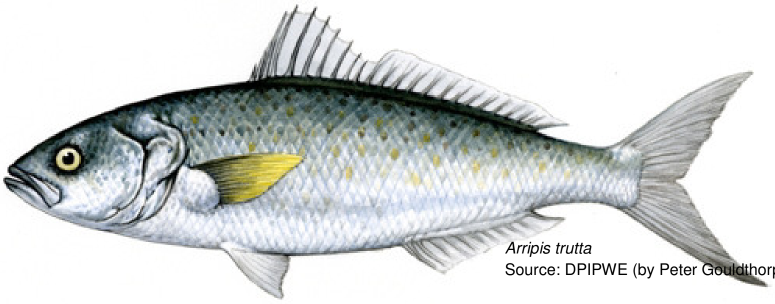


Figure 3.28 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for hand collection.

4. Eastern Australian Salmon

Arripis trutta

STOCK STATUS	SUSTAINABLE
Species has a long history of exploitation across south-eastern Australian. Low commercial landings in Tasmania in 2014/15 are driven by market demand not abundance. The current level of fishing pressure in Tasmania is well below historical levels and unlikely to cause the biological stock to become recruitment overfished.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Arripis trutta
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Open water. Down to 30 m depth.	Edgar (2008)
Distribution	• From Victoria to Queensland (Brisbane) and around Tasmania.	Edgar (2008)
Diet	• Fish (pelagic predominantly)	Stewart et al. (2011)
Movement and stock structure	• One single well-mixed stock along southeast Australia • Travel great distances between the different States • Increased population mixing occurs with both increasing age and decreasing latitude	Stewart et al. (2011)
Natural mortality	• *M* between 0.35 and 0.50.	Stewart et al. (2011)
Maximum age	• Maximum sampled is 12 years but potentially up to 26 years.	Stewart et al. (2011)
Growth	• Maximum length: 89.0 cm. • Maximum weight: 9.4 kg • Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where *L* is the fork length (cm), *t* is the age (years), L_∞ is the average maximum length for the species, *k* is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are: **Sex** / L_∞ / / $t_{0\infty}$ Females / 65.0 / 0.24 / -0.15 Males / 61.3 / 0.27 / -0.13	Edgar (2008) Frimodt (1995) Stewart et al. (2011)
Maturity	• Size-at-50% maturity: 42.13 cm • Age at 50% maturity: 2.19 years	Stewart et al. (2011)

Spawning	• From October to March, off New South Wales. • The relationship between batch fecundity and fork length is exponential with $F = 14581e^{0.0659\,L}$, where *F* is the fecundity (in number of eggs) and *L* is the fork length (cm). • The relationship between batch fecundity and age is exponential with $F = 96604e^{0.227\,A}$, where *F* is the fecundity (in number of eggs) and *A* is the age (in years).	Stewart et al. (2011)
Early life history	• Eggs, larvae and juveniles drift and migrate from spawning grounds to Tasmania and Victorian waters during autumn and winter. • Juveniles (4–6 cm fork length) appear in shallow Tasmanian waters between January and September.	Kailola et al. (1993)
Gillnet post release survival	• Low: 20 – 62% depending on soak duration	Lyle et al. (2014a)

Background

There are two species of Australian Salmon cohabiting in Tasmanian waters: *Arripis trutta* (Eastern Australian Salmon) and *Arripis truttaceus* (Western Australian Salmon). The Eastern Australian Salmon constitute 94% of Tasmanian commercial catches.

Australian Salmon have a long history of exploitation in Tasmania, with large-scale commercial fishing occurring at least since 1958 (Stewart et al. 2011). There are two distinct sectors in the commercial fishery: a small number of large vessels specifically equipped to capture and store large quantities of Australian Salmon, and a large number of small vessels which target the species on an opportunistic basis or take them as by-product. One company operating up to three vessels accounts for around 85% of landings for the species.

Beach seining usually accounts for the majority of the catch, however in 2014/15 it was much more evenly spread between gear types including *inter alia*: beach seine (7.6 t), mesh net (3.5 t), purse seine (5.6 t) and gillnet (5.7 t). Large-scale beach seine operations involve deploying a net around a school of Australian Salmon using a small boat and then hauling the net into the shallows, forcing the fish to the cod-end, which is then transferred to the mother ship. Spotter planes are typically used to locate the schools. Purse seine and gillnetting are often used by smaller operators. A total commercial catch trigger of 435 t (120% of the average annual catch between 1996/97 and 2006/07) applies to the Tasmanian fishery.

Most commercially caught Australian Salmon are frozen whole and sold as rock lobster bait with production levels linked to the demand for bait. Some Australian Salmon are sold fresh for human consumption.

Australian Salmon is the second most commonly captured fish species by recreational fishers (Lyle 2005, Lyle et al. 2009, Lyle et al. 2014b), who mainly use line fishing methods to target the species.

FISHING METHODS	Mainly beach seine, also purse seine and gillnet. Line for recreational.
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, Beach seine licence) • Species licence (Australian Salmon licence) – 8 issued, 1 commonly used. • Spatial and temporal area closures for Australian Salmon licence.

	Output control: • Trip limit of 500kg for operators with Scalefish licences but no Australian Salmon licence. • Possession limit of 30 and bag limit of 15 individuals for recreational fishers • Minimum size (200 mm TL) • Total commercial catch trigger of 435 t
MAIN MARKET	Local and interstate

Current assessment

Catch, effort and CPUE

Following a large catch in 2012/13 (331.3 t) landings were at a historic low of 23 t in 2014/15 (Fig. 4.1). The low catch was due to a dramatic decline in the landings by beach seine fishers that historically landed the majority of the catch. The majority of catch in 2014/15 was caught on the northwest coast, while it was more widespread in previous years across the northeast, northwest and southeast coasts (Fig.4.1A and 4.2). Effort and catch rates remain low (Fig. 4.1B and 4.1C), however it should be noted that catch rate is influenced by the skewed nature of the data (i.e. the majority of catches are small but the total catch is influenced by a small number of extremely large catches). In addition, catch rate is not a particularly sensitive indicator of fish stock condition for schooling species such as Australian Salmon, especially if search time is not taken into account.

Ecological Risk Assessment

In the 2012/13 ecological risk assessment (ERA) of the Tasmanian scalefish fishery, beach seining was considered a very low risk activity with regard to Australian Salmon. Beach seining was also considered a low risk activity with regards to non-retained species as bycatch is usually released alive and “herded” not “meshed/gilled” and a very low risk in regards to the general ecosystem (Bell et al. 2016).

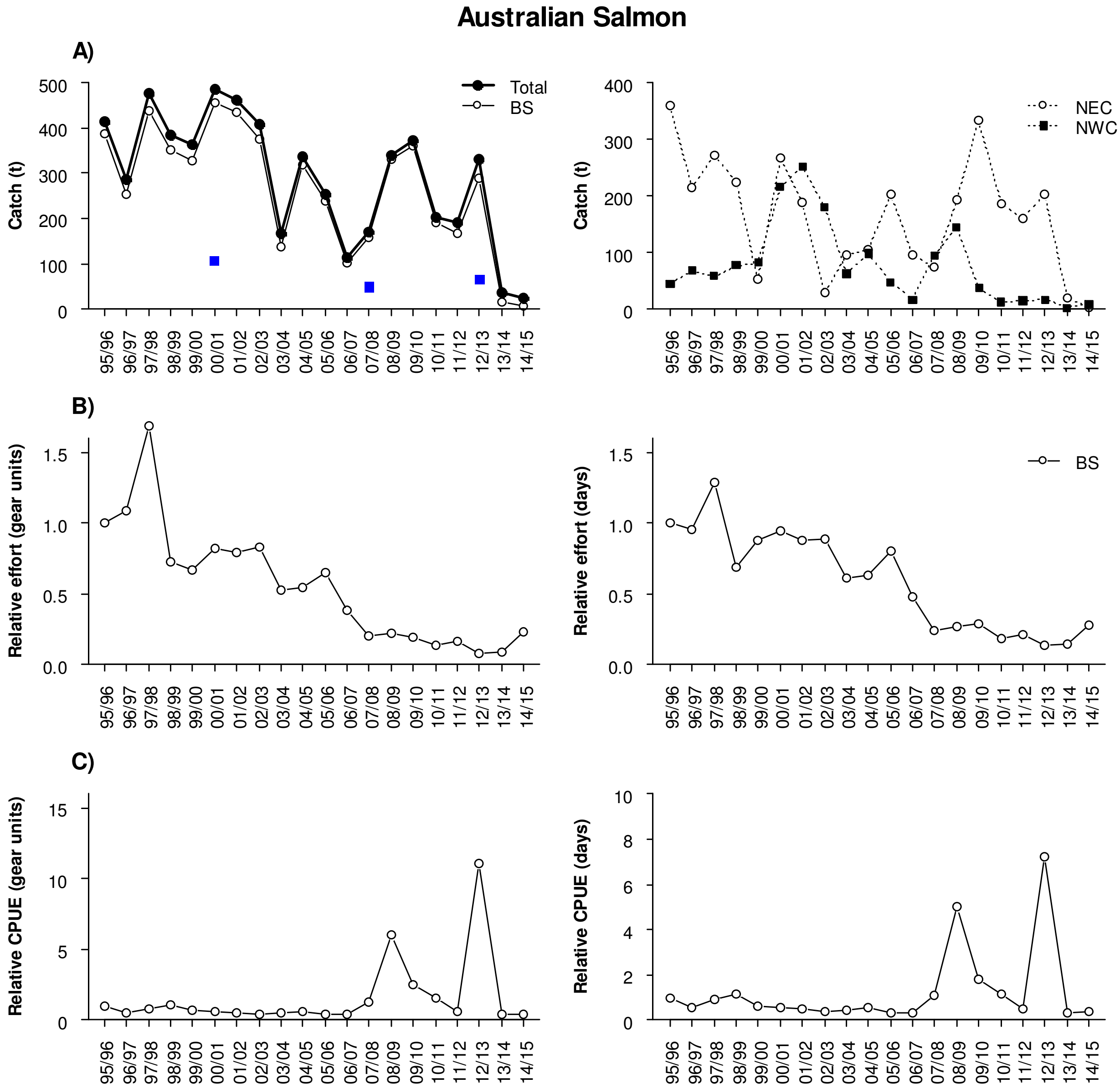


Figure 4.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS= beach seine, NEC= northeast coast, NWC= northwest coast.

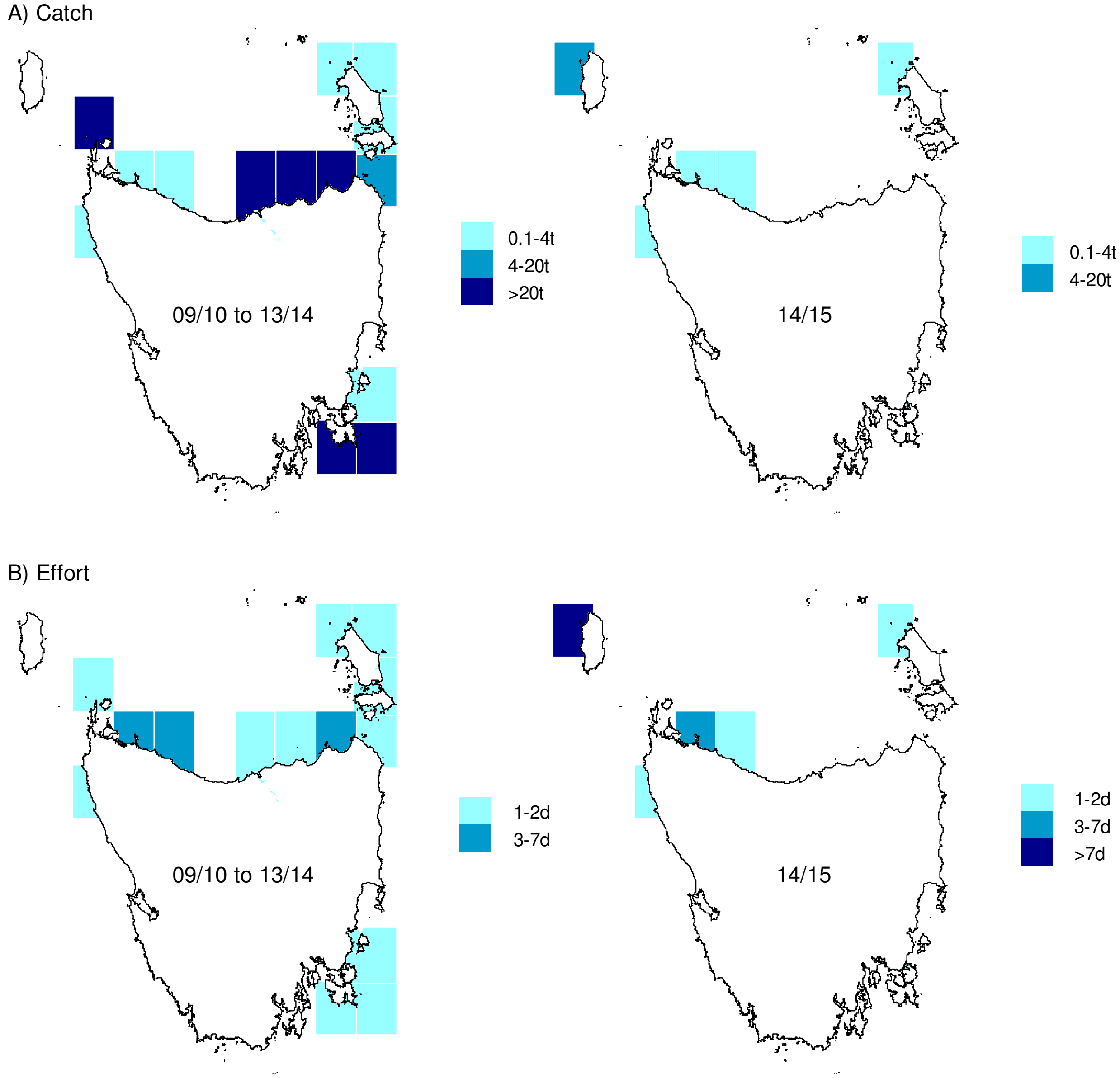


Figure 4.2 (A) Australian Salmon catches (t) and (B) effort (days) by fishing blocks averaged from 2008/09 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Total commercial catch >435 t	No	
	• Catch > higher catch from the 1990/91 to 1997/98 range (878.8 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (287.3 t)	Yes	264.1 t (91.9%)
	• Catch increases by > 30% from previous year (>48.98 t)	No	
	• Catch decreases by > 30% from previous year (<26.38 t)	Yes	3.2 t (12.1%)
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>835 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0196 t/days fished)	No	

Given that catch rates are not a significant indicator of stock status, the biomass performance indicators (based on CPUE and CPUE trends) were not calculated for Australian Salmon.

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Total commercial catch >435 t	No	
	• Catch > 3rd highest catch value from the reference period (462.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (254.2 t)	Yes	231 t (90.9%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (188.7 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (240.1 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (105.2 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (13.8% in 2007/08)	Yes	Latest estimate (2012/13) 19.0%
Stock stress	• Significant change in the size/age composition	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status **SUSTAINABLE**

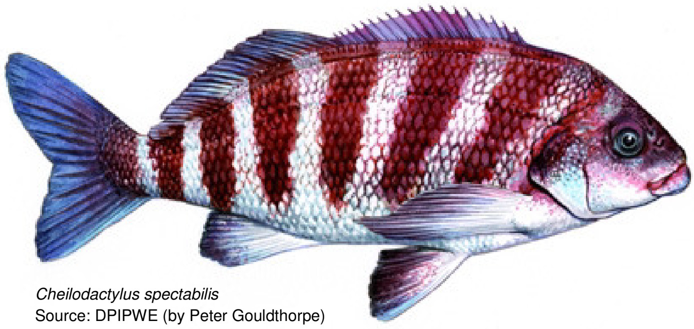
Although several catch reference points were breached as a result of the low landings in 2014/15, annual production of Australian Salmon is strongly linked to the fishing practices of a single operator that is responsible for the overwhelming majority of landings. During the 2014/15 season, this operator was heavily involved in other fisheries and other business ventures and therefore Australian Salmon landings were greatly reduced. Most other beach seine fishers rarely, if at all, target Australian Salmon. Due to the reduced catch, the Rock Lobster industry predominantly relied on Australian Salmon imported from New Zealand for bait. Based on these factors, the reduced catch is not considered indicative of any changes in abundance.

Eastern Australian Salmon represent a single well-mixed stock along southeast Australia and the Tasmanian fishery catches mostly sub-adults. There has been little change in size and age composition in Tasmania or other states (NSW and VIC) suggesting the species is not overexploited. The eastern Australian biological stock is sustainably fished as a whole and the current level of commercial and recreational fishing pressure in Tasmania is well below historical levels and unlikely to cause the biological stock to become recruitment overfished.

5. Banded Morwong

Cheilodactylus spectabilis

STOCK STATUS	TRANSITIONAL DEPLETING
Mature biomass has declined steady since the early 2000s. Modelling indicates fishing pressure at 2014/15 levels will continue to deplete the stock resulting in it becoming recruitment overfished. Reductions in catch quotas have been progressively applied but positive increases in biomass have not yet been observed.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends; changes in size/age composition



Cheilodactylus spectabilis
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

<table>
<tr><th>Parameters</th><th>Estimates</th><th>Source</th></tr>
<tr><td>Habitat</td><td>• Rocky reefs down to 50m depth. Females and juveniles inhabit the shallow section of the reef while males dominate in the deeper section of the reef.</td><td>McCormick (1989a, b)</td></tr>
<tr><td>Distribution</td><td>• South Sydney (New South Wales) to eastern Victoria, Tasmania, New Zealand</td><td>Gomon et al. (2008)</td></tr>
<tr><td>Diet</td><td>• Invertebrates, algae, crabs.</td><td>McCormick (1998)</td></tr>
<tr><td>Movement and stock structure</td><td>• Limited movement of juveniles and adults, generally restricted to within 5km of the release site
• No information on the stock structure</td><td>Murphy & Lyle (1999)
Ziegler et al. (2006)
Buxton et al. (2010)</td></tr>
<tr><td>Natural mortality</td><td>• Low. Estimated at M=0.05</td><td>Murphy & 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 described by a Schnute-Richards growth function
$L = L_{\infty}(1 + \alpha^{(-at^{c})})^{-\frac{1}{b}}$ where L is the length (mm), t is the age (years), L_{∞} is the average maximum length for the species and α, a, b and c are (year-specific) constants.
The most recent parameters estimates (2007) are:
<table>
<tr><th>ex</th><th>L_{∞}</th><th></th><th>b</th><th>c</th><th>α</th></tr>
<tr><td>Female</td><td>442</td><td>18.8</td><td>$3.3e^{-7}$</td><td>0.05</td><td>51.4</td></tr>
<tr><td>Males</td><td>516</td><td>2.3</td><td>0.0088</td><td>0.33</td><td>0.1</td></tr>
</table></td><td>Schnute & Richards (1990)
Ziegler et al.(2007a)</td></tr>
</table>

	• Length-weight relationship for 2007 was estimated at $W = 3.563E^{-5}L^{2.875}$ for females and $W = 3.729E^{-5}L^{2.852}$ for males, where W is weight (g) and L is the fork length (cm).	
Maturity	• Size-at-50% maturity estimated at 320 mm for females (~2.5 years of age).	Ziegler et al.(2007a)
Spawning	• Spawning occurs between mid-February to late May. • Species is a serial spawner.	Murphy & Lyle (1999)
Early life history	• Eggs and larvae are concentrated on the surface. • Banded Morwong has a pelagic stage distributed offshore, as suggested by the large amounts of larvae caught off the shelf break of eastern Tasmania. • Juveniles appear in shallow water on rocky reefs and tide-pools between September and December, after a pelagic phase of 4-6 months.	B. Bruce, Pers. Com. Wolf (1998)
Gillnet post release survival	• High: 97% irrespective of gillnet soak duration	Lyle et al. (2014a)

Background

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, with reported catches peaking at 145 t in 1993/94. Since then, catches have stabilised around 30 - 40 t. A quota management system with a Total Allowable Catch (TAC) was introduced in 2008 (see Fig. 5.1 for areas). Up to and including the 2015/16 quota year a given number of fish were allocated to each quota unit and the tonnage associated with the TAC was inferred. From 2016/17 onwards quota will be set in weight. The TAC is currently undergoing a staged reduction as follows:

Quota year	TAC (in t)	TAC (in no. fish)	No. of Fish/Quota Unit	Kg / Quota Unit
2012/13	38.8	29,825	25	-
2013/14	37.2	28,632	24	-
2014/15	35.7	27,439	23	-
2015/16	35.7	27,439	23	-
2016/17	32.2	N/A	-	27

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. 5.5). 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 5–20 m depth range. Any catches taken by commercial fishers who do not hold Banded Morwong quota are required to be released. High release rates are also a characteristic of the recreational fishery, with recreational landings of between 1 and 2 t per year. Post-release survival under current maximum permitted gillnet soak durations is very high (Lyle et al. 2014a).

FISHING METHODS	Mainly graball net
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Species licence (Banded Morwong licence) • Temporal closure (March-April)

	Output control: • Possession limit of 4 and bag limit of 2 individuals for recreational fishers • Minimum and maximum size (360-460 mm TL) • TAC of 27,439 fish (35.7 t) for the 2015/16 licensing year
MAIN MARKET	Interstate

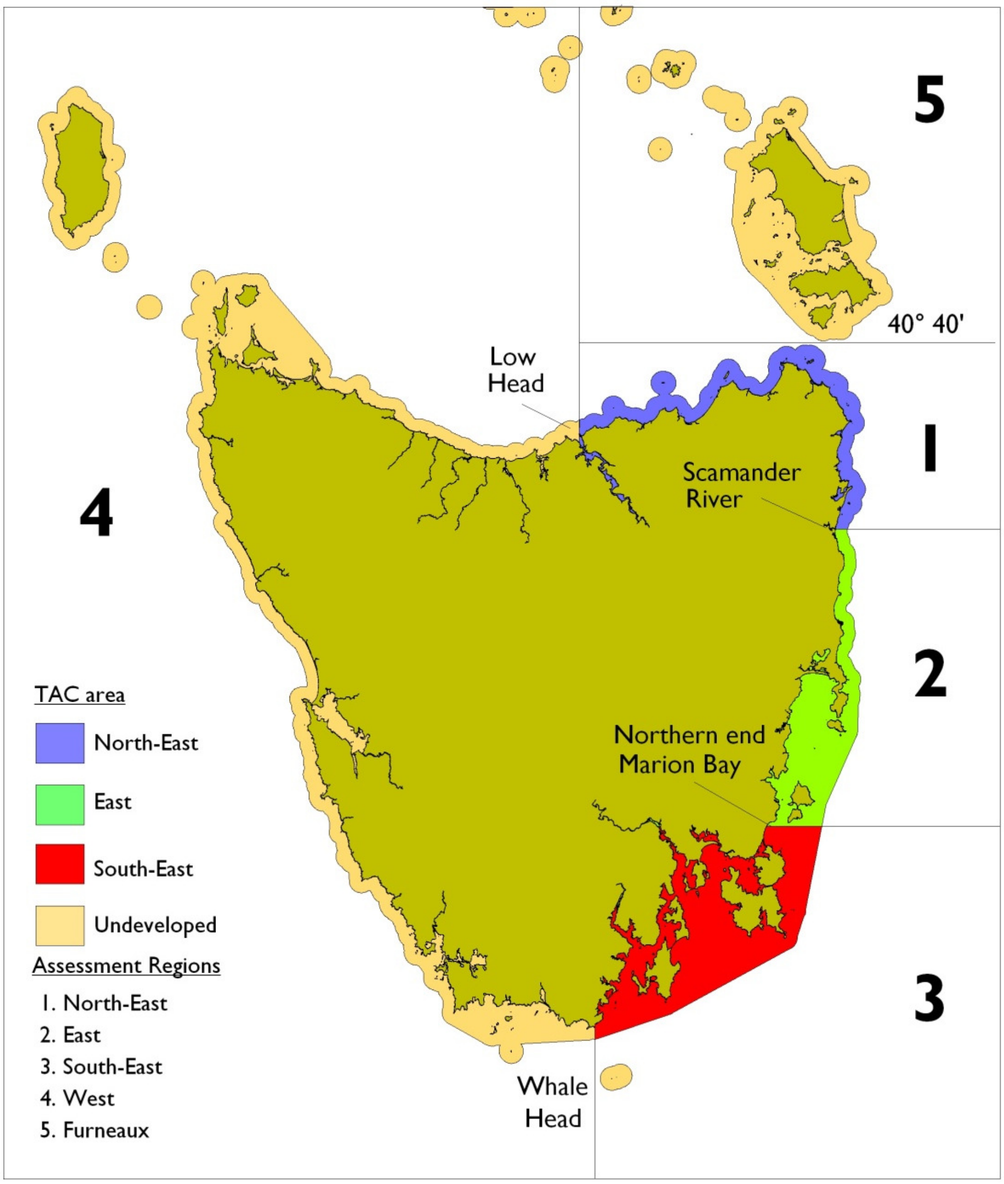


Figure 5.1 Designated TAC areas for Banded Morwong (Areas 1, 2 and 3) from Low Head on the north coast to Whale Head in the south. Areas 4 and 5 are currently undeveloped.

Current assessment

Biological characteristics

Size composition

Significant changes in the size composition between the late 1990s and the early 2000s raised concerns about the Banded Morwong stock (Fig. 5.2 and Ziegler et al. 2007a). Size composition appears to have stabilised since, with average size of Banded Morwong around 36 cm with fewer large, legal size, fish being present in landings (Fig. 5.2). Comparison between average growth curves show that there are fewer differences between female growth curves post-2007 than between growth curves pre-2007, suggesting that the acceleration of growth (which was evident in the early 2000s) may also have stabilised.

Age composition

Age composition also showed signs of change from the late 1990s (Fig. 5.2 and Ziegler et al. 2007a). The age structure is now dominated by young fish around 4–5 years old (Fig. 5.2). There are relatively very few individuals older than 15 years old in current population samples compared to the late 1990s.

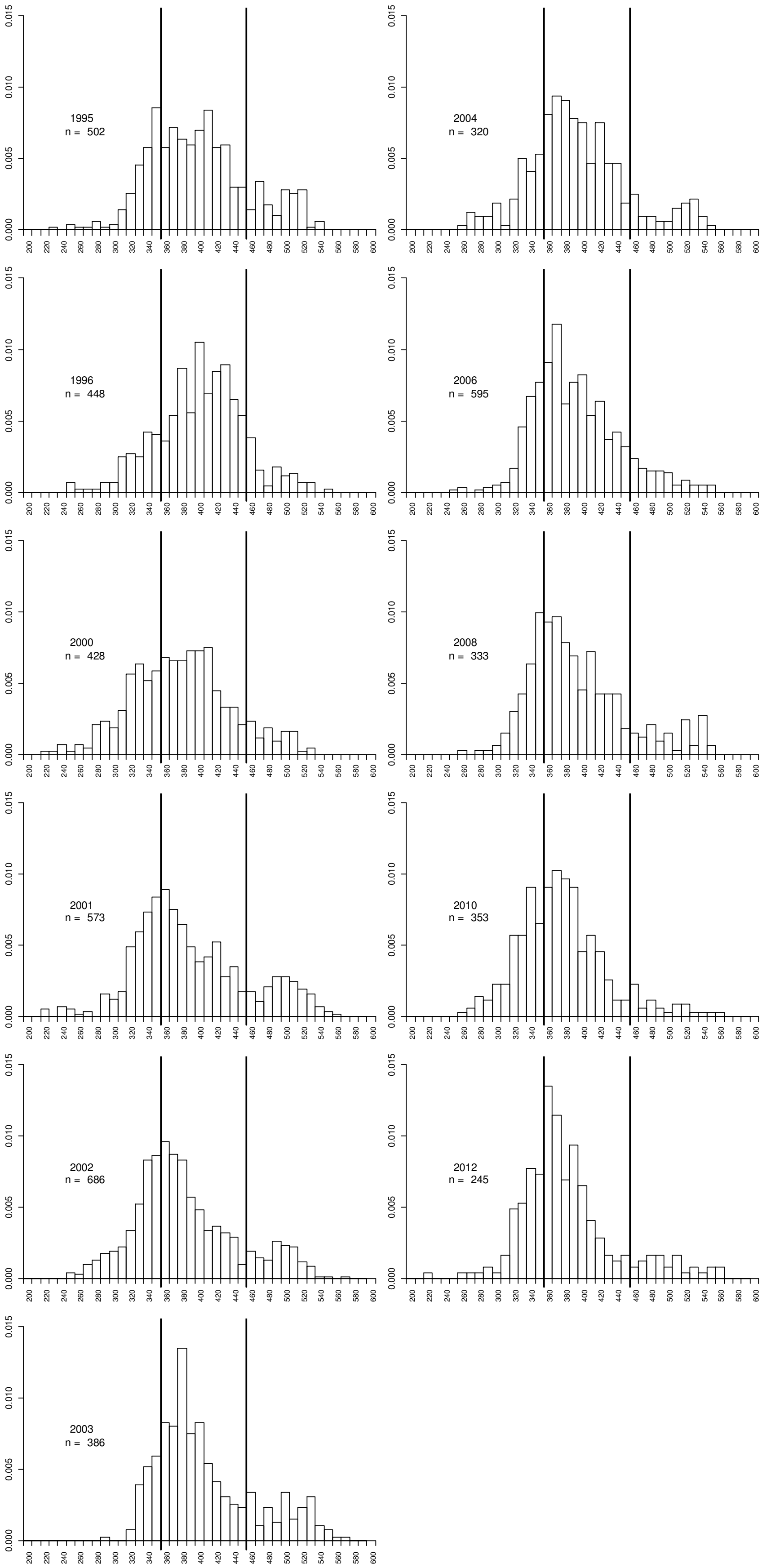


Figure 5.2. Size composition of Banded Morwong by year. *n* is the sample size, the solid lines represent the minimum and maximum size limits. Year is the year in which the majority of that quota season involved, i.e. 2012 is the 2012 quota season beginning May 2012 and finishing February 2013.

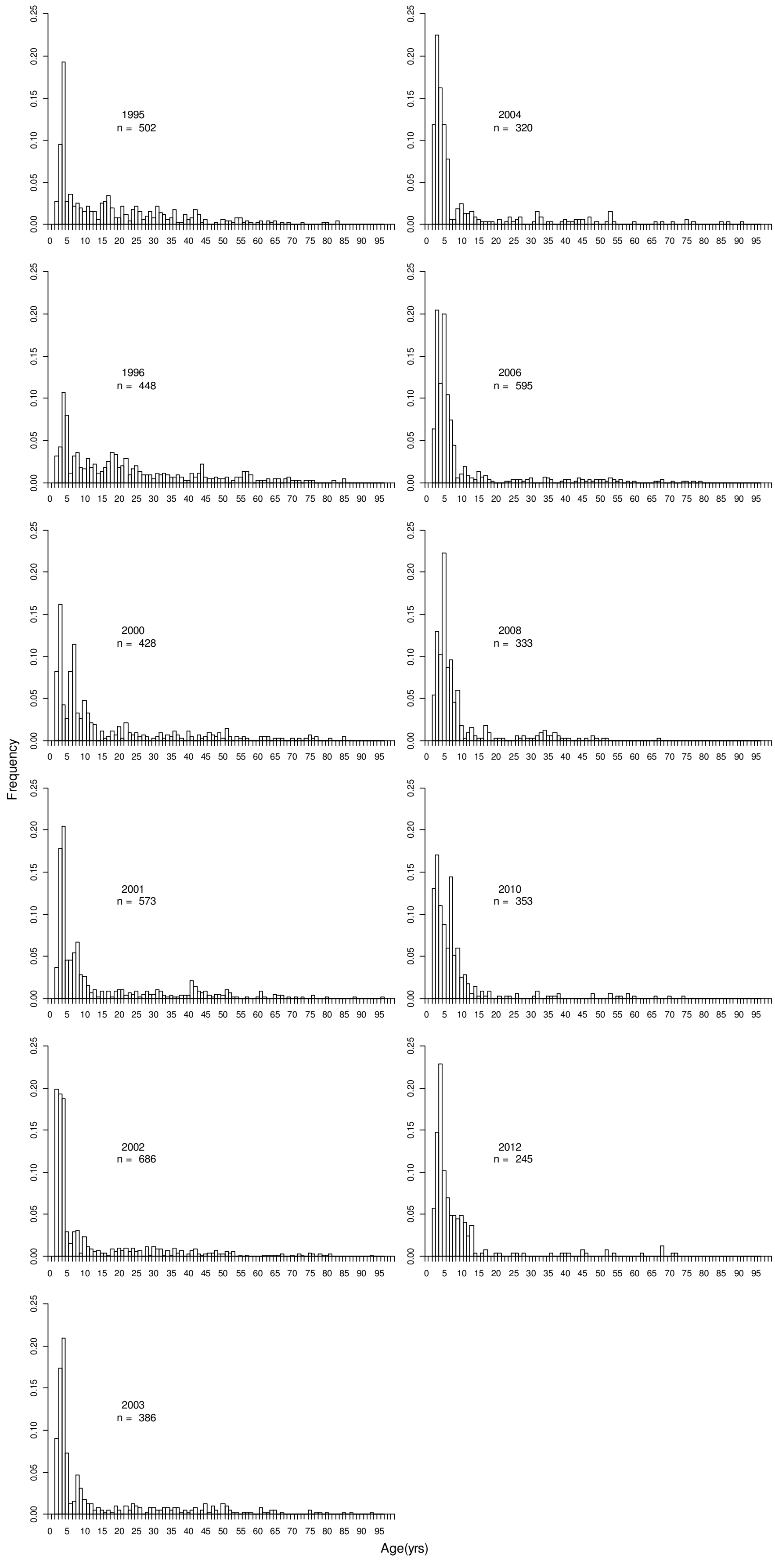


Figure 5.3 Age composition of Banded Morwong by year. *n* is the sample size. Year is the year in which the majority of that quota season involved, i.e. 2012 is the 2012 quota season beginning May 2012 and finishing February 2013.

Catch, effort and CPUE

The assessment year for Banded Morwong is based on the quota year (1st March to end of February the following year) rather than fishing year (July to June) as for the other scalefish species. The present Banded Morwong assessment includes data up to and including the 2014/15 quota year (which ended February 28, 2015). Note that Banded Morwong catch figures elsewhere in this report are reported for fishing years to allow for comparison between species.

Commercial catches under the quota system are reported as numbers of fish rather than weight, which are then converted to weight based on an average of 1.3 kg per fish. State-wide catches have been relatively stable since the introduction of the quota system in 2008/09, and in 2014/15 were estimated at 31.9 t (Fig. 5.2). The total catch in the TAC area (Region 1–3 in Fig.5.1) was 30.3 t (10.8 t in 1 and 11.1 t in 2 and 8.4 t in 3), which represented 85% of the 2014/15 TAC.

In 2014/15, catches in Region 3 (SEC), which had been previously stable over time, declined by 3.7 tonnes. Catches in Region 2 (EC) also declined by 3.1 tonnes from the previous season. Conversely, catches in Region 1 (NEC) increased by 4.4 tonnes over the previous fishing season (Fig. 5.2 and Fig. 5.4).

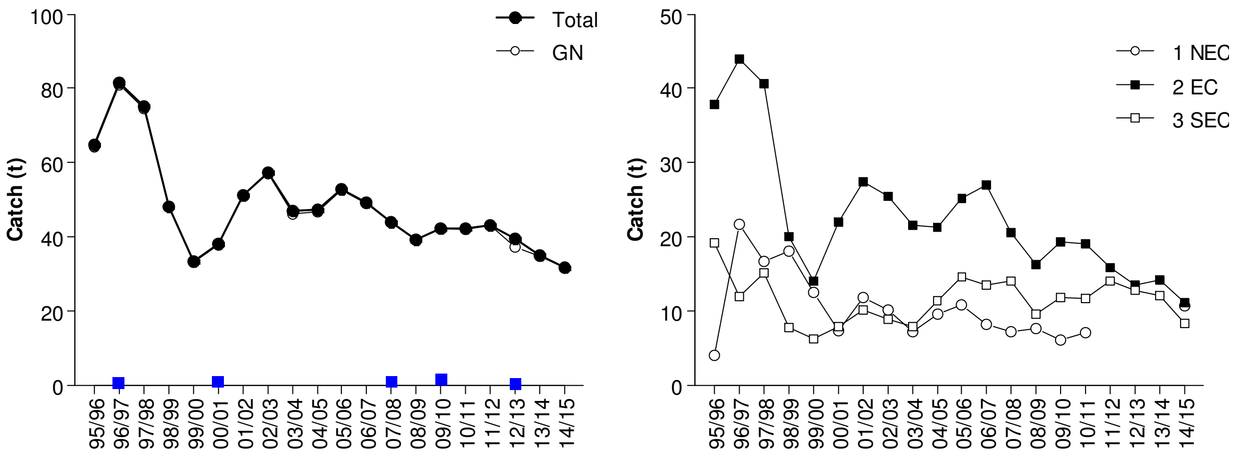


Figure 5.2 Banded Morwong commercial catches (t). Left: Total state-wide (Total) and graball net (GN) catches, and best estimates of recreational catches (blue squares); Right: regional graball net catches in the TAC areas 1 NEC, 2 EC and 3 SEC. Note: catches in the NEC post 2010/11 are confidential due to less than five vessels being active.

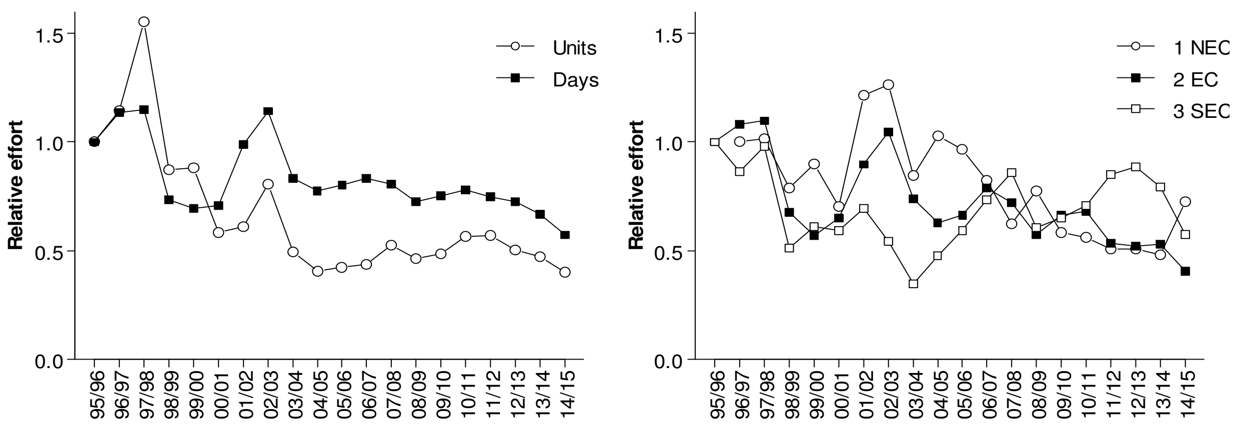


Figure 5.3 Left: State-wide commercial effort by method based on gear units and day fished relative to 1995/96. Right: Relative effort in day fished in the TAC areas 1 NEC, 2 EC and 3 SEC.

In 2014/15 effort in both days fished and gear units (100m net hour) decreased compared to 2013/14 (Fig. 5.3). Fishers have progressively reduced their fishing activity and deployed less gear on average for each day fished over the last 10 years (Fig. 5.4). Increasing levels of seal interactions over time has driven affected fishers to fish with less gear or doing fewer sets each day to reduce losses to seals (Ziegler et al. 2006).

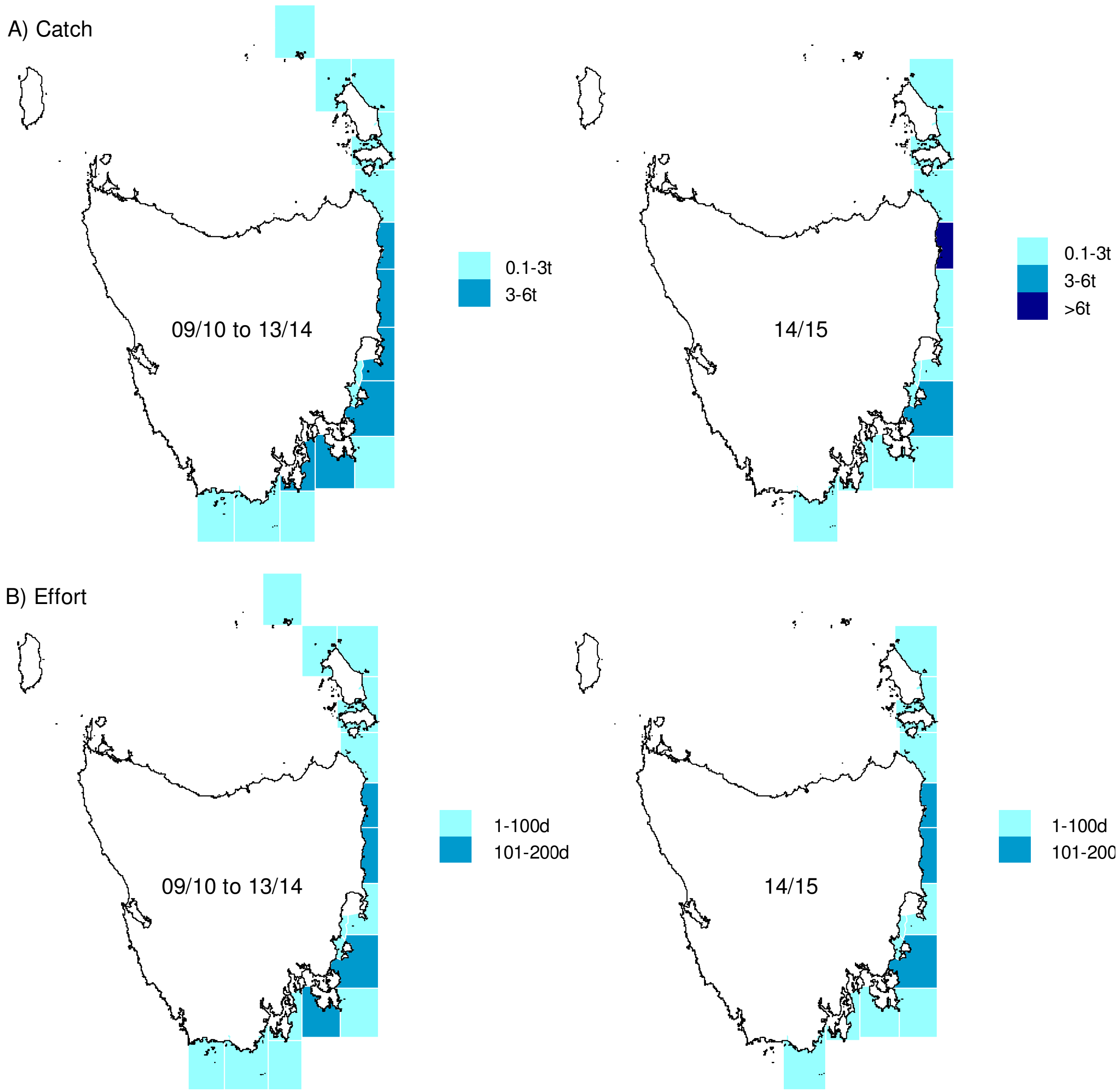


Figure 5.4 (A) Banded Morwong catches (tonnes per year) and (B) effort (days per year) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Overall standardised catch rates in the whole TAC area fell between 1995/96 and 1999/2000, before rising back to the 1995/96 levels (Fig. 5.5). In 2010/11 however, catch rates sharply declined to a level in 2012/13 where they were just over half of 1995/96 levels. Catch rates increased across the whole TAC area in 2013/14 and 2014/15 to about 70% of the 1995/96 level. Region 1 (NEC) saw an increase in catch rates between 2009/10 and 2010/11 to levels comparable to the late 1990s, however in 2011/12 catch rates declined sharply before trending up in 2013/14 and 2014/15. Region 3 (SEC) also saw an increase in catch rates between 2009/10 and 2011/12 before catch rates fell in 2012/13 to their 2nd lowest level since 1995/96 and have remained at this low level since then. Region 2 (EC) catch rates remained relatively stable between 2000 and 2010 before declining to record lows in 2012/13. In the last two years there has been a slight increase in catch rates although they remain low relative to historic levels.

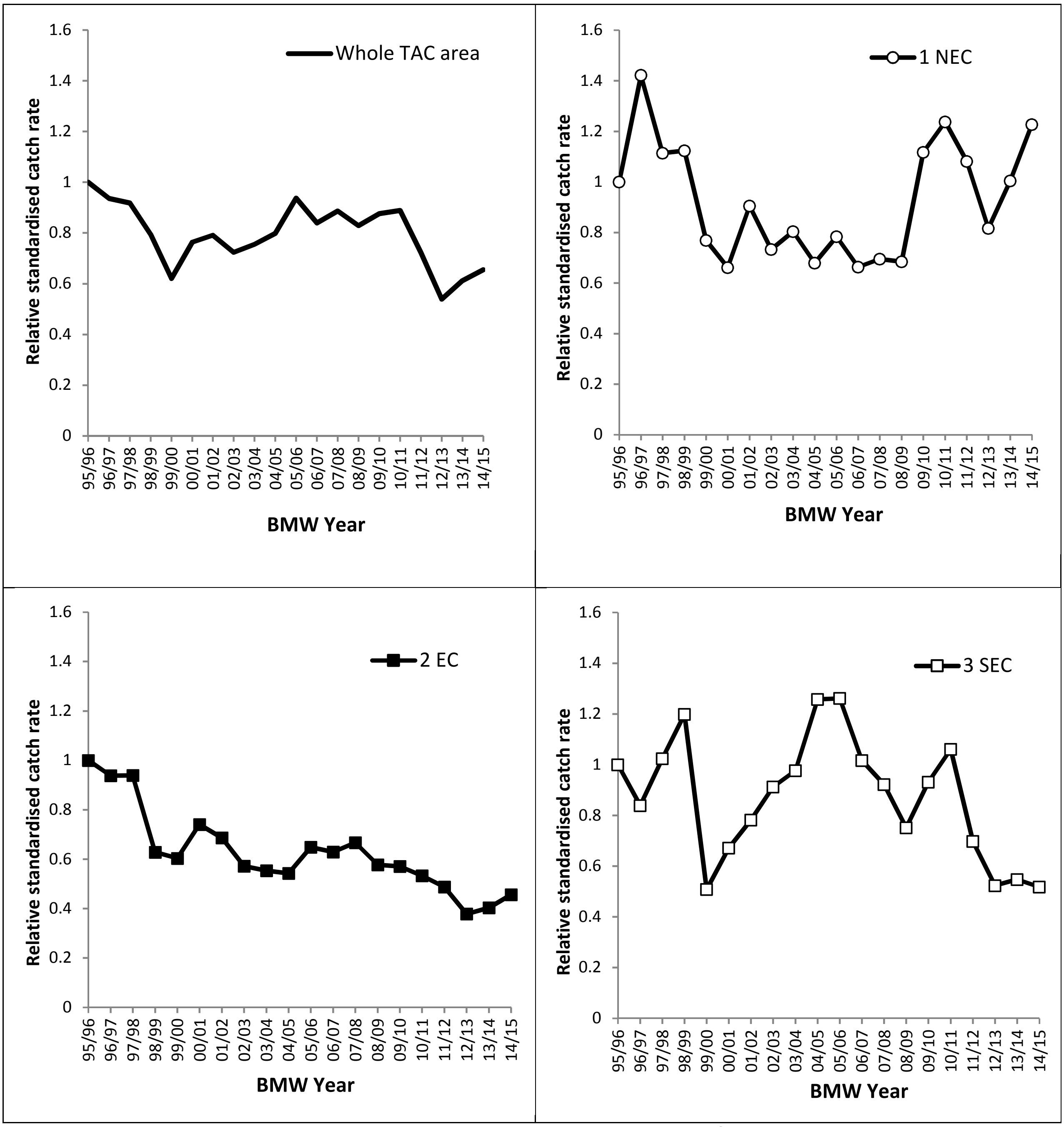


Figure 5.5 Banded Morwong standardised graball catch per unit effort (CPUE by days fished) relative to 1995/96, from the whole TAC area (top left), and in the TAC areas 1 NEC, 2 EC and 3 SEC (bottom left and right).

Selected stock assessment results

For the 2014/15 assessment the Banded Morwong population model was re-implemented in CASAL (Bull et al. 2012). The CASAL framework is a widely used for fisheries assessments, including most of New Zealand’s fish stocks. The implementation of the Banded Morwong model in CASAL is mathematically equivalent to previous model (Ziegler et al. (2007b)). Utilising CASAL has improved the robustness of the model and improved the ability to evaluate alternative management strategies.

The model was used to estimate biomass trajectories through to the present and into the future under various catch scenarios. Separate analyses were done in each of the three quota regions and combined over the whole quota region.

For the individual regions the catch scenarios considered were based on the minimum, mean and maximum catches in the last three years, this provides some indication of the spatial variability in catch and the likely under-catch relative to the TAC. Figure 5.6 shows the percentage of the virgin spawning stock biomass that remains from 1990 to the present and projected onwards to 2025. This shows the initial sharp decline (as expected in any developing fishery) and after some increases in the mid-2000s (particularly the South East), a gradual ongoing decline. The East Coast appears to have stabilised above the reference level of 30% and may experience stock rebuilding under future catch scenarios. In contrast the North East and South East are estimated to be below the reference level and under most scenarios are likely to experience ongoing spawning stock biomass declines.

The estimate for the East Coast has remained consistent with the 2013/14 assessment, whilst the estimate for the South East Coast has decreased substantially. The latter is primarily due to record low CPUE in recent years and an increased estimate of initial biomass levels. It should also be noted that stock assessments for a fishery of this size are prone to variability due to limited data availability, hence a greater emphasis should be placed on the whole of fishery model for TAC setting purposes.

For the whole quota region three additional scenarios - 27t, 28t and 29t – were considered in addition to scenarios based on recent catches. Given recent quota under-catches of approximately 15%, the TACs required to achieve the 27t, 28t and 29t catch scenarios are respectively estimated at 31.8t, 32.9t and 34.1t. Figure 5.7 shows the probability of exceeding the 30% spawning stock biomass limit reference point under each of these scenarios. The 27t catch scenario achieves this limit reference point with the required 90% in five years (2021) whilst 28t nearly achieves this and the other scenarios do not (see Table 5.1).

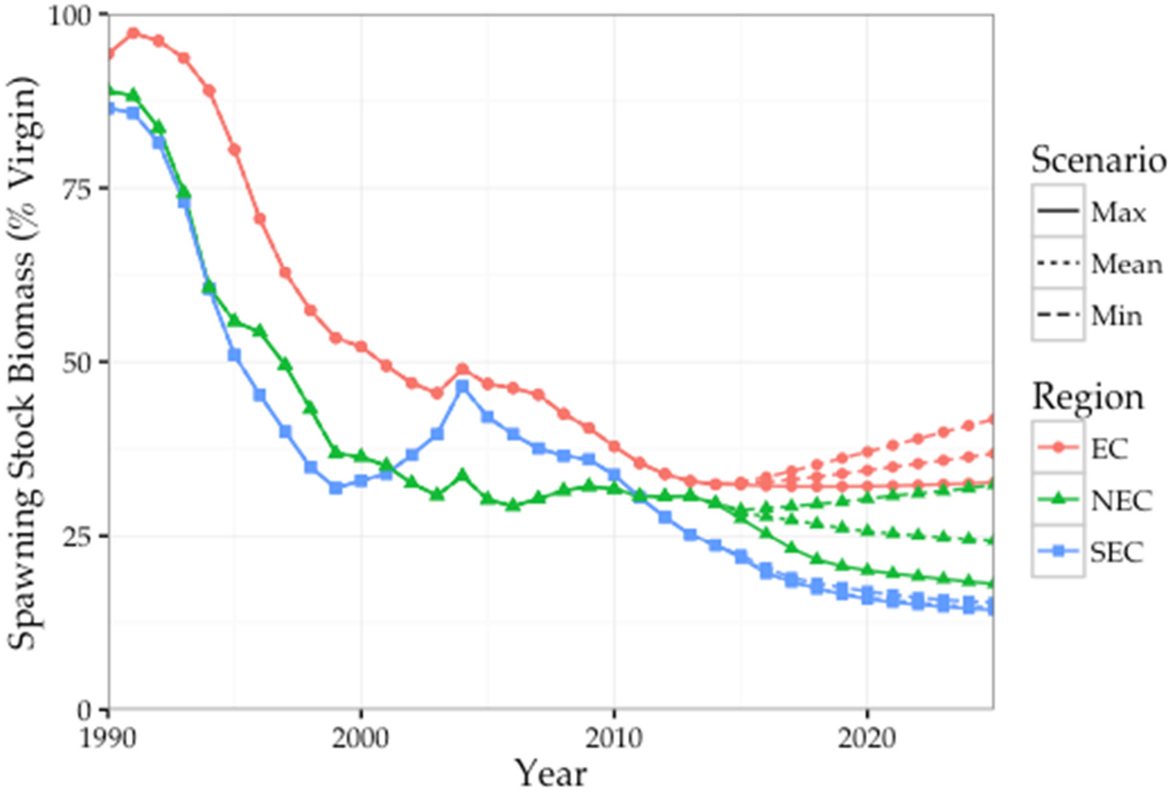


Figure 5.6 The banded morwong spawning stock biomass expressed as a percentage of the unfished spawning stock biomass. Future scenarios considered are the minimum, mean and maximum catches in each of the three quota regions over the last three years.

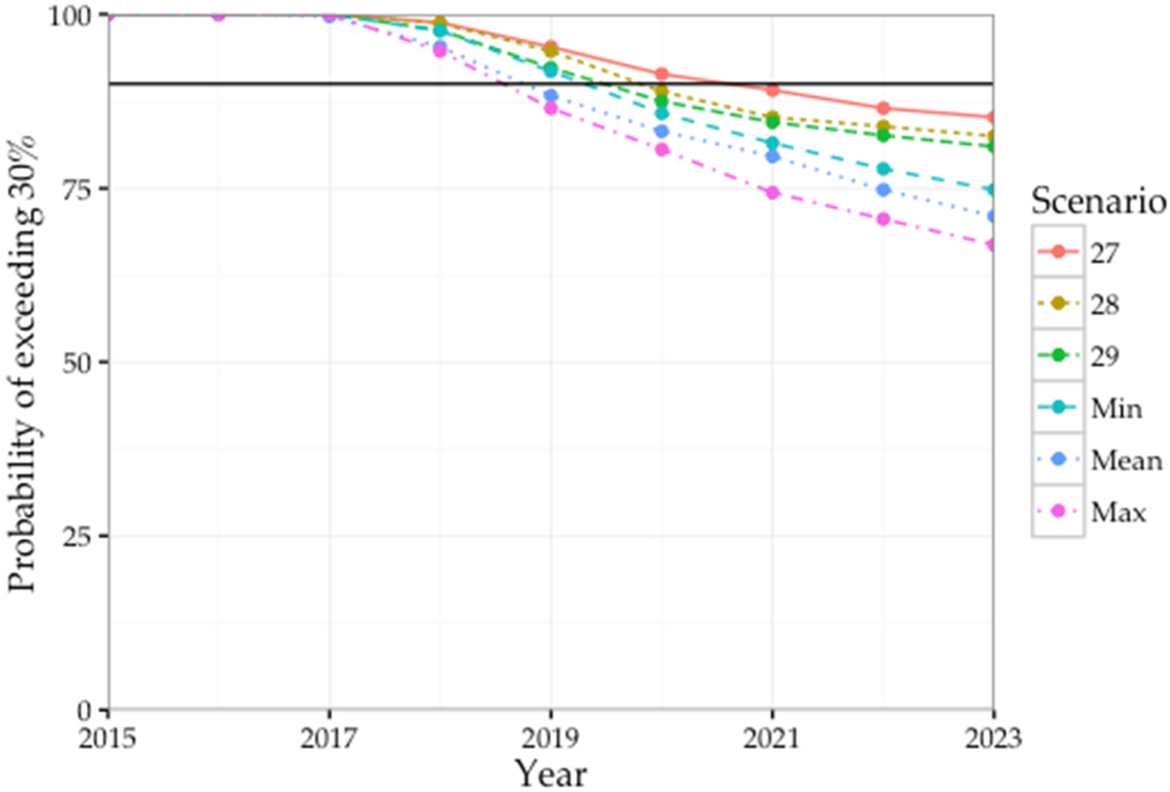


Figure 5.7 The probability of exceeding the 30% spawning stock biomass limit reference point under three different catch scenarios for the quota area. The scenarios are 27t, 28t, 29t, the minimum catch over the last three years (30t), the mean catch over the last three years (31.5t) and the maximum catch over the last three years (32.8t). The limit reference point must be exceeded in five years (2020) with a 90% probability (as shown by the dark horizontal line), this is almost achieved by 28t.

Table 5.1 Probabilities of the mature biomass being above 30% of the virgin biomass (with a 90% probability) in five years (2020 under various catch scenarios.

Region	31.8t TAC (27t catch)	32.9t TAC (28t catch)	34.1t TAC (29t catch)	Min (30t catch)	Mean (31.5t catch)	Max (32.8t catch)
Quota Area	91	89	88	86	83	81

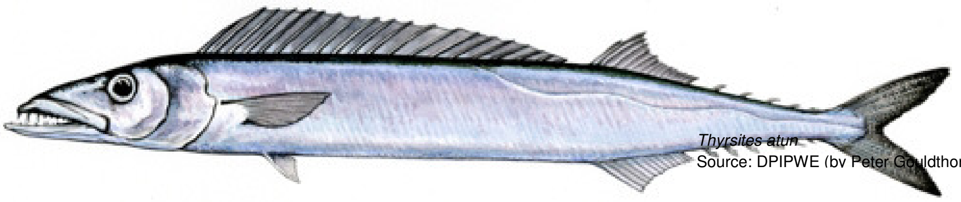
Stock status **TRANSITIONAL DEPLETING**

The stock is not yet considered to be recruitment overfished; modelling indicates that fishing pressure at 2014/15 levels will continue to deplete the stock resulting in it becoming recruitment overfished in the near future. As a result, reductions in catch quotas have been progressively applied to halt the biomass decline, however a positive increase in biomass resulting from previous catch reductions has not yet been observed. Due to the biological characteristics of Banded Morwong, stock recovery is expected to be a slow process. The above evidence indicates that the level of fishing pressure applied up to and including 2014/15 is likely to cause the stock to become recruitment overfished. Nevertheless, the modelling here suggests that a catch of 28 t or less should result in biomass increases. If a catch below this level is achieved and the corresponding biomass increases are observed, a future assessment would result in a sustainable classification.

6. Barracouta

Thyrsites atun

STOCK STATUS	NOT ASSESSED
Catches of Barracouta have been declining steadily since the mid-2000s due to a decrease in targeted effort as a result of a lack of market opportunities. Catch rates are not considered indicative of stock status and the status of the stock is uncertain.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Thyrsites atun
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Open water and coastal bays. Down to 550 m depth.	Edgar (2008) Kailola et al. (1993)
Distribution	• From midwestern Australia to south Queensland, and around Tasmania. Also widely in the southern hemisphere in temperate latitudes.	Edgar (2008)
Diet	• Pelagic crustaceans, cephalopods, fishes (e.g. anchovy and Jack Mackerel)	Nakamura and Parin (1993)
Movement and stock structure	• Schooling fish • Some stocks undertake annual migrations lasting 6–9 months and covering several hundreds of km. • Also moves through the water column from 200 m depth to the surface • At least 5 stocks: 3 in southeastern waters, 1 in South Australia and 1 in Western Australia	Paul (2000) Kailola et al. (1993) Blackburn and Gartner (1954)
Natural mortality	• $M = 0.3$	Hurst et al. (2012)
Maximum age	• At least 10 years, potentially up to 15 years.	Kailola et al. (1993) Hurst et al. (2012)
Growth	• Maximum length: 1.4 m • Maximum weight: 6 kg • Growth described by von Bertalanffy growth function $L = L_{\infty}\left(1 - e^{-k(t-t_0)}\right)$ where L is the fork length (cm), t is the age (years), L_{∞} is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are : **Sex** | L_{∞} | k | $t_{0\infty}$ Combined | 91 | 0.42 | -0.25	Edgar (2008) Nakamura and Parin (1993) Grant et al. (1978) Blackburn (1960)

	• Length-weight relationship was estimated at $W = 0.1064\ L^{2.2385}$ for females and males combined where *W* is weight (g) and *L* is the fork length (cm).	
Maturity	• Sexual maturity at about 50–60 cm FL and about 2–3 years of age	Hurst et al. (2012)
Spawning	• October to March in Tasmania	Kailola et al. (1993)
Early life history	• Little data. Eggs are pelagic and juveniles inhabit sheltered waters of southern bays and estuaries.	Kailola et al. (1993) Hurst et al. (2012)
Gillnet post release survival	• NA	

Background

Barracouta used to be the subject of a large commercial trolling fishery in Tasmania in the 1960s and 1970s, with catches ranging from 600 – 1 600 t (Kailola et al. 1993). Demand for Barracouta, however, declined in the mid-1970s and there is now little commercial fishing for the species. Barracouta abundance also fluctuates greatly in State waters annually.

FISHING METHODS	Mostly troll and hand-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) **Output control:** • Possession limit of 30 and bag limit of 15 individuals for recreational fishers
MAIN MARKET	Local

Current assessment

Catch, effort and CPUE

Trolling is the main fishing method used to target Barracouta. Catches peaked in the early 2000s with maximum of 132.1 t but gradually declined from 2004/05 to 1.1 t in 2013/14, with a total of 1.7 t landed in 2014/15 (Fig. 6.1A). Catches and fishing effort were traditionally concentrated off southern Tasmania; however during 2013/14 and 2014/15 catch and effort was concentrated off the north coast (Fig. 6.2).

After the peak in the early 2000s, effort declined and has stabilised since 2007/08 at a low level (Fig. 6.1B). Catch rates have been relatively stable over time but have been at their lowest levels in 2014/15 (Fig. 6.1C); however, it is likely that fishers utilising fishing gears historically used to target Barracouta are now targeting other species and as a result, catch rate is unlikely to be a reliable indicator of abundance.

Barracouta are targeted and also taken as by-product by the recreational sector. Catches were estimated at 46.9 t in 2000/01 (Lyle 2005), 10.8 t in 2007/08 (Lyle et al. 2009) and 31 t in 2012/13 (Lyle et al. 2014b), the latest estimate being considerably greater than the commercial harvest in recent years.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, trolling was considered a negligible risk activity with regard to Barracouta, by-product species, non-retained species and the general environment (Bell et al. 2016).

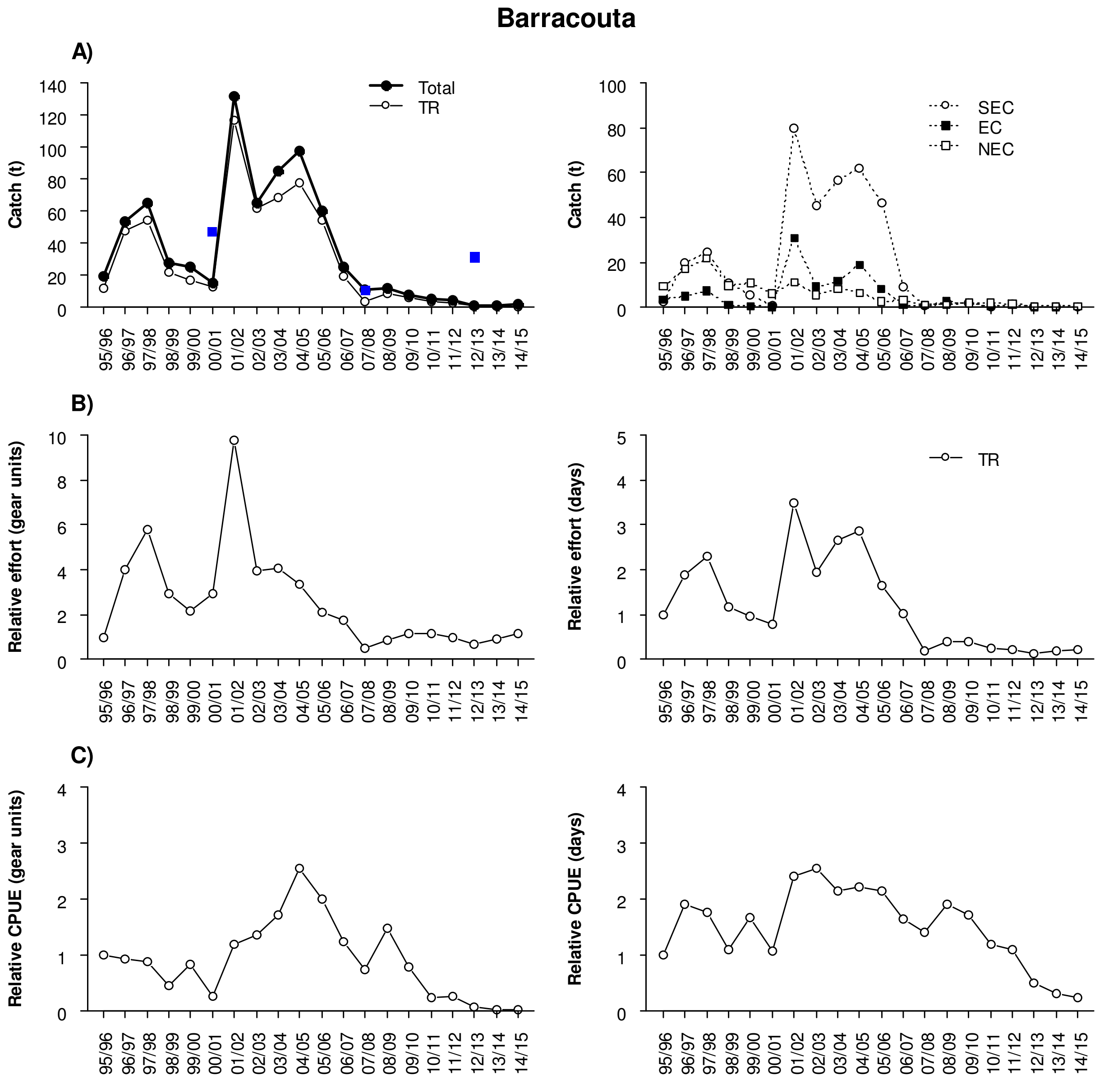


Figure 6.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. TR= troll, HL= hand-line, SEC= southeast coast, EC= east-coast.

A) Catch

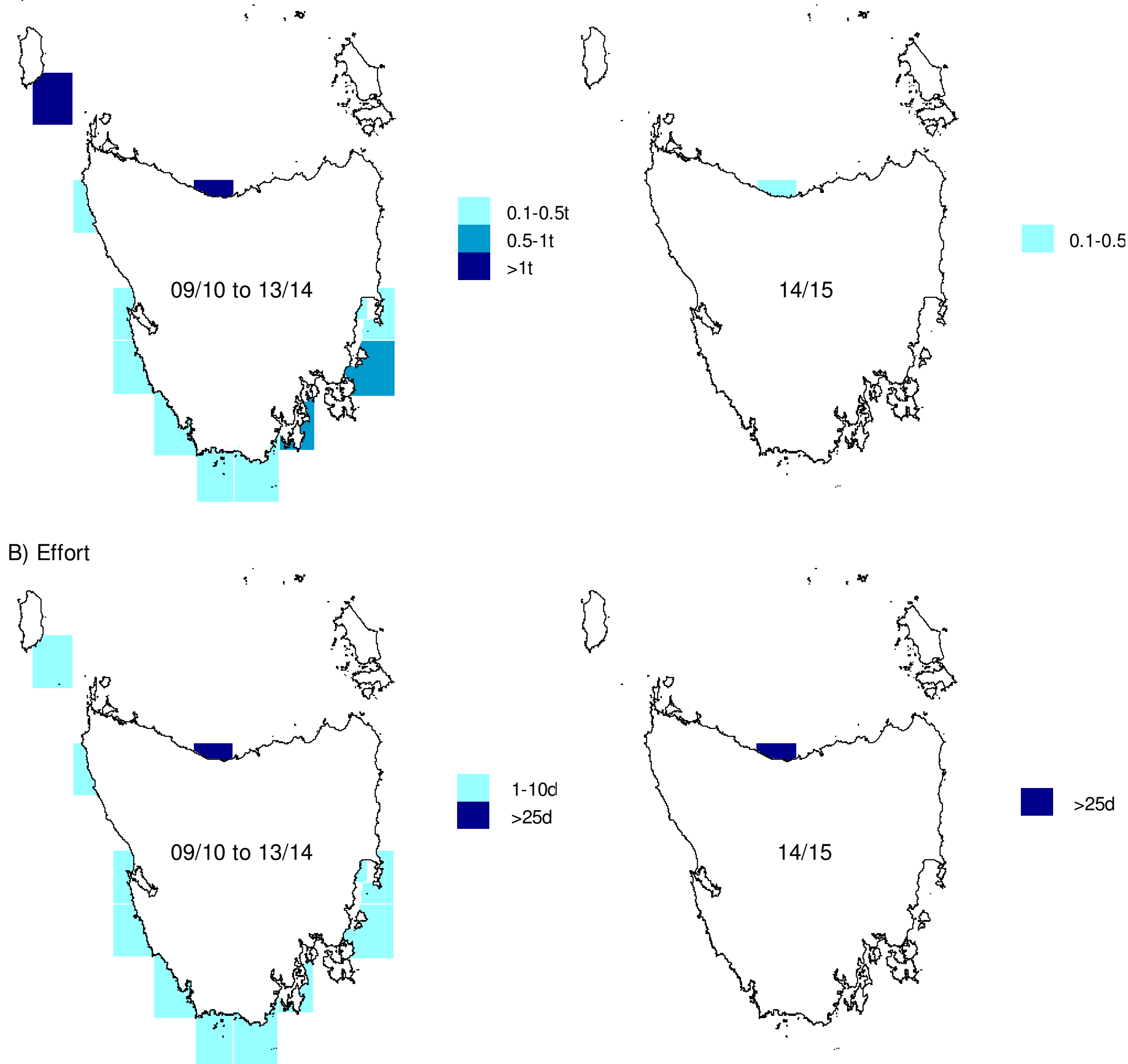


Figure 6.2 (A) Barracouta catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (351.5 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (19.3 t)	Yes	17.6 t (91.2%)
	• Catch increases by > 30% from previous year (>1.46 t)	Yes	0.2 t (13.7%)
	• Catch decreases by > 30% from previous year (<0.78 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>773 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0145 t/days fished)	Yes	0.006 t/days fished (44.2%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (85.2 t)	No	
	• Catch < 3rd lowest catch value from the reference period (25.0 t)	Yes	23.3 t (93.2%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (46.9 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (43.8% in 2007/08)	Yes	Latest estimate (2012/13): 96.6%
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0085)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status

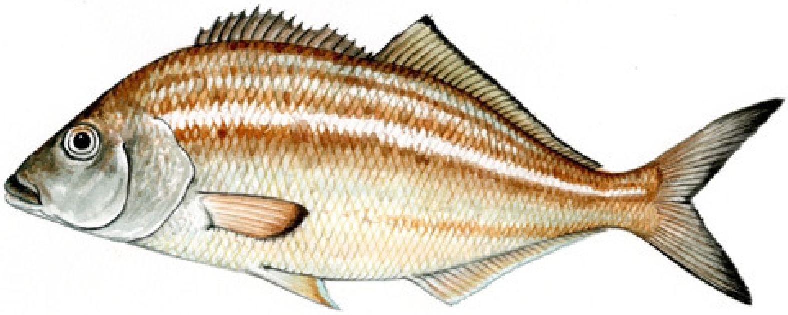
NOT ASSESSED

Historically, the population of Barracouta has undergone large fluctuations in population size and availability, possibly linked to recruit variability and environmental factors. Catches of Barracouta have been declining steadily since the mid-2000s due to a decrease in targeted effort as a result of a lack of market opportunities. The increase in recreational catch proportion mainly reflects the sharp fall in commercial landings rather than increased targeting by recreational fishers. Consequently, catches and catch rates are not considered indicative of stock status. As such, the status of the stock is uncertain and substantial effort would be required to gather sufficient data to assess it.

7. Bastard Trumpeter

Latridopsis forsteri

STOCK STATUS	OVERFISHED
Trends in commercial catch suggest record low population levels and that the species is recruitment overfished. The current minimum legal size limit is below the size of maturity. Species is considered medium risk in the ERA. Current low levels of fishing pressure may be too high to allow stock to recover.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Latridopsis forsteri
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Exposed reefs and sandy bottom down to 160 m depth.	May & Maxwell (1986) Edgar (2008)
Distribution	• Sydney (New South Wales) to southern South Australia, Tasmania, southern New Zealand	Edgar (2008)
Diet	• Small fish, invertebrates.	Edgar (1997)
Movement and stock structure	• Schooling fish, usually in small numbers. Large individuals occur in deeper waters. • Juveniles tend to remain associated with areas of reef for periods of time • No information on the stock structure.	Edgar et al. (2004) Gomon et al.(2008)
Natural mortality	• Undetermined.	
Maximum age	• Up to 20 years	Murphy and Lyle (1999)
Growth	• Maximum length: 65 cm • Maximum weight: 4 kg • Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where L is the fork length (cm), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are : **Sex** / L_∞ / k / $t_{0\infty}$ Combined / 59.4 / 0.144 / -2.9 •	Edgar (2008) Gomon et al.(2008) Murphy and Lyle (1999)

Maturity	• Sexual maturity at sizes >45 cm and ages > 4 years.	Murphy and Lyle (1999)
Spawning	• Believed to spawn in late winter	Murphy and Lyle (1999)
Early life history	• Small juveniles settle from the plankton on reefs in large numbers at intervals of several years.	Edgar (2008)
Recruitment	• Variable. No-stock recruitment relationship established.	
Gillnet post release survival	• High: 95 – 83% depending on gillnet soak duration	Lyle et al (2014a)

Background

Bastard Trumpeter was one of the first fish species to have been commercially exploited in Tasmania. Their apparent abundance around reefs close to newly established Hobart meant that they were an important source of seafood for the fledgling colony. Their exploitation was further aided by the relative ease at which they could be caught using gillnets set within accessible shallow inshore reefs.

Bastard Trumpeter are taken today almost exclusively by graball nets. Bastard Trumpeter have also long been recognised as an important fish for recreational fishers. The species resides on inshore reefs until about 4–5 years of age (and approximately 50 cm long) before moving offshore into deeper water as they approach maturity, apparently remaining in that habitat for the remainder of their lives (Harries and Lake 1985, Murphy and Lyle 1999). Hence, both commercial and recreational fisheries are based almost entirely on juvenile fish.

FISHING METHODS	Graball net
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) **Output control:** • Possession limit of 10 and bag limit of 5 individuals for recreational fishers • Trip limit 200 kg for commercial • Legal minimum length (380 mm TL)
MAIN MARKET	Local

Current assessment

Biological characteristics

Size composition

Length frequency histograms (Fig. 7.1) for Bastard Trumpeter based on research and commercial catch sampling indicate a large recruitment event moving through the population in the mid to late 1990s. A lack of sampling data between 2000 and 2009 inhibits further analysis but there was a noticeable lack of smaller-sized individuals, especially in the 30 – 35cm length category in 2011 and 2012 possibly influenced by gear selectivity (large mesh sizes). While there is a lack of data post 2012, there is some evidence to suggest that fish smaller than 40cm are underrepresented. This is unlikely to be explained solely by mesh selectivity and thus there is the possibility that there has been lower than (recent) average recruitment in the late 2000s.

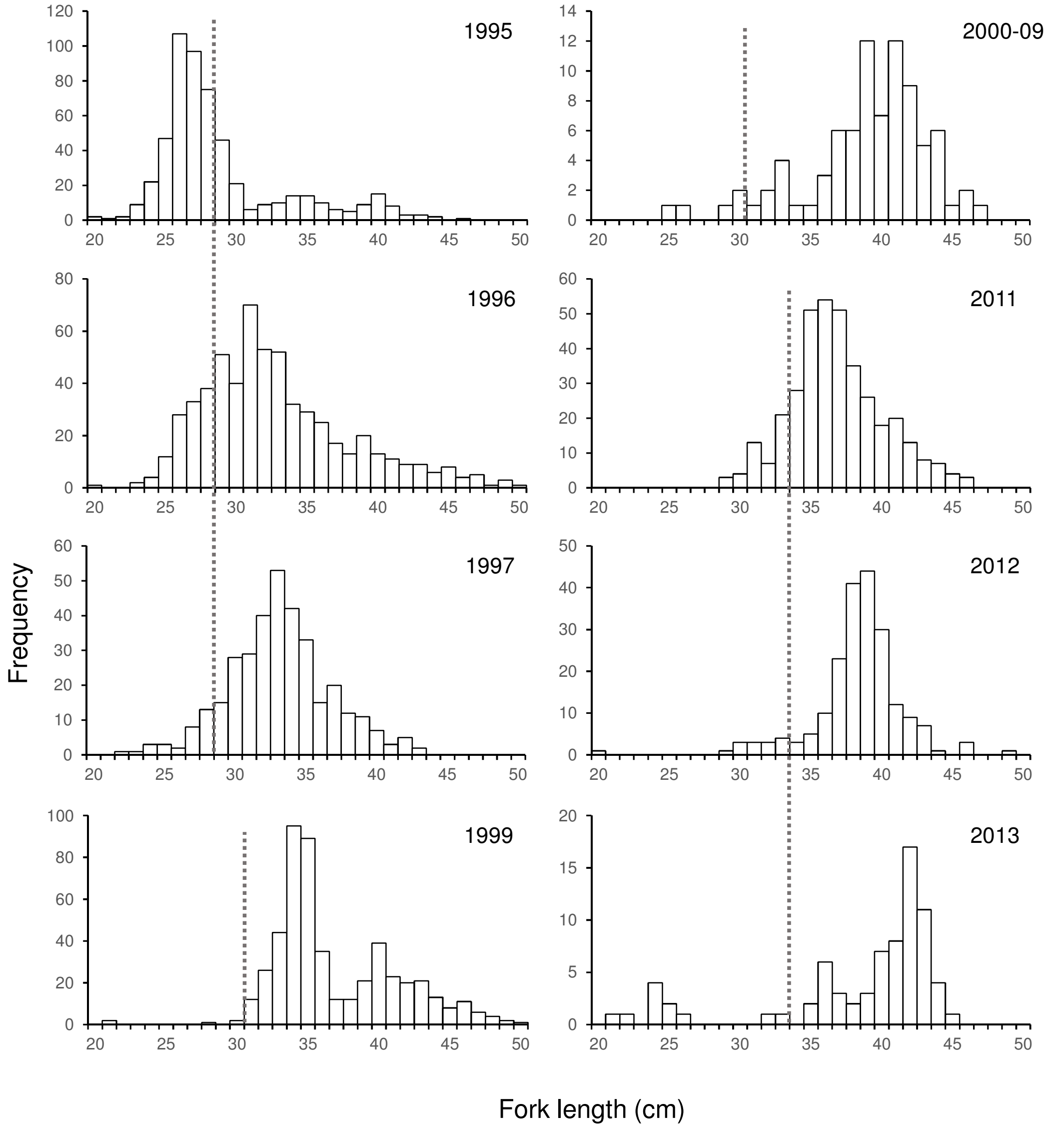


Figure 7.1 Length frequency histograms for Bastard Trumpeter based on research fishing and commercial catch sampling. Dotted lines indicated minimum legal size limit (converted from Total Length to Fork Length) that applied at the time of sampling.

Catch, effort and CPUE

Bastard Trumpeter catches have been declining steadily since the mid-1990s and reached a historic low of 6.8 t in 2014/15 (Fig. 7.2A). Bastard Trumpeter are taken almost exclusively by graball net from inshore waters off the east, south and west coasts (Fig. 7.3). Bastard Trumpeter have been predominantly taken by recreational fishers in recent years, although the estimated catch in 2012/13 was also a historic low of 9.8 t (Lyle et al. 2014b) and is considerably lower than the 2010 estimate of 27.3 t (Lyle and Tracey 2012).

Commercial graball effort has followed a similar downward trend to catches since the mid-1990s (Fig. 7.2B). Daily catch rates have remained relatively stable since 2006/07 at a reduced level (Fig. 7.2C). This lack of obvious trend, despite the sharp decrease in catches, presumably reflects the fact that Bastard Trumpeter are taken primarily taken as by-product rather than as a target species. This is exacerbated by the fact that the majority of gillnetting effort now targets Banded Morwong with 140 mm mesh sizes, selecting only the largest Bastard Trumpeter.

Previously, a larger proportion of fishers used smaller mesh sizes (<114 mm) to target Bastard Trumpeter and/or Blue Warehou.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, gillnetting was considered a medium risk activity with regard to Bastard Trumpeter, due to the population status for this species being uncertain and the possibility that even small amounts of fishing pressure in some areas are too high (Bell et al. 2016).

6.

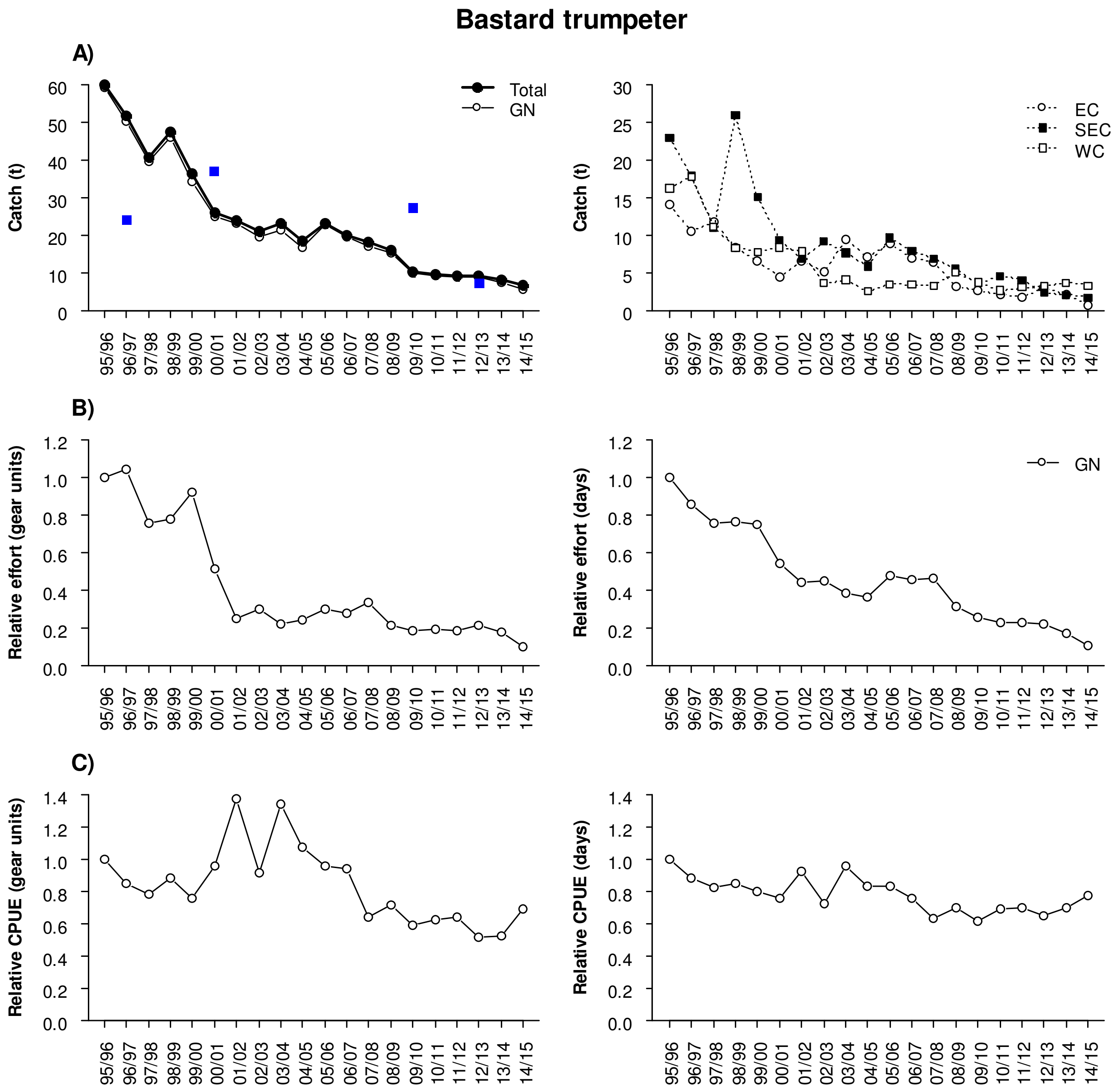


Figure 7.2 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and days fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. GN= graball net, EC= east coast, SEC= southeast coast and WC= west coast. Data includes AFMA catch in State waters.

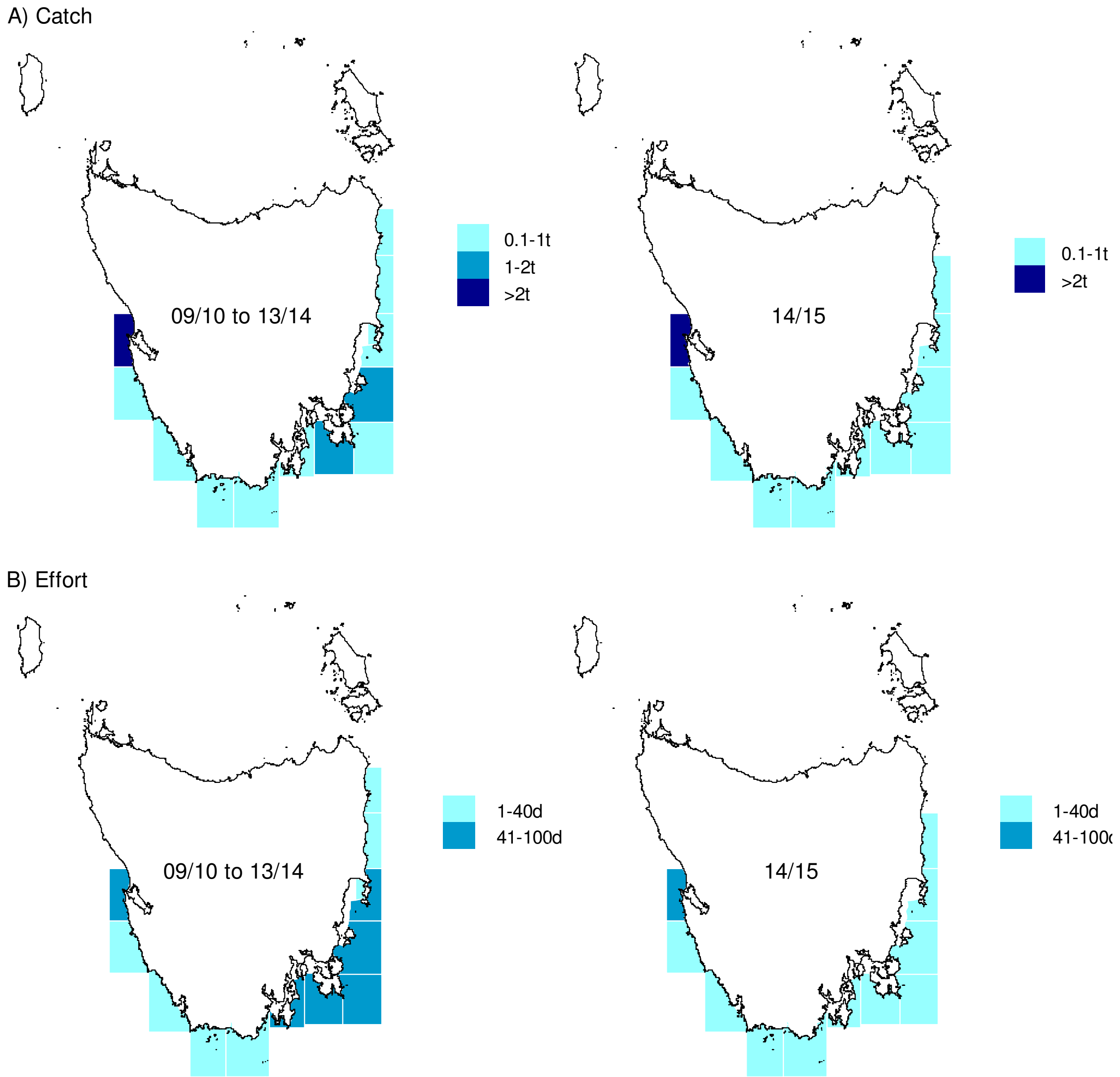


Figure 7.3 (A) Bastard Trumpeter catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right). Data includes AFMA catch in State waters.

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (63.3 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (34 t)	Yes	27.2 t (80%)
	• Catch increases by > 30% from previous year (>10.8 t)	No	
	• Catch decreases by > 30% from previous year (<5.8 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>2717 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0090 t/days fished)	Yes	0.0005 t/day fished (5.6%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (47.6 t)	No	
	• Catch < 3rd lowest catch value from the reference period (21.0 t)	Yes	14.1 t (67.3%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (7 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (-11.3 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (24 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (73.6% in 2010)	No	
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.0105 t/days fished)	Yes	0.0017 t/day fished (16.2%)
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0011)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status

OVERFISHED

Due to the historic low catches in 2014/15, the lowest catch and catch rate reference points were breached. As Bastard Trumpeter is a by-product species, total catch rather than catch rate may be a better indicator of abundance/availability for the species. Consequently, 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, although a lack of market demand for Bastard Trumpeter appears to be a factor influencing landings. Onboard observations suggest that legal sized Bastard Trumpeter are sometimes discarded by Banded Morwong fishers but survivability remains high. Given the majority of gillnetting effort is now targeted at Banded Morwong using larger gillnets than those used historically to target Bastard Trumpeter, both catch and catch rate may be inaccurate. Nevertheless, fishing practices are likely to have remained fairly consistent in recent years (2007/08 – present) so the low, stable catch rate trend and declining catches are likely to be representative of a population that has not substantially rebuilt despite significant reduction in both commercial and recreational gillnet effort.

The Tasmanian fishery is based almost entirely on juveniles. As fish grow, they appear to move offshore and are rarely caught. No information is available on the adult portion of the population but it is clear that fishing pressure exerted on those individuals that evade the inshore fishery is very low (by-catch in shark nets, trawl, Danish seine or deep-water fish traps used by the Commonwealth SESSF appears to be negligible). The species exhibits high recruitment variability resulting in short-term variation in catches, which has been a feature of this fishery over the past century (Harries and Croome 1989). Anecdotal reports and low inshore catches suggest that recruitment level has been low in recent years and limited length frequency data for 2011 and 2012 indicate a reduction in the number of smaller-sized individuals in the fishery relative to the late 1990s. Given studies have shown that the presence of unfished marine reserves can increase the abundance of large fish such as Bastard Trumpeter relative to fished sites around Tasmania (Edgar and Barrett 1999) and that the commercial and recreational fisheries are based on juveniles, recruitment as well as growth overfishing is likely to be occurring.

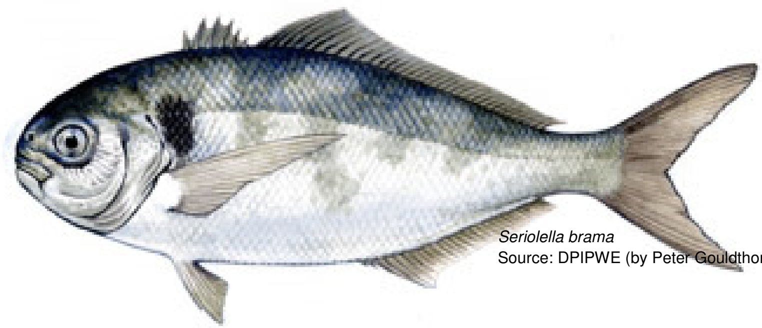
It is worth noting that the stabilisation of the catch since 2009/10 corresponds to the introduction of several management measures for the species (increase in the minimum legal size, introduction of commercial and recreational catch limits). However, the current minimum size limit of 38 cm TL is still well below the size at maturity (>45 cm FL, Murphy and Lyle 1999). While there has been discussion at recent SFAC meetings about increasing the minimum size limit to recover stocks this would at the same time effectively close down the current commercial and recreational fisheries for the species. Further reductions in the recreational bag limit for this species were also introduced in 2015.

Given the continued reduction in catches, which may indicate a lack of recruitment, the current rating of medium risk from gillnetting in the ERA and the current minimum legal size limit below the size of maturity, Bastard Trumpeter are classified as overfished.

8. Blue Warehou

Seriolella brama

STOCK STATUS	OVERFISHED
This is a Commonwealth-managed species that is classified as overfished (see: http://www.afma.gov.au/portfolio-item/blue-warehou/). It is sporadically abundant in Tasmanian waters. Despite a reduction in Total Allowable Catch (TAC) for the Commonwealth fishery to 118 t and the initiation of a rebuilding strategy, stocks have shown little evidence of recovery.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery/Southern and Eastern Scalefish and Shark Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Seriolella brama
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Inshore reefs/harbours and open water down to 400 m depth.	Edgar (2008) Smith (1994)
Distribution	• New South Wales to South Australia, Tasmania, New Zealand	Edgar (2008) Gomon et al.(2008)
Diet	• Invertebrates (mainly salps), krill, crabs, squids	Gavrilov and Markina (1979) Annala (1994) Bulman et al. (2001)
Movement and stock structure	• Schooling fish, highly mobile. • Small juveniles pelagic, commonly in association with jellyfish in open coastal waters. Sub-adults often found in sheltered waters of large marine embayments. • Although genetics has not confirmed separate stocks, there are indications of population structuring. It is likely that two stocks occur in southern Australian waters (east and west of Bass Strait).	Gavrilov and Markina (1979) AFMA (2008, 2011) Bruce et al. (2001b) Robinson et al. (2008)
Natural mortality	• Estimated between M=0.30 and M=0.45.	Knuckey and Sivakumaran (2001)
Maximum age	• Up to 15 years	AFMA (2012)
Growth	• Maximum length: 90 cm • Maximum weight: 4 kg	Gomon et al.(2008) Frimodt (1995) BWAG (1998)

	• Growth (in New Zealand) described by von Bertalanffy growth function $L = L_\infty(1 - e^{-k(t-t_0)})$ where L is the length (cm), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are: **Sex** | L_∞ | **k** | $t_{0\infty}$ Combined | 54.65 | 0.37 | -0.67 • Length-weight relationship was estimated at $W = 0.03L^{2.9}$ for females and males combined, where W is weight (g) and L is the total length (cm).	
Maturity	• Size-at-50% maturity estimated at 36 cm (3.67 years) for females. • Batch fecundity (BF): $ln(BF) = 2.614ln(L) + 2.366$, where L is length in cm.	Knuckey and Sivakumaran (2001)
Spawning	• Peak spawning in winter, with major regional differences in the magnitude and timing of spawning. • Major spawning ground on the central west and northwest coasts in Tasmania	Bruce et al. (2001b)
Early life history	• Larvae restricted to shelf and slope waters. • Larvae likely to be transported by Zeehan Current from spawning grounds of western Tasmania to southeastern Tasmania nursery areas. • Larvae settle to the bottom at length > 14.5 mm BL	Bruce et al. (2001b) Neira et al. (1998)
Recruitment	• Variable. No-stock recruitment relationship established.	
Gillnet post release survival	• Low: 35%, but small legal minimum length so rarely discarded.	

Background

Blue-warehou occur seasonally in Tasmanian inshore waters, the region representing the southern-most extent of the species' distribution. The availability of Blue Warehou in coastal waters is assumed to be influenced by prevailing oceanographic conditions and availability of prey species, in particular salps. These factors produce marked inter-annual variability in abundance and hence catch taken from State waters.

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 historical levels. The species is assessed at the Commonwealth level with Tasmanian (and other state) catches included in the stock assessment modelling.

FISHING METHODS	Mainly graball net, also small mesh nets and seine net
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) **Output control:** • Possession limit of 20 and bag limit of 10 individuals for recreational fishers • Minimum size (250 mm TL)
MAIN MARKET	Local and interstate

Current assessment

Catch, effort and CPUE

In Tasmania, Blue Warehou is taken primarily in graball nets with lesser quantities taken by small mesh nets and seine (Fig. 8.1A). They are captured using a variety of methods by Commonwealth fisheries including other gillnet categories (e.g. shark gillnets), Danish seine and trawl.

Due to low availability since the early 2000s, the species has been rarely targeted. The current catch of 2.8 t is down from the previous year (5.8 t) and represents the historic minimum since records have been maintained. Peak Tasmanian landings were 317.6 t in 1991/92, which corresponded with the peak Australia wide landings of almost 3,000 t (AFMA 2012). Commonwealth commercial catches have also been down in recent years: 65.1 t in 2013 season and 16.2 t in 2014 season. Two stocks of Blue Warehou occur in southern Australian waters, the east and the west Bass Strait stocks (Bruce et al. 2001b), which has led to the species being managed by the Australian Fisheries Management Authority (AFMA) as two stocks. The Tasmanian fishery is mainly centred off the southeast coast and thus probably targets the eastern stock (Fig. 8.2). Catches are also taken off the northwest coast, probably involving the western stock.

Blue Warehou are also targeted by recreational fishers using gillnets, and to a lesser extent line fishing. Historically, recreational catches have been lower than commercial catches (Fig. 8.1A), although in 2010 catch estimates were similar for both sectors (32.5 t for recreational and 37.5 t for commercial) and the 2012/13 the recreational catch of 15.4 t (Lyle et al. 2014b) exceeded the commercial catch of 8.5 t.

Following an increase in commercial graball effort between 1995/96 and 1998/99 that resulted in increased catches, effort has fallen to a substantially lower level (Fig. 8.1B). Current effort is amongst the lowest since 1995/96, which is largely a response to the reduced availability of Blue Warehou in Tasmanian waters but has also been influenced by the quota management system introduced for the Banded Morwong sector.

Graball catch rates increased markedly in the latter part of the 1990s reflecting increased availability and targeting of Blue Warehou around Tasmania at the time (Fig. 8.1C). Catch rates have since declined, but remained relatively stable throughout the 2000s before a further decline since 2009/10.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, gillnetting was considered a high risk activity with regard to Blue Warehou, due to historical overfishing (Bell et al. 2016).

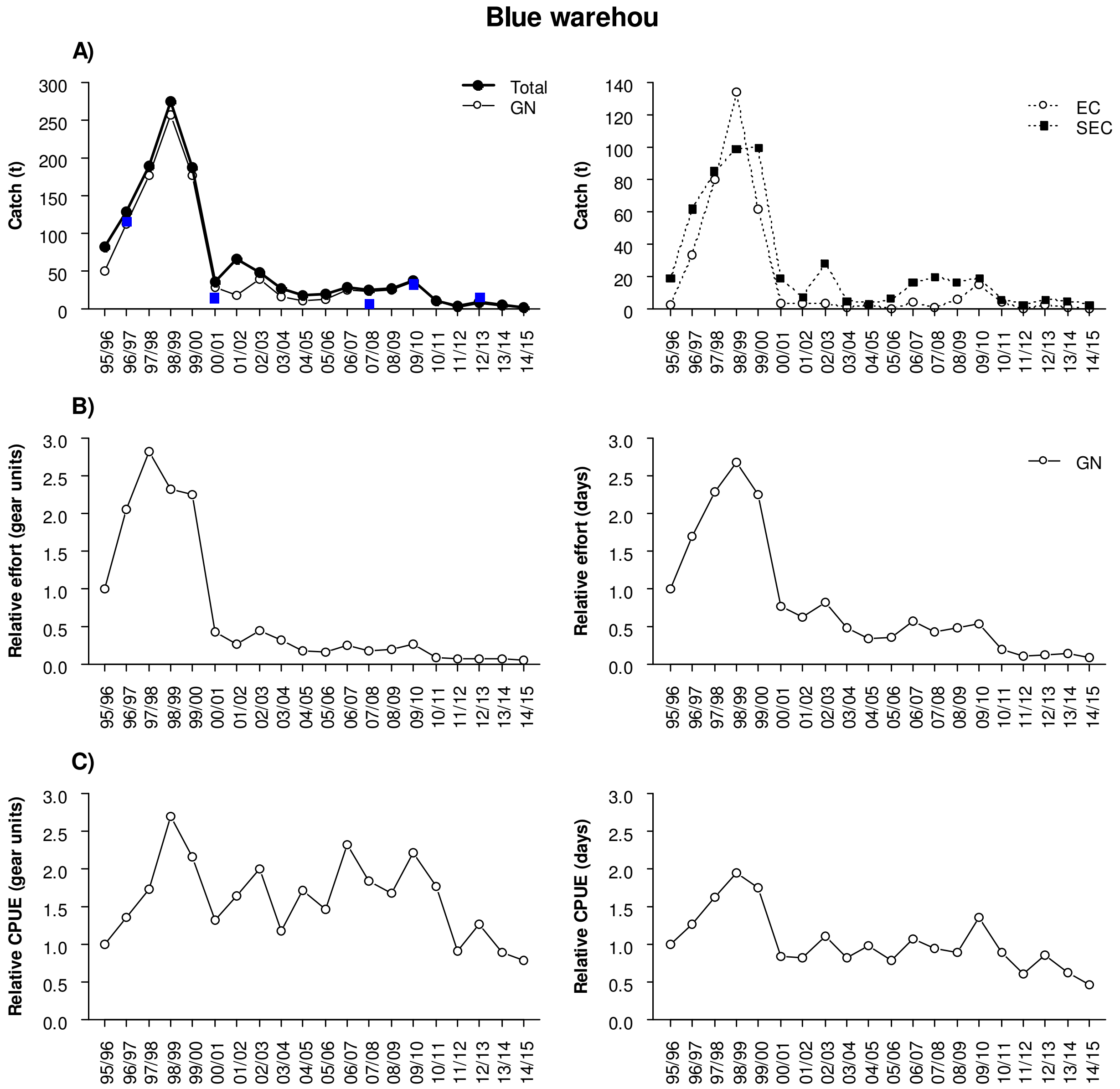


Figure 8.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. GN= graball net, SEC= southeast coast, EC= east coast.

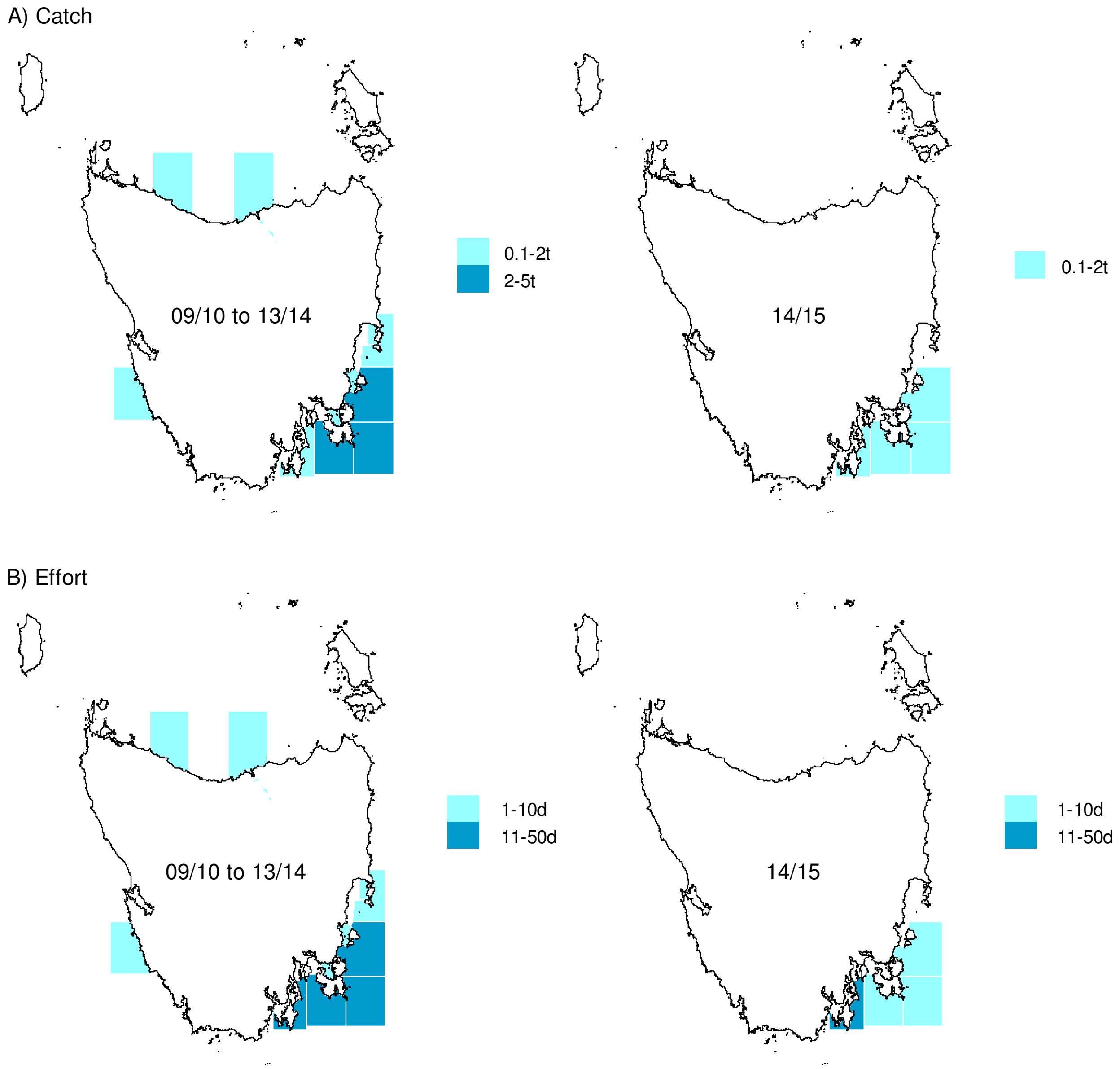


Figure 8.2 (A) Blue Warehou catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (317.6 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (82.3 t)	Yes	79.5 t (96.6%)
	• Catch increases by > 30% from previous year (>7.6 t)	No	
	• Catch decreases by > 30% from previous year (<4.1 t)	Yes	1.3 t (32%)
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (2387 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (0.0183 t/days fished)	Yes	0.0087 t/days fished (47.5%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Commercial catch limit of 318 t as per Memorandum of Understanding (MoU)	No	
	• Catch > 3rd highest catch value from the reference period (186.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (27.5 t)	Yes	24.7 t (89.8%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (84.7 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (151.6 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (65.3 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (57.3%, in 2010)	Yes	Latest estimate (2012/13): 63.6%
Biomass	• CPUE < 3rd lowest CPUE value from the reference period (0.0229 t/days fished)	Yes	0.0133 t/days fished (58.1%)
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0113)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status **OVERFISHED**

The availability of Blue Warehou in Tasmanian inshore waters is influenced by a range of environmental factors as well as stock size. As such, despite several reference limits being breeched, catch and CPUE may not be a good indicator of abundance/availability for the species.

Nevertheless, decreasing catch and catch rates over the last 20 years are almost certainly linked to reduced biomass. This is predominantly a result of overfishing by Commonwealth and State fisheries during the 1990s when >2500 t were caught in several years and >1000 t annually between 1987 and 1998 (AFMA 2012). These figures include all state landings and the Tasmanian landings accounted for around 10% of the total Australian Blue Warehou landings throughout much of this period (AFMA (2012); Appendix 3). In recent years catches have declined substantially and it is possible that in 2013/14 and 2014/15 the Tasmanian recreational catch of Blue Warehou exceeded the catches from Commonwealth and Tasmanian commercial fishers. While the reduced Commonwealth and Tasmanian catches may be advantageous for the stock(s) in the long-term it has been noted that it makes it more difficult to assess the "true" state of stock(s) due to a lack of fishery dependent data.

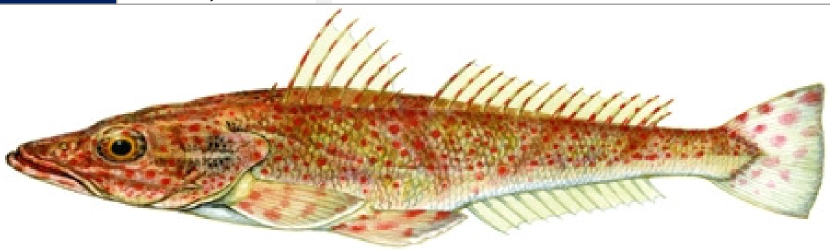
Blue Warehou is under a Commonwealth rebuilding strategy (first introduced in 2008 and later reviewed in 2014), which aims in the first instance to rebuild both east and west stocks to or above the default limit reference biomass point (B_{LIM}) of 20 per cent of the unfished spawning biomass by 2024 (AFMA 2014). Consequently, the Commonwealth Total Allowable Catch (TAC) for Blue Warehou has been progressively decreased since 2003, and was further reduced to 118 t (split 27 t in the east and 91 t in the west) for 2012/13, 2013/14 and 2014/15 since both the western and eastern stocks were considered to be overfished and unlikely to recover under the existing management arrangements (AFMA 2012). AFMA considers the reduction in recent catches (just 16.2 t in 2014 season) to be in part a result of their active management, through organising crew length frequency programs, education programs, port visits and encouraging vessels with "high" catches to direct phone call AFMA to discuss catches (Marcus Finn, pers. comm. 2014). Further management measures include: SESSF fishery closures and gear requirements. There was also a voluntary Commonwealth industry closure implemented between 2008 and 2012 in areas of high Blue Warehou abundance that were believed to be spawning grounds but this was discontinued following review in 2013 due to the patchiness and unpredictability of the species in these areas (AFMA 2014). In Tasmania, management measures include bag and possession limits and a minimum size limit but if Blue Warehou stocks being to recover these may not be enough to prevent targeting from State commercial and recreational fishers (SFAC 2015).

Despite the Commonwealth and Tasmanian management measures outlined above, there have been few signs of recovery for the species and the Fishery Status Reports classified the status of Blue Warehou stocks in 2014 as overfished (for biomass) and uncertain (for fishing mortality (Patterson et al. 2015). Blue Warehou were not assessed in the 2014 Status of Australian Fish Stocks but the most recent Blue Warehou Rebuilding Strategy suggests there has yet to be a significant recovery (AFMA 2014). As such, Blue Warehou is assessed as overfished in Tasmanian waters.

9. Tiger Flathead

Platycephalus richardsoni

STOCK STATUS	SUSTAINABLE
This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/tiger-flathead/). In Tasmania, Tiger Flathead are caught predominately by the commercial sector and in recent years, catches have declined to around 20 – 30 tonnes, equivalent to less than 1% of Commonwealth trawl landings.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery/ Southern and Eastern Scalefish and Shark Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Platycephalus richardsoni
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	Exposed sand and silt habitat. 10-400 m depth	Edgar (2008) Tilzey et al. (1990)
Distribution	Victoria to New South Wales and around Tasmania.	Edgar (2008) Gomon et al.(2008)
Diet	Fish	Coleman and Mobley (1984)
Movement and stock structure	Young inhabit shallow waters of the continental shelf and move into the outer shelf zone as they reach maturity	Kailola et al. (1993) Jordan (1998)
Natural mortality	*M* between 0.21 and 0.46	Klaer (2010)
Maximum age	12 years	Rowling (1994) Bani (2005)
Growth	Maximum length: 650 mm (FL) Maximum weight: 2.9 kg Growth (in NSW) described by von Bertalanffy growth function $L = L_{\infty}\left(1 - e^{-k(t-t_0)}\right)$ where L is the length (mm), t is the age (years), L_{∞} is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are:	Edgar (2008) Gomon et al.(2008) Barnes et al. (2011)

Sex	L_{∞}	*k*	$t_{0\infty}$
Females	750.2	0.13	-1.0
Males	418.9	0.26	-1.0

	Length-weight relationship was estimated at $W = 3.25 \times 10^{-6} L^{3.13}$ for females and males combined where W is weight (g) and L is the total length (mm).	
Maturity	Reach sexual maturity at 4-5 years and total length of 30 cm for males and 36 cm for females.	Fairbridge (1951)
Spawning	December to February	Kailola et al. (1993) Jordan (2001b)
Early life history	Unknown	Jordan (2001b)
Recruitment	No-stock recruitment relationship established	
Gillnet post release survival	Moderate: 50% (all soak durations and including both graball and mullet nets)	Lyle et al. (2014a)
Rod and-line post release survival	High: >99% for circle hooks and 94–97% for conventional hooks.	Lyle et al. (2007)

Background

Several species of Flathead occur in Tasmanian waters, but the commercial catches are dominated by Tiger Flathead taken by Danish seine. Both Sand Flathead and Tiger Flathead species were not routinely distinguished in commercial catch returns until 2007; consequently catches prior to 2007 have been inferred based on fishing gear with associated catch rates and fishing effort accurate only as of the 2007/08 fishing season.

Tiger Flathead constitute a minor component of the recreational harvest of flathead (around 10%).

FISHING METHODS	Danish seine
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) **Output control:** • Possession limit of 30 and bag limit of 20 individuals (Sand and Tiger Flathead) for recreational fishers • Minimum size (320 mm TL)
MAIN MARKET	Mostly local

Current assessment

Catch, effort and CPUE

The 2014/15 total commercial catch of Tiger Flathead was 23.5 t. The commercial fishery for Flathead has not undergone major changes in its operations since 1995/96. It was therefore possible to back calculate catches for Tiger Flathead prior to 2007, when species were not distinguished, based on the average proportion of species by gear type from 2007/08 to 2011/12 (Fig. 9.1). Tiger Flathead catches declined steadily between 2000/01 and 2003/04 but more than doubled in 2005/06 (Fig. 9.1 and 9.2). Since then catches have declined to around 20 – 30 t per annum.

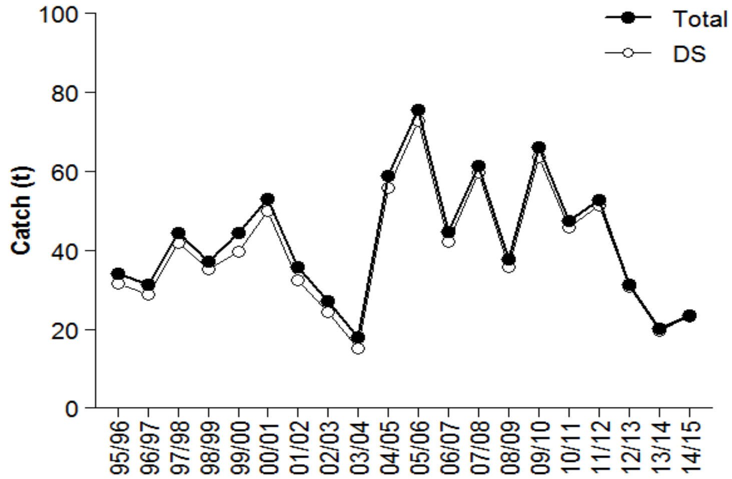


Figure 9.1 Back-calculated annual commercial catch (t) by gear for Tiger Flathead.

Danish seine fishing effort declined in 2014/15 relative to the previous year but both catches and catch rate increased (Fig. 9.2). Danish seine catch rates have fluctuated strongly in recent years and presumably reflect the degree of targeting of the species (Fig. 9.2). Peaks in Danish seine CPUE are influenced by a small number of operators that exclusively targeted Tiger Flathead during those years. Catches in 2014/15 were derived mainly from the southeast and east coasts (Fig. 9.3).

Recreational Flathead catches were estimated at 361 t in 2000/01 (Lyle 2005), 292 t in 2007/08 (Lyle et al. 2009) and 235.9 t in 2012/13 (Lyle et al. 2014b). Tiger Flathead constitute a minor component of the recreational flathead harvest (around 10%).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, Danish seining was considered a low risk activity with regard to Tiger Flathead and very low risk to by-product species, such as sharks and mixed fish. Risks to the general ecosystem varied from very low, in terms of discarded fish attracting wildlife, to medium, for possible changes to the seafloor from the net dragging (Bell et al. 2016).

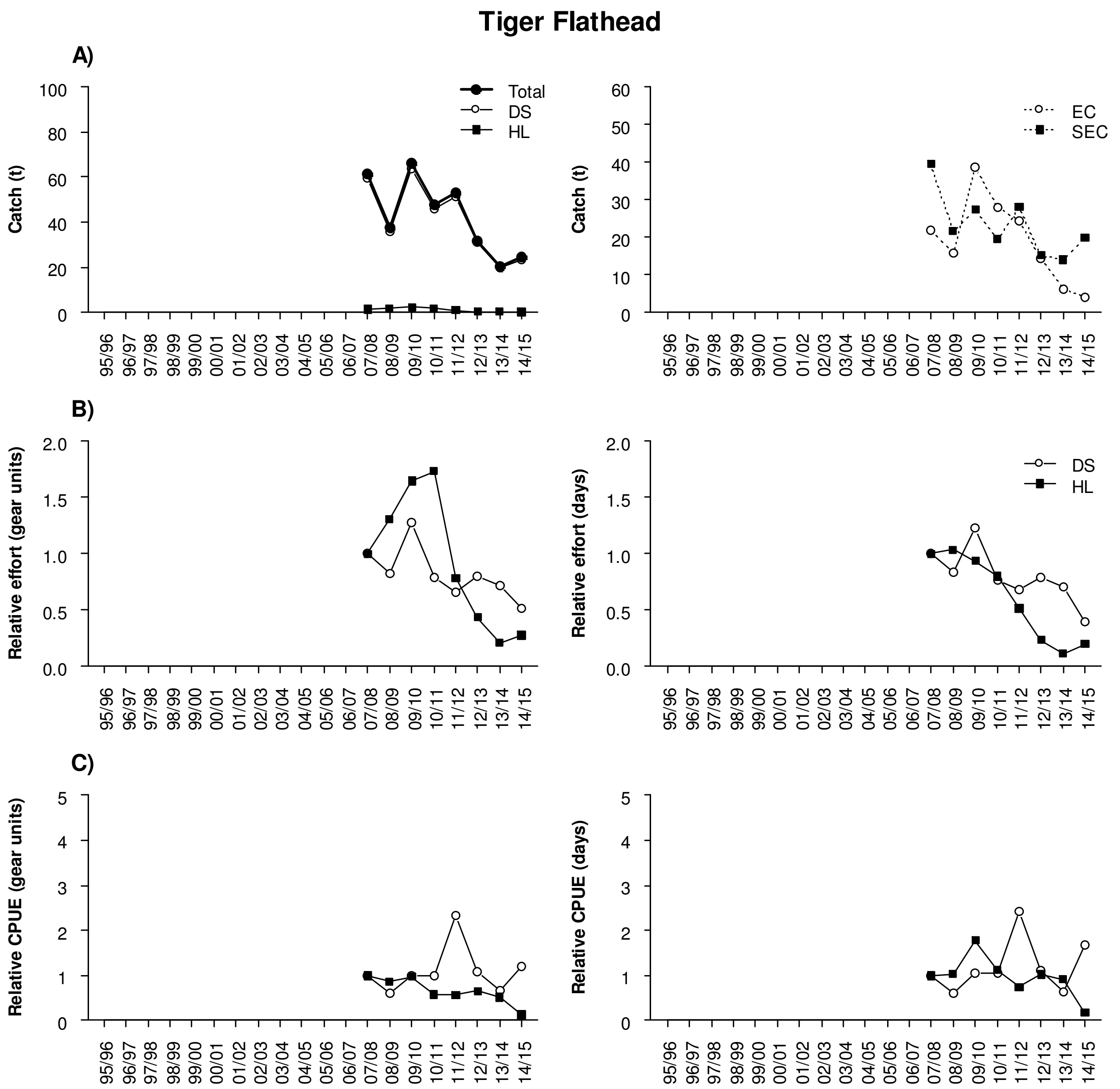


Figure 9.2 A) Tiger Flathead annual commercial catch (t) by gear (left) and region (right). B) Tiger Flathead commercial effort by method based on gear units (left) and day fished (right) relative to 2007/08. C) Tiger Flathead commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 2007/08. DS= Danish seine, HL= hand-line, SEC= southeast coast, EC= east coast.

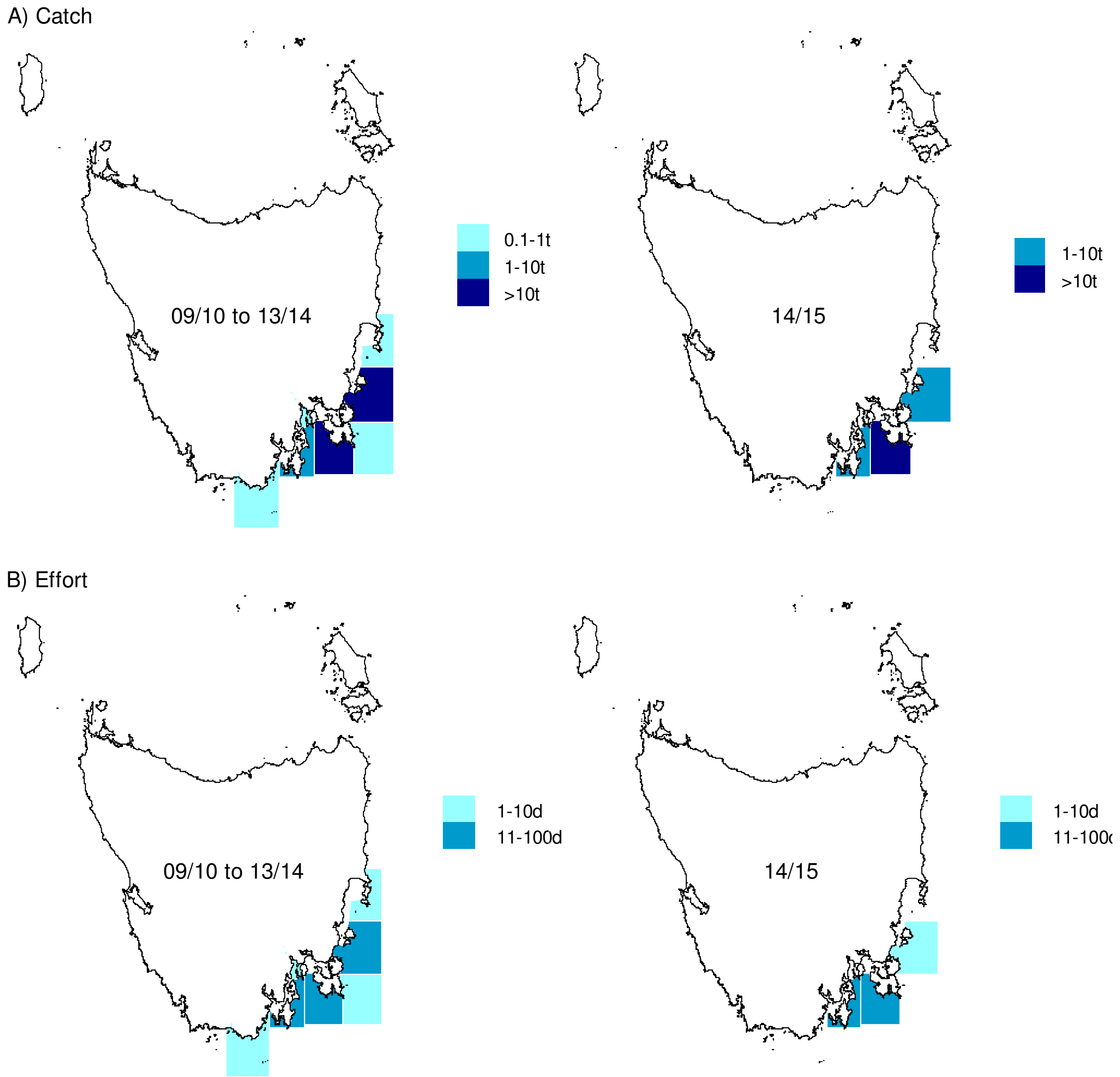


Figure 9.3 (A) Tiger Flathead catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points for Flathead (combined)

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (165.3 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (51.8 t)	Yes	15.5 t (40%)
	• Catch increases by > 30% from previous year (> 40.5 t)	No	
	• Catch decreases by > 30% from previous year (<21.8 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1341 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0104 t/days fished)	Yes	0.0019 t/days fished (18.2%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (63.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (50.5 t)	Yes	14.2 t (28.1%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (-32.6 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (43.5 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (361 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (80.0% in 2007/08)	Yes	Latest estimate (2012/13) 85.5%
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.013 t/days fished)	Yes	0.0046 t/days fished (35.3%)
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0038)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	**Tiger Flathead**	**SUSTAINABLE**

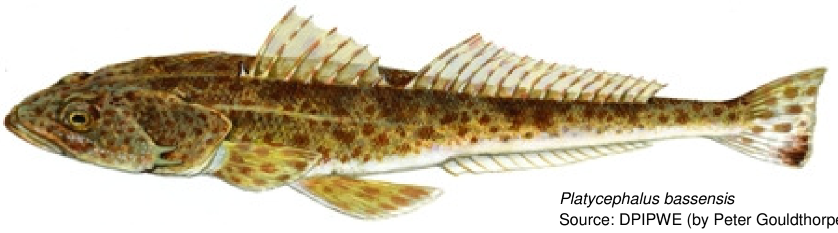
Danish seine catches are highly variable and tend to be inversely related with catches of School Whiting (refer Fig. 2.1), which is also targeted using Danish seine. In 2014/15 catches of Tiger Flathead increased to 23.5 tonnes, while School Whiting catches declined to 2.9 tonnes (significantly reduced from the previous year). While commercial catches of Tiger Flathead have been maintained at higher levels in the past, there are additional and significant trawl catches of Flathead (almost exclusively Tiger Flathead) taken from Commonwealth waters as part of the South East Trawl Fishery. In the 2014 fishing season the total Commonwealth catch of Tiger Flathead was 2,838 t, so the Tasmanian catches only constitute a fraction (less than 1%) of the overall landings from this stock (extending from New South Wales to Victoria), which has been classified as sustainably fished in recent years (Flood et al. 2012, Flood et al. 2014, Patterson et al. 2015). In accordance with the Commonwealth assessment, Tiger Flathead is assessed as sustainable in Tasmanian waters.

While Tiger Flathead only constitutes a small proportion of the total recreational catch of Flathead, various management changes were introduced in 2015 to improve the sustainability of this species including: an increase in the minimum size limit from 300 mm to 320 mm and introduction of a daily bag limit of 20 per fisher with a possession limit of 30.

10. Southern Sand Flathead

Platycephalus bassensis

STOCK STATUS	TRANSITIONAL DEPLETING
Both Flathead species are caught by commercial and recreational fishers, however, Sand Flathead dominates the recreational catch (> 90%). Fishery independent surveys suggest relatively low abundances of legal sized fish, particularly in south-eastern Tasmania, with populations subject to heavy fishing pressure, especially relative to historic levels. Fishing pressure in 2014/15 is likely to cause the stock to become recruitment overfished.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Platycephalus bassensis
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	Sheltered sand and silt habitat. Down to 100m depth.	Edgar (2008) Tilzey et al. (1990)
Distribution	From Western Australia to New South Wales and around Tasmania.	Edgar (2008) Gomon et al.(2008)
Diet	Fish and crustaceans	Ayling et al. (1975)
Movement and stock structure	Seasonal movements between inshore and offshore in east and southeast Tasmania	Kailola et al. (1993) Jordan 1998
Natural mortality	*M* between 0.28 and 0.59 (per year)	Bani (2005)
Maximum age	20 years	Bani (2005)
Growth	• Maximum length: 51.5 cm. • Maximum weight: 3.1 kg • Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where L is the length (cm), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Growth appears very variable according to location and year. Parameters estimates (for Coles Bay) are:	Edgar (2008) Gomon et al.(2008) Bani (2005) Gomon et al.(2008)

ex	L_∞	k	$t_{0\infty}$	Year
Females	39.01	0.25	-1.57	001/02
	45.35	0.15	-2. 3	2002/03
Males	37.43	0.21	-1.76	2001/02
	34.40	0.39	- .51	2002/03

Maturity	• Size-at-50% maturity estimated at 21.7 cm for males, and between 24.7 and 26.3 cm for females depending on location. • Age at 50% maturity variable: 2.5–3.5 years for males and 2.6–5.2 years for females depending on location.	Bani and Moltschaniwsky (2008)
Spawning	• From October to March, with a peak from October-December. Spawning occurs throughout their range in southern and eastern Tasmania, including on the shelf.	Kailola et al. (1993) Jordan (2001b)
Early life history	• Settlement occurs over an extended period, between 4 to 14 months after spawning • Size at settlement around 2.1 cm.	Jordan (2001b)
Recruitment	• No-stock recruitment relationship established	
Gillnet post release survival	• Moderate: 50% (all soak durations and including both graball and mullet nets)	Lyle et al. (2014a)
Rod and line post release survival	• High: >99% for circle hooks and 94–97% for conventional hooks.	Lyle et al. (2007)

Background

Several species of Flathead occur in Tasmanian waters. Sand Flathead are caught mainly by hand-line and as a by-product in graball nets. Both Sand Flathead and Tiger Flathead species were not routinely distinguished in commercial catch returns until 2007; consequently, catches prior to 2007 have been inferred based on fishing gear with associated catch rates and fishing effort accurate only as of the 2007/08 fishing season.

Sand Flathead are targeted recreationally by hand-line or rod and reel and constitute around 90% of the total Flathead recreational harvest.

FISHING METHODS	Hand-line, rod and reel, and graball net (Sand Flathead)
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) **Output control:** • Possession limit of 30 and bag limit of 20 individuals (Sand and Tiger Flathead) for recreational fishers • Minimum size (320 mm TL)
MAIN MARKET	Mostly local

Current assessment

Biological characteristics

Concerns surrounding the abundance of Sand Flathead led to the establishment of an annual fishery-independent survey, which has been conducted since 2012 (Ewing and Lyle 2015). The survey uses fishing gear and targeting practices typical of recreational fishers in areas of significant effort, including the D'Entrecasteaux Channel, Frederick Henry-Norfolk Bay and Great Oyster Bay; with sampling occurring during February and March. Fishing was generally conducted over a minimum of three (not necessarily consecutive) days per region, with between 19-21 standard sites fished in each region. Sites sampled in 2015 represent a range of suitable habitats (including depths) for targeting Sand Flathead and provide wide spatial coverage within the given region (Ewing and Lyle 2015).

Size composition

Length frequency histograms from the fishery-independent survey (Fig. 10.1) indicate that the majority of Sand Flathead in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay were below the minimum size limit (at the time) of 300 mm, indicating a low abundance of legal sized fish (Fig. 10.1a and 10.1b). Conversely, in Great Oyster Bay approximately half of the fish were larger than 300 mm indicative of a relatively strong year class (Fig. 10.1c).

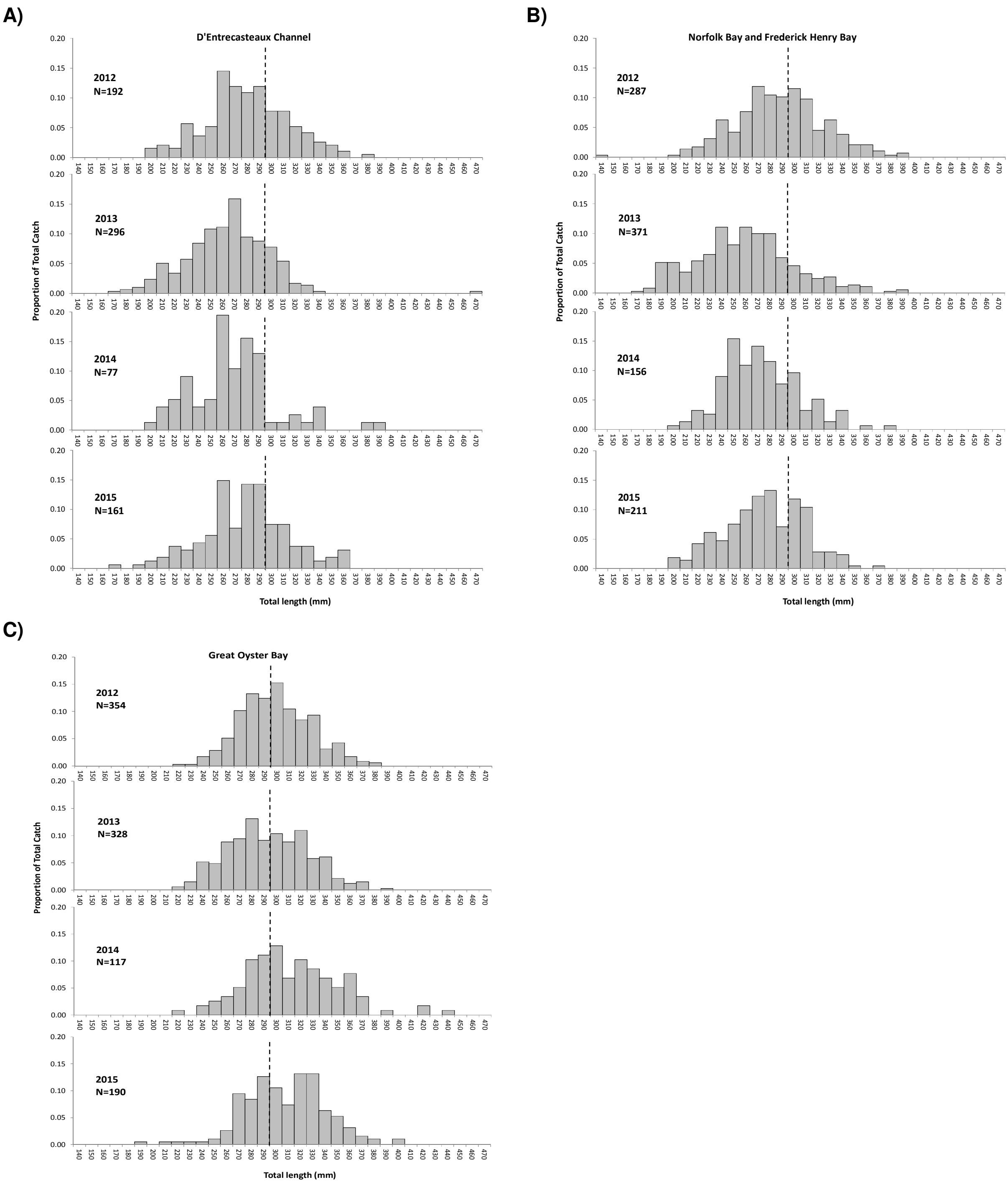


Figure 10.1 Length frequency histograms for Sand Flathead captured in: A) D'Entrecasteaux Channel; B) Frederick Henry-Norfolk Bay; and C) Great Oyster Bay. Dotted lines indicated minimum legal size limit (300 mm) at the time of the surveying.

Age composition

Age frequency histograms from the fishery-independent survey (Fig. 10.2) indicate that the majority of Sand Flathead in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay are four years of age and that the abundance and proportion of females declines rapidly in the older age classes (Fig. 10.1a and 10.1b). Conversely, in Great Oyster Bay the age structure is strongly influenced by older age classes (Fig 10.1c). There remains an obvious bias towards males in age classes older than around seven years, which is likely to the result of higher fishing pressure on females who reach the minimum size limit faster than the slower growing males (Ewing and Lyle 2015).

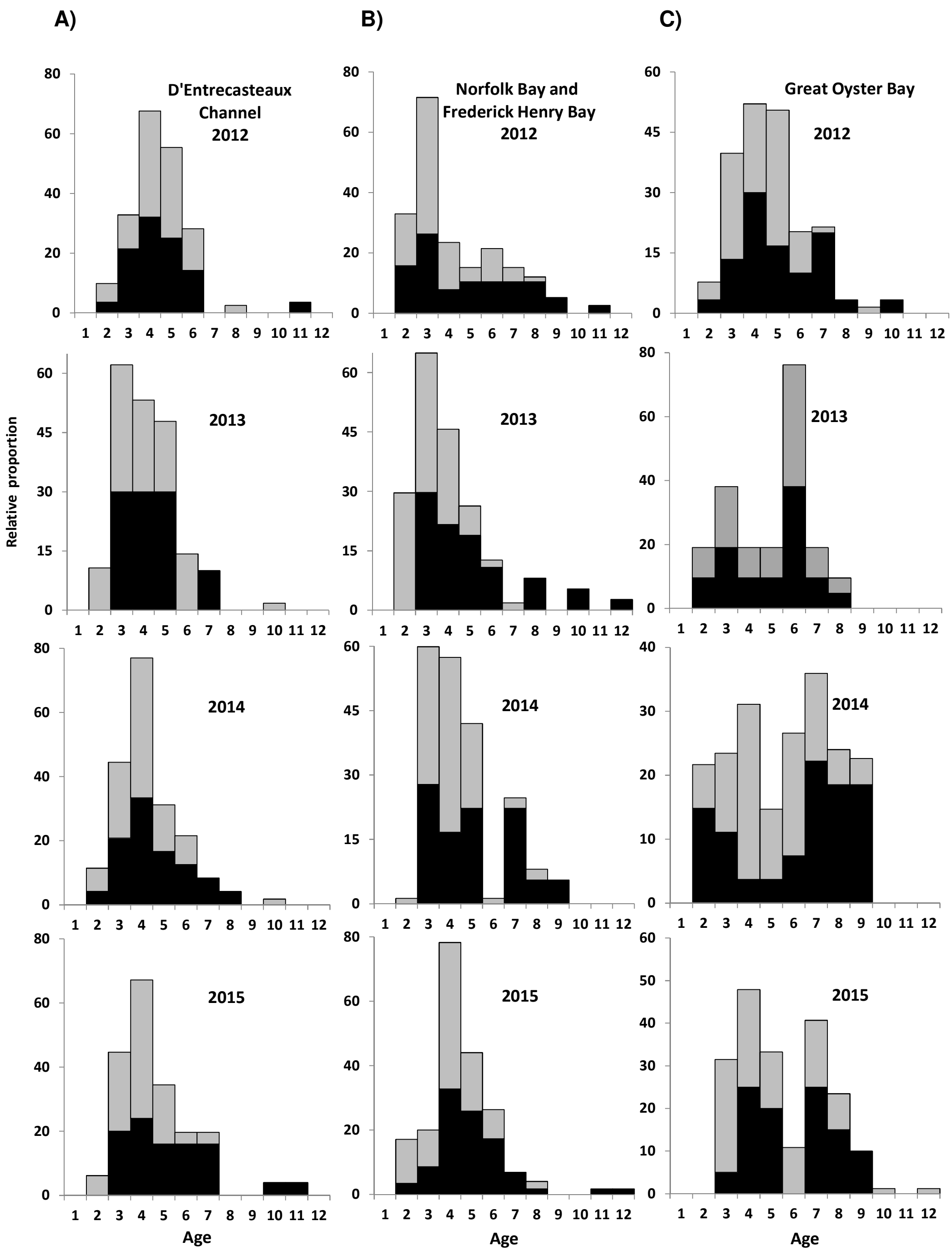


Figure 10.2 Age frequency histograms for aged Sand Flathead for A) D'Entrecasteaux Channel; B) Frederick Henry-Norfolk Bay; and C) Great Oyster Bay. The black bars indicate males and grey bars indicate females.

Recreational CPUE

Standardised catch rates from the fishery-independent survey indicate that the populations of legal sized Sand Flathead in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay is stable but at a significantly depleted level (Fig. 10.3c). The standardised catch rate in Great Oyster Bay was initially higher but has declined through time suggesting that a reduction in abundance may be occurring, however further monitoring is required (Fig. 10.3c). Overall the information highlights that catch rates are stable or declining, catches are dominated by fish below the minimum legal size limit and populations show clear evidence of heavy depletion (Ewing and Lyle 2015).

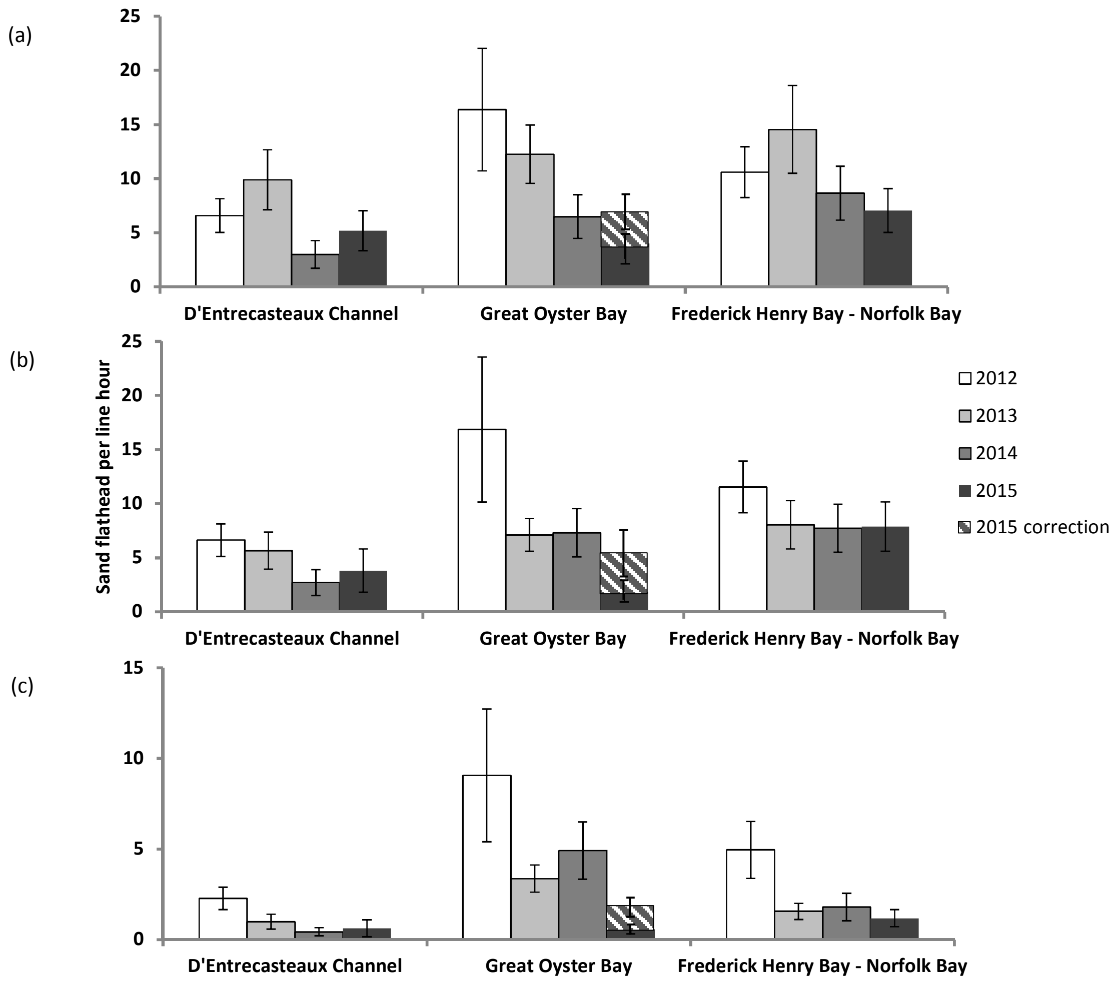


Figure 10.3 Mean catch rates (fish per line hour) by region and year for Sand Flathead: (a) raw catch rates; (b) standardised catch rates; and (c) standardised catch rates for fish above minimum legal size. Hatched columns for Great Oyster Bay in 2015 indicate the increase in catch rate when corrected for redundant fisher effort. Error bars represent 95% confidence intervals.

Commercial catch, effort and CPUE

The 2014/15 total commercial catch of Sand Flathead was 8.0 t. The commercial fishery for Flathead has not undergone major changes in its operations since 1995/96. It was therefore possible to back calculate catches for Sand Flathead prior to 2007, when species were not distinguished, based on the average proportion of species by gear type from 2007/08 to 2011/12 (Fig. 10.4). Sand Flathead catches remained relatively stable between 10 and 15 t per annum until 2008/09 before declining and now fluctuate around 5 to 8 t per annum (Fig. 10.4 and 10.5).

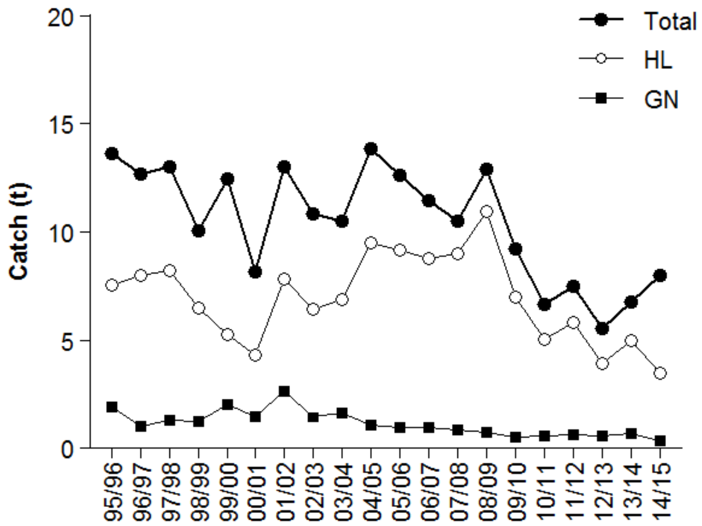


Figure 10.4 Back-calculated annual commercial catch (t) by gear for Sand Flathead.

Hand-line fishing effort has been relatively stable the last three fishing seasons after significant declines but both catches and catch rate declined (Fig. 10.2). In 2014/15, 3.4 t of the Sand Flathead catch was taken by Danish seine, which represented an increase from previous season. Hand-line catch although fluctuating has been slowly declining through time. There have been reports from the commercial sector that Sand Flathead availability has been declining since 2009, which could account for this trend. Catches in 2014/15 were derived mainly from the southeast and east coasts (Fig. 10.3).

Recreational Flathead catches were estimated at 361 t in 2000/01 (Lyle 2005), 292 t in 2007/08 (Lyle et al. 2009) and 235.9 t in 2012/13 (Lyle et al. 2014b). Sand Flathead are by far the dominant species taken (>90% in numbers).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, hand-lining was considered a medium risk with regard to Sand Flathead due to evidence of the population being subject to heavy fishing pressure. Hand-lining was considered a medium risk to by-product mixed fish species due to the uncertainty surrounding their population status. Impacts on communities and protected species were generally low or negligible although heavy fishing pressure on Sand Flathead populations in inshore and estuarine waters was considered to represent a medium risk to the trophic structure of these systems (Bell et al. 2016).

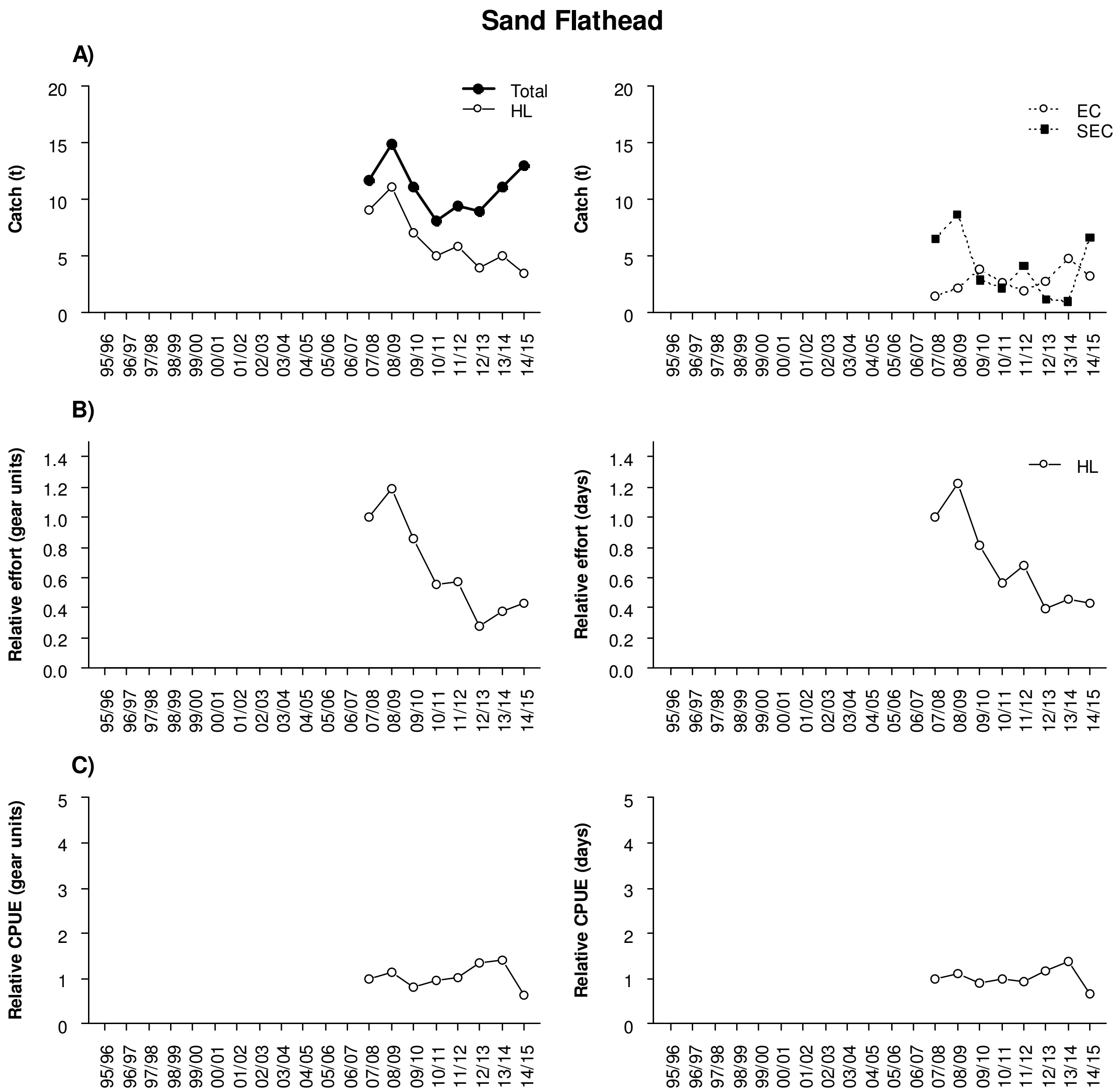


Figure 10.5 A) Sand Flathead annual commercial catch (t) by gear (left) and region (right). B) Sand Flathead commercial effort by method based on gear units (left) and day fished (right) relative to 2007/08. C) Sand Flathead commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 2007/08. HL= hand-line, SEC= southeast coast, EC= east coast.

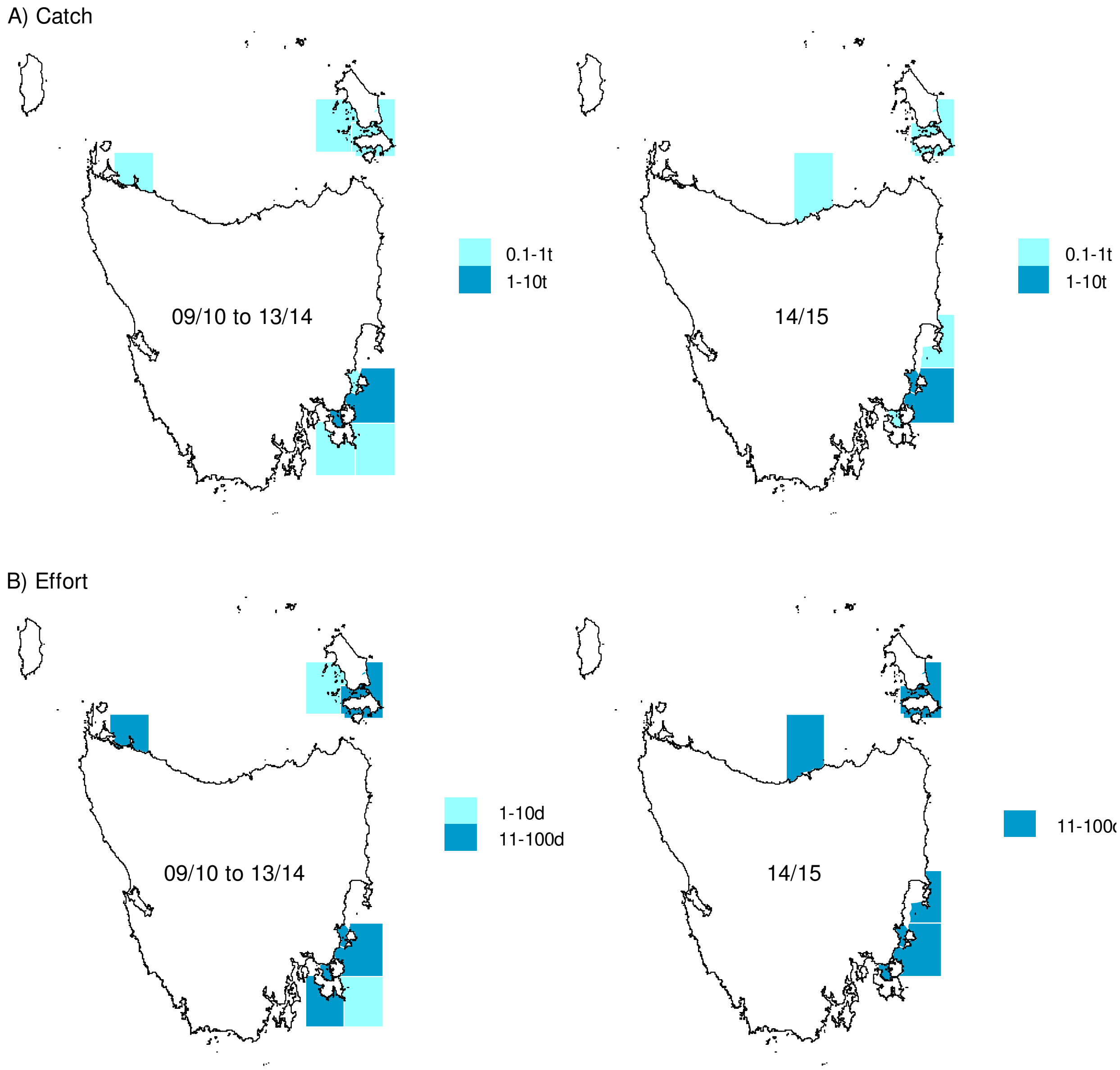


Figure 10.6 (A) Sand Flathead catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points for Flathead (combined)

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (165.3 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (51.8 t)	Yes	15.5 t (40%)
	• Catch increases by > 30% from previous year (> 40.5 t)	No	
	• Catch decreases by > 30% from previous year (<21.8 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1341 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0104 t/days fished)	Yes	0.0019 t/days fished (18.2%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (63.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (50.5 t)	Yes	14.2 t (28.1%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (-32.6 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (43.5 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (361 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (80.0% in 2007/08)	Yes	Latest estimate (2012/13) 85.5%
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.013 t/days fished)	Yes	0.0046 t/days fished (35.3%)
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0038)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	Southern Sand Flathead	TRANSITIONAL DEPLETING

The main impact on Sand Flathead stocks is from the recreational sector with catches >20 times that of the commercial sector. Due to an absence of targeting among commercial fishers, a Sand Flathead fishery-independent survey commenced in 2012 to support classification of this species.

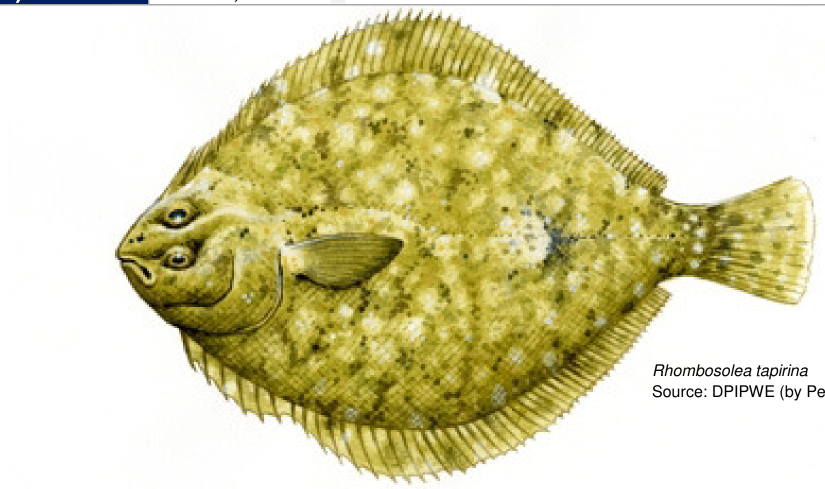
The survey over the last three years has identified a low relative abundance of legal size fish, particularly in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay with a higher proportion of older age class males, which is likely a factor of females reaching the minimum size limit faster than slower growing males (Ewing and Lyle 2015). Catch rates indicate that populations of legal sized fish are heavily depleted relative to historic levels in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay with a similar decline perhaps underway in Great Oyster Bay (Ewing and Lyle 2015).

In late 2015, various management changes were introduced to improve the sustainability of this species including: an increase in the minimum size limit from 300 mm to 320 mm and introduction of a daily bag limit of 20 per fisher with a possession limit of 30. Any effect of these management changes will be closely monitored through the annual fishery-independent survey and in future assessments. As the current fishing pressure on the stock remains high and likely to cause the stock to become recruitment overfished, Sand Flathead is classified as transitional depleting.

11. Flounder

Pleuronectidae family

STOCK STATUS	NOT ASSESSED
Greenback Flounder constitute the majority of the commercial catches, which remains small due to the ban on overnight gillnetting and lack of market demand. Catch is an unreliable estimate of abundance and the status of the stock remains uncertain.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Rhombosolea tapirina
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Sheltered sand. Between 0 and 100 m depth.	Edgar (2008)
Distribution	• Southern Western Australia to southern New South Wales, and around Tasmania. Also in New Zealand.	Edgar (2008)
Diet	• Polychaetes and benthic crustaceans.	Edgar (2008) Ferguson (2006)
Movement and stock structure	• Several genetically distinct stocks in Australia: west coast of Tasmania, east coast of Tasmania, Victoria.	van den Enden (2000)
Natural mortality	• Estimated at *M*= 0.85 (for New Zealand stock)	Sutton et al. (2010)
Maximum age	• 10 years	Sutton et al. (2010)
Growth	• Maximum length: 45 cm • Maximum weight: 0.6 kg • Growth (New Zealand) described by von Bertalanffy growth function $L = L_{\infty}\left(1 - e^{-k(t-t_0)}\right)$ where *L* is the fork length (cm), *t* is the age (years), L_{∞} is the average maximum length for the species, *k* is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are :	Edgar (2008) Kailola et al. (1993) Sutton et al. (2010)

Sex	L_{∞}	*k*	$t_{0\infty}$
Females	55.82	0.26	-1.06
Males	52.21	0.24	-1.32

	• Length-weight relationship was estimated at $W = 0.036\ L^{2.7}$ for females and $W = 0.039\ L^{2.64}$ for males where *W* is weight (g) and *L* is the tail length (cm).	
Maturity	• Sexual maturity at about 218.6 mm TL for females and 190 mm TL for males.	Crawford (1984)
Spawning	• From June to October. • Females are serial spawners and move from the shallows in deeper areas of tidal rivers and estuaries, and offshore for spawning. • The relationship between batch fecundity and fork length is linear between 24.7 and 34.3 cm with $F = -1053.65 + 85.85L$, where *F* is the fecundity (in number of eggs) and *L* is the tail length (cm). • Pelagic eggs, 0.7-1.0 mm in diameter	Crawford (1984)
Early life history	• Incubation of 82-93 hours • Larvae hatch at 1.9 mm between May and November. Larvae remain in the plankton for over 30 days until they reach 6 mm, and then undergo metamorphosis which finishes 65 days post-hatching. • Settlement inshore occurs during late winter to early summer. • Juveniles live on sand flats in water less than a meter deep.	Edgar (2008) Crawford (1984, 1986) Jenkins (1986)
Recruitment	• No-stock recruitment relationship established.	
Gillnet post release survival	• High: 96.1%	Lyle et al. (2014a)

Background

While the various Flounder species are not always differentiated in the logbooks, Greenback Flounder constitute the vast majority of the commercial catch. Long-snouted Flounder (*Ammotretis rostratus*) are also taken in small quantities. The main fishing methods used to target flounder are spear and gillnet. However, the ban in 2010 of night setting for gillnets has essentially dissipated gillnet fishing for Flounder.

FISHING METHODS	Spear, graball net, some beach seine
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational gear licence (graball and/or mullet net licence) **Output control:** • Possession limit of 30 and bag limit of 15 individuals for recreational fishers • Minimum size: 25 cm
MAIN MARKET	Local (Tasmania)

Current assessment

Catch, effort and CPUE

State wide Flounder landings have declined steadily since the mid-1990s, reaching 1.5 t in 2014/15 (Fig. 11.1A). Since the ban on night netting, Flounder have been caught almost exclusively using spear. Commercial catches have contracted spatially over recent years and are now restricted to Norfolk Bay and the Tamar estuary (Fig. 11.2).

Flounder is an important recreational species, and catches for the recreational sector exceed those of the commercial sector (Fig. 11.1A). Recreational catches were estimated at 15.2 t in 2000/01 (Lyle 2005), 10.1 t in 2007/08 (Lyle et al. 2009) and 7.2 t in 2012/13 (Lyle et al. 2014b). Consistent with the trend in catches, effort for both methods has been declining steadily since the mid-1990s, with graball effort currently at minimal levels.

Catch rates based on gear units have remained relatively steady over time, although based on daily catches there has been a general decline for gillnets (Fig. 11.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, spearing was considered a very low risk to Flounder populations due to the negligible fishing effort directed at this species in recent years. All other ecosystem components were considered negligible risk because spearing has rarely been used in recent years and is highly selective, with fish sighted and captured individually (Bell et al. 2016).

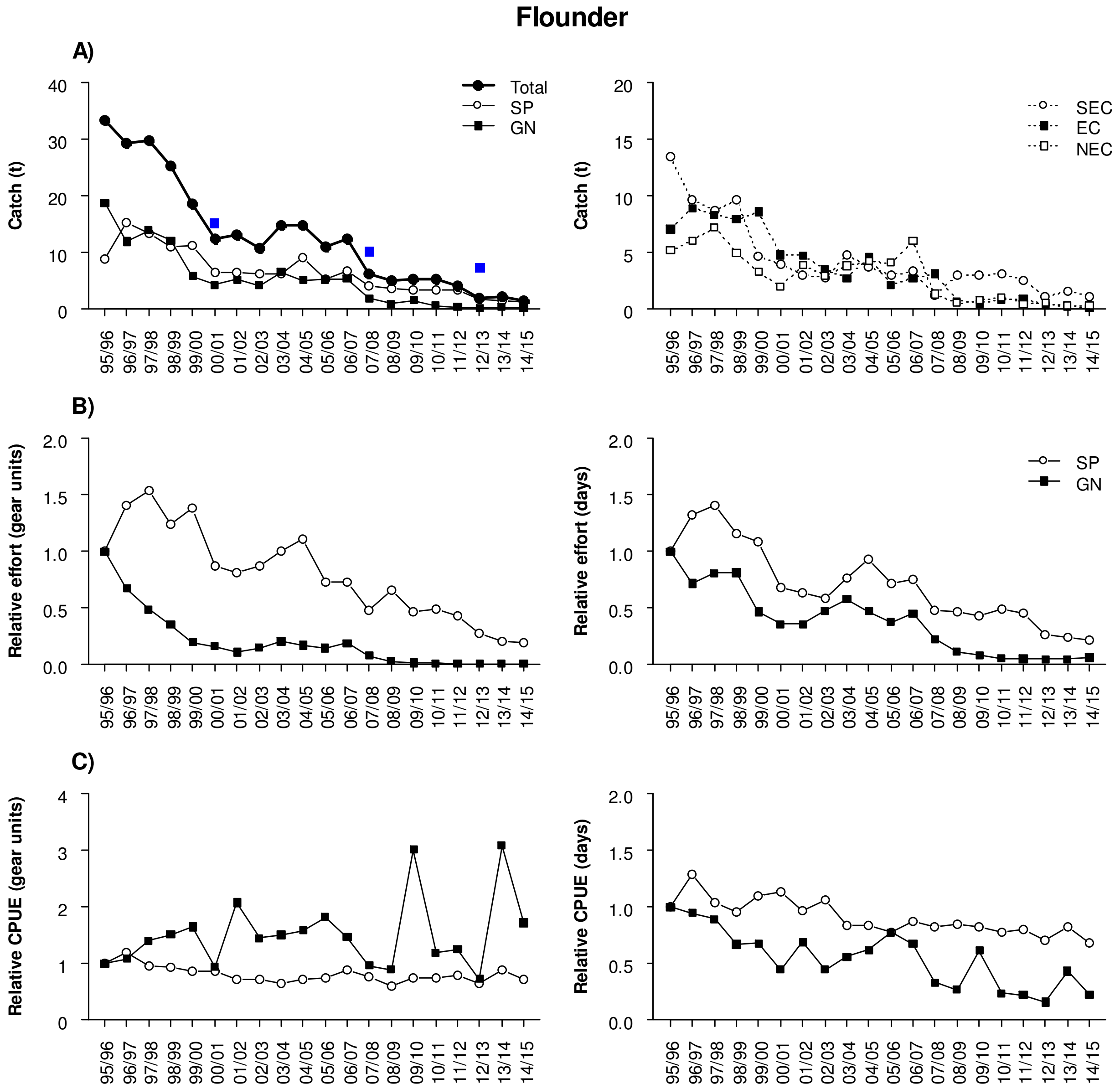


Figure 11.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. SP= spear, GN= graball net, NEC= northeast coast, SEC= southeast coast, EC= east coast.

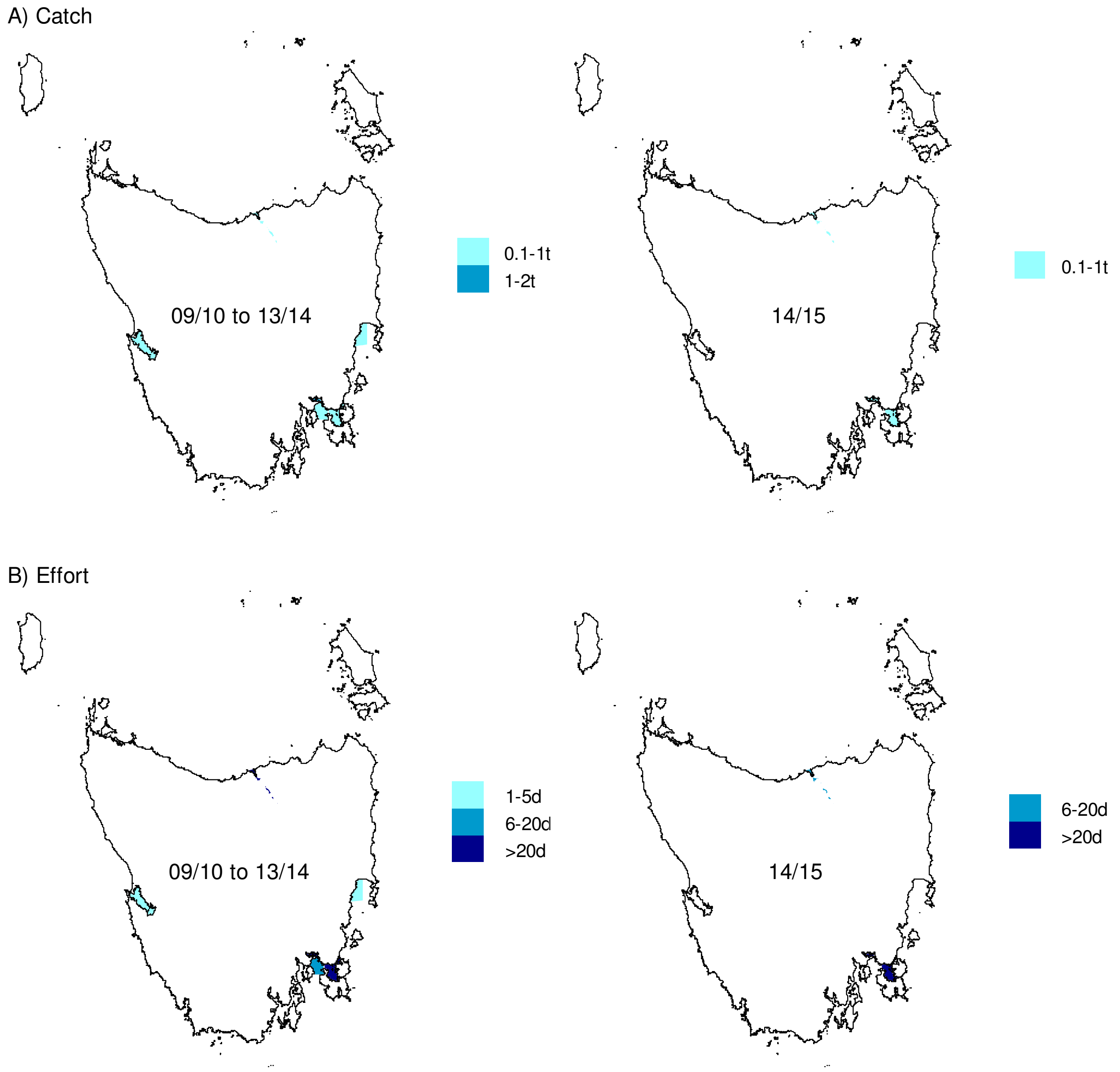


Figure 11.2 (A) Flounder catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (44 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (27.1 t)	Yes	25.6 t (94.5%)
	• Catch increases by > 30% from previous year (>2.8 t)	No	
	• Catch decreases by > 30% from previous year (<1.5 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (1392 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0126 t/days fished)	Yes	0.0045 t/days fished (35.7%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (29.4 t)	No	
	• Catch < 3rd lowest catch value from the reference period (12.3 t)	Yes	10.8 t (87.5%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (15.2 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (56.3% in 2007/08)	Yes	Latest estimate (2012/13): 77.4%
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0017)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status

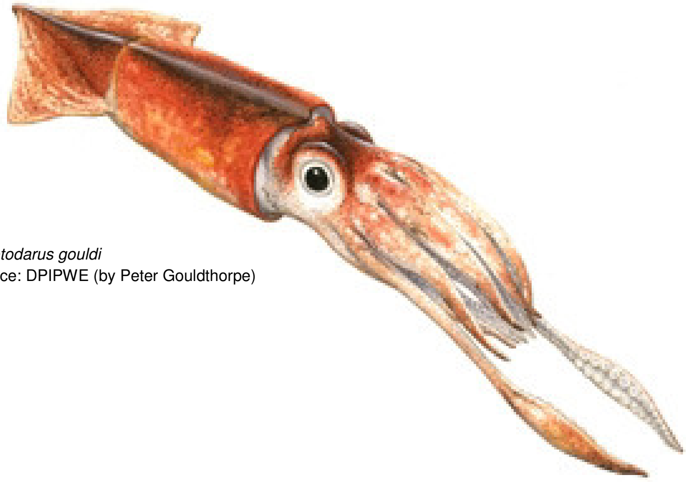
NOT ASSESSED

The decrease in catches for the species is likely to be related to market demand but has also been impacted by the ban on overnight gillnetting. The Tasmanian catch is sold locally and demand for Flounder has decreased over the last two decades to the extent that the catch is now so small that its unreliable estimate of abundance. This status of the species remains uncertain.

12. Gould's Squid

Nototodarus gouldi

STOCK STATUS	SUSTAINABLE
This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/goulds-squid/). Dual-endorsed vessels fish in Tasmanian waters especially in years of peak abundance. Species is characterised by high inter-annual variability in abundance in State waters with low catches in the last two fishing seasons suggesting that the recent focus of the fishery was in Commonwealth waters.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery/Southern Squid-jig Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Nototodarus gouldi
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Open water. Inhabits coastal, inner shelf and shelf break waters down to 600 m depth.	Stark (2008)
Distribution	• From southern Queensland to mid-Western Australia, and around Tasmania	Dunning (1998) Dunning and Förch (1998)
Diet	• Small planktonic crustaceans, fish and squids	Machida (1983) O'Sullivan and Cullen (1983) Smith (1983) Uozumi (1998)
Movement and stock structure	• Move widely within a 300km^2 area but no large-scale migration between feeding and spawning areas as for other similar squid species • Stock structure uncertain but appears to be only one population in southern Australia	Jackson et al. (2005a) Triantafillos et al. (2004)
Natural mortality	• No estimates available	
Maximum age	• Around 1 year	Jackson et al. (2005b)
Growth	• Maximum length: 40 cm. • Maximum weight: 1.6 kg	Norman and Reid (2000)

	• Size-at-age highly variable between individuals, years and locations. • Growth rate rapid: between 2.559 and 5.596 $g.d^{-1}$ for females, and between 1.622 and 5.307 $g.d^{-1}$ for males.	Jackson et al. (2005b) Jackson et al. (2003)
Maturity	• Size-at-50% maturity: between 30.6 to 31.4 cm ML for females, and 20.5 to 21.5 cm ML for males.	Stark (2008)
Spawning	• Spawns once and then die • Spawning all year-round • Egg mass are free-floating gelatinous sphere of at least 1.5 m in diameter and contains several thousands of eggs	Jackson et al. (2005b) Uozumi (1998) O'Shea et al. (2004)
Early life history	• Hatching throughout the year.	Jackson et al. (2005b) Uozumi (1998)
Recruitment	• Highly variable. No-stock recruitment relationship established.	

Background

Gould's Squid, like most cephalopod species, has a very brief life cycle and can vary significantly in abundance between years. Environmental conditions are acknowledged as influences on larval and juvenile survival (Flood et al. 2012). It is likely that there is only one biological stock throughout southern Australian waters.

The Commonwealth Southern Squid-jig Fishery operates in Bass Strait waters using automatic squid-jigs and Gould's Squid are a regular by-product in the South East Trawl Fishery. Occasionally, Gould's Squid become available in high numbers in Tasmanian State waters, particularly around southeast Tasmania. Consequently, dual endorsed vessels may fish in State waters during the summer before moving back to traditional fishing grounds in Bass Strait.

Gould's Squid are processed into "tubes" and frozen. Given the unpredictable occurrence of the species in Tasmanian waters there is limited local processing capacity, which has limited the development of the fishery. There is also limited market demand with consumers preferring Southern Calamari. Due to the abovementioned factors, catch does not necessarily reflect biomass.

FISHING METHODS	Automated squid-jig
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, Automated squid-jig licence) • Temporal and spatial closures (October-November) of some east coast waters **Output control:** • Possession limit of 30 and bag limit of 15 individuals for recreational fishers
MAIN MARKET	Interstate

Current assessment

Catch, effort and CPUE

Gould's Squid availability in Tasmanian waters is highly variable as reflected in the catch history (Fig. 12.1A). Since 1995/96, there have been a few peaks of abundance, notably in 1999/2000, 2011/12 and 2012/13. The Gould's Squid catch for 2012/13 was the highest since 1995/96 (~1000 t) with the Australia-wide catch predominantly coming from Tasmanian waters (Flood et al. 2014). By contrast in 2013/14 no Gould's Squid were landed by automatic jig in Tasmanian waters and only 18.7 tonnes was caught in 2014/15. Historically, in between the peaks, catches of the species have fluctuated between 0.1 and 50 t. The majority of the catch is taken in the southeast and east coast of Tasmania (Fig.12.2).

Gould's Squid catches from the recreational sector (Fig. 12.1A) were estimated at 5 t in 2000/01 (Lyle 2005), 36.6 t in 2007/08 (Lyle et al. 2009) and 21.4 t in 2012/13 (Lyle et al. 2014b).

Effort tends to follow the catch pattern closely and matches the availability of the species. In recent years high catches have been achieved with relatively low effort with a record catch obtained in 2012/13 (Fig. 12.1B).

Overall, catch rates remained relatively low until 2008/09. Prior to 2013/14 there was an increase in catch rate, both in gear units and by days fished (Fig. 12.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery automatic squid jig fishing methods were considered a very low risk activity with regard to Gould's Squid, non-retained species and the general environment. They were considered a medium risk to Southern Calamari due to increasing commercial and recreational catches coupled with fishery indicators that the stock is relatively heavily fished in Tasmania (Bell et al. 2016)

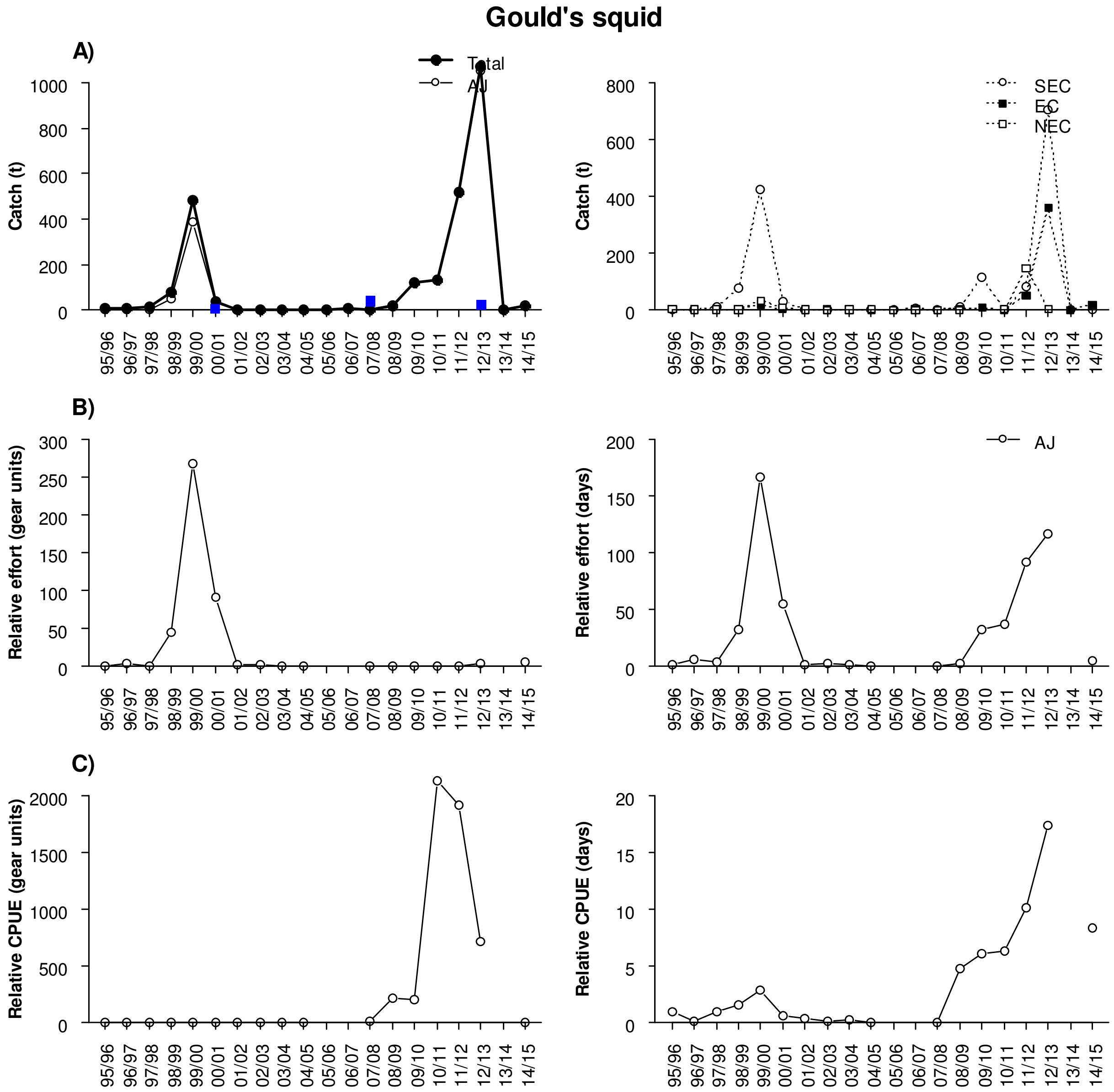


Figure 12.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. AJ= automatic squid-jig, NEC= northeast coast, SEC= southeast coast, EC= east coast. Note: no notable catch and effort using Automatic squid-jig was recorded for 2005/06, 2006/07 or 2013/14 and the data includes AFMA catch in State waters.

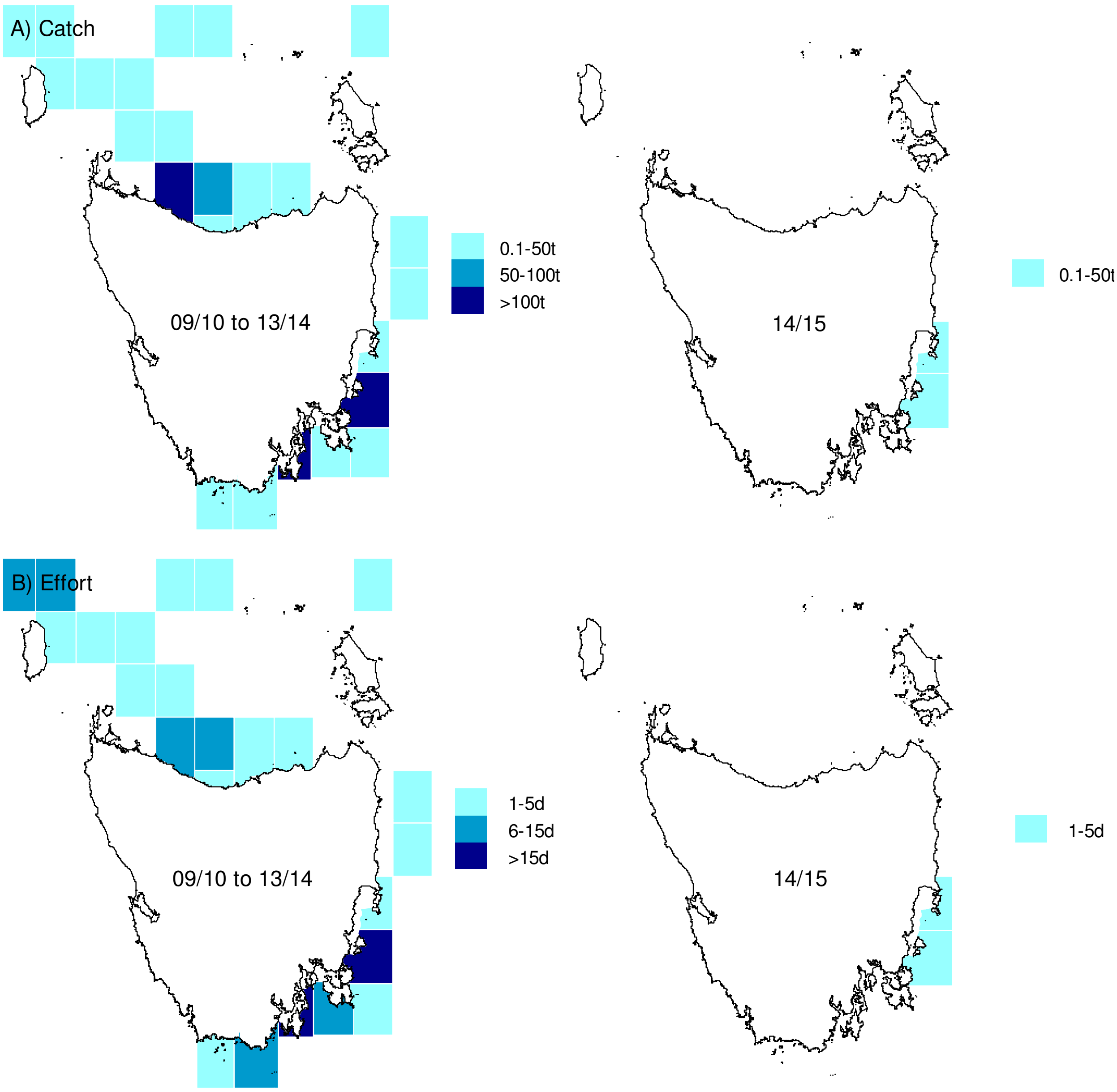


Figure 12.2 (A) Gould's Squid catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right). No notable catch of Gould's Squid was recorded in 2013/14 and the data includes AFMA catch in State waters.

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (35.1 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (5.7 t)	No	
	• Catch increases by > 30% from previous year (>0.04)	Yes	18.7 t (53276.4%)
	• Catch decreases by > 30% from previous year (0.019 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>227 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0048 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (37.9 t)	No	
	• Catch < 3rd lowest catch value from the reference period (2.1 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (5 t)	Yes	16.4 t (328%)
	• Proportion of recreational catch to total catch > previous proportion estimate (44.4% in 2007/08)	No	
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0574)	Yes	0.52 (-906.5%)
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	SUSTAINABLE

Catch reference points were breached during the 2014/15 season as a result of the zero catch and lack of automatic squid-jig effort occurring in state waters in 2013/14. Relative to previous seasons however, the 18.7 tonnes of Gould's Squid landed in 2014/15 was low, suggesting that the focus of the fishery was in Commonwealth waters. Spatial variability in abundance does not necessarily indicate a decrease in abundance in the southern Australian Gould's Squid stock.

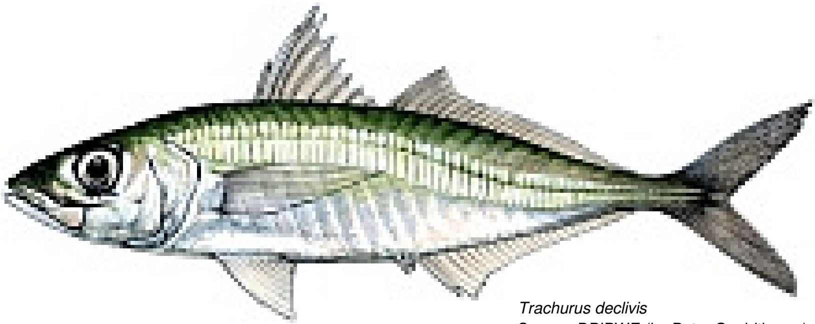
A recreational reference point was also breached, however it is unlikely that the recreational sector poses a threat to the stock as estimated catches remain small in comparison to the commercial sector when Gould's Squid are available in Tasmanian waters and even more so when the Southern Squid-jig Fishery catches are taken into consideration.

Gould's Squid are short lived, spawn year round and display highly variable growth and size/age at maturity, meaning they can rapidly increase in numbers during favourable environmental conditions. As a result, Gould's Squid may be less susceptible to overfishing than longer lived species (Flood et al. 2012). However, their short life span (1 year) implies a reliance on a single cohort, which leaves the species very susceptible to environmental impacts on subsequent recruitment. The fishing effort in the Commonwealth Southern Squid-jig Fishery has decreased markedly since the late 1990s due to economic factors and catches are considered lower than the historical catches from the late 1970s. A biological stock depletion study found that no overfishing had occurred (Sahlqvist and Skirtun 2011). The species was classified as not overfished or subject to overfishing in the 2014 Fishery Status Reports (Patterson et al. 2015), and as Sustainable in the Key Australian Fish Stock Reports (Flood et al. 2012, Flood et al. 2014). This assessment has therefore been applied to the Tasmanian component of the fishery.

13. Jack Mackerel

Trachurus declivis

STOCK STATUS	SUSTAINABLE
This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/). Only minor catches of this species in recent years due to one operator leaving the fishery and do not reflect the stock status.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery/Small Pelagic Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Trachurus declivis
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Open water. Between 0-500 m depth.	Edgar (2008)
Distribution	• Western Australia (Shark Bay) to southern Queensland and around Tasmania. Also in New Zealand.	Edgar (2008)
Diet	• Krill, planktonic crustaceans, fish	Kailola et al. (1993)
Movement and stock structure	• Schooling fish. Normally live in continental shelf waters. May move close to seabed during winter. • Most likely 2 subpopulations, one eastern Australian (east Tasmania and along the eastern seaboard of Australia) and one western Australian (west Tasmania, Great Australian Bight and Western Australia.	Kailola et al. (1993) Bulman et al. (2008)
Natural mortality	• Estimated between $M = 0.63$ and 0.70	Stevens and Hansfeld (1982)
Maximum age	• 25 years	Paul (2000)
Growth	• Maximum length: 64 cm • No difference between male and female growth. Growth described by von Bertalanffy growth function $L = L_{\infty}(1 - e^{-k(t-t_0)})$ where L is the length (cm), t is the age (years), L_{∞} is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are: **Sex** / L_{∞} / k / $t_{0\infty}$ Combined / 36.2 / .267 / -1.21	Paul (2000) Lyle et al. (2000)

	• Length-weight relationship was estimated at $W = 1.46.10^{-8}L^{2.982}$ for both males and females, where W is weight (g) and L is the length (cm).	
Maturity	• Sexual maturity between 3 and 4 years of age, at sizes around 27 cm and weights around 250 g.	Webb (1976)
Spawning	• Occurs over a wide area in Tasmania. • Between late December and early March • Pelagic eggs	Stevens and Hansfeld (1982)
Early life history	• Larvae carried by inshore currents • Juveniles inhabit coastal and estuarine waters although they may sometimes be found offshore	Kailola et al. (1993) Williams and Pullen (1986)
Recruitment	• No-stock recruitment relationship established.	
Gillnet post release survival	• NA	

Background

The Jack Mackerel fishery in Tasmania started in the early 1970s, with a one year venture catching 6 300 t in 1973. In 1985 another venture aimed at fishmeal production using purse seine nets commenced and Jack Mackerel landings rose rapidly to over 40 000 t in 1986/87 (Kailola et al. 1993). By 2000, fishers were struggling to catch surface schools and the industry began mid-water trawling for the species (and redbait) in Commonwealth waters. Small quantities of Jack Mackerel are also taken inshore as by-product of beach seining and inshore purse seining.

FISHING METHODS	Mainly purse seine, also beach seine
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Species licence (Mackerel A or B) • Recreational gear licence (beach seine) **Output control:** • Possession limit of 60 and bag limit of 30 individuals for recreational fishers • Commercial catches taken by Mackerel licence holders (A & B) are decremented against the TAC allocated to the Commonwealth Small Pelagic Fishery
MAIN MARKET	Local (Tasmania)

Current assessment

Catch, effort and CPUE

Catches of Jack Mackerel in Tasmanian waters and reported in the General Fishing Returns have been variable since 1995/96, oscillating between 2.6 and 59.8 t up until 2007/08 when there was a sharp increase in purse seine effort targeting Jack Mackerel (Fig. 13.1A). The Jack Mackerel catches peaked at 919.6 t in 2008/09, but declined sharply in 2010/11 and 2011/12 to around 60 t, the result of the major purse seiner ceasing operations. Catches usually focus on the southeast coast (Fig. 13.2). Only 5.5 t was recorded in Tasmanian waters in 2014/15. It should be noted that between 1995 and 1999, purse seine catches taken as part of the then Zone A Jack Mackerel fishery, and recorded in a separate logbook, ranged from 447 (1995/96) to 8 458 t (1997/98), averaging 4 485 t per year for that period. These data are not presented in Fig. 13.1A.

Jack Mackerel is not a significant recreational species, catches estimated at 3.2 t in 2000/01 (Lyle 2005), 1.0 t in 2007/08 (Lyle et al. 2009) and 5.2 t in 2012/13 (Fig. 13.1A).

The use of purse seining by a major operator between 2008/09 to 2009/10 resulted in a spike in effort for that period of time. Beach seine effort has been declining slowly over time though Jack Mackerel represent a by-product and no meaningful catch rate trends can be drawn from these data (Fig. 13.1B). Purse seine catch rates were low until the species began being targeted in 2008/09 and remained high until 2011/12, which was the last year that the species was targeted (Fig. 13.1C). Since that time, landings have been low and there has been no targeted fishing in Tasmanian waters and few landings in the Commonwealth Small Pelagic Fishery (Flood et al. 2014).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, offshore purse seining was considered a negligible risk activity to populations of Jack Mackerel due to the small amount of catch currently taken in the fishery. However, it is noted that if catches increased then the risks would need to be reassessed (Bell et al. 2016).

Jack mackerel

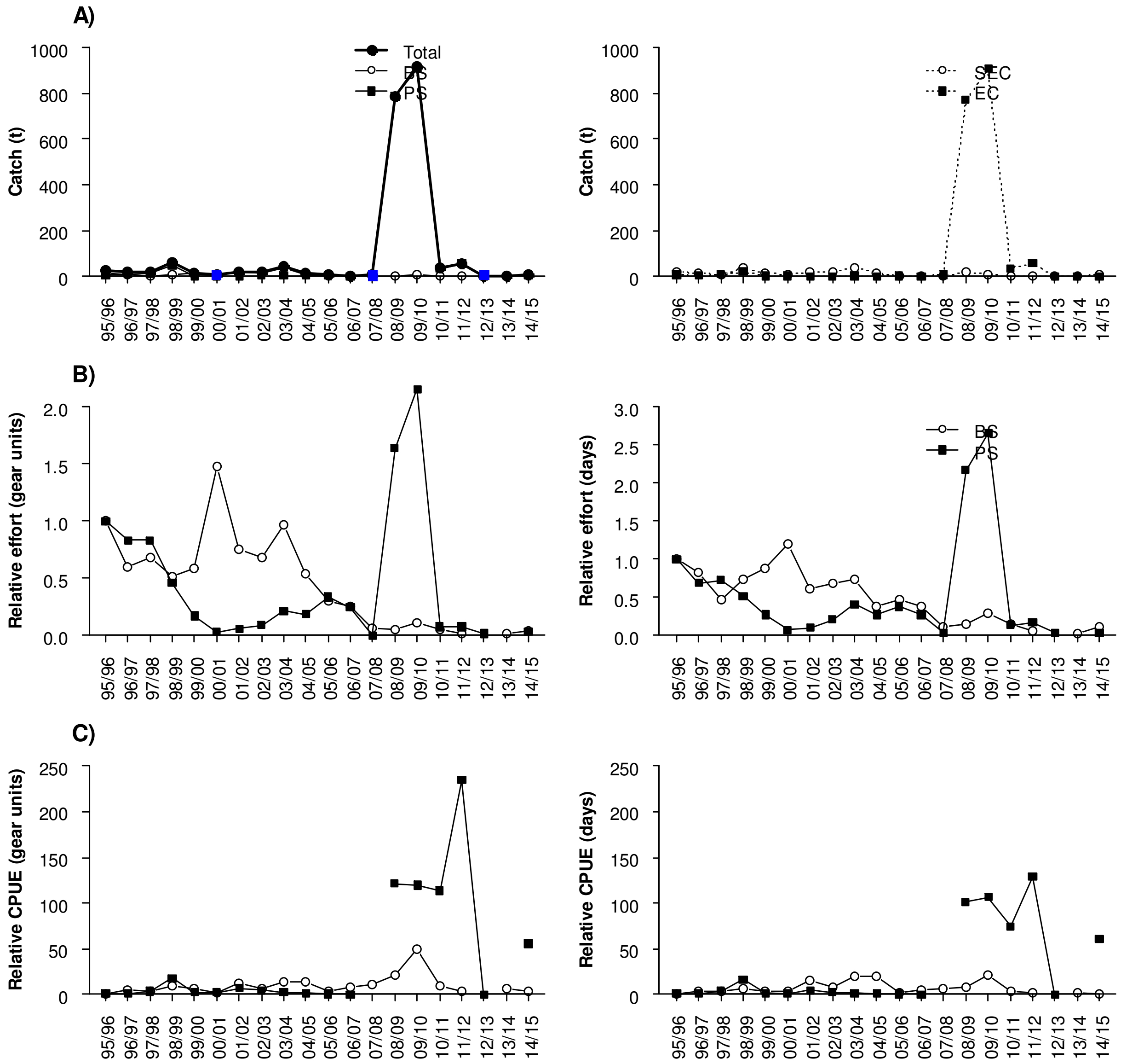


Figure 13.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS= beach seine, PS= purse seine, SEC= southeast coast, EC= east coast. No catch for Jack Mackerel was reported during 2013/14.

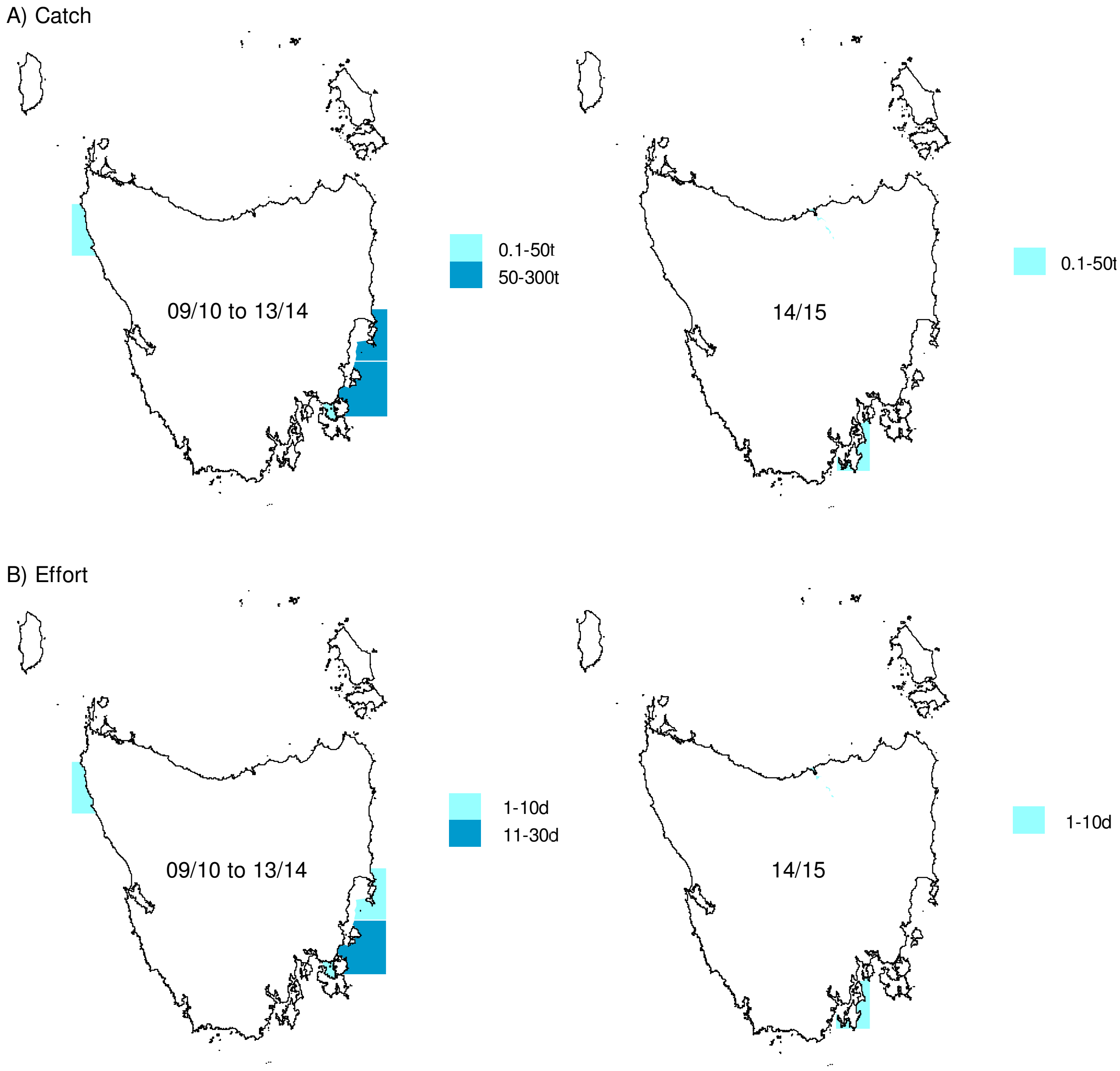


Figure 13.2 (A) Jack Mackerel catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14. No notable catch for Jack Mackerel was reported during 2012/13 or 2013/14.

Limit reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (48.4 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (6.1 t)	Yes	0.6 t (9.8%)
	• Catch increases by > 30% from previous year (>0.48 t)	Yes	5 t (1049.4%)
	• Catch decreases by > 30% from previous year (<0.26 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>239 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0191 t/days fished)	Yes	0.0043 t/days fished (22.5%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (26.2 t)	No	
	• Catch < 3rd lowest catch value from the reference period (8.6 t)	Yes	3.1 t (36.1%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (3.2 t)	Yes	2.0 t (62.5%)
	• Proportion of recreational catch to total catch > previous proportion estimate (0.4% in 2007/08)	Yes	Latest estimate (2012/13: 96.3%
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0254)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

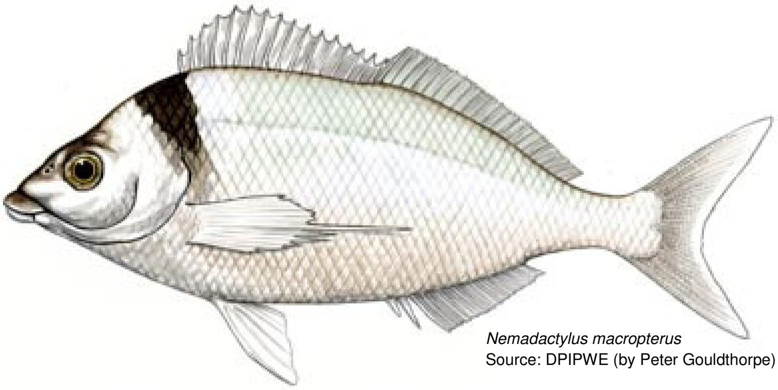
Stock status	**SUSTAINABLE**

The reference point for lowest catch and catch rate were breached due to minimal fishing occurring in 2014/15. Additionally, the reference point for a > 30 % increase in catch from the previous year was also breached due to negligible fishing occurring for this species in 2013/14. The minimal commercial catch in 2014/15 also meant that the recreational catch was proportionally higher than historically and therefore breached the recreational reference points. Recent trends in the commercial fishery have been the response of a single operator entering and leaving the fishery and do not reflect the stock status. In fact a 2014 study assessed the spawning stock biomass for eastern Australia to be in the order of 150 000 tonnes (Ward et al. 2015). Jack Mackerel are assessed by the Commonwealth Small Pelagic Fishery Resource Assessment Group and, based on current catch levels and spawning biomass, the eastern Jack Mackerel stock is assessed as not overfished and not subject to overfishing (Flood et al. 2014, Patterson et al. 2015) and this assessment has been applied to the Tasmanian component of the fishery.

14. Jackass Morwong

Nemadactylus macropterus

STOCK STATUS	SUSTAINABLE
This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/) with very low commercial catches in Tasmania.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery/Southern and Eastern Scalefish and Shark Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Nemadactylus macropterus
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Exposed sand and silt, reefs. Between 5 and 400 m depth.	Edgar (2008)
Distribution	• From mid Queensland to southern Western Australia, and around Tasmania. Also in New Zealand, southern Africa and South America.	Edgar (2008)
Diet	• Polychaete worms, crustaceans, molluscs and echinoderms	Godfriaux (1974)
Movement and stock structure	• No genetic variation in southern Australia indicating larval mixing. • Existence of at least 3 sub-populations: Tasmania, New South Wales/Victoria and Great Australian Bight	Richardson (1982) Grewe et al. (1994) Elliott and Ward (1994) Thresher et al. (1994)
Natural mortality	• *M* = 0.10 (New Zealand population)	Parker and Fu (2011)
Maximum age	• 50 years	Edgar (2008)
Growth	• Maximum length: 70 cm TL • Maximum weight: 2.9 kg • Growth varies according to location. Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where L is the length (cm FL), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are: **Sex** | L_∞ | k | t_0	Francis (2001) Kailola et al. (1993) Jordan (2001a)

	Females 38.4 0.36 -0.07 Mal s 36.2 0.42 0.15	
Maturity	• Sexual maturity at about 25 cm TL and about 3 years of age	Edgar (2008)
Spawning	• Between February and June • At least 2 spawning areas: northern one (probably southern New South Wales and eastern Victoria) and a southern one (probably western and southern Tasmania).	Lyle and Ford (1993) Bruce et al. (2001a)
Early life history	• Planktonic larval stage of 7-10 months. • Larvae up to 30 mm drift with current on the surface up to 250 km east of Tasmania • Settlement at 7-9cm long. • Juveniles live near shallow reefs	Francis (2001) Bruce et al. (2001a) Kailola et al. (1993)
Recruitment	• No-stock recruitment relationship established.	
Gillnet post release survival	• Moderate: 52%	Lyle et al (2014a)

Background

Jackass Morwong is a Commonwealth-managed species. While there is a good market for Jackass Morwong, the species is not available in large numbers in Tasmanian waters and is mainly a by-product of graball netting rather than a target species. Tasmanian commercial catches reached a maximum of around 250 t in the late 1980s due to the inshore trawl fishery, but this fishery has since ceased operations and State catches declined significantly. Most of the Jackass Morwong catch originates from trawling outside Tasmanian waters and while the stocks were assessed to be overfished from 2008 to 2010, the 2014 Fishery Status Reports classified this species as not overfished nor subject to overfishing (Patterson et al. 2015). The species was not assessed in the 2014 Status of Australian Fish Stocks.

FISHING METHODS	Mainly graball net, also hand-line and drop-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational licence (graball and/or mullet net) **Output control:** • Possession limit of 20 and bag limit of 10 individuals for recreational fishers • Minimum size: 25 cm TL
MAIN MARKET	Local

Current assessment

Catch, effort and CPUE

Total commercial catch of Jackass Morwong was 0.8 t in 2014/15 (Fig 14.1A). Commercially, Jackass Morwong is mainly caught by gillnet and landings have declined steadily since 1995/96. The majority of the catch is taken from the east and southeast coast (Fig. 14.2).

Jackass Morwong is an important recreational species, with catches estimated at higher levels than those of the commercial fishery (Fig. 14.1A). Estimates were 31.9 t in 2000/01 (Lyle 2005), 6.8 t in 2007/08 (Lyle et al. 2009), 7.7 t in 2011/12 (Tracey et al. 2013) and 16.1 t in 2012/13 (Lyle et al. 2014b). In addition to gillnet catches, Jackass Morwong are commonly caught recreationally by line fishing, often associated with targeted fishing for Striped Trumpeter.

A decline in effort of both gear units and days fished has mirrored the declining catches for the species (Fig. 14.1B). Catch rates have slowly declined since the early 2000s (Fig. 14.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, gillnetting was considered a medium risk activity with regard to Jackass Morwong (Bell et al. 2016).

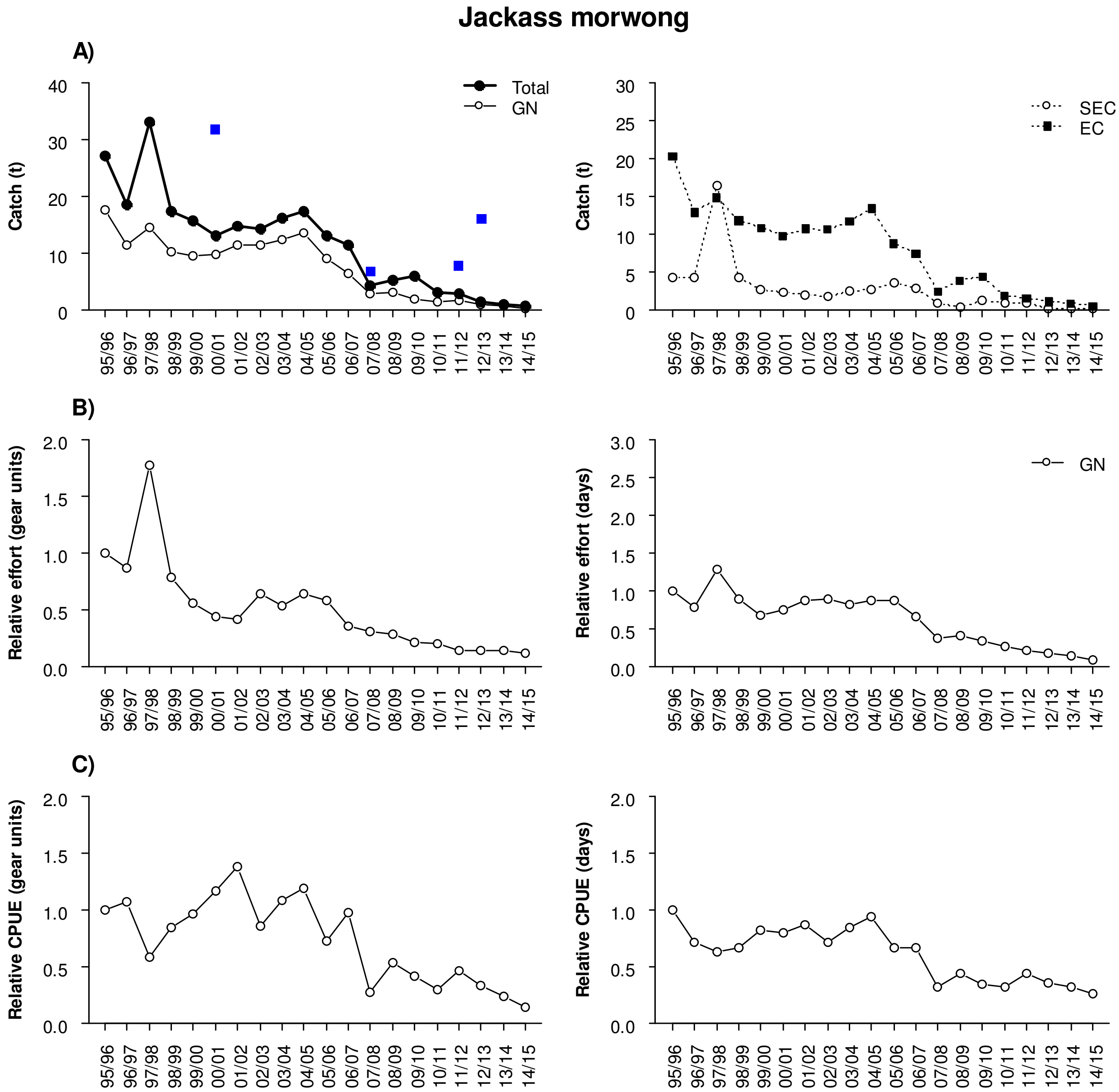


Figure 14.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. GN= graball net, SEC= southeast coast, EC= east coast.

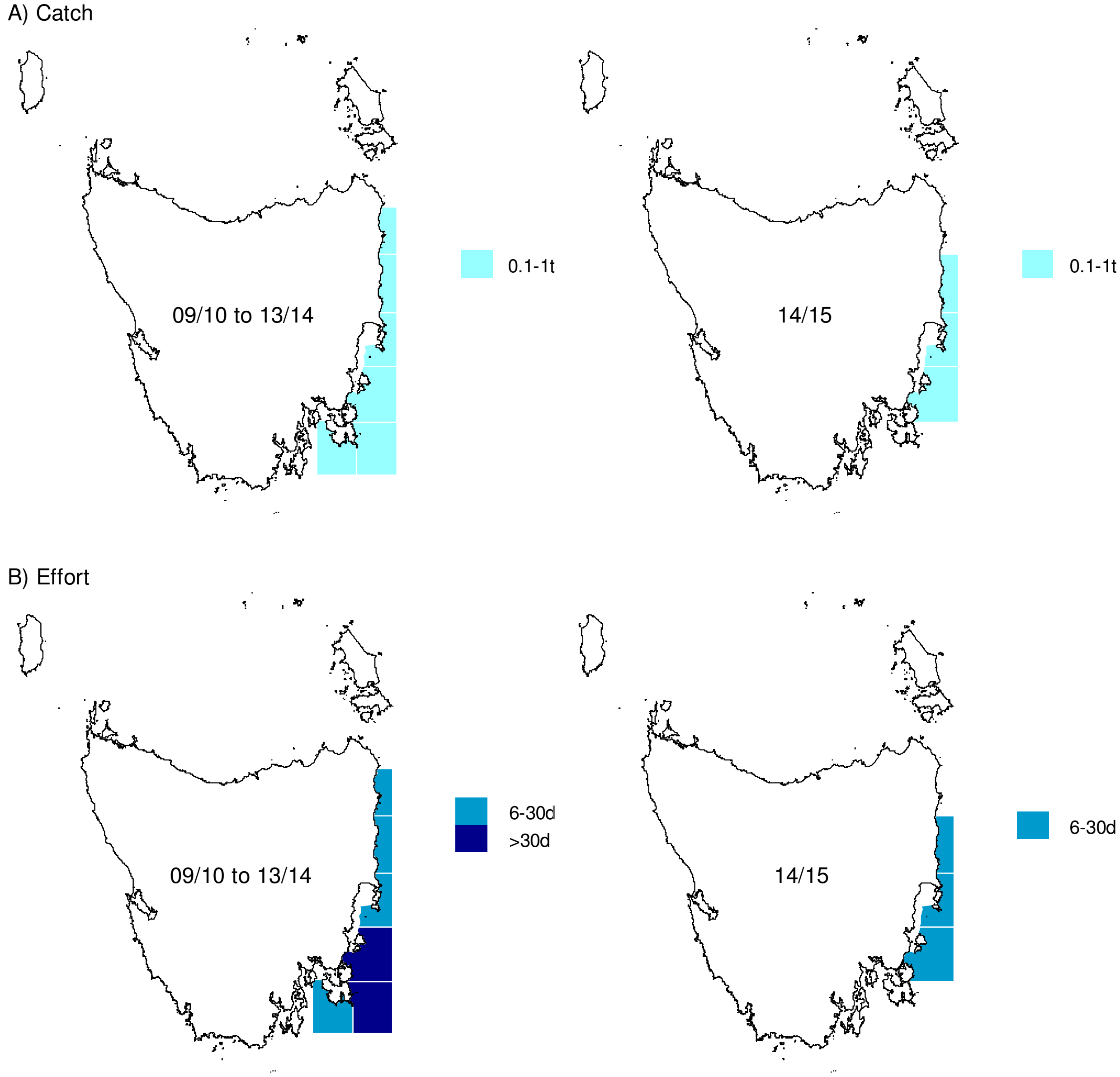


Figure 14.2 (A) Jackass Morwong catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (136.9 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (19 t)	Yes	18.2 t (95.8%)
	• Catch increases by > 30% from previous year (>1.35 t)	No	
	• Catch decreases by > 30% from previous year (<0.7 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1057 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0095 t/days fished)	Yes	0.0041 t/days fished (43%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (18.7 t)	No	
	• Catch < 3rd lowest catch value from the reference period (13.1 t)	Yes	12.3 t (93.7%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (31.9 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (64.2% in 2007/08)	Yes	Latest estimate (2012/13): 88.5%
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period • (-0.0017)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	**SUSTAINABLE**

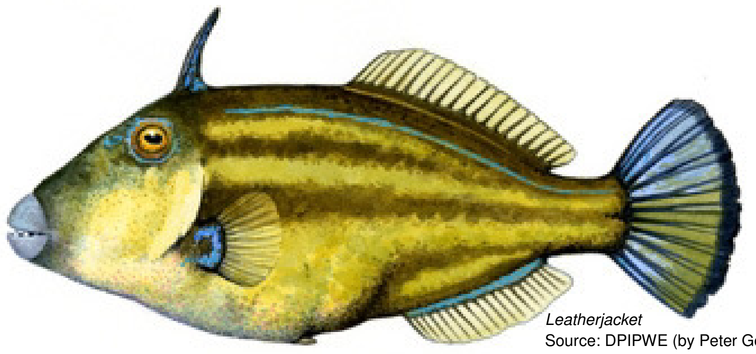
The lowest catch and catch rate reference points were breached, which reflects the ongoing declining commercial catches in Tasmanian waters. Linked to this decline, one of the recreational indicators was breached, indicating that the proportion of recreational catch to total catch had increased in 2012/13 since the last recreational survey (2007/08).

A single east Australian stock of Jackass Morwong is shared between the Commonwealth and Tasmania with catch and catch rates declining in Commonwealth fisheries in a fashion similar to that observed in the Tasmanian fishery. This was driven by a prolonged period of reduced recruitment that is believed to be a result of climate induced changes to ocean currents in eastern Tasmania (Wayte 2013). Due to the extended larval phase of Jackass Morwong, these changes have meant that larvae are often dispersed away from Tasmanian waters with successful recruitment being correlated with years where oceanographic conditions are comparable to historical averages (Wayte 2013). While the Jackass Morwong stocks were considered overfished in the late 2000s, Fishery Status Reports since 2011 have reclassified the stock as not overfished and not subject to overfishing (Woodhams et al. 2013, Flood et al. 2014, Patterson et al. 2015). This assessment was due to a reduction of catches for the species as a response to management action in the Commonwealth fishery and revision of the stock assessment model. The total catch (recreational and commercial) of Jackass Morwong for Tasmania is low compared to the Commonwealth catch (which was 213 t in 2014) and the stocks are most likely shared. Although there has not been a formal Commonwealth assessment since 2012, unpublished Commonwealth statistics indicate the east coast stock is rebuilding under current total allowable catch levels and there has not been further reductions required. As the Fishery Status Reports describe the stock biomass as sustainable and fishing mortality as sustainable, this ranking has been applied to the Tasmanian fishery which shares the same stock.

15. Leatherjacket

Monacanthidae family

STOCK STATUS	UNDEFINED
Various species of Leatherjackets are found inshore around Tasmania's coastline and are not differentiated in logbooks. Leatherjackets are a by-product species and are not actively targeted due to a lack of market demand. Catch is therefore not a good indicator of abundance and there is little biological information to confidently classify the status of Leatherjacket stocks.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Leatherjacket
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Seagrass and reefs. Down to 200 m depending on species.	Edgar (2008)
Distribution	• Australia is the centre of diversity for this family with more than half of the estimated 90 species occurring here, mainly in temperate areas.	Edgar (2008)
Diet	• Epiphytes attached to seagrass, algae, fish flesh, molluscs and crustaceans depending on species. Many species are omnivorous.	FishBase (2013)
Movement and stock structure	• Many species are site-attached	Barrett (1995b)
Natural mortality	• Undefined for most species	
Maximum age	• No information	
Growth	• Maximum length: from 90 mm to 600 mm	Edgar (2008)
Maturity	• Little information	
Spawning	• Little information	
Early life history	• Little information	
Gillnet post release survival	• High: 95%	Lyle et al (2014a)

Background

Leatherjackets are a by-product of fish traps and they are also caught in netting operations but are generally discarded. While Leatherjackets are consumed on the mainland, there is little market demand for the species in Tasmania.

FISHING METHODS	Mainly fish trap, also graball net and hand-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational gear licence (graball and/all mullet net) **Output control:** • Possession limit of 20 and bag limit of 10 individuals for recreational fishers • Minimum size: 20 cm
MAIN MARKET	Local

Current assessment

Catch, effort and CPUE

Leatherjacket catches have declined continuously since the early 2000s, reaching a minimum of 2 t in 2014/15 t (Fig. 15.1A). While catches from graball nets have consistently remained at low levels since 1995/96, catches from fish traps have declined over time. Leatherjackets are caught on the east, northeast and northwest and southeast coasts (Fig. 15.2).

Leatherjackets are also caught by the recreational sector, with catch estimates in recent surveys at a similar level to commercial catches (Fig. 15.1A). Estimates were 8.2 t in 2000/01 (Lyle 2005), 2.6 t in 2007/08 (Lyle et al. 2009), 2.3 t in 2009/10 and 1.8 t in 2012/13 (Lyle et al. 2014b).

Both fish trap and graball fishing effort has decreased through time (Fig. 15.1B). Fish trap effort (in gear units and fishing day) dropped significantly around 2007/08. Abalone gut was the preferred bait used in fish traps; however a ban on its use has been in place since 2008 to prevent the spread of an abalone virus (AVG). Following this ban, fishing effort using fish traps declined as other baits are considered inferior.

Catch rates in gear unit and days fished have remained relatively stable over time for both graball nets and fish traps and are presently at levels similar to those at the beginning of the time series (Fig. 15.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, fish trapping was considered a very low risk to Leatherjacket species, which is the main by-product of fishing for Wrasse. This is because the current catch of Leatherjacket is low due to the ban on using abalone gut for bait, which significantly reduced trapping effort on Wrasse. Risks to non-retained species and the general ecosystem were assessed as either low or negligible (Bell et al. 2016).

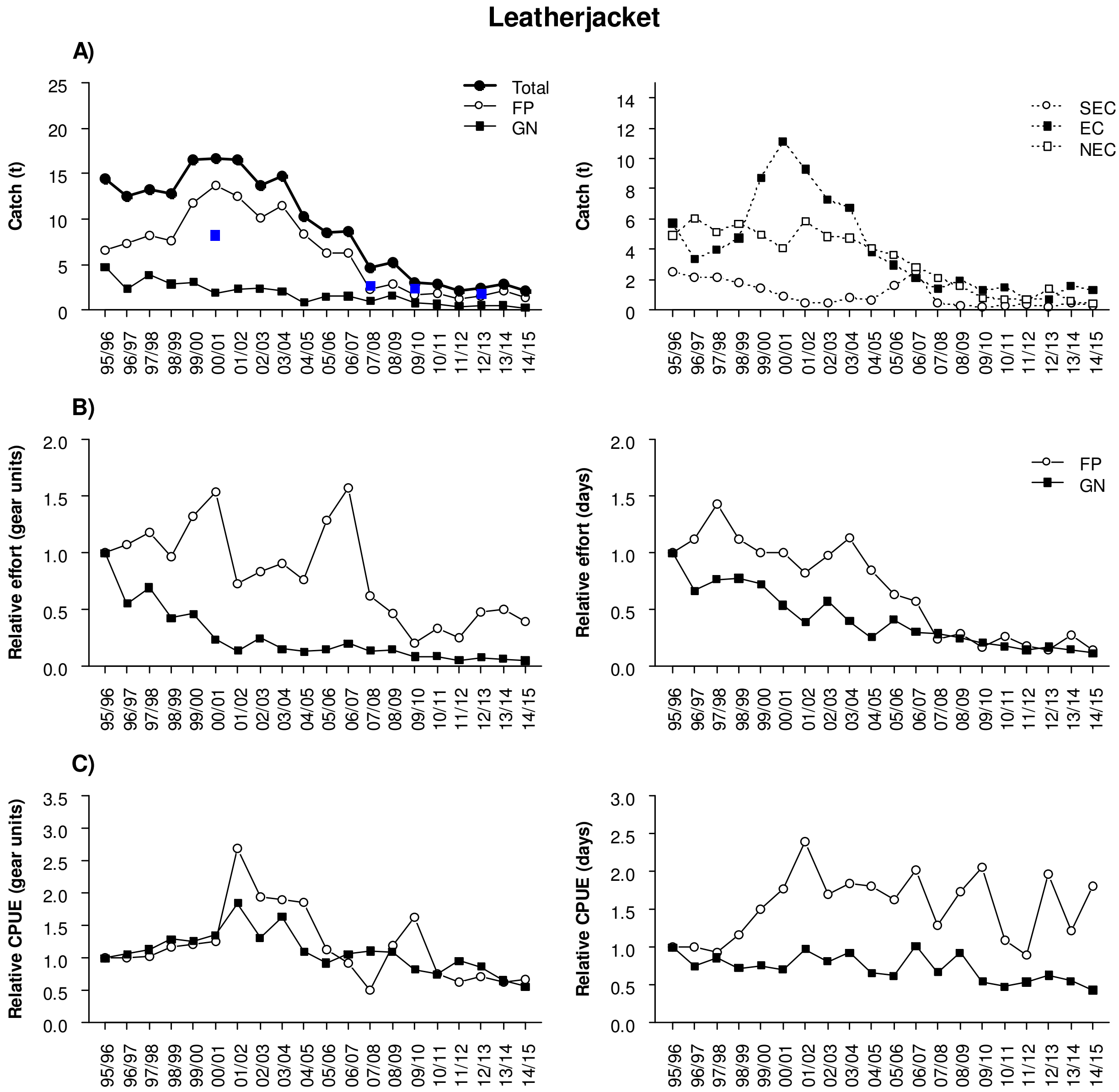


Figure 15.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. FP= fish trap, GN= graball net, SEC= southeast coast, EC= east coast, NEC= northeast coast.

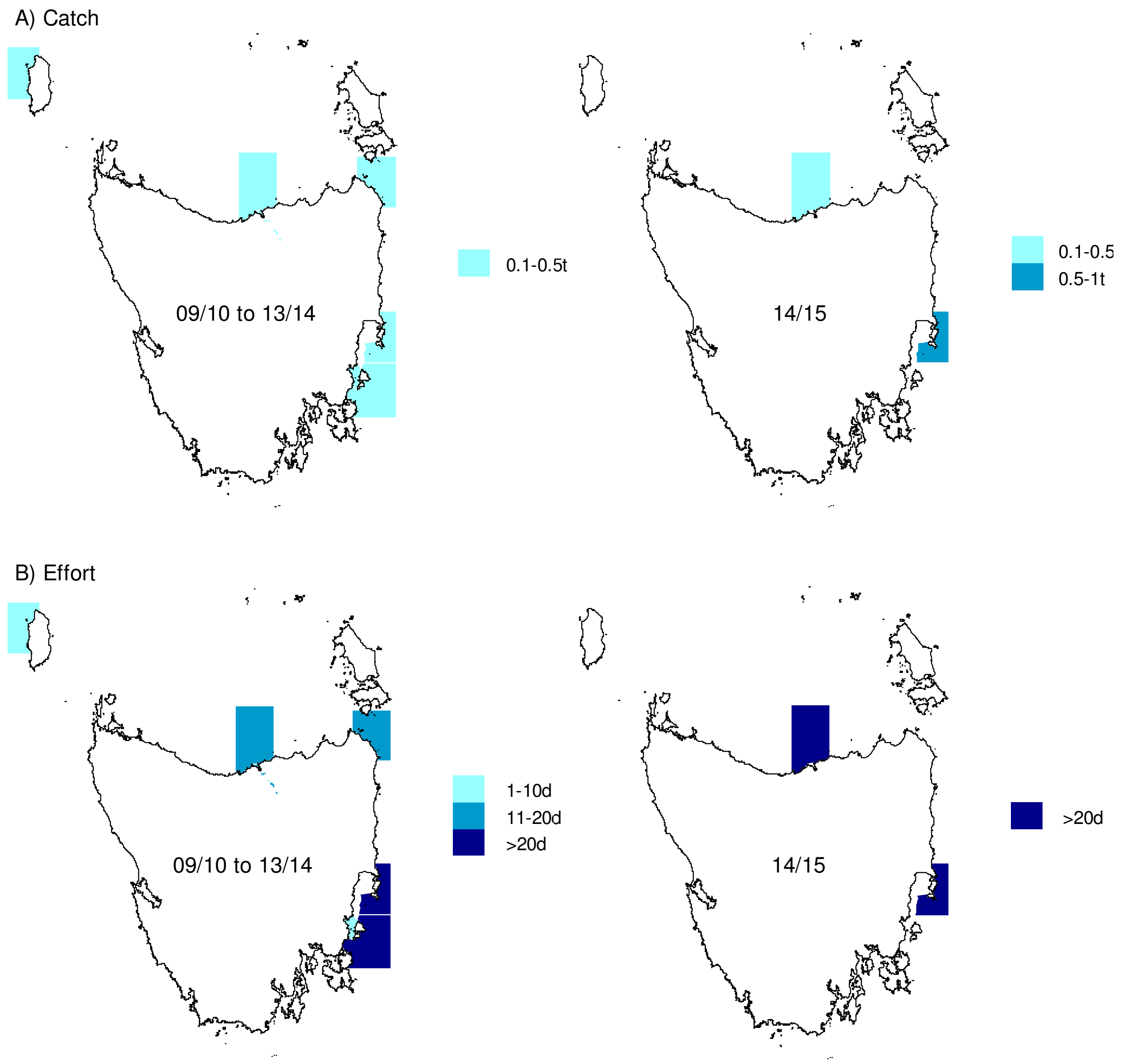


Figure 15.2 (A) Leatherjacket catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (27.7 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (12.2 t)	Yes	10.2 t (83.6%)
	• Catch increases by > 30% from previous year (>3.8 t)	No	
	• Catch decreases by > 30% from previous year (<2 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1607 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (0.0046 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (16.5 t)	No	
	• Catch < 3rd lowest catch value from the reference period (10.4 t)	Yes	8.3 t (80.1%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (8.2 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (38.0% in 2007/08)	Yes	Latest estimate (2012/13): 41.9%
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0014)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status

UNDEFINED

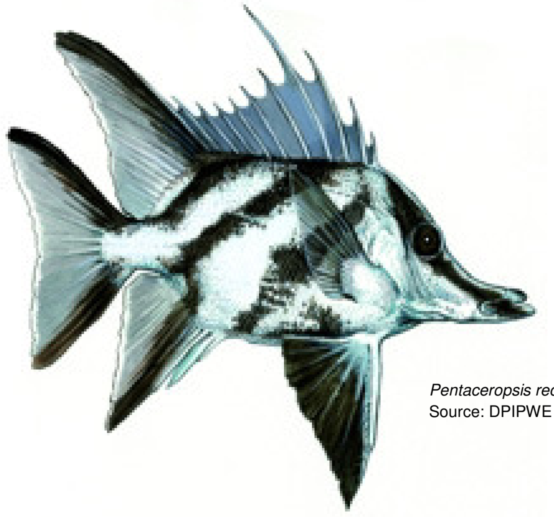
The very low landings in 2014/15 meant that the lowest catch, lowest fishing mortality and the proportion of recreational to commercial catch reference points were breached. These decreased catches are, however, the result of a decline in the use of fish traps and a lack of demand.

Leatherjackets tend to be site-attached and have limited home ranges. Two decades of monitoring eastern Tasmanian Marine Protected Areas (MPA) show that there is no significant difference in Leatherjacket abundances inside or outside of MPA's (e.g. brown striped Leatherjacket, Toothbrush Leatherjacket). Leatherjackets also have a very high post release survival following capture in gillnets (Lyle et al. 2014a). These results, along with the low landings, suggest that fishing is unlikely to have a significant impact on Leatherjacket populations. There is however too little information at the species level to confidently classify the status of Leatherjacket stocks.

16. Longsnout Boarfish

Pentaceropsis recurvirostris

STOCK STATUS	NOT ASSESSED
Boarfish are a by-product species with low catches due to the large minimum legal size. There is too little information available to confidently assign a stock status for this species.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Pentaceropsis recurvirostris
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Exposed reef. Between 4 and 260 m depth.	Edgar (2008)
Distribution	• From mid New South Wales to southern Western Australia, and around Tasmania.	Edgar (2008)
Diet	• Brittle stars, polychaetes and brown algae	Edgar (2008) Scott et al. (1974)
Movement and stock structure	• Unknown	
Natural mortality	• Unknown	
Maximum age	• Unknown	
Growth	• Maximum length: 61 cm	Edgar (2008)
Maturity	• Unknown	
Spawning	• Unknown	
Early life history	• Unknown	
Gillnet post release survival	• High: 99.7%	Lyle et al (2014a)

Background

Boarfish are a by-product of graball netting. Due to the large minimum legal size and the requirement to release undersized fish, boarfish are also a regularly discarded. Boarfish are considered good eating and there is a small local market for them. Shark nets also catch boarfish as a by-product in State waters; these catches have been reported to the Commonwealth since 2000/01.

FISHING METHODS	Graball net, shark net in the past
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational gear licence (graball and/or mullet net) **Output control:** • Trip limit of 50 kg for commercial fishers • Possession limit of 4 and bag limit of 2 individuals for recreational fishers • Minimum size: 45 cm
MAIN MARKET	Mainly local

Current assessment

Catch, effort and CPUE

In Tasmania, boarfish catches are now exclusively derived from graball net (Fig. 16.1A). Catches have been declining through time but appear to have stabilised since 2008/09 with landings in 2014/15 of 0.6 t, which is lower than the previous year (1 t) (Fig. 16.1A). Catches are taken exclusively from the east and southeast coasts (Fig. 16.2). Boarfish are not caught by rod and line and no recreational catch estimates are available for the graball and spearfishing catch of this species. However, fewer than 1000 individuals were recorded (both kept and released) in the 2012/13 survey (Lyle et al. 2014b) indicating that boarfish are not a common recreational species.

After peaking in 1997/98, commercial graball net effort has remained stable (Fig. 16.1B). Catch rates have remained relatively stable over time (Fig. 16.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, gillnetting was considered a medium risk activity with regard to Longsnout Boarfish, which is a by-product of Banded Morwong fishing.= (Bell et al. 2016).

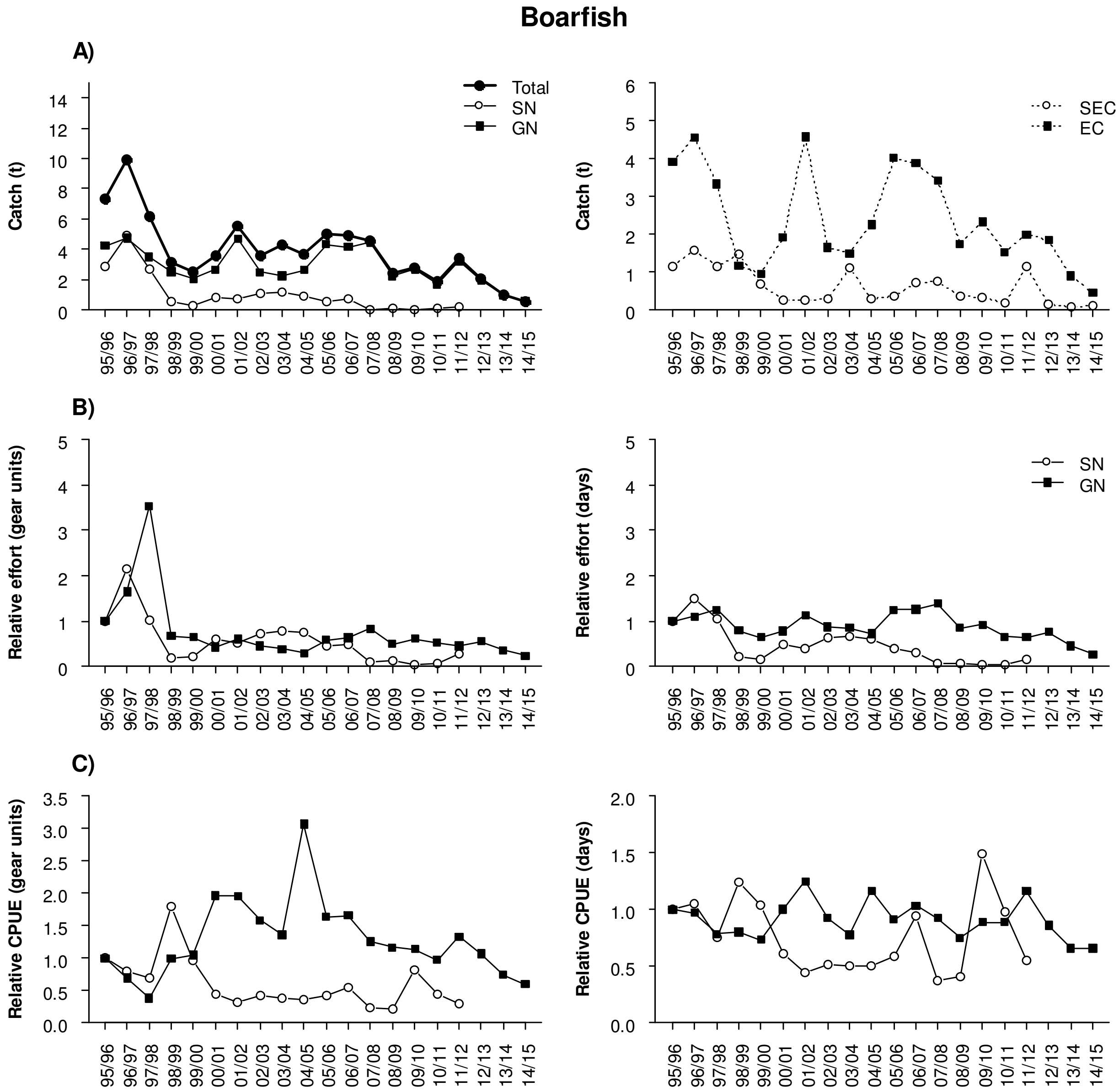


Figure 16.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. SN= shark net, GN= graball net, SEC= southeast coast, EC= east coast.

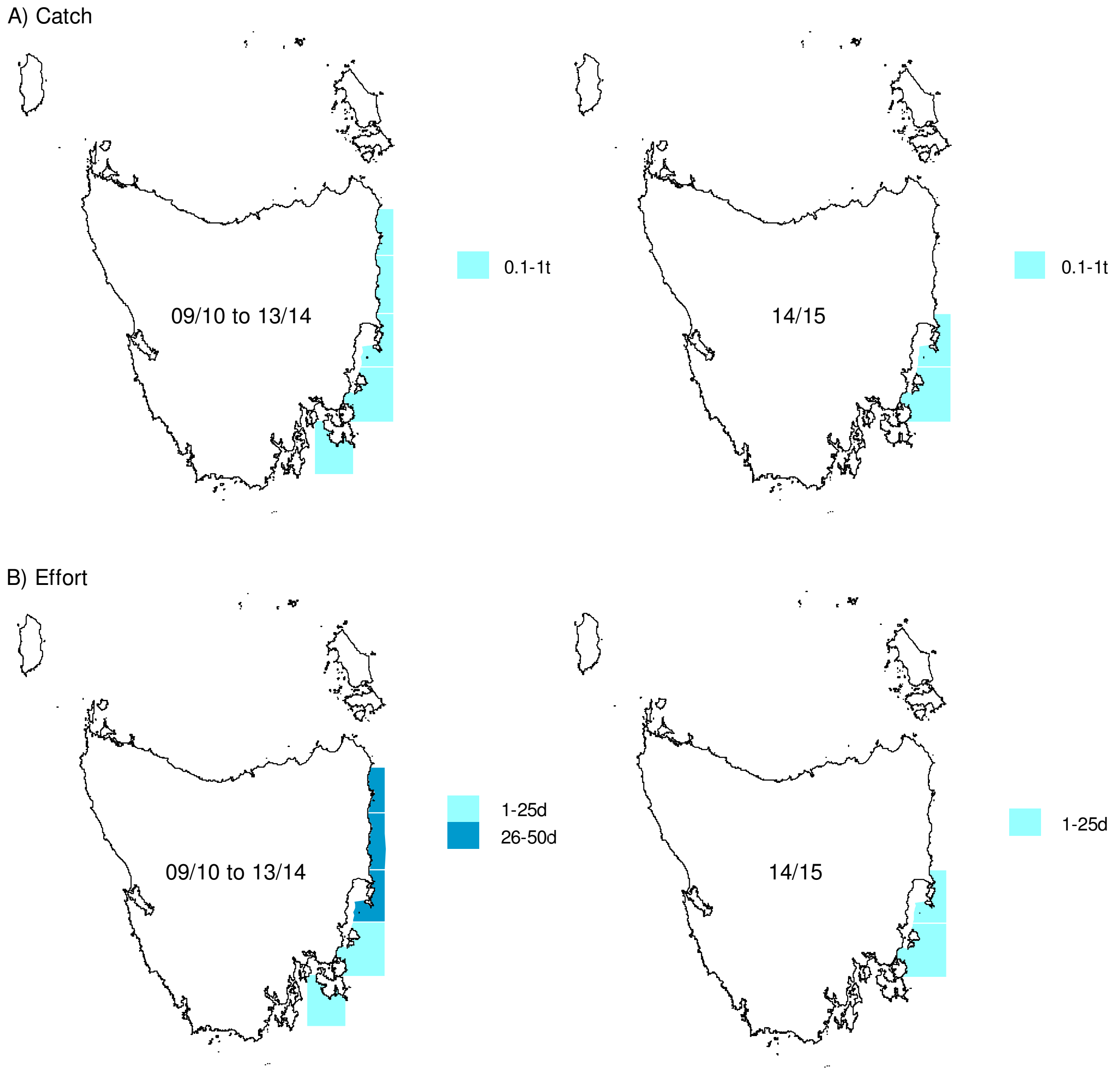


Figure 16.2 (A) Boarfish catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (10.4 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (7.2 t)	Yes	6.6 t (91.7%)
	• Catch increases by > 30% from previous year (>1.4 t)	No	
	• Catch decreases by > 30% from previous year (< 0.7 t)	Yes	0.1 t (13.7%)
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>858 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0038 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (6.2 t)	No	
	• Catch < 3rd lowest catch value from the reference period (3.6 t)	Yes	3 t (83.5%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period	Not estimated	
	• Proportion of recreational catch to total catch > previous proportion estimate	Not estimated	
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0009)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

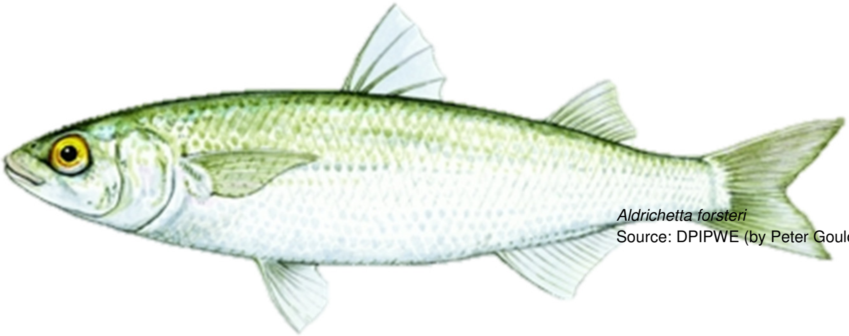
Stock status	NOT ASSESSED

Reference points associated with low catches were breached. Catches are lower now due to a lesser quantity of gillnetting effort than occurred in the reference period. Boarfish is a by-product species that is taken in very small quantities. In addition to catches taken in State waters, there is also a by-product fishery from Commonwealth shark netting activity. The high size limit means that the majority of individuals captured are released and the species has very high post-release survival (Lyle et al. 2014a). There is too little information available to assign a stock status for this species.

17. Yelloweye Mullet

Aldrichetta forsteri

STOCK STATUS	SUSTAINABLE
Catches are at low levels but this is unlikely to be indicative of abundance. Yelloweye Mullet are most abundant in estuarine habitats, where netting is prohibited or restricted, thereby providing a high degree of protection throughout most of their range. It's therefore unlikely that the stock is recruitment overfished or that current fishing pressure is too high as to cause recruitment overfishing.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Aldrichetta forsteri
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Sheltered sand, seagrass, up to 20 m depth. May ascend rivers into freshwaters.	Edgar (2008)
Distribution	• Western Australia (Shark Bay) to New South Wales, and around Tasmania, New Zealand.	Edgar (2008)
Diet	• Planktonic animals for juveniles, benthic crustaceans and molluscs for medium-sized fish and almost exclusively algae for larger fish	Edgar (2008)
Movement and stock structure	• Schooling fish • No genetic studies but there appears to be 2 populations (eastern Australia and western Australia)	Kailola et al. (1993)
Natural mortality	• *M* estimated at 0.66 (New Zealand)	Paul and Taylor (1998)
Maximum age	• 7 years	Curtis and Shima (2005)
Growth	• Maximum length of 50 cm. • Maximum weight: 950 g • Differential growth between males and females, and between locations • Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where L is the fork length (cm), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero.	Edgar (2008) Curtis and Shima (2005) Gorman (1962) Last et al. (1983) Chubb et al. (1981)

<table>
<tr><td></td><td>Parameters estimates are:
<table><tr><th>Sex</th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr><tr><td>Combined</td><td>40</td><td>0.51</td><td>-0.03</td></tr></table>• Length-weight relationship was estimated at $W = 0.000239\ L^{3.2}$ for females and males combined where W is weight (g) and L is the fork length (cm).</td><td></td></tr>
<tr><td>Maturity</td><td>• 2-3 years</td><td>Kailola et al. (1993)</td></tr>
<tr><td>Spawning</td><td>• Form large aggregation prior to spawning
• Spawn in coastal waters in summer and autumn, probably in estuaries
• Fecundity between 125,000 and 630,000 eggs
• Pelagic eggs</td><td>Chubb et al. (1981)
Kailola et al. (1993)</td></tr>
<tr><td>Early life history</td><td>• Juveniles enter estuaries and sheltered bays when they are 3-4 cm long, and remain there until they reach 25-30 cm tail length.
• As they grow older, animals gradually move to more open coastal waters</td><td>Kailola et al. (1993)</td></tr>
<tr><td>Gillnet post release survival</td><td>• Low: 10%</td><td>Lyle et al (2014a)</td></tr>
</table>

Background

Mullet are occasionally targeted by netting, specifically beach and purse seining as well as small mesh net. The vast majority of catch is Yelloweye Mullet, but it is possible that some of the catch includes Sea Mullet (*Mugil cephalus*). Mullet are also targeted by recreational fishers using rod and line or small mesh gillnets called 'mullet nets'.

<table>
<tr><td>FISHING METHODS</td><td>Mostly beach seine, also small mesh net (mullet net for recreational) and purse seine</td></tr>
<tr><td>MANAGEMENT METHODS</td><td>Input control:
• Gear licence (Scalefish fishing licence, small mesh gillnet licence)
• Recreational gear licence (graball and/or mullet net)

Output control:
• Possession limit of 30 and bag limit of 15 individuals for recreational fishers
• Minimum size: 25 cm</td></tr>
<tr><td>MAIN MARKET</td><td>Mostly local</td></tr>
</table>

Current assessment

Catch, effort and CPUE

Mullet are caught using beach seine and small mesh nets. After peaking in 1999/2000, Yelloweye Mullet catches have decreased and stabilised at less than 5 t since 2007/08. The catch for 2012/13 was 9.2 t, which was similar to the landings in the early 2000s and was due to an increase in beach seine catch in the east and southeast coasts. The catch in 2014/15 was 4.9 t, a level comparable to that for most other recent years (Fig. 17.1A). Recreational catches were estimated at 6.5 t in 1996/97, 30 t in 2000/01, 1.7 t in 2009/10 and 7.1 t in 2012/13 (Lyle et al. 2014b)(Fig. 17.1A).

Beach seine effort was relatively stable until 2005/06 after which it declined rapidly and remained at low levels (Fig. 17.1B).

Catch rates for beach seining have remained relatively constant over time with a sharp increase in 2012/13 before declining again to average levels (Fig. 17.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, beach seining was considered a negligible risk activity with regard to Yelloweye Mullet due to the low annual catch and the fact they are widespread and not targeted in estuarine habitats (Bell et al. 2016).

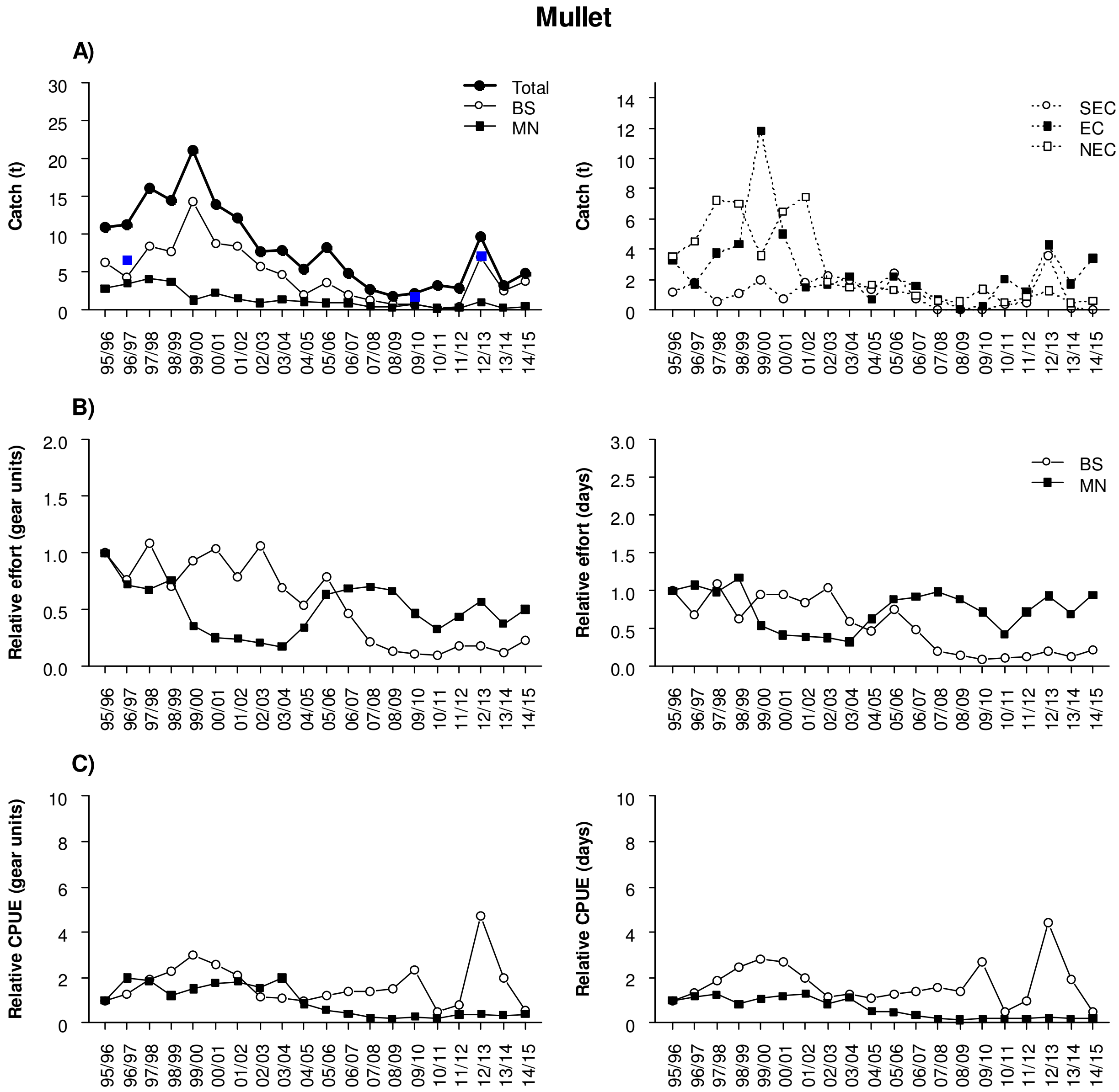


Figure 17.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS= beach seine, MN= mesh net, EC= east coast, SEC= southeast coast and NEC= northeast coast.

A) Catch

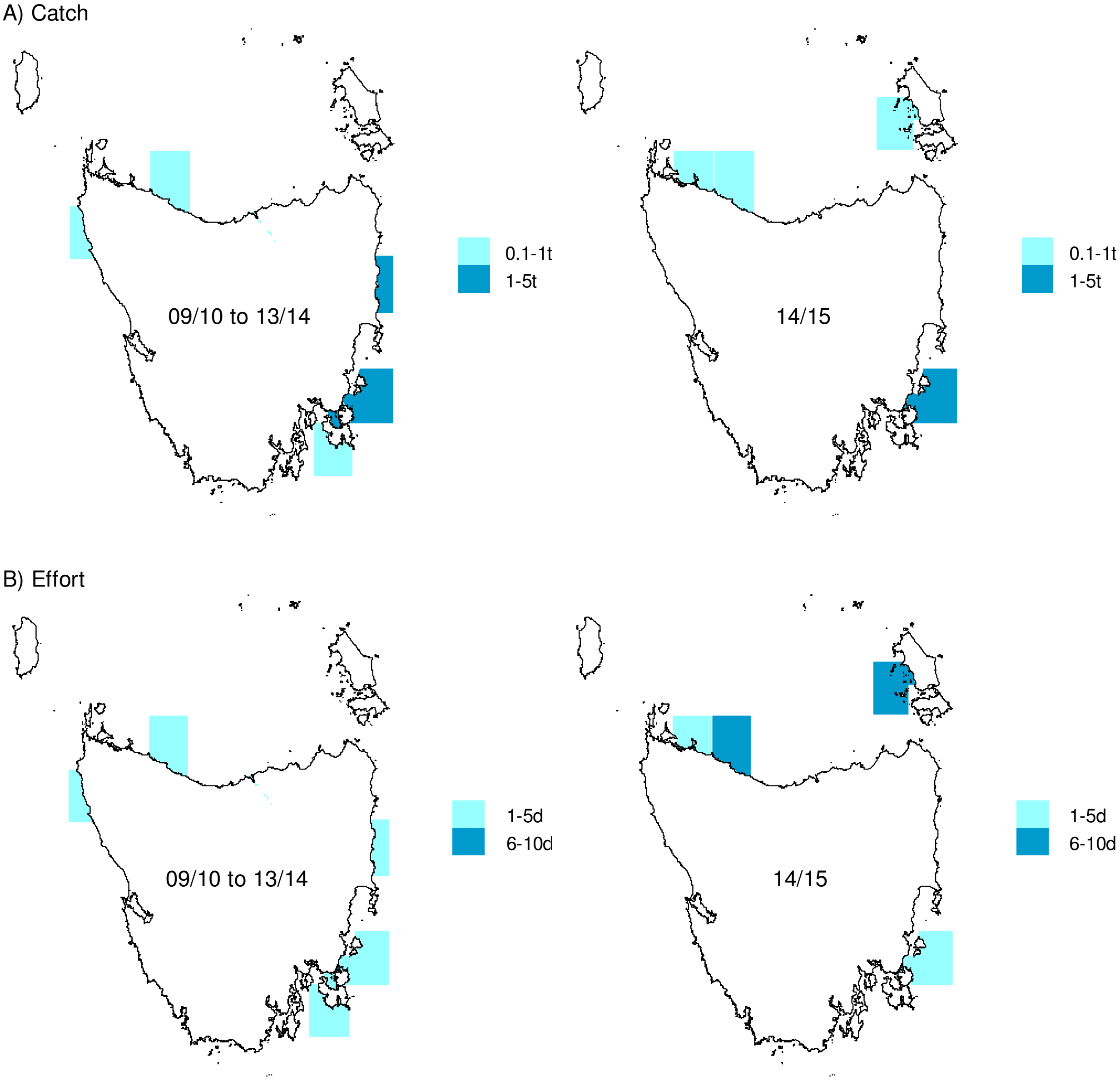


Figure 17.2 (A) Yelloweye Mullet catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (31.2 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (10.8 t)	Yes	6.4 t (59.3%)
	• Catch increases by > 30% from previous year (>3.8 t)	Yes	0.5 t (13%)
	• Catch decreases by > 30% from previous year (<2.1 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>327.8 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0107 t/days fished)	Yes	0.0016 t (14.9%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (14.5 t)	No	
	• Catch < 3rd lowest catch value from the reference period (7.3 t)	Yes	2.9 t (39.6%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (30.0 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (73.3% in 2007/08)	No	
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0061)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	**SUSTAINABLE**

Other than in 2012/13, catches of Yelloweye Mullet have been stable at low levels for the past six years, following a decrease in effort in the traditional fishing grounds in northern Tasmania. The low catch in 2014/15 meant that the reference points for catch and fishing mortality were breached and there was a slight increase in catch from 2013/14, which meant the >30% increase in catch from previous year reference point was breached. Yelloweye Mullet are by far the most abundant mullet species in southern Australia and are extremely abundant in estuaries (Edgar 2008). Limited commercial fishing or no recreational gillnetting occurs in most Tasmanian estuaries meaning Yelloweye Mullet are afforded a high degree of protection throughout much of their range. Further, low recreational catches indicate that they are not often targeted with rod and line in estuaries and as such current catches are highly unlikely to result in recruitment overfishing. Given the low commercial and recreational catches and high degree of protection afforded to the habitat of Yelloweye Mullet the stock is classified as sustainable in Tasmanian waters.

18. Snook

Sphyraena novaehollandiae

STOCK STATUS	UNDEFINED
The catch of Snook has been relatively stable in recent years around 6 – 9 tonnes. Catch rates are an unreliable estimate of abundance and a lack of information as to the biological vulnerability of this species to fishing means there is insufficient information to confidently classify the status of the stock.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends

Species biology

Parameters	Estimates	Source
Habitat	• Exposed reef, sand, seagrass, offshore waters. Down to depth of 20 m.	Edgar (2008)
Distribution	• Western Australia to southern Queensland, and northern Tasmania.	Edgar (2008)
Diet	• Fish	Coleman and Mobley (1984) Scott et al. (1974)
Movement and stock structure	• Highly migratory pelagic species that often occurs in shoals of 50 or more individuals	Kailola et al. (1993)
Natural mortality	• No information	
Maximum age	• No information	
Growth	• Maximum length of 1.1 m, maximum weight of 5.6 kg, maximum age of about 20 years.	Edgar (2008) Kailola et al. (1993)
Maturity	• 42 cm length	Bertoni (1995)
Spawning	• Assumed to take place from October to January	Kailola et al. (1993)
Early life history	• No information	
Gillnet post release survival	• NA	

Background

Two separate families of 'Pike' are caught in Tasmania, the Longfin Pike (*Dinolestes lewini*) and Snook or Shortfin Pike (*Sphyraena novaehollandiae*). Pikes are mainly targeted by troll and small-mesh net (north coast only), and are also a by-product of beach seining and graball netting. While there is a local and interstate market for Snook, Longfin Pike are of lesser demand. There are some uncertainties about the correct reporting of the two species in logbooks. The vast majority of 'Pike' catches are likely to be Snook, which is confirmed by anecdotal reports from the industry and thus only this species is assessed.

FISHING METHODS	Troll, also beach seine, graball net and small mesh net
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational gear licence (graball and/or mullet net) **Output control:** • No possession or bag limits for recreational fishers
MAIN MARKET	Local and interstate (Victoria)

Current assessment

Catch, effort and CPUE

Snook catches were variable but followed a relatively stable trend from 1998/99 to 2002/03, before declining in the mid-2000s to less than 5 tonnes. Since then catches have averaged around 6 to 9 tonnes (Fig. 18.1A). In 2013/14 and 2014/15 catches were almost identical at 9.1 t and 9 t respectively. Although there was a peak in Snook catches in the southeast in 1996/97 and 1997/98, catches traditionally originate from the northwest coast (Fig. 18.2).

There are no estimates of recreational landings (by weight) but evidence suggests that Pike are not a major recreational target (Lyle et al. 2009, Lyle and Tracey 2012) and that around 57% of all Pike caught by recreational fishers are released (Lyle et al. 2009). Nevertheless, in 2012/13, 3,895 Pike were landed by recreational fishers (Lyle et al. 2014b) and if an average weight of 1 kg per fish is assumed, the landings in 2012/13 would have been approximately 4 t.

Troll effort for Snook has been variable through time. Since peaking in 2010/11 effort slowly declined, however in 2014/15 there was a sharp increase in both gear units and days fished (Fig. 18.1B). Beach seine effort in both gear units and days fished has remained stable over time but Snook represent a by-product of this fishing method rather than a target.

Catch rates in gear units and days fished have been variable for both troll and mesh net gear types through time, whereas catch rates for beach seine have been relatively stable (Fig. 18.1C).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, trolling was considered a low risk activity with regard to Snook. While Snook are targeted throughout most of its range by multiple fishing methods the low combined catch is likely to be within sustainable levels. Trolling was also considered a negligible risk to all other ecosystem components (Bell et al. 2016).

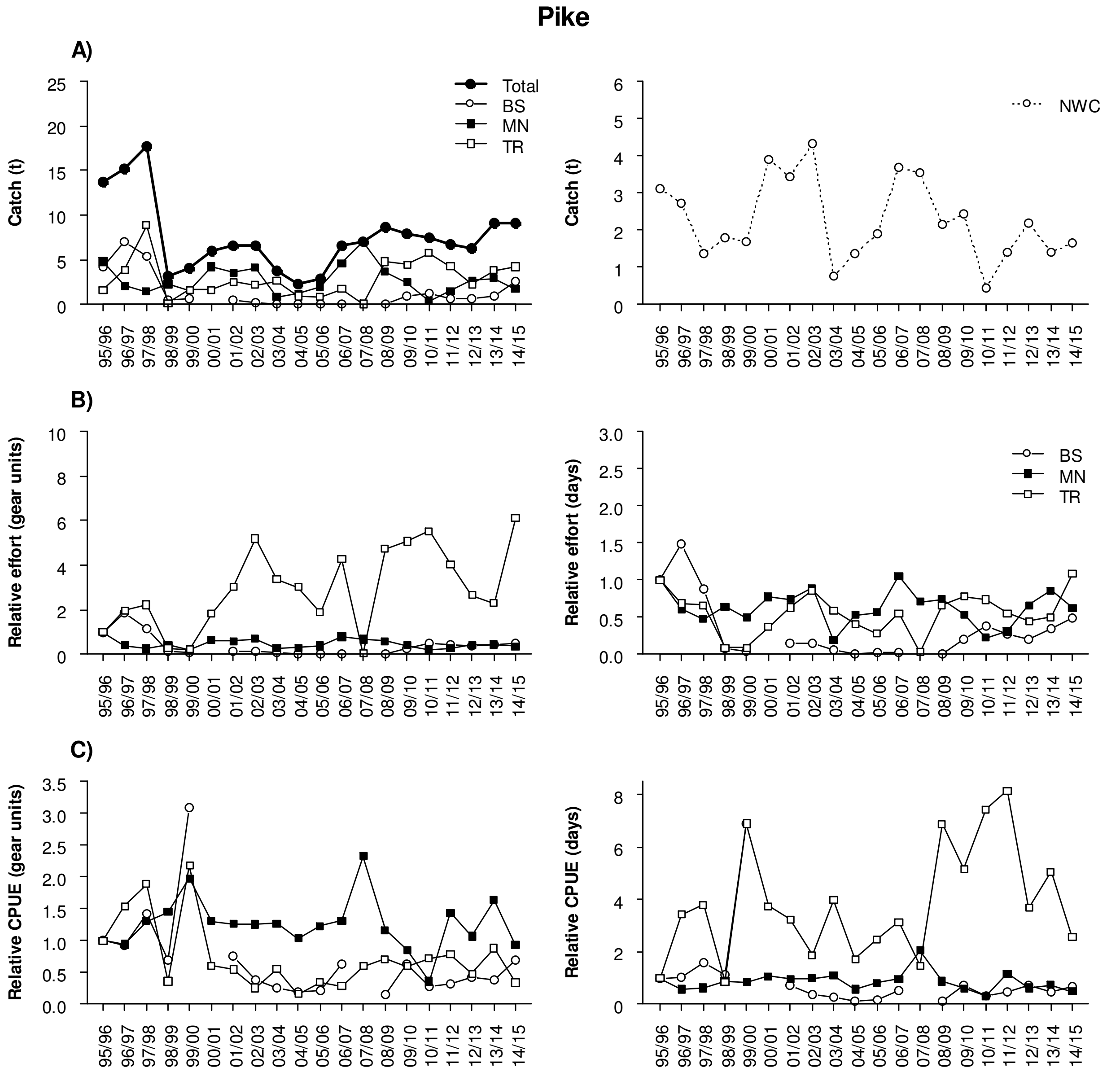


Figure 18.1 A) Annual commercial catch (t) by gear (left) and region (right). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS = beach seine, TR = troll, MN = small mesh gillnet, NWC = northwest coast.

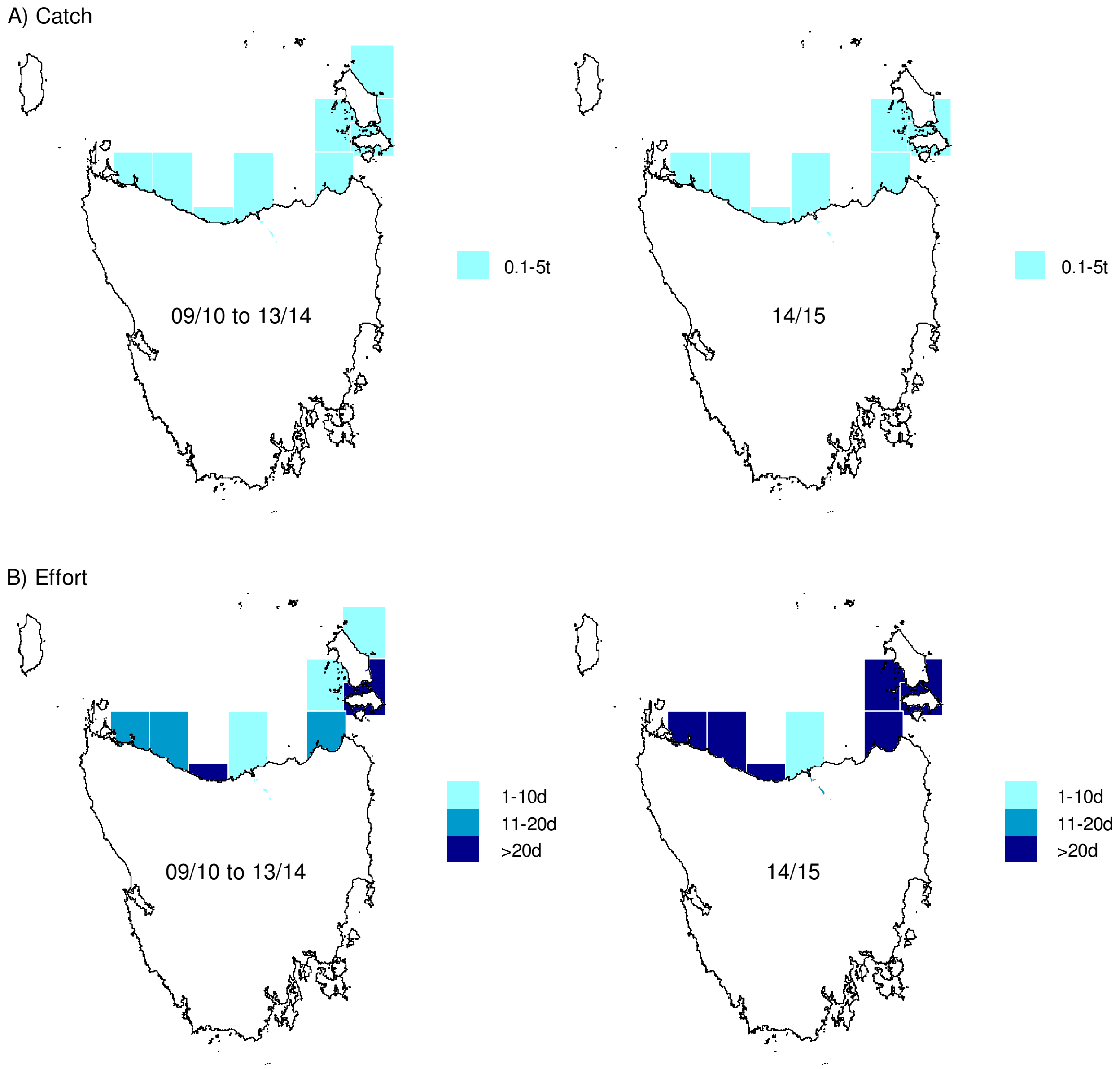


Figure 18.2 (A) Snook catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (18.8 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (9.5 t)	Yes	0.5 t (5.3%)
	• Catch increases by > 30% from previous year (>11.8 t)	No	
	• Catch decreases by > 30% from previous year (<6.4 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>503.8 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0111 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (13.7 t)	No	
	• Catch < 3rd lowest catch value from the reference period (3.2 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (based on numbers)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate	Not estimated	
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0035)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

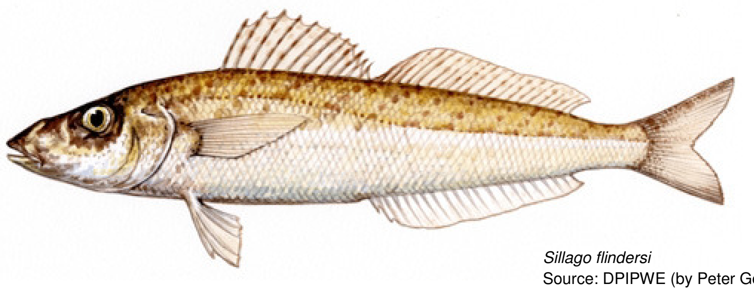
Stock status | UNDEFINED

The lowest catch reference point was breached, reflecting the reduced catch relative to the reference period. The fishery for Snook is relatively small and mainly limited to the northern part of Tasmania. Moreover, the species is rarely targeted recreationally. Due to a relatively stable catch rate and the above factors, Snook are unlikely to be overfished; however, as they represent a by-product, or target in mixed species fisheries, catch rate may be unreliable. While catches are low and likely to be within sustainable levels, a lack of information as to the biological vulnerability of this species to fishing means there is insufficient information to confidently classify the status of the stock.

19. Eastern School Whiting

Sillago flindersi

STOCK STATUS	SUSTAINABLE
This is a Commonwealth-assessed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/eastern-school-whiting/). Catches fluctuate due to the interstate market and are (generally) based on a single operator and the species targeted (Tiger Flathead or Eastern School Whiting). Tasmanian commercial catches are a fraction of the Commonwealth commercial catch.	
IMPORTANCE	Minor
STOCK(S)	Tasmanian Scalefish Fishery/Southern and Eastern Scalefish and Shark Fishery (Commonwealth)
INDICATOR(S)	Catch, effort and CPUE trends



Sillago flindersi
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Costal lakes, estuaries and along outer coast. Down to 170 m depth.	Gomon et al. (2008)
Distribution	• Endemic to southeastern Australia, from southern Queensland to western Victoria, and around Tasmania	Gomon et al. (2008)
Diet	• Feed mainly on crustaceans, amphipods, decapods, mysids and copepods. Juveniles consume mostly copepods.	Burchmore et al. (1988)
Movement and stock structure	• There is some evidence of 4 genetically distinct stocks (2 in New South Wales, 1 in Tasmania and 1 in Victoria). • Commonwealth assessments state that the evidence for separate stocks is weak and manage the species as s single stocks.	Dixon (1987) Morison et al. (2012)
Natural mortality	• No information but likely to be around $M = 0.7$ based on related species.	Butcher and Hagedoorn (2003)
Maximum age	• 7 years	Kailola et al. (1993)
Growth	• Maximum length: 33 cm SL • Growth described by von Bertalanffy growth function $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ where L is the length (cm), t is the age (years), L_∞ is the average maximum length for the species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are:	Gomon et al. (2008) Tilzey (1994)

Sex	L_∞	k	t_0

	Combined | 23.9 0.46 -0.50	
Maturity	• Reached at 2 years and a size of 14-16 cm FL	Hobday and Wankowski (1987) Burchmore et al. (1988)
Spawning	• Spring to late summer. • Females release between 30 000 and 110 000 eggs in total during the season	Hobday and Wankowski (1987)
Early life history	• Juveniles inhabit inshore waters.	FishBase (2013)
Gillnet post release survival	• NA	

Background

There is a large Commonwealth fishery for School Whiting that has landed 1000–2500 t for the last 30 years with about 75% of the catch taken by Danish seine vessels operating out of Lakes Entrance, Victoria (Morison et al. 2012). The New South Wales state managed fishery has been increasing in recent years and now accounts for around 60% of the total catch, which has led to some equity disagreements as their catch is deducted from the Commonwealth total allowable catch (Morison et al. 2012). School Whiting have been exploited in Tasmania since the mid-1970s with catches ranging from 20–175 t throughout the 1980s (Kailola et al. 1993). The vast majority of the catch is taken by Danish seine in the south of the State. Danish seine fishing operations target either School Whiting (with Flathead as a by-product) or Flathead (with School Whiting as by-product), which accounts for the often opposing trends in catches for the two species. School Whiting are mainly marketed and processed in Melbourne. In recent years, increasingly large catches of King George Whiting (*Sillaginodes punctatus*) have been recorded from small mesh netting operations in the north of the State and this species is increasingly becoming a target of both commercial and recreational fishers. King George Whiting tend to be very large in Tasmanian waters and there is evidence that northern Tasmania may be an important spawning location – King George Whiting in Victoria are comprised entirely of juveniles with the seed stock previously believed to come from South Australia.

FISHING METHODS	Danish seine
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, small mesh gillnet) • Danish seine licence (with whiting codend endorsement) **Output control:** • Possession limit of 30 and bag limit of 15 individuals for recreational fishers
MAIN MARKET	Interstate

Current assessment

Catch, effort and CPUE

Catches have been variable but relatively stable over time, with a yearly average of 33.5 t between 1995/96 and 2014/15 (Fig. 19.1A). Landings sharply increased from around 16 t in 2011/12 and 2012/13 to 37.2 t in 2013/14 before declining to their lowest ever in 2014/15 at just

2.9 tonnes. Catches were concentrated on the southeast coast as has historically been the case (Fig. 19.2). Recreational catches on average are low compared to commercial catches, and were estimated at 0.8 t in 2000/01 (Lyle 2005), 3.4 t in 2007/08 (Lyle et al. 2009) and 2.1 t in 2012/13 (Lyle et al. 2014b) (Fig. 19.1A).

Effort in both gear unit and days fished has been decreasing steadily over time, with a sharp decrease in 2014/15 (Fig. 19.1B). Catch rates by gear units and days fished have generally increased since 1995/96, though there are fluctuations (Fig. 19.1C), which are likely caused by changes in target species (i.e. School Whiting versus Tiger Flathead).

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, Danish seining was considered a low risk activity with regard to School Whiting due to low effort and fishing activities occurring within only a very small fraction of the species range (Bell et al. 2016).

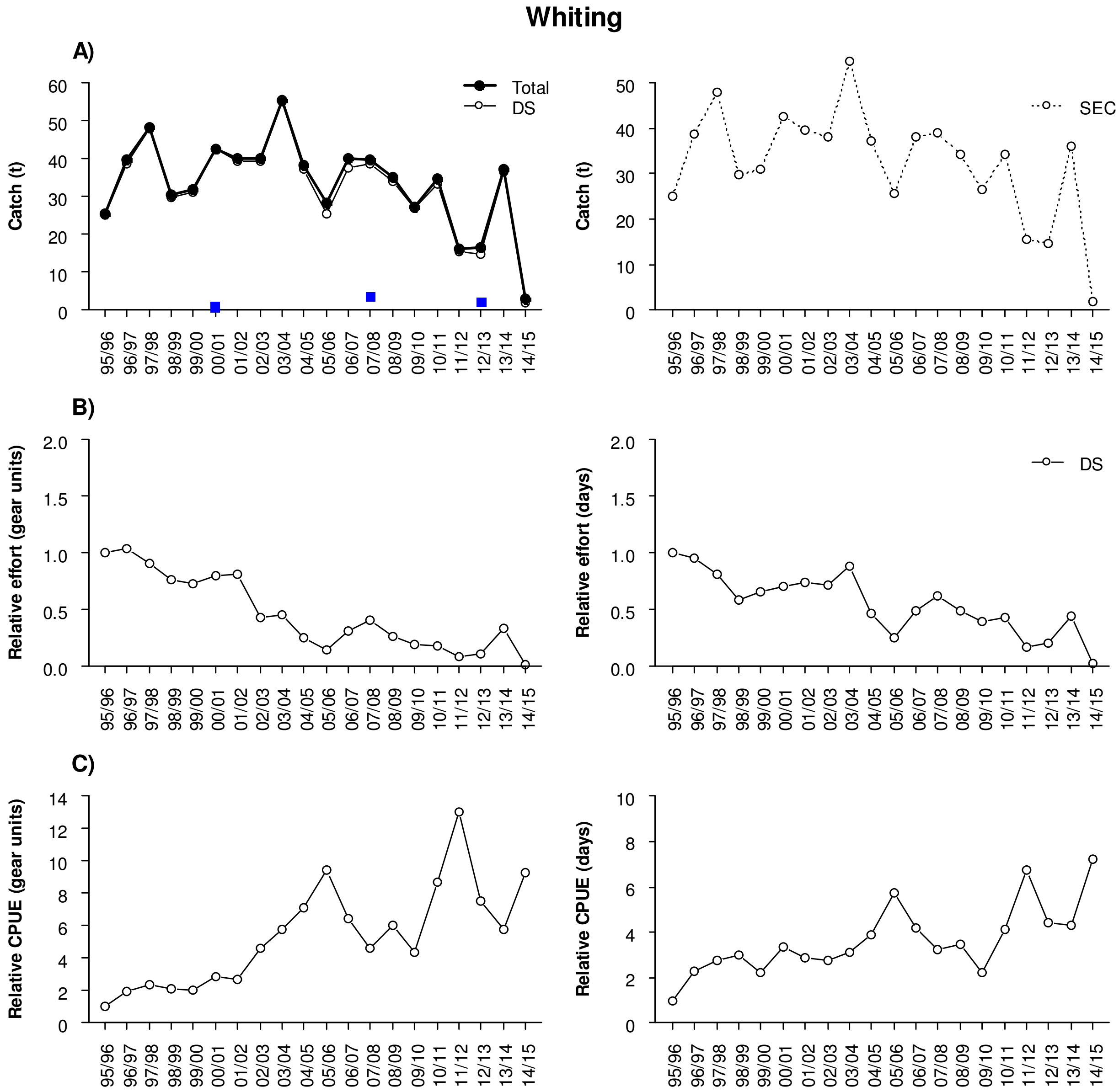


Figure 19.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. DS= Danish seine, SEC= southeast coast.

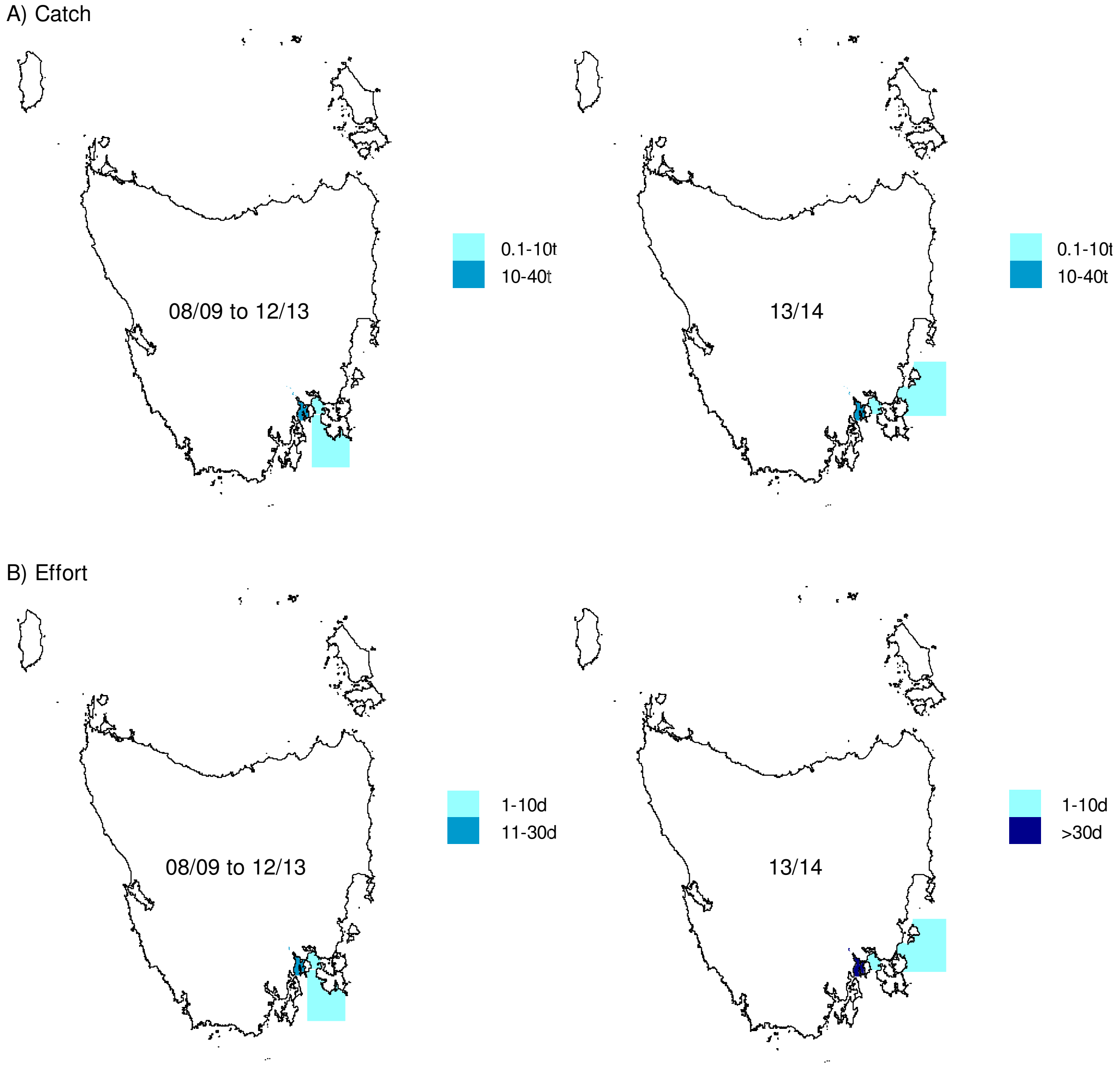


Figure 19.2 (A) School Whiting catches (t) and (B) effort (days) by fishing blocks averaged from 2008/09 to 2012/13 (left) and during 2013/14 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (152.3 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (25.5 t)	Yes	22.6 t (88.6%)
	• Catch increased by > 30% from previous year (>48.5 t)	No	
	• Catch decreased by > 30% from previous year (>26.1 t)	Yes	23.2 t (88.9%)
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>210.1 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0145 t/days fished)	Yes	0.0095 t (65.4%)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (42.7 t)	No	
	• Catch < 3rd lowest catch value from the reference period (30.6 t)	Yes	27.6 t (90.3%)
	• Latest recreational catch estimate > recreational catch estimate from the reference period (0.8 t)	Yes	1.3 t (162%)
	• Proportion of recreational catch to total catch > previous proportion estimate (8.7% in 2007/08)	No	
Biomass	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0664)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status **SUSTAINABLE**

The >30% decrease in catch from previous year reference point was breached, along with lowest catch and fishing mortality reference points however, this may not be significant in a commercial fishery that is dependent on the interstate market and is (generally) based on a single operator, fishing at a low level of effort (days fished). Catch and effort patterns have been dictated to a large extent by the level of targeting, with the primary catcher switching between targeting of Flathead or School Whiting depending upon factors such as market demand.

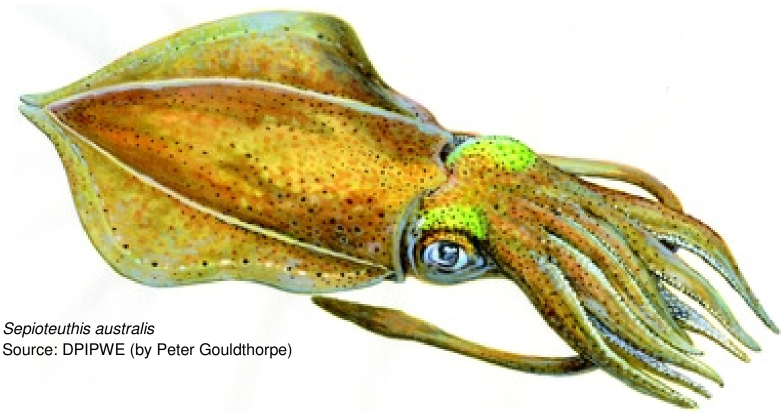
While the most recent recreational catch was higher than during the reference period, catches by the recreational sector remain low and are inconsequential at the scale of the stock.

The most recent Commonwealth stock assessment was carried out using data up until 2010 (see stock assessment summary by Morison et al. (2012)). While outdated, this stock assessment showed increasing catch rates and given a total allowable catch is in place it is unlikely that the species has been recruitment overfished in recent years. The Tasmanian fishery represents only a small proportion of the overall catch when compared with Commonwealth landings (798 t in 2014). Based, on this evidence, and catch rate trends from New South Wales, Victoria (and Tasmania), the most recent Status of Australian Fish Stocks ranked School Whiting as sustainably fished (Flood et al. 2014) along with the latest Fishery Status Report (Patterson et al. 2015) and we have followed this classification in this assessment.

20. Southern Calamari

Sepioteuthis australis

STOCK STATUS	SUSTAINABLE
Both commercial and recreational fishing effort in the northern areas of the State have increased to a historic high. Despite this, catch rates in the northern areas have continued to rise in recent years, while remaining stable in southern areas of the State. Vulnerability of Southern Calamari to fishing pressure is unclear but probably high, with the ERA considering the species to be at medium risk. There are no indications as yet that the fishing mortality is excessive and likely to cause the stock to become recruitment overfished.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch and CPUE trends



Sepioteuthis australis
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Shallow inshore water.	Gomon et al. (2008)
Distribution	• Endemic to southern Australia and northern New Zealand waters	Gomon et al. (2008)
Diet	• Various crustaceans and fishes	Norman (2000)
Movement and stock structure	• Highly mobile. Undergoes migration between feeding grounds and spawning grounds. • Preliminary genetic studies showed there are a minimum of 5 genetically distinct stocks in Australia. 98% of the Tasmania population belongs to a single genetic stock which is also found in various proportions in the South Australian, New South Wales and Western Australian populations, suggesting some degree of interbreeding between these areas. • A recent, and more thorough, genetic study showed a single stock across southern Australia with Tasmania being particularly important in terms of reproduction.	Triantafillos & Adams (2001) Triantafillos (2004) Smith *et al*. (2015)
Natural mortality	• High. • Embryo mortality rate between 5% and 25%.	Steer et al. (2004)
Maximum age	• Short-lived (<1 year). Maximum recorded ages are 275 days for males and 263 days for females.	Pecl et al.(2004)

Growth	• Rapid growth at 7-8% body weight/day in individuals <100days old, decreasing to 4-5% BW/day in squids older than 200 days. • No gender difference in growth. Growth from 80 days (when recruitment to inshore waters occurs) best described by a power function $L = 2e^{-6}t^{3.5332}$ where *L* is the mantle length (mm) and *t* is the age (days). • Extremely variable growth. Some variability may be explained by temperature and food availability (individuals hatched in warmer season/year generally grow faster) but there is also a genetic component. • Length-weight relationship was set at $W = 0.00081L^{2.427}$ where *W* is weight (g) and *L* is the dorsal mantel length (mm).	Pecl et al.(2004) Triantafillos (2004) Data from Pecl (2004)
Maturity	• Size-at-50% maturity estimated at 184.5mm for females.	Data from Pecl (2006)
Spawning	• Major spawning period in spring/summer (September to February) in Tasmania, with low levels of spawning occurring all year round • Great Oyster Bay (east coast Tasmania) a known spawning ground. Spawning aggregations are male-biased. • Multiple spawners with individual spawning activity occurring over several months (up to 3.5 months). • Females deposit eggs together in collective egg masses, attaching the finger-like capsules to the substrate by small stalks.	Moltschaniwskyj & Pecl (2003) Pecl et al. (2004) Pecl et al. (2006)
Early life history	• Incubation time estimated at 4 to 8 weeks depending on water temperature. Hatchlings (2.4-7 mm) swim to the surface and can be found near spawning grounds for 20-30 days. • Habitat and ecology between 20-80 days unknown. • From 80-150 days, juveniles are found in deeper water adjacent to spawning ground. • Individuals become available to the fishery between 90-120 days of age.	Steer et al. (2002) Pecl (2000) Pecl (2004)

Background

The fishery for Southern Calamari initially developed in the mid-1990s in Great Oyster Bay and then expanded rapidly to the southeast (including Mercury Passage, Maria Island and Tasman Peninsula) during the latter half of the 1990s. Annual catches rose from less than 20 t prior to 1995/96 to around 90 t in 1998/99. Since then, catches have fluctuated between 40 and 110 t. The expansion of the fishery was accompanied by a massive increase in effort, particularly squid-jig, which has become the primary capture method in recent years. Calamari are taken in lesser quantities by purse seine, beach seine, spear and dipnet. Although some night fishing occurs, Calamari are mainly targeted during the day over shallow areas of seagrass and macro-algae where they aggregate to spawn.

FISHING METHODS	Squid-jig (main), purse seine, beach seine, spear, dipnet
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence)

	• Species licence (Southern Calamari licence) for the Southeast region • Danish seine licence • Class seine licences • Temporal and spatial closures (mid-October to mid-November) of some east coast waters **Output control:** • Daily bag limit of 10 and possession limit of 20 individuals for recreational fishers • Trip limit of 10 calamari in 24-hour period for SE waters for scalefish licence holders not the holder/operator of a calamari or seine licence
MAIN MARKET	Local and interstate

Current assessment

Catch, effort and CPUE

The total commercial catch of Southern Calamari for 2014/15 was 75.8 t (Fig. 20.1A). Initially the main fishery was concentrated off the central east and southeast coasts, but more recently catches have increased of the northeast and northwest of the state (Fig. 20.2). Spawning area closures were first introduced in 1999 and appear to have been successful in reducing pressure on the main east coast spawning grounds (Great Oyster Bay and Mercury Passage) and in encouraging industry to spread their effort throughout the State (Fig. 20.1A). Catches have steadily increased off the northeast coast since 2009/10 (Fig. 20.1A) and off the northwest coast since 2010/11, with current production levels now above those of the Mercury Passage and the southeast coast (Fig. 20.1A).

Low availability of Calamari in Great Oyster Bay has been confirmed by industry reports for several years now. These observations are consistent with surveys of egg production from the main inshore spawning beds in Great Oyster Bay that indicated very low egg densities for 2011 and 2012, and continues the general decline in egg production since 2004 (Fig. 20.3). Assuming egg production is related to the abundance of adults on spawning grounds, then the general decline in catch rates in Great Oyster Bay (Fig. 20.1D) is likely to be influenced by the closures during peak fishing periods and by a reduced spawning stock size. Industry has however reported large number of egg masses outside the Great Oyster Bay area, e.g. around Maria Island and in the north of the State, suggesting that there are other spawning grounds providing recruitment for the stock. Despite the above, CPUE has remained relatively stable in the nearby Mercury Passage and has, if anything, increased slightly in recent years (20.1D).

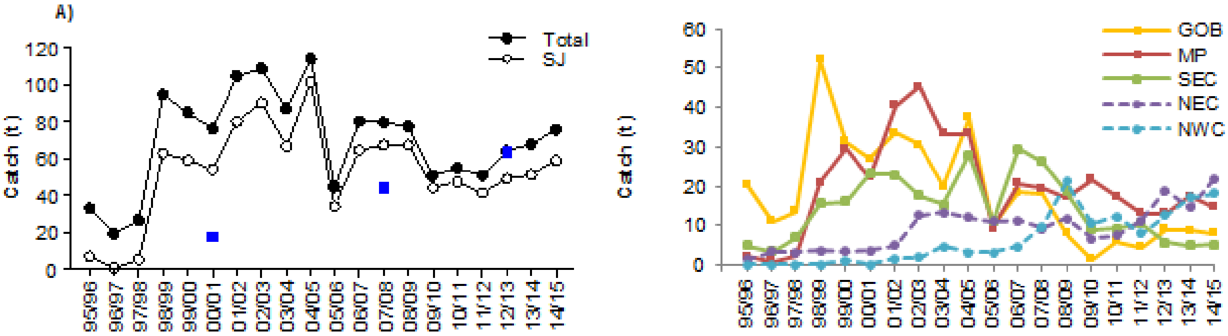
The shift in catch and effort to the northeast and northwest coasts has been accompanied by a general trend of increasing catch rates in both areas (Fig. 20.2E). There was a large increase in effort in both areas in 2014/15 and a further increase in catch rate for the northeast whereas in the northwest the catch rate fell slightly (Fig. 20.1C and E). Effort and CPUE in the Great Oyster Bay area and Mercury Passage have remained relatively stable for the last few years.

The most recent recreational catch estimate (2012/13) indicated that landings were 63.5 t (Lyle et al. 2014b) and similar to commercial landings. This is a considerable increase from previous years with landings from the recreational fishery growing consistently since 2000 (Fig. 20.1A), indicating high interest by recreational fishers in the species.

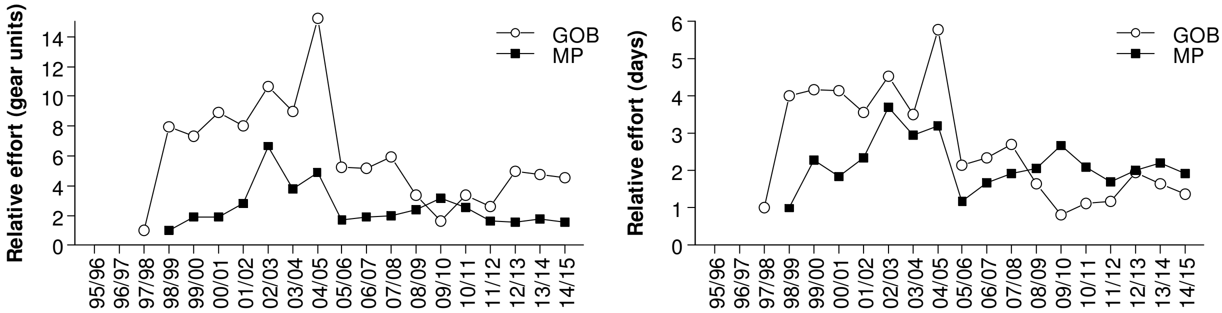
Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery squid jig fishing methods were considered a medium risk with regard to Southern Calamari due to increasing commercial and recreational catches, particularly in the north coupled with fishery indicators that the stock is relatively heavily fished in Tasmania. All other risks were considered negligible apart changes to trophic structure which had a low risk. This is because Southern Calamari are an important predator and stock depletion may impact other components of the ecosystem (Bell et al. 2016).

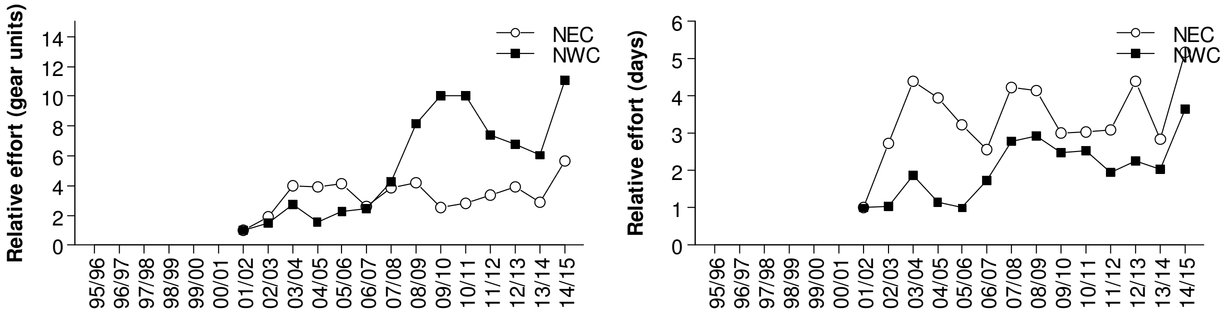
A)


Total
SJ
Catch (t)
GOB
MP
SEC
NEC
NWC
Catch (t)

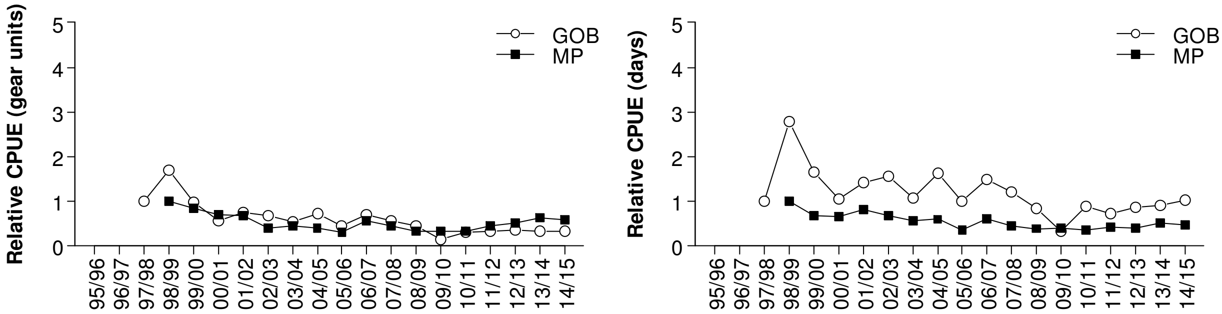
B)


GOB
MP
Relative effort (gear units)
GOB
MP
Relative effort (days)

C)


NEC
NWC
Relative effort (gear units)
NEC
NWC
Relative effort (days)

D)


GOB
MP
Relative CPUE (gear units)
GOB
MP
Relative CPUE (days)

E)

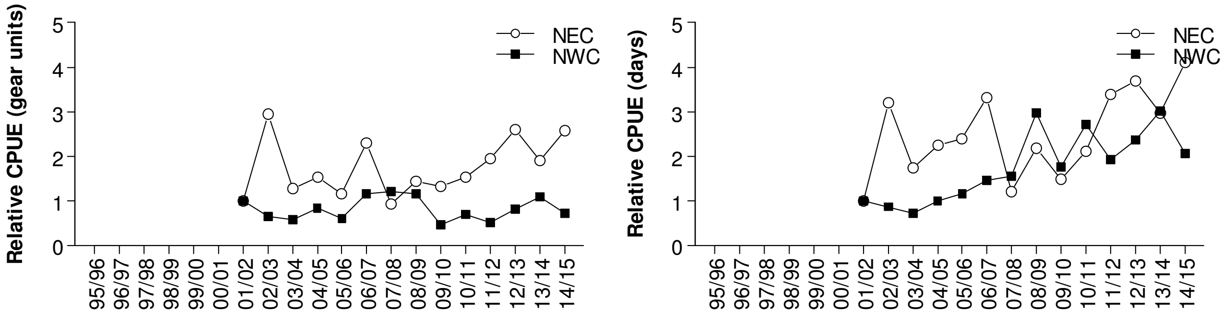

NEC
NWC
Relative CPUE (gear units)
NEC
NWC
Relative CPUE (days)

Fig. 20.1 A) Annual commercial catch (t) by gear (left) and by region (right), and best estimates of recreational catches (single squares); Commercial squid-jig effort based on B) gear units (left) and days fished (right) relative to 1998/99 for MP and 1997/98 for GOB and C) gear units (left) and days fished (right) relative to 2001/02 for NEC and NWC; Commercial squid-jig catch per unit effort (CPUE) based on D) weight per gear unit (left) and weight per day (right) relative to 1998/99 for MP and relative to 1997/98 for GOB, and E) weight per gear unit (left) and weight per day (right) relative to 2001/02 for NEC and NWC; SJ = squid-jig, DN = dipnet; NWC= northwest coast, NEC= northeast coast, SEC = southeast coast, MP = Mercury Passage, GOB = Great Oyster Bay. Only years with >5 operators are shown.

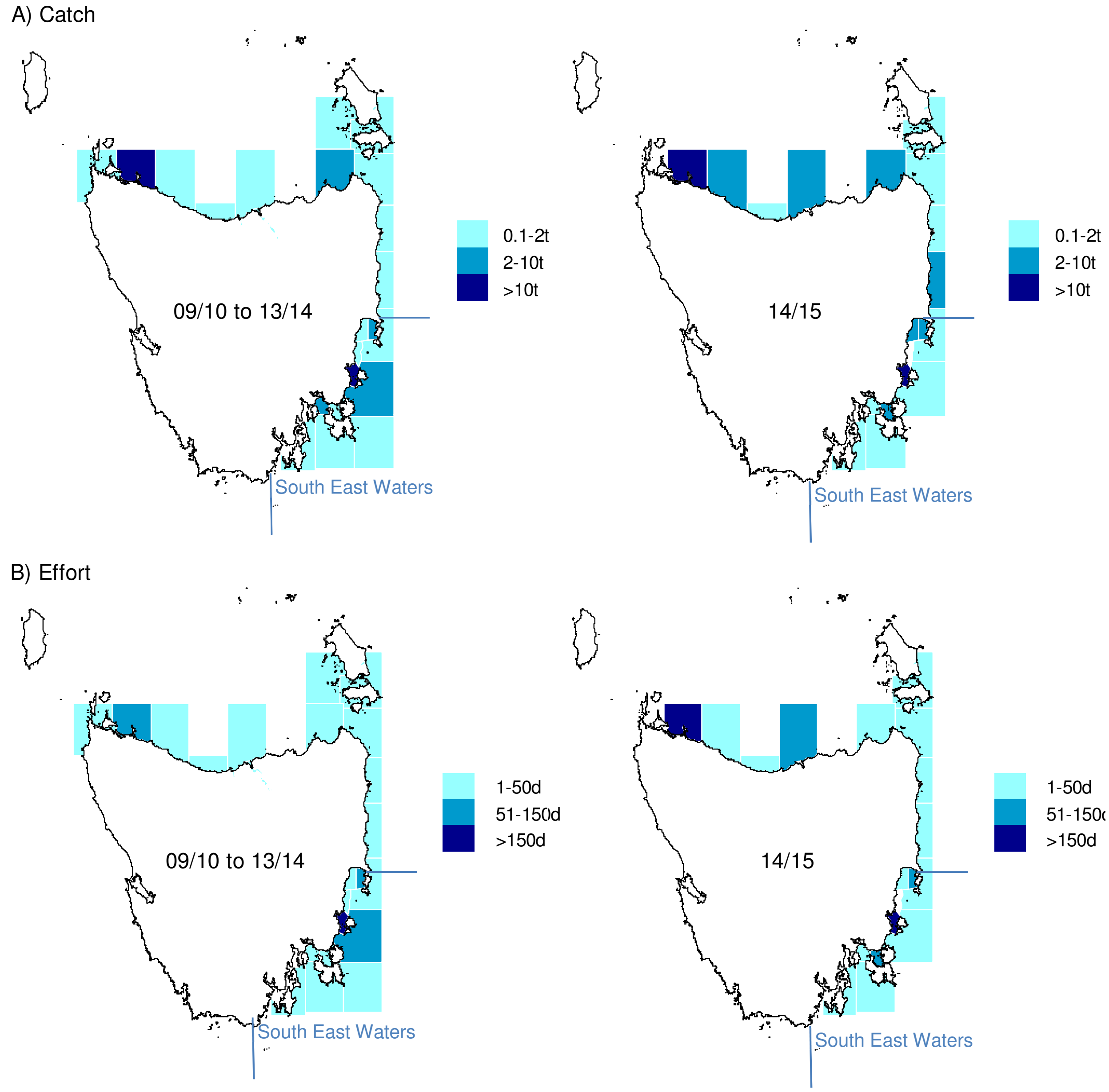


Figure 20.2 (A) Calamari catches (t) and (B) effort (days) by fishing blocks averaged from 2008/09 to 2013/14 (left) and during 2014/15 (right). South East Waters management boundaries are also displayed.

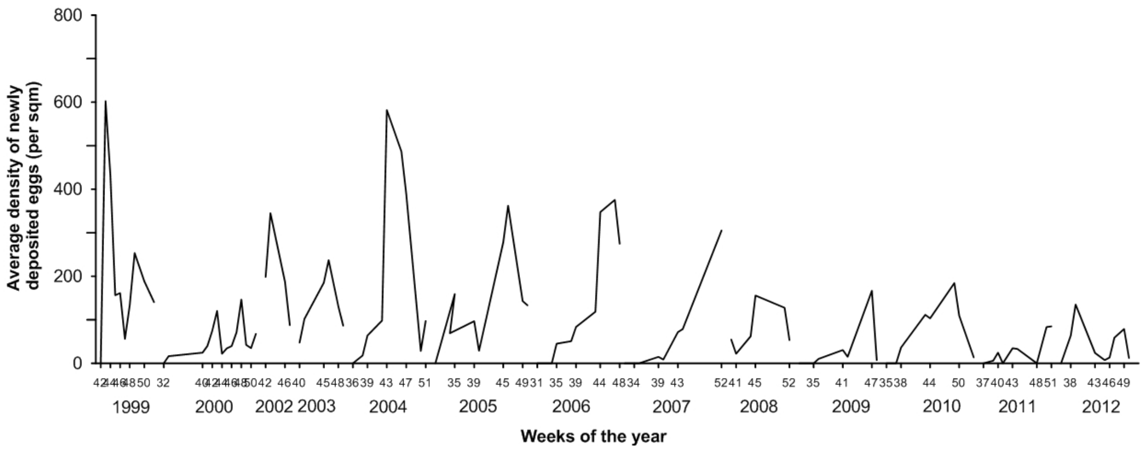


Figure 20.3 Calamari egg production estimated from dive surveys of the main inshore spawning beds in Great Oyster Bay by week of year. No survey was performed in 2013, 2014 or 2015.

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > highest catch from the 1990/91 to 1997/98 range (33 t)	Yes	42.9 t (130%)
	• Catch < lowest catch from the 1990/91 to 1997/98 range (5.8 t)	No	
	• Catch increases by > 30% from previous year (>88.1 t)	No	
	• Catch decreases by > 30% from previous year (<47.4 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>879 days fished)	Yes	452.1 days fished (56.6%)
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0114 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (104.8 t)	No	
	• Catch < 3rd lowest catch value from the reference period (33 t)	No	
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (67.9 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (-69.7 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (17.7 t)	Yes	47.6 t (269%)
	• Proportion of recreational catch to total catch > previous proportion estimate (30.3% in 2007/08)	Yes	Latest estimate (2012/13): 51.3%
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.0198 t/days fished)	No	
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0030)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status	**SUSTAINABLE**

The current reference range for catch and effort are based on a period prior to the development of the fishery, and therefore result in a triggering of the reference points. The proposed reference points overcome this shortfall by using a more appropriate reference range. None of the proposed indicators were breached for commercial catches. The recreational reference points were breached as a result of growing interest in the species from this sector, with the recreational catch of similar magnitude to that for the commercial sector. Thus overall fishing pressure on the species has increased over the past decade or so, despite relative stability in commercial landings.

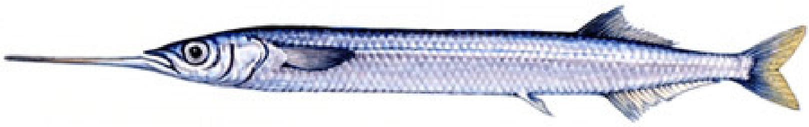
Vulnerability of Calamari to fishing pressure is unclear but probably high because spawning aggregations are targeted and the species has an annual or sub-annual life span that renders the stock susceptible to spawning and/or recruitment failure. The species-specific licence has effectively capped commercial effort in the south east and, if the population is allowed to spawn (during the fishing closures) prior to the main harvest period, the population may be able to sustain high rates of fishing mortality without detrimental effects on future recruitment in this area. There remains high, and increasing, interest in the species from the recreational sector, particularly in the southeast, including the D'Entrecasteaux Channel (closed to commercial fishing), Norfolk and Frederick Henry Bay, and Great Oyster Bay. While catch rates have slightly improved in Great Oyster Bay following a strong decline in catches and catch rates in 2008/09 and 2009/10, there is a need to monitor the developments in the fishery over the coming years, especially in light of the decreasing egg production in one of the main known spawning areas. The identification of source and sink populations supporting the Tasmanian fishery is critical to ensure the sustainable use of this resource. Particularly because a recent genetic study showed that Tasmania was the most important state for providing recruitment throughout southern Australia (Smith et al. 2015), which may show the positive influence the spawning closures have had as they are not in place in other states.

Catch and effort have increased over time outside of the South East Waters (defined as waters between Whale Head to Lemon Rock for calamari management), particularly in the north east and north west coasts. In 2014/15, fishing effort increased to a historic high in both the north east and north west coasts, with anecdotal evidence also suggesting high recreational fishing effort in the region. Virtually nothing is known about the status of the stocks off the north coast, which has resulted in a research project being initiated. Despite recent increases in fishing effort, catch rates in the northern areas have tended to rise, while remaining relatively stable in southern areas of the State. While Southern Calamari may be vulnerable to intensive fishing pressure there are no indications as yet that fishing mortality is excessive and likely to cause the stock to become recruitment overfished. The stock is therefore classified as sustainable, while recognising that fishery performance will need to be monitored closely into the future.

21. Southern Garfish

Hyporhamphus melanochir

STOCK STATUS	TRANSITIONAL DEPLETING
After a strong decline in catches in 2006/07 and 2007/08 coupled with changes in population structure, which prompted management actions, this species showed signs of recovery. However, a lack of recent length and age frequency data has prevented any further assessment of population recovery. Over the last two fishing seasons there have been significant reductions in the catch rates of both fishing methods, particularly beach seine (which is the main catching method), suggesting that fishing mortality may be too high and likely to cause the stock to become recruitment overfished.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends; changes in size/age composition



Hyporhamphus melanochir
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Shallow inshore water (<20m depth) in association with seagrass beds.	Gomon et al. (2008)
Distribution	• Eden (New South Wales) to Perth (Western Australia), including Bass Strait and Tasmanian waters. Endemic to Australia.	Gomon et al. (2008)
Diet	• Predominantly herbivores (seagrass, algal filaments). Also consume planktonic crustaceans, worms, diatoms and stray insects landing on the surface.	Edgar (2008), Klumpp and Nichols (1983)
Movement and stock structure	• Schooling fish, highly mobile. • School near the surface at night and close to bottom during day. • There are 4 genetically distinct populations distributed in Western Australia, western South Australia, eastern South Australia/Victoria and Tasmania. • It is likely that at least two Garfish subpopulations exist in Tasmania, as suggested by the different size and age characteristics exhibited through sampling of the north and east coasts. This has not been confirmed genetically.	Grant (1991) St Hill (1996) Jones et al. (2002) Hartmann & Lyle (2011)
Natural mortality	• High. Estimated at 55% for adults of four years and over for the east coast population.	Jones (1990)
Maximum age	• Up to 9 years old. In recent years, individuals 6 years and older have been rare in catches.	Jordan et al. (1998) Hartmann & Lyle (2011)
Growth	• From 6 month onwards, growth follows a Von Bertallanffy growth function with $L_\infty = 34.3, k = -0.54$ and $t_0 = 0.23$ • Length-weight relationship: $W = 0.0011L^{3.4403}$ where W is weight (g) and L is the fork length (cm).	Jordan et al. (1998)

		Hartmann & Lyle (2011)
Maturity	• Size-at-50% maturity estimated at 19.9cm for females and 17.1cm for males. • The relationship between batch fecundity and fork length is linear with $F = 188.75L - 3585.8$, where F is the fecundity (in number of eggs) and L is the fork length (cm).	Hartmann & Lyle (2011)
Spawning	• Spawning is concentrated in shallow (<5 m deep) over beds of drift algae in eastern Tasmania. It occurs over an extended period of at least five months from October to February, with peak activity occurring between October and December. • Eggs are around 2.93 mm in diameter and are negatively buoyant, sinking to the bottom after fertilisation and becoming attached to drift algae.	Jordan et al. (1998)
Early life history	• Incubation time estimated at one month. Large hatchlings (7.8-8.5mm) are assumed to stay in shallow waters as evidenced by the presence of small juvenile (0+ cohort) in the coastal sheltered waters of east Tasmania.	Jordan et al. (1998)
Recruitment	• Variable. No-stock recruitment relationship established.	
Gillnet post release survival	• NA	

Background

Traditionally a winter beach seine fishery, catches were initially centred off the northeast coast, including Flinders Island. More recently the fishery has extended to the east and southeast coasts and with the introduction of dip-nets, catches have increasingly been taken over the summer months. Nowadays, Garfish is caught almost exclusively by beach seine on the northeast coast and mainly by dip-nets off the southeast and east coasts.

FISHING METHODS	Mainly dip-net and beach seine
MANAGEMENT METHODS	**Input control**: • Temporal closure during spawning: mid-Nov to mid-Dec for southern waters, mid-Jan to mid-Feb for northern waters (Northern and southern waters are delineated by a line following the north coast of Tasmania, joined and bounded in the west by a line of latitude through Cape Grim and in the east by a line of latitude through Cape Naturaliste). • Gear restriction (Scalefish fishing licence, Purse seine licence, Beach seine licence) **Output control***:* • Legal size: 25 cm (upper jaw to end of tail) • Possession limit of 30 and bag limit of 15 individuals for recreational fishers
MAIN MARKET	• Mainly local

Current assessment

Biological characteristics

The sharp and unexpected decline in catches in 2006/07 and 2007/08 prompted the need to better understand stock status and resulted in the introduction of a one month closed season in 2009 to protect the species during the spawning season.

Size composition

Post the mid-1990s there was a reduction of 2–3 cm in the average size of Garfish in eastern Tasmania, and up to 5–6 cm in northern Tasmania (Fig. 21.3). Annual length frequency distributions tended to be unimodal with a peak between 28–33 cm in the 1990s and 27–28 cm during the late 2000s. These reductions were associated with a sharp decline in commercial catches and may be indicative of a more general change in population structure. Since 2011 however, there appears to be a recovery with average size in eastern Tasmania moving towards 30 cm.

A similar pattern was apparent in the north coast. During the mid-1990s individuals between 35 and 40 cm were relatively common in the catch with modal peaks >30 cm but in subsequent years fish larger than about 35 cm were rare and modal peaks were generally <30 cm (Fig. 21.3). Since 2012, there has been an increase in the average size of Garfish, and in the catch of larger fish (>35 cm). Since 2012 however, no new Garfish size and age data have been processed.

Age composition

The age structure of east and north coast catches taken between 2008 and 2011 were similar, and both were dominated by 2–4-year-old fish (Fig. 21.2). In both the east and the north coasts, these dominant classes accounted for between 80 and 90% of the catch numbers annually. Fish aged up to 7 years and 8 years were represented in catches from the north and east coast respectively, although individuals 6 years or older were rare (<2% numbers for the north and <8% for the east coast). By contrast, the age structure of east coast catches taken between 1995–1997 were characterised by a broader range of age classes, 3–7 year olds, with 4 and 5 year olds dominating and accounting for 43% of the total sample (Jordan et al. 1998). Over the past decade there was no evidence for changed gear selectivity (e.g. via gear modifications), nor have there been reported changes in fishing practices or market preference that would account for the shift to younger/smaller fish. The contraction in age structure and sharp fall in catches since the mid-2000s may therefore reflect fundamental changes in population structure, which may have resulted from heavy fishing pressure and/or poor recruitment during the early 2000s.

In 2012, however, the age distribution changed in both regions, with a lesser proportion of two year olds in the catch and fish >3 years old becoming more prevalent, indicating the start of a recovery (Fig. 21.2). The age distribution in the east coast is now dominated by 3–5 years old, which represented over 75% of the catch numbers. The age distribution in the north is still dominated by 2–4 years old (80% of the catch numbers) but in both regions there is an increase in the proportion of older fish with individuals 6 years or older accounting for around 13% in numbers. Since 2012 however, no new Garfish size and age data have been processed.

Catch, effort and CPUE

The total commercial catch of Garfish for 2014/15 was 33.8 t, which is similar to 2013/14 but lower than the previous five years catch (43–61 t) (Fig. 21.3A). After many years of relative stability in Garfish catches at 80–90 t per annum, catches fell sharply in 2006/07 and have fluctuated between 35–70 t since that time. Catches, both historically and in 2014/15, were concentrated off the northeast coast (Fig. 21.3A and Fig. 21.4A). Historically, there were also moderate landings in the east and southeast, however these were greatly reduced in 2013/14 and 2014/15 (Fig. 21.3A and Fig. 21.4A).

Recreational Garfish catches are low compared to commercial catches and were estimated around 2 t in 2000/01, 2007/08 and 2012/13 (Henry and Lyle 2003, Lyle et al. 2009, Lyle et al. 2014b).

Effort of both commercial gear types has been slowly decreasing through time and there was a further notable reduction in 2014/15, particularly for dip net (Fig. 21.3B and Fig. 21.4B). Dip-net effort initially increased to a peak during 1998/99 but has subsequently decreased to a lower level (Fig. 21.3B, days fished), while beach seine effort experienced a more recent decline and reached a historic minimum in 2014/15.

Catch rates for beach seine have fluctuated much more strongly over time than those for dip-net but increased for both methods between 2011/12 and 2012/13 before declining in 2013/14 and again in 2014/15 (Fig. 21.3C). The most recent catch rates are comparable to levels in the late 2000s when there were concerns about the stock status.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, beach seining was considered a low risk activity with regard to Southern Garfish due to low catches and signs of population recovery at the time. Beach seining was also considered a low risk activity with regards to non-retained species as bycatch is usually released alive and “herded” not “meshed/gilled” and a very low risk in regards to the general ecosystem (Bell et al. 2016).

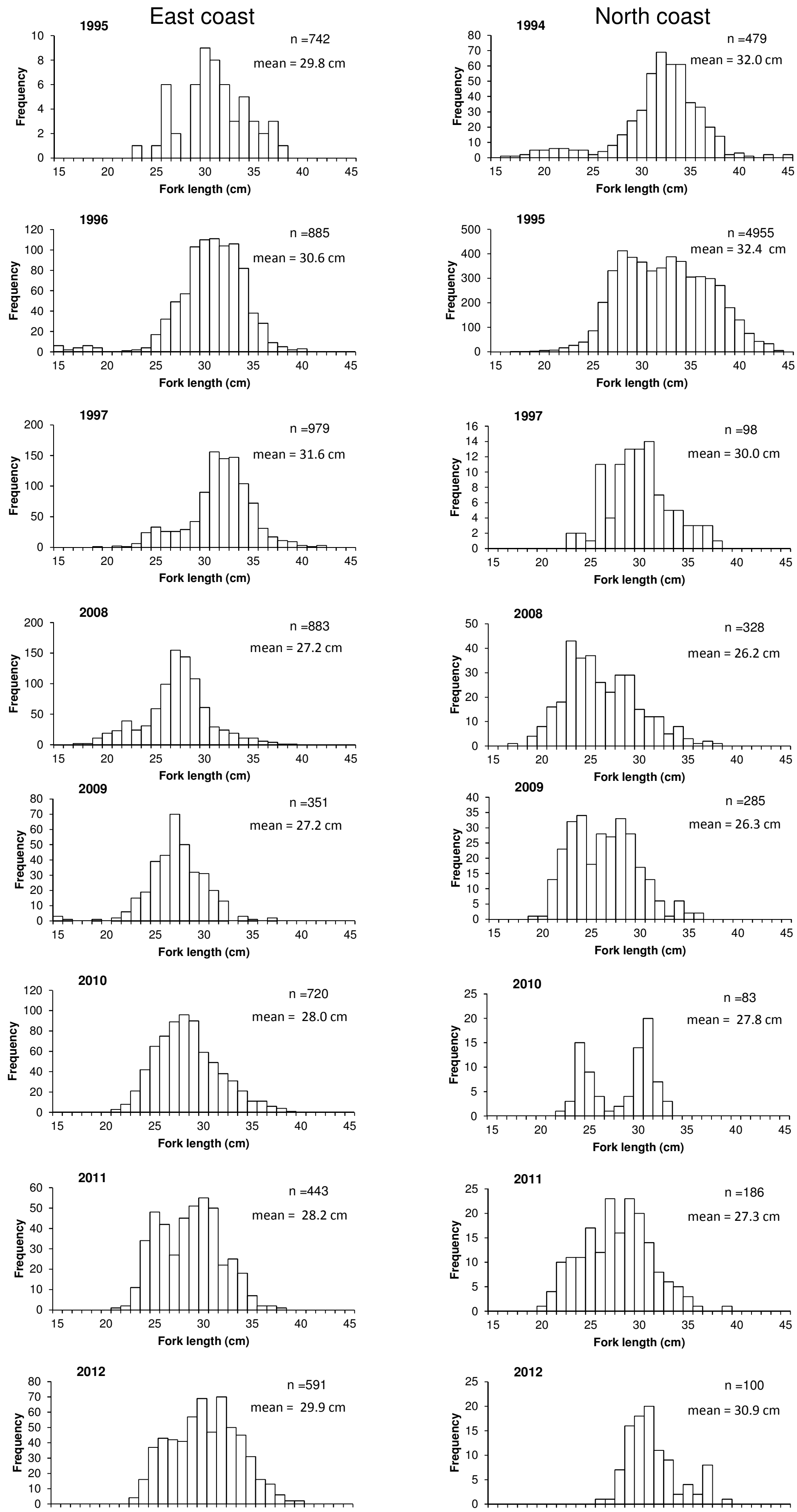


Figure 21.1. Size composition of Southern Garfish by year for east coast (left) and north coast (right) commercial catches. *n* is the sample size.

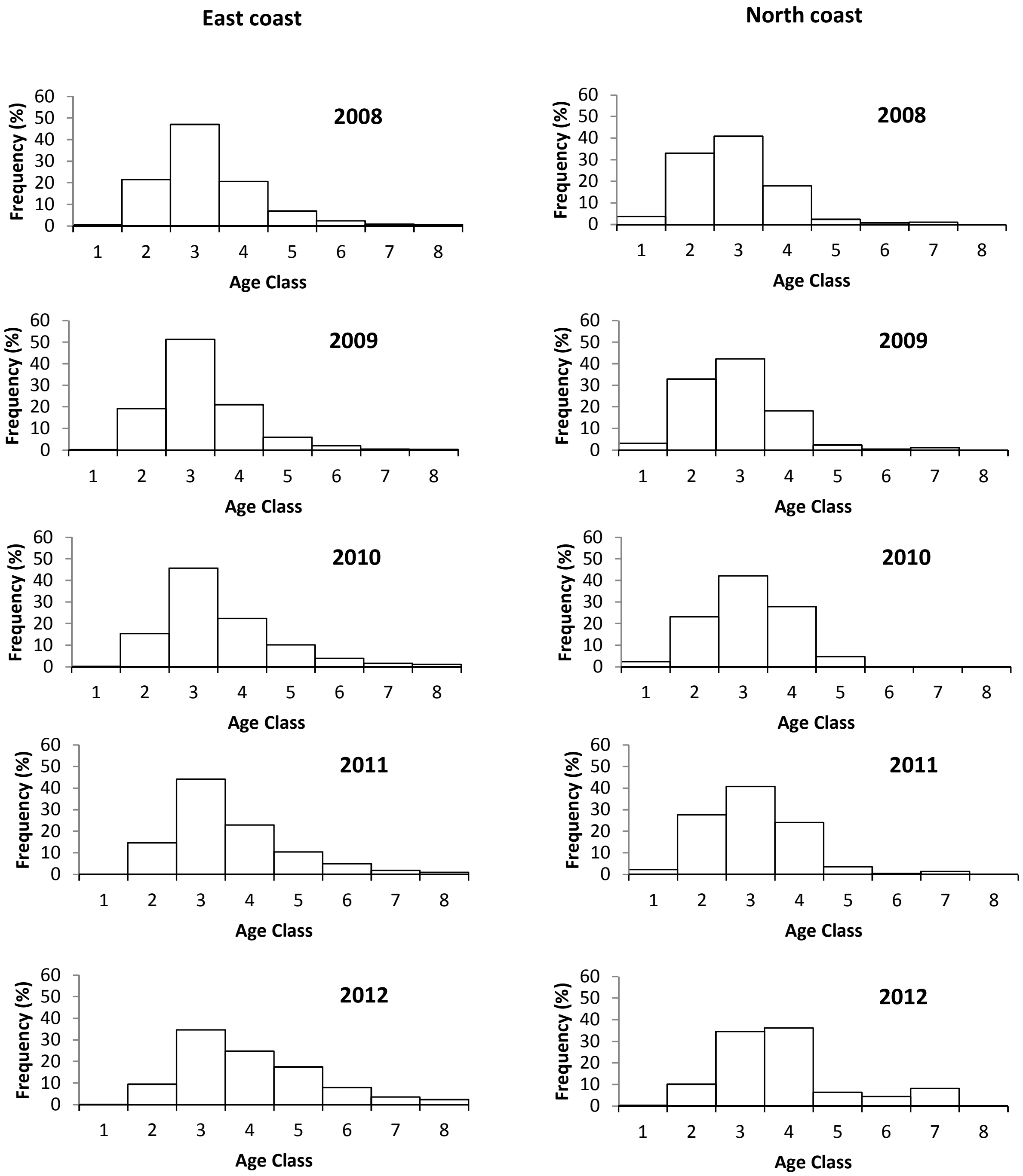


Figure 21.2. Age composition of Southern Garfish by year for east coast (left) and north coast (right) commercial catches.

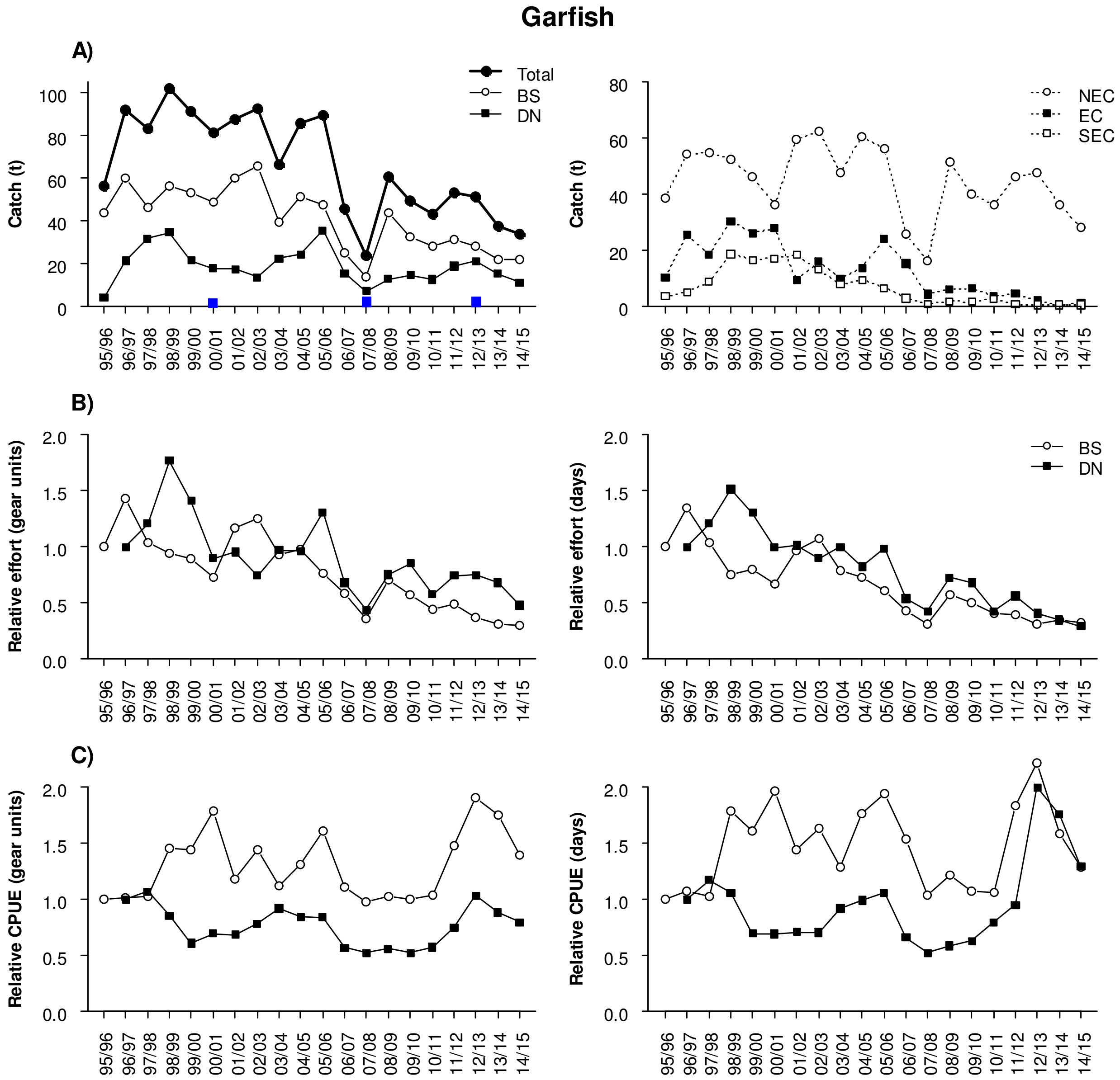


Figure 21.3 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. BS= beach seine, DN= dip-net, SEC= southeast coast, EC= east coast, NEC= northeast coast.

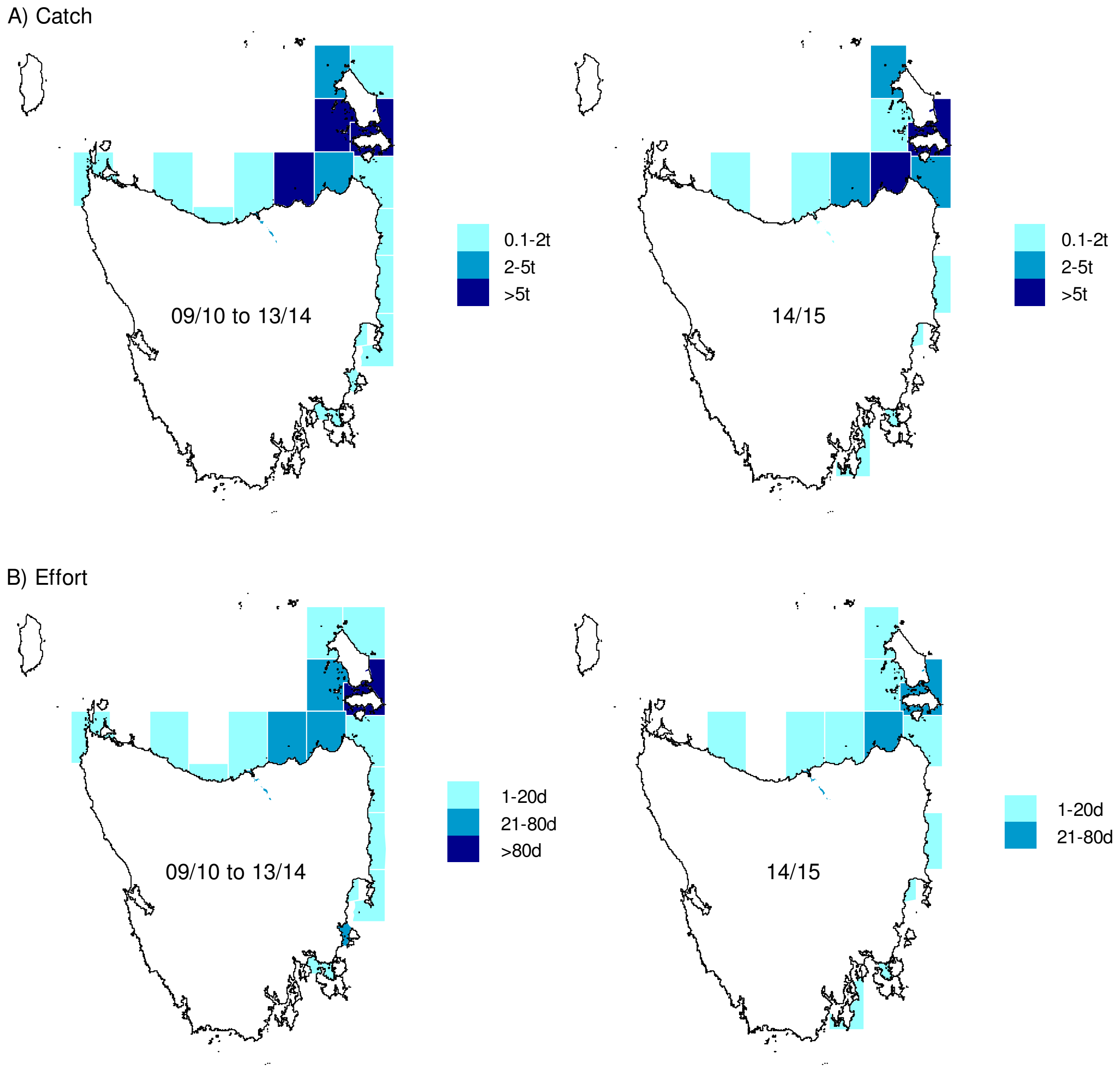


Figure 21.4 (A) Garfish catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (91.6 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (56.2 t)	Yes	22.4 t (39.9%)
	• Catch increases by > 30% from previous year (>49.2t)	No	
	• Catch decreases by > 30% from previous year (<26.5 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1081 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0306 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (91.6 t)	No	
	• Catch < 3rd lowest catch value from the reference period (66.2 t)	Yes	32.5 t (49.1%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (35.5 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (-43.6 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (1.9 t)	Yes	0.1 t (5.3%)
	• Proportion of recreational catch to total catch > previous proportion estimate (3.7% in 2007/08)	Yes	Latest estimate (2012/13): 3.8%
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.05 t/days fished)	No	
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0084)	Yes	0.0056 t (67%)
Stock stress	• Significant change in the size/age composition of commercial catches	No	
	• Significant numbers of unhealthy fish landed	No	

Stock status	**TRANSITIONAL DEPLETING**

Catch and fishing mortality reference points were breached reflecting that low 2014/15 catch relative to levels prior to 2006/07. Catch rates over the last two fishing seasons have also declined, coupled with a reduction in beach seine and dip net effort. There has also been a notable reduction in the catch from the east and southeast of the state. While the recreational reference points were also breached, catches have remained essentially unchanged and are insignificant when compared to the commercial catch.

Vulnerability of Southern Garfish to fishing pressure is unclear but is probably moderate to high due to the schooling behaviour of the species, which means they can be efficiently targeted under favourable conditions. As a relatively short-lived species, and with a population dominated by relatively few age classes, any recruitment variability is likely to have a marked impact on population size.

There was evidence of a reduction in average fish size and a truncation of the age structure up to 2011 that may have been indicative of a more general change in population structure from heavy fishing pressure and/or poor recruitment. There were early signs of population recovery in 2012 (increasing size and age), which may be linked to the implementation of the spawning closure for commercial operators in 2009. The catch rates during 2011/12 and 2012/13 fishing seasons implied some degree of stock recovery. Further, the current minimum legal length of 25 cm total length is above the size at maturity for both sexes and therefore likely to offer a relatively high degree of protection to the population (size at 50% maturity is 17.1 cm fork length for males and 19.9 cm for females, Hartmann and Lyle 2011).

Over the last two fishing seasons catch rates for this species have declined with industry advising that this is not market driven but a factor of the stock dynamics (SFAC 2015). Nevertheless, there has been some scarcity evident in the north over the last fishing season. Some industry members have also expressed concern about the effects of dip-nets on the schooling behaviour of Garfish. Specifically, it has been suggested that intense dip-net activity tends to cause schools to break and hence reduce opportunities to use beach seines to target the species, 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. Further monitoring of the stock will be required and currently a research priority of the fishery is determining the effectiveness of existing closures in terms of timing and location.

Significant reductions in catch rate suggest that fishing mortality may be too high in some areas, including the northeast where the majority of the catch is landed. The decline in catch rates is also evident across both gear types but greatest for beach seine, which is the main fishing method in terms of landings. This decline in beach seine catch rates to a level similar to 2006/07 and 2007/08 when the stock was in a depleted state, implies that fishing mortality may be too high and likely to cause the stock to become recruitment overfished. The stock is therefore classified as transitional depleting.

22. Striped Trumpeter

Latris lineata

STOCK STATUS	UNDEFINED
A lack of length and age frequency data in recent years has prevented an assessment of the extent of population recovery in Striped Trumpeter. Consequently, the justification for the previous stock status is no longer appropriate as there is not enough biological information to confidently classify the stock.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery, Commonwealth fisheries
INDICATOR(S)	Catch, effort and CPUE trends

Latris lineata
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Exposed reefs and rocky bottom down to 300m depth.	Edgar et al. (2004) Gomon et al.(2008)
Distribution	• Sydney (New South Wales) to Albany (Western Australia), Tasmania, New Zealand, Amsterdam Islands (southern Indian Ocean) and most of temperate Southern hemisphere (excl. South Africa and South America).	Edgar et al. (2004) Gomon et al.(2008)
Diet	• Small fish, cephalopods, crustaceans.	Nichols et al. (1994)
Movement and stock structure	• Juveniles have limited movement, remaining around shallow reefs for several years before moving into deeper offshore reefs. • Adults have the capacity to undergo wide-scale movements (e.g. Tasmania to St Paul Island in Indian Ocean) • Uniform stock structure in Tasmanian waters (no significant genetic separation of populations)	Tracey and Lyle (2005) Lyle and Jordan (1999) Lyle and Murphy (2001) Tracey et al. (2007b)
Natural mortality	• Estimated at *M*=0.1.	Tracey and Lyle (2005)
Maximum age	• Estimated at 43 years.	Tracey and Lyle (2005)
Growth	• Maximum length: 1.2 m • Maximum weight: 25 kg	Gomon et al.(2008)

<table>
<tr>
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<td>
• Rapid juvenile growth (mean FL = 28 cm after 2 years, 42 cm after 4 years). Slower adult growth (large range of size-at-age over 50 cm FL)
• Growth for both sex described by a two-phase von Bertalanffy growth function
$$L = \left(1 - \int_{t=-t_0}^{+t^{\delta}} \frac{1}{\sigma\sqrt{2\pi}} e^{\left(\frac{-(t-t_{01})^2}{2\sigma^2}\right)}\right)\left(L_{\infty 1}\left(1 - e^{-k_1(t-t_{01})}\right) + \varepsilon\right) + \left(1 - \int_{t=t^{\delta}}^{+t_{max}} \frac{1}{\sigma\sqrt{2\pi}} e^{\left(\frac{-\left(t-t^{\delta}\right)^2}{2\sigma^2}\right)}\right)\left(L^{\delta} + \left(L_{\infty 2} - L^{\delta}\right)\left(1 - e^{-k_2(t-t_{02})}\right) + \varepsilon\right)$$
where *L* is the length (mm), *t* is the age (years), $L_{\infty 1} and\ L_{\infty 2}$ are the average maximum length for the species for the 1st and 2nd growth phase respectively, k_1 and k_2 are constants, t_{01} and t_{02} are the (theoretical) age where length equals zero for the 1st and 2nd growth phase respectively, L^{δ} and t^{δ} are the length and age of transference from one growth phase to the next, t_{max} is the maximum age present in the sample, σ^2 is the standard deviation of cumulative density function with mean t^{δ}, and ε is an error term.
Parameters estimates are:
<table>
<tr><th>$L_{\infty 1}$</th><th>k_1</th><th>t_{01}</th><th>L^{δ}</th><th>$L_{\infty 2}$</th><th>k_2</th><th>t_{02}</th><th>t^{δ}</th><th>σ^2</th></tr>
<tr><td>532.77</td><td>0.43</td><td>0.03</td><td>450.1</td><td>871.59</td><td>0.08</td><td>3.49</td><td>4.4</td><td>1.0</td></tr>
</table>
• Length-weight relationship for both sex was estimated at $W = 2E^{-5}L^{3.00}$, where *W* is weight (g) and *L* is the fork length (mm).
</td>
<td>Murphy and Lyle (1999)

Tracey and Lyle (2005)</td>
</tr>
<tr>
<td>Maturity</td>
<td>• Size-at-50% maturity estimated at 54 cm FL (62 cm TL; 6.8 years) for females and 53 cm FL (61 cm TL; 6.2 years) for males.
• Batch fecundity (BF) estimate:
$BF = 4.15E^{-8}FL^{4.69}$, where *FL* is fork length in cm.</td>
<td>Tracey et al. (2007a)
IMAS unpublished data</td>
</tr>
<tr>
<td>Spawning</td>
<td>• July to early October depending on geographic location (early start and finish at lower latitudes).
• Multiple spawners, highly fecund (100,000 to 400,000 eggs for females weighing 3.2 kg and 5.2 kg respectively).
• Small pelagic eggs (1.3 mm diameter).</td>
<td>Ruwald et al. (1991)
Ruwald, 1992 (1992)
Hutchinson (1993)</td>
</tr>
<tr>
<td>Early life history</td>
<td>• Complex and extended larval phase of at least 9 months before settlement.
• No information on size and timing of settlement. Juveniles of around 18 cm FL (23 cm TL) have been caught on shallow reefs off southeast coast in January.</td>
<td>Ruwald et al. (1991)
Ruwald, 1992 (1992)
Murphy and Lyle (1999)</td>
</tr>
<tr>
<td>Recruitment</td>
<td>• Highly variable. No-stock recruitment relationship established.</td>
<td>Murphy and Lyle (1999)</td>
</tr>
<tr>
<td>Gillnet post release survival</td>
<td>• NA</td>
<td></td>
</tr>
</table>

Background

Striped Trumpeter have a long history of commercial exploitation in Tasmania, being highly valued for its eating qualities. There is also a high level of interest in the species from recreational fishers and charter boat operators. The species is taken by a variety of fishing gears, with hand-line and drop-line the primary methods. Juvenile Striped Trumpeter are occasionally taken in graball nets in inshore waters and usually in depths <50 m, whereas adult fish are taken in deeper offshore waters by line methods 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 southwest coasts of Tasmania.

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. As part of the Tasmanian scalefish management plan, gear restrictions for all commercial scalefish fishers operating in State waters were introduced in 1998. This, however, enabled dual endorsed operators (i.e. holders of a Tasmanian licence and a Commonwealth permit for southern shark or South East Non Trawl fisheries) as well as rock lobster fishers to take unrestricted quantities of Striped Trumpeter in offshore waters using their gear allocations. In 2000, the State Government introduced a combined trip limit of 250 kg for Striped Trumpeter, yellowtail kingfish and snapper for all fishers (Commonwealth and State) in inshore and offshore waters relevant to Tasmania to limit the potential for expansion of effort directed at these species. Over time, there have been additional management measures targeted at the species, including a spawning closure, a decrease in the recreational possession limit and several increases in the minimum size limit for the species (currently 55 cm total length (TL), which is still below the size at maturity of 62 cm TL for females and 61 cm TL for males).

Although the seasonal closure does not restrict fishing by Commonwealth vessels, in 2013 the Commonwealth reduced their Striped Trumpeter trip limit component to 150 kg (it is still a part of the 250 kg combined species trip limit, but only a maximum of 150 kg can comprise Striped Trumpeter).

FISHING METHODS	Mainly hand-line, also graball net and drop-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Temporal closure (Sept–Oct) **Output control:** • Trip limit of 250 kg • Trip limit of 150 kg for Commonwealth operators • On water bag limit of 4 individuals for recreational fishers • Possession limit of 8 individuals for recreational fishers • Minimum size (550 mm TL)
MAIN MARKET	Mainly local

Current assessment

Biological characteristics

Size composition

In 1999, the size distribution was unimodal and dominated by 50 cm fork length (FL) fish, with a tail of larger fish (Fig. 22.1). Many of the subsequent sample sizes were low and sampling has been opportunistic, which may not represent population size structure. Years with good sample sizes, however, suggest that no significant recruitment occurred for about a decade during the late 1990s and early 2000s following a major recruitment event in 1993. This 1993 cohort still dominated the catches in 2009 and at this time, samples were dominated by fish around 62 cm in length. In 2010, the size distribution changed and was again dominated by 50 cm fish, suggesting a new wave of recruits had entered the fishery (Fig. 22.1). The size structure appeared stable between 2010 and 2012 suggesting recruitment over at least 3 consecutive years. There was a lack of samples between 2013 and 2016 with the distribution more evenly spread but again 50 cm fish were the most commonly sampled.

Age composition

The very strong 1993 year class (5 year olds in 1999, 6 year olds in 2000, etc.) was prominent in samples obtained from research fishing and commercial catches up until 2009 (Fig. 22.2). As for size, the low sample sizes in many years may not represent population age structure. Notwithstanding these concerns, the data demonstrated a consistent lack of recent recruits (3–5 year olds) up until 2010 which, along with catch declines, implied an extended period of low recruitment. During this time the population appears to have been sustained largely by strong year classes spawned during the 1990s.

Samples from 2010 to 2016 were dominated by 4–6 year olds (the age at which the species tends to recruit to the offshore hook fishery), providing evidence of recent recruitment success. While the relative strength of these cohorts is unknown, they provide a positive sign for the future of the stock, although caution is recommended since the number of individuals sampled between 2013 and 2016 is low and previous indicators have suggested that the adult segment of the population may still be in a depleted state (due to fishing and lack of recruitment over many years). Few individuals older than 10 years old have been sampled in recent years but again this a factor of the low sample size rather than a major contraction in the population age structure.

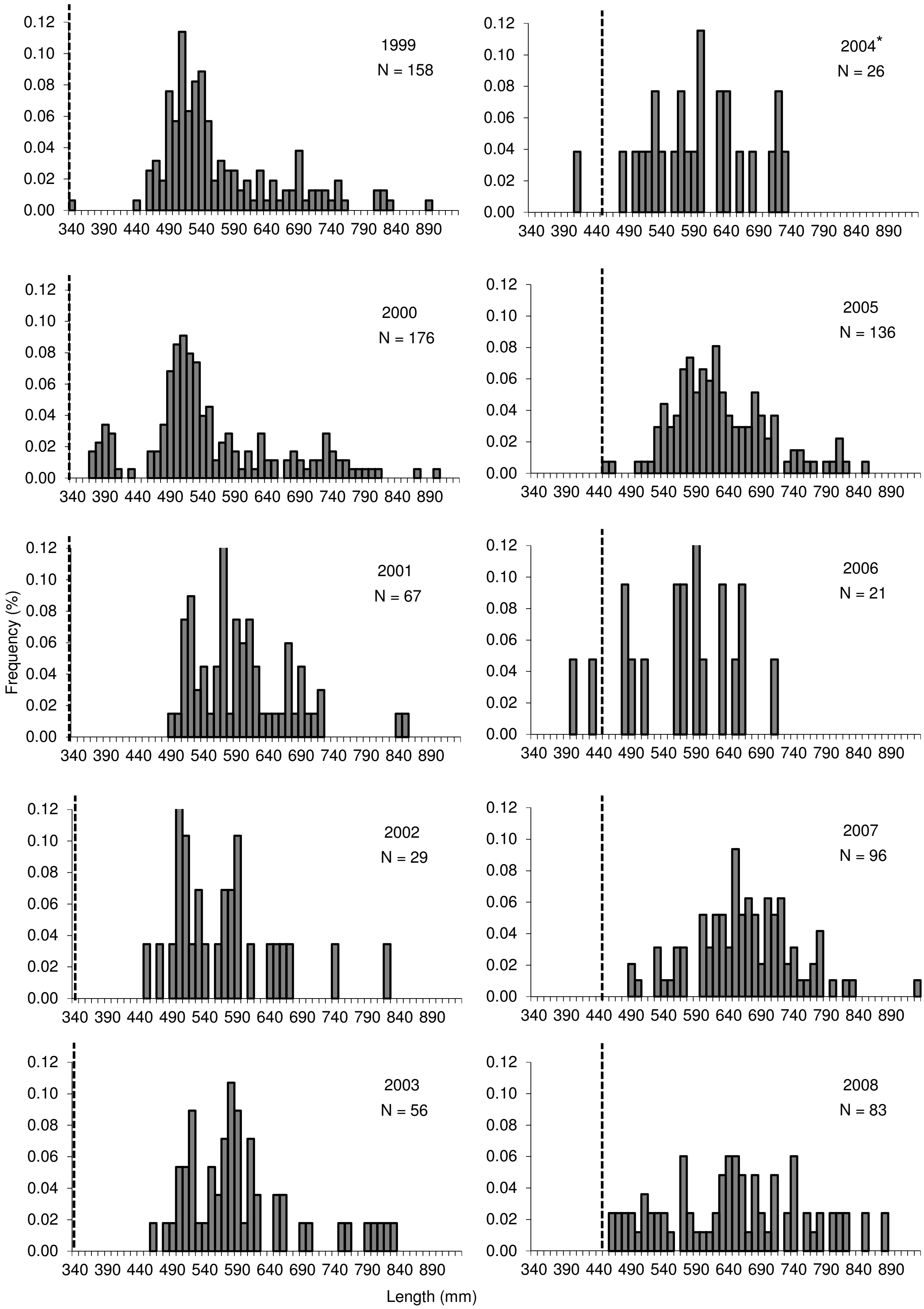


Figure 22.1 Striped Trumpeter length composition (financial year 1999−2016) from commercial catches. *n* = sample size. Dotted line indicates the minimum legal size limit and * indicate years when the minimum size limit was changed. Length is fork length.

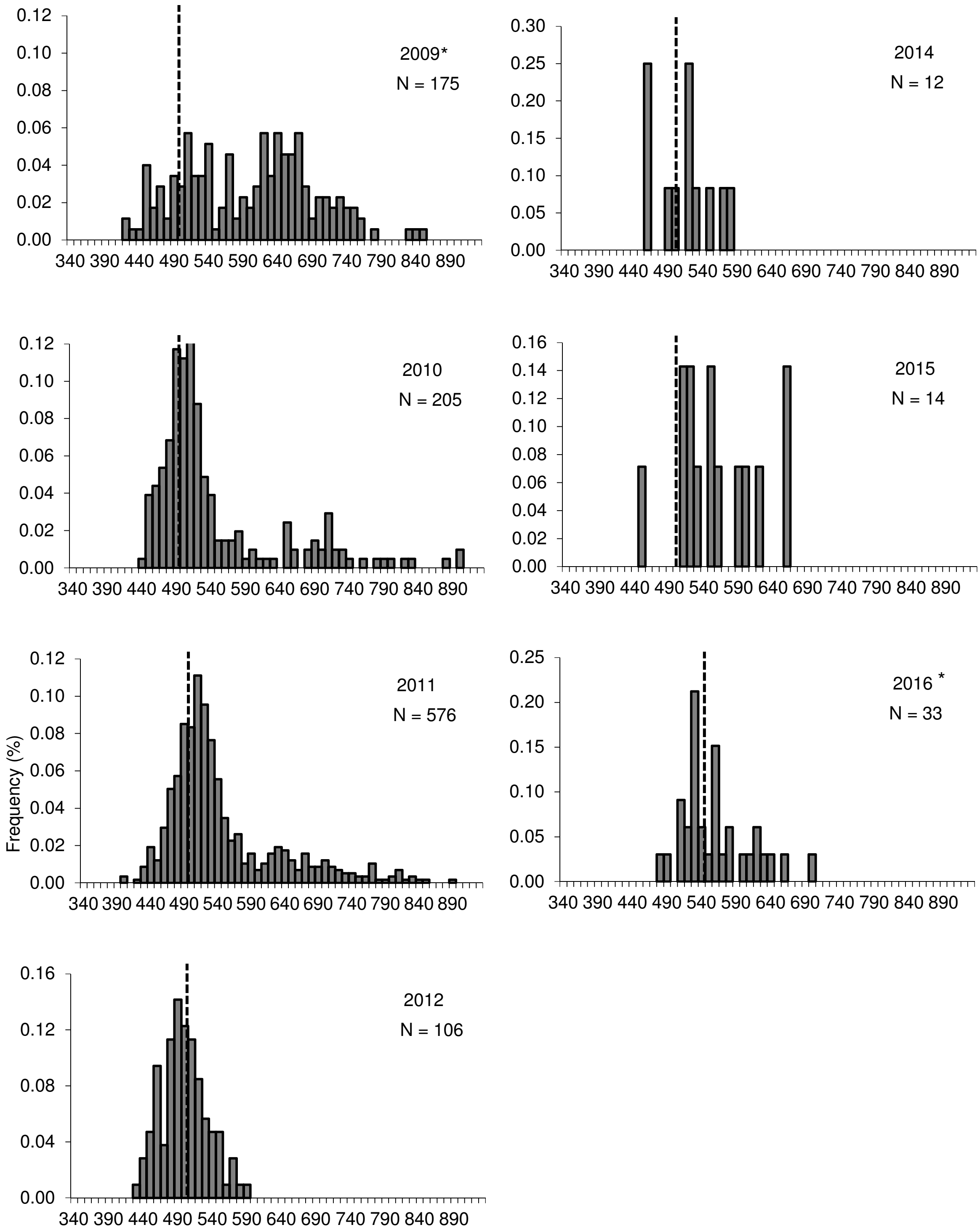


Figure 22.1 - continued

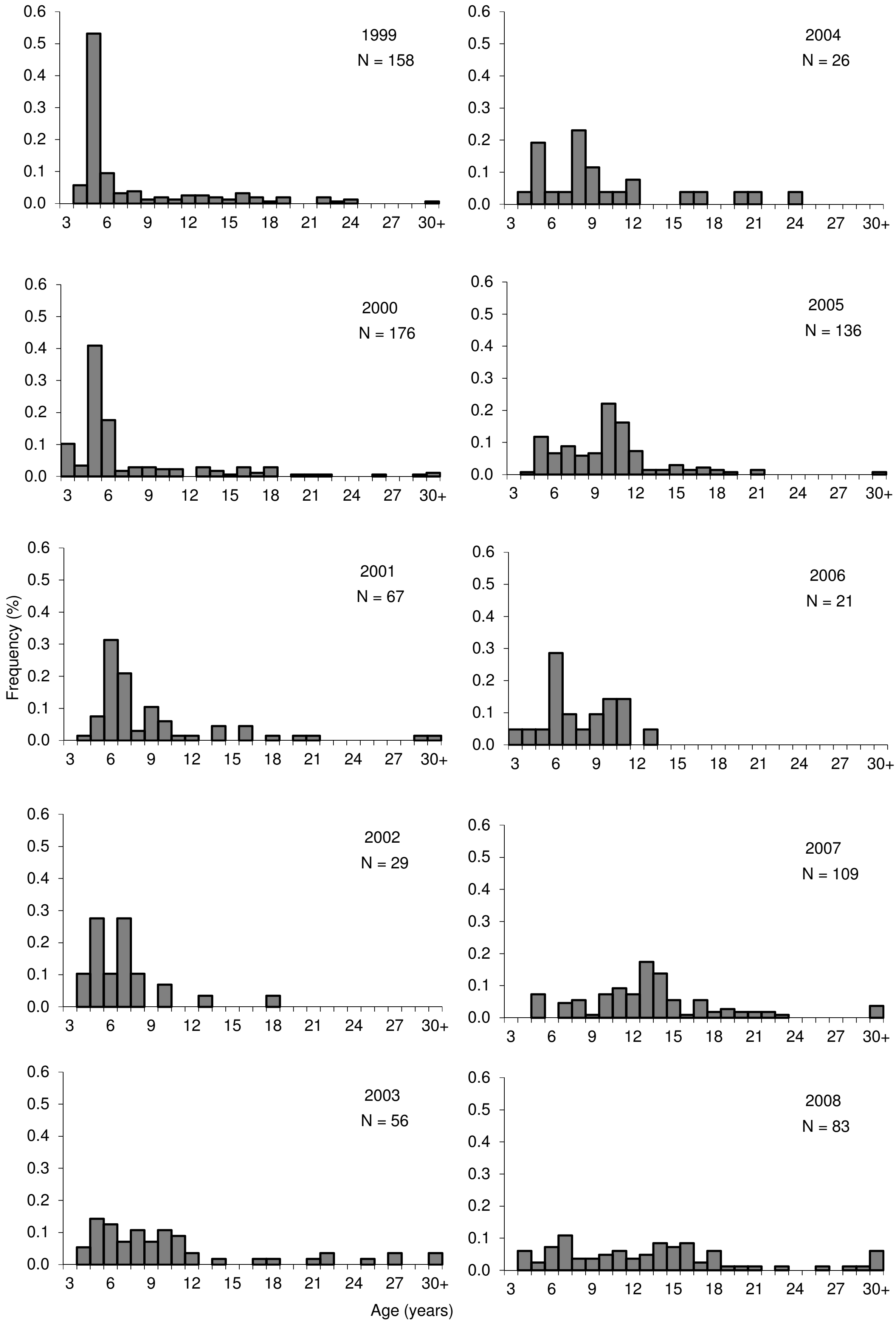


Figure 22.2 Striped Trumpeter age composition (1999–2016) from commercial catches. *n* = sample size (year 2009 to 2016 on following page).

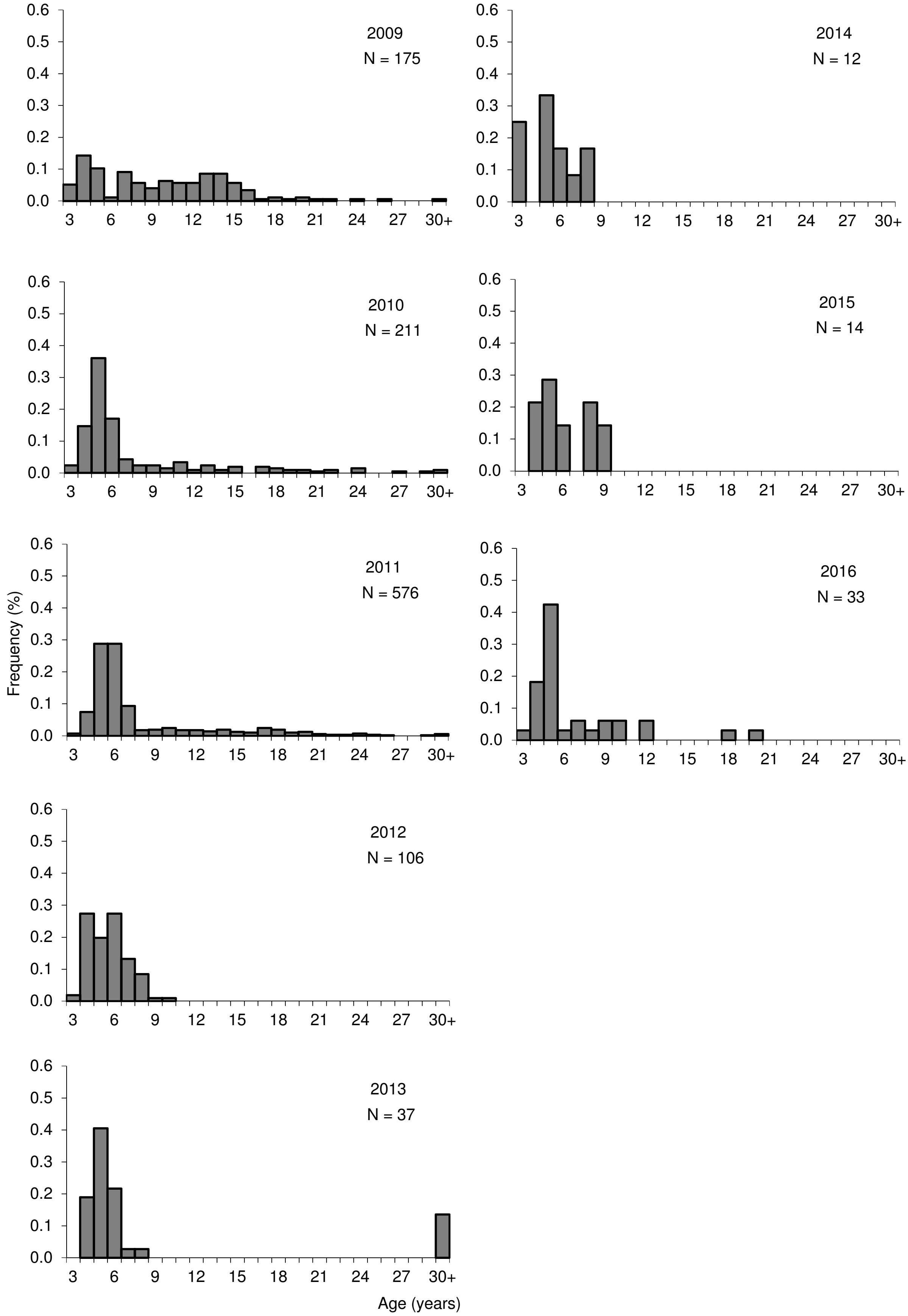


Figure 22.2 (continued)

Catch, effort and CPUE

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 the Victorian and Commonwealth logbooks, is presented in Table 22.1. In the early 1990s catches by Victorian vessels were significant, peaking at around 37 t. Since the mid-1990s, data from this sector have been unavailable, though it is assumed that subsequent catches have been reported in Commonwealth logbooks. Other than 1999/2000 when >14 t was taken, Commonwealth catches have been relatively low although there was a sharp rise in the reported catch in 2014/15 to 10.9 t, such that the Commonwealth exceeded that reported by Tasmanian operators.

Annual production was high at over 110 t in the early 1990s, Victorian vessels accounting for 17–39% of the total, but then fluctuated between 70–80 t through the mid-1990s before increasing again to over 100 t by the late 1990s (Table 22.1). Catches almost halved in 2000/01 to less than 50 t and have remained low since that time. This trend was observed by all methods in Tasmania (Fig. 22.3A). In 2014/15 catch increased to 20.5 tonnes caused primarily by increased catches reported in Commonwealth logbooks. The catch in 2014/15 was around double the catch reported in 2013/14 (10.3 tonnes), which was the lowest reported since records have been kept.

	Catch (t)			
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
1999/2000	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	18.8		3.5	22.3
2007/08	13.1		3.0	16.1
2008/09	10.5		2.8	13.3
2009/10	10.0		2.3	12.8
2010/11	15.0		4.8	19.8
2011/12	15.8		5.4	21.2
2012/13	12.2		0.8	13.0
2013/14	8.0		2.3	10.3
2014/15	9.6		10.9	20.5

Table 22.1 Annual commercial catches of Striped Trumpeter (t) south of latitude 39 12'S. Data based on Tasmanian (General Fishing return), Victorian and Commonwealth catch returns.

Commonwealth catches are believed to have been substantially underreported in the past which, coupled with limited information regarding recreational catches, represents a major source of uncertainty in estimating total mortality. The recreational fishery has heavily targeted Striped Trumpeter in the past, with an estimated 38 t in 2000/01 (Lyle 2005). Estimates of recreational catches in 2007/08 were highly uncertain but likely to be lower, with an estimated 19 t for combined catches of striped and Bastard Trumpeter (Lyle et al. 2009). Estimates in 2011/12 and 2012/13 were 31.9 and 15.2 t respectively for Striped Trumpeter and exceeded the commercial catch for the species in both years (Fig. 22.3A). These catch estimates do not fully represent catches by charter boats. Interestingly, in recent years good numbers of large Striped Trumpeter have been found in waters off Portland in western Victoria and have become increasingly targeted by recreational fishers. Apart from the north coast, Striped Trumpeter catches have historically been reported from all areas around the state (Figs. 22.3A and 22.4). Since 2009/10, catches in the northwest coast have increased to match those of the southeast, with the majority taken from the west coast and off Flinders Island in 2014/15 (Figs. 22.3A and 22.4).

The observed catch trends reflect the influence of especially strong year classes that entered the fishery between 1995/96 and 1997/98. Increased 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, may also have been relatively strong. The subsequent decline in graball catches presumably reflects the movement of these 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 provided a strong disincentive for some operators to target the species and may have contributed to the sharp falls in drop-line and hand-line effort since 2000/01.

Fishing effort increased during the latter part of the 1990s, presumably linked to the increased availability of Striped Trumpeter (Fig. 22.3B). Subsequently, effort for all methods has declined, with hand-line fishing remaining the dominant method. Fishing activity has been focussed mainly on the southeast and west coasts and to a lesser extent off the east and northeast (Fig. 22.3B).

Drop-line and hand-line catch rates have declined slowly since 2012/13 in terms of gear units but not catch per day which has remained relatively stable (Fig. 22.3C). Graball catch rates increased steadily up until 2003/04, despite declining catches during the latter half of the period. The sharp fall in graball catch rates after 2004/05 may have been influenced by the minimum size limit increase that took effect during 2004. Over the last two fishing seasons graball catch rates have increased slightly but overall catch and effort for this method remained low.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, hand-lining was considered a medium risk with regard to Striped Trumpeter due to evidence of the population being subject to heavy fishing pressure from combined fishing methods. Hand-lining for Striped Trumpeter was also considered a medium risk to by-product mixed fish species, such as Jackass Morwong and Ocean Perch, due to the uncertainty surrounding their population status. Impacts on communities and protected species were generally low or negligible (Bell et al. 2016).

Striped Trumpeter

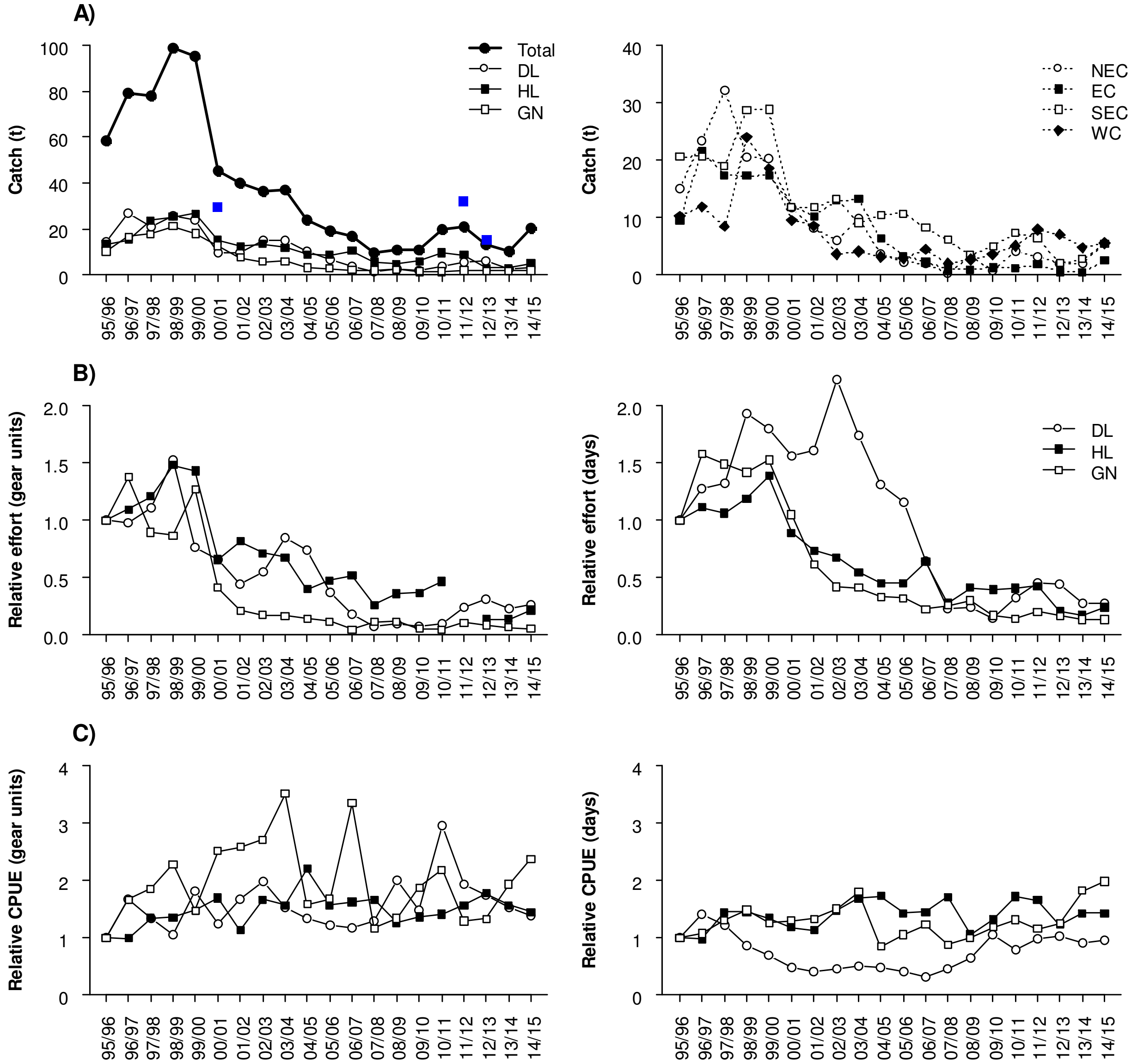


Figure 22.3 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. HL= hand-line, GN= graball net, DL = drop-line, SEC= southeast coast, EC= east coast, NEC= northeast coast, WC = west coast. Data includes Commonwealth catch in State waters.

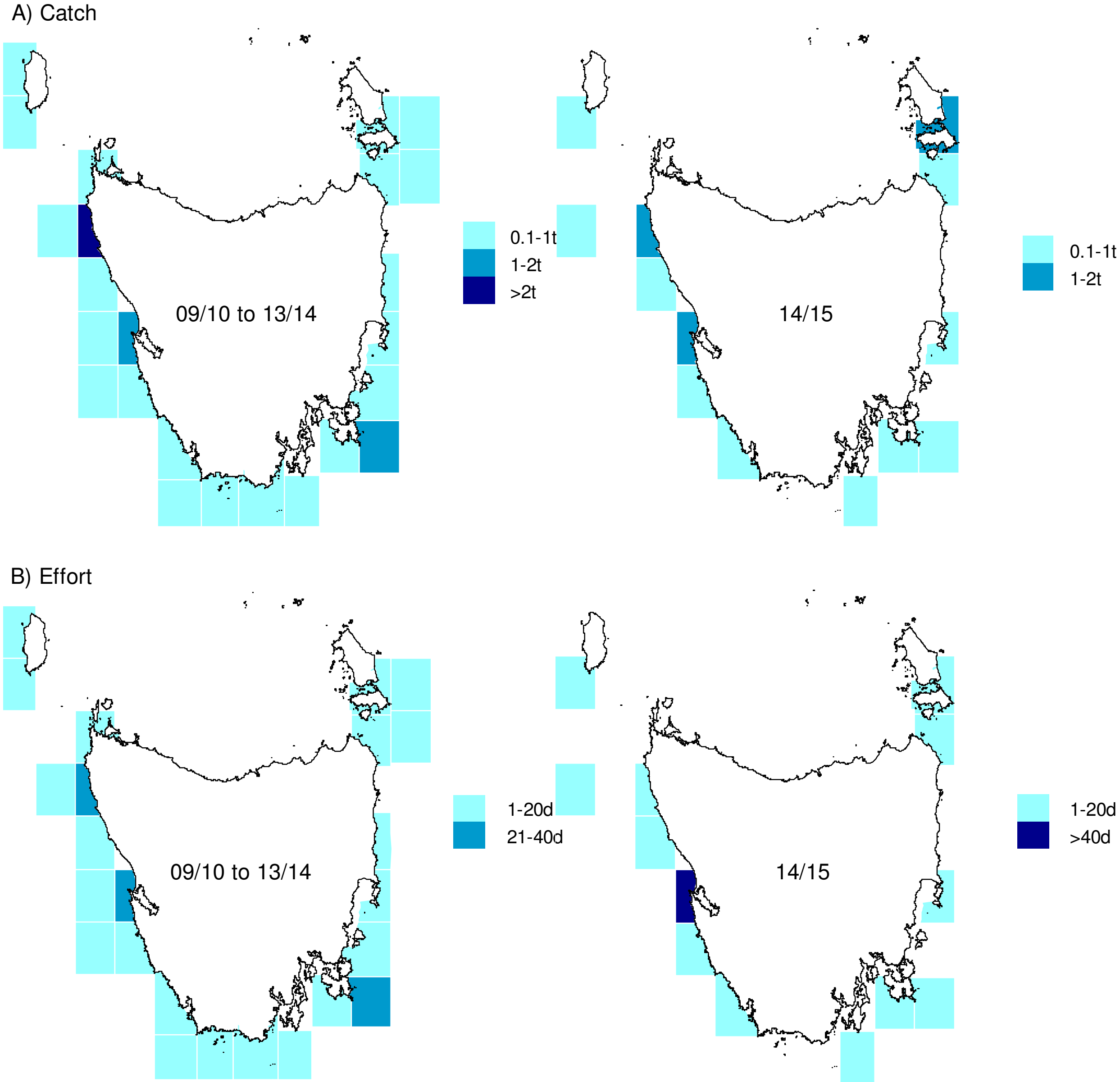


Figure 22.4 (A) Striped Trumpeter catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right). Data includes Commonwealth catch in State waters.

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (80.4 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (52.7 t)	Yes	32.2 t (61.1%)
	• Catch increases by > 30% from previous year (>13.4 t)	Yes	7.1 t (53%)
	• Catch decreases by > 30% from previous year (<7.2 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>1695.1 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0171 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (79.4 t)	No	
	• Catch < 3rd lowest catch value from the reference period (23.9 t)	Yes	3.4 t (14.2%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (21.1 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (49.5 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (19.6 t)	Yes	2.3 t (7.8%)
	• Proportion of recreational catch to total catch > previous proportion estimate (61.1% in 2011/12%)	No	
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.0210 t/days fished)	No	
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0034)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	No	
	• Significant numbers of unhealthy fish landed	No	

Stock status **UNDEFINED**

The sharp decline in commercial catches since 2000/01 gave rise to concerns about the 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. Age composition data collected between 2010 and 2012 provided some encouraging signs regarding new recruits entering the fishery (4 -6 year olds). The strength of these cohorts is difficult to assess due to the paucity of samples in recent years, however there seemed to be older individuals present among samples obtained in 2016.

Research undertaken during 2010 confirmed that the current minimum size limit was below the size at maturity (>60 cm TL cf minimum size limit of 55 cm TL) and that with the increasing proportion of small fish in the catch, due to the recent recruitment events, there was potential for growth overfishing if fishing pressure were to increase dramatically. Aligning the size limit with size at maturity, thereby allowing fish to spawn before they become vulnerable to capture, would almost certainly increase spawning biomass and enhance recruitment potential.

Growing interest from the recreational sector suggests that recreational catches represent an increasingly significant proportion of total fishing mortality. While the implementation of an on-water catch limit of four fish for recreational fishers may help to constrain recreational harvest, the presence of small legal sized fish may provide an incentive for high grading as fishers seek to maximise the weight of their catch under the reduced bag limit.

Commonwealth catches have averaged about 3 t per year since 2000, though there have been concerns that the catch has been significantly underreported. Perhaps reflecting this, the reported catch taken by Commonwealth operators in 2014/15 was almost five times greater than for the previous year (10.9 t), despite the recent implementation of a reduced trip limit (150 kg) for that sector. As such it is likely that this may be a more accurate reflection of the Commonwealth landings which in the most recent year were of the same magnitude as those reported by Tasmanian commercial fishers.

A spawning season closure during September and October (not recognised by the Commonwealth managed sector), when fish are particularly vulnerable to capture, was introduced in 2009. Fishing trials have confirmed that while there may be some variability in the timing of spawning around the state, the closure encompasses the bulk of the spawning season in all areas.

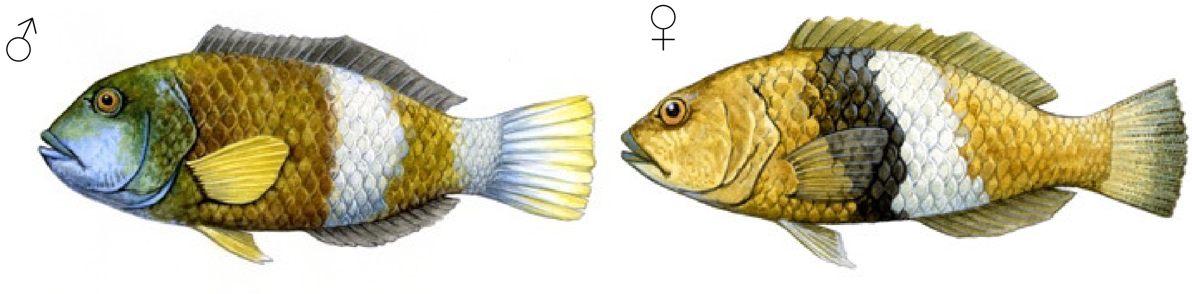
The influx of 4–6 year olds between 2010 and 2012 provided positive signs of population recovery after a prolonged period of low recruitment, which led to the previous stock status of transitional-recovering. The relative strength of these year classes however is not known due to the lack of length and age frequency data in recent years. Furthermore, fishery indicators (catch and catch rate trends) and the lack of recent recreational catch data provide limited insight into current stock status. As a consequence, the justification for the previous stock status is no longer considered appropriate as there is not enough biological information to confidently classify the stock.

23. Wrasse

Bluethroat Wrasse *Notolabrus tetricus*

Purple Wrasse *Notolabrus fuciola*

STOCK STATUS	SUSTAINABLE
Catches, effort and catch rates have remained relatively stable for almost a decade providing no indicators that recent fishing mortality is too high. There is, however, some uncertainty over the size of the catch taken by rock lobster fishers and used for bait.	
IMPORTANCE	Key
STOCK(S)	Tasmanian Scalefish Fishery
INDICATOR(S)	Catch, effort and CPUE trends



Notolabrus tetricus
Source: DPIPWE (by Peter Gouldthorpe)

Species biology

Parameters	Estimates	Source
Habitat	• Bluethroat Wrasse: Sheltered and exposed reefs, from 1 to 160m depth. • Purple Wrasse*:* Predominantly on exposed reefs up to 90m depth.	Edgar (2008)
Distribution	• Bluethroat Wrasse: from Sydney (New South Wales) to Ceduna (South Australia). • Purple Wrasse*:* New Zealand and Australian waters, from southern New South Wales to Kangaroo Island (South Australia).	Edgar (2008)
Diet	• Both species consume a range of molluscs and crustaceans.	Shepherd & Clarkson (2001) Denny & Schiel (2001)
Movement and stock structure	• Bluethroat Wrasse: site-attached. Females have overlapping home ranges and males are territorial, at least during the reproductive season. No emigration of individuals between reefs has been noted for this species. • Purple Wrasse: site-attached, with no evidence of territorial behaviour. Movements between reefs is limited and likely to be restricted to a small proportion of the population. • No information on the stock structure for any species	Barrett (1995b)
Natural mortality	• Low adult mortality for both species. Estimated at M =0.2 for Bluethroat Wrasse.	Smith et al. (2003) Barrett (1995a)

Maximum age	• Bluethroat Wrasse: 11 years • Purple Wrasse: up to 24 years	Barrett (1995a) Welsford (2003)
Growth	• Bluethroat Wrasse: From 6 months onwards, growth (males and females confounded) follows a Von Bertallanffy growth function with $L_\infty = 36.12, k = 0.2$ and $t_0 = -0.35$. Length-weight relationship was set at $W = 0.0545L^{2.7157}$ (both sexes) where *W* is weight (g) and *L* is the fork length (cm). • Purple Wrasse: From 2 years onwards, growth (males and females confounded) follows a Von Bertallanffy growth function with $L_\infty = 44.7, k = 0.085$ and $t_0 = -3.23$. Length-weight relationship (both sexes) was set at $W = 0.0161L^{3.0407}$ where *W* is weight (g) and *L* is the fork length (cm).	Welsford (2003) Barrett (1995a) Unpublished data
Maturity	• Bluethroat Wrasse: protogynous hermaphrodite (i.e. developing into female first before changing to male) with sex change happening between 27 and 32 cm in Tasmania. However, not all individuals undergo a sex inversion. Size at 50% maturity reached at 29.89 cm for females (corresponding to around 8 years old). Batch fecundity unknown. • Purple Wrasse: gonochoristic species (i.e. sex is fixed at maturity). Size at 50% maturity reached at 18.41 cm for females (corresponding to around 3 years old). Batch fecundity is estimated at 74500 ± 34900 eggs/kg.	Barrett (1995a) Hardwood & Lokman (2006) Unpublished data
Spawning	• The spawning season for both species extends from August to January.	Barrett (1995a)
Early life history	• Bluethroat Wrasse: planktonic larval duration ranges from 44 to 66 days. • Purple Wrasse: planktonic larval duration ranges from 40 to 87 days. • Settlement on the reefs at around 10.4mm for both species.	Welsford (2003)
Gillnet post release survival	• Moderate – High: 83 – 59% depending on gillnet soak duration	Lyle et al (2014a)

Background

Of the several species of Wrasse occurring in Tasmanian waters, Purple Wrasse (*Notolabrus fucicola*) and Bluethroat Wrasse (*N. tetricus*) are the main species taken commercially. Wrasse are targeted for live fish markets as well as being sold as dead product and utilised as bait for rock lobster (bait usage is likely to be under-reported). Fish marketed live are distinguished in the logbooks, and 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 distinguished in catch returns since 2007. While there is an apparent market preference for Bluethroat Wrasse, Purple Wrasse are more robust for live handling.

FISHING METHODS	Fish trap and hand-line
MANAGEMENT METHODS	**Input control**: • Gear licence (Scalefish fishing licence) • Species licence (Wrasse licence)

	• Rock lobster licence (for bait only) **Output control*:*** • Legal size: 30 cm. • Possession limit of 10 and bag limit of 5 individuals for recreational fishers
MAIN MARKET	• Interstate (live trade) and local (bait and food).

Current assessment

Catch, effort and CPUE

Wrasse are targeted all around Tasmania, the west coast being the least fished area (Fig. 22.2). Wrasse catches fluctuated between 75–110 t between 1995/96 and 2007/08, peaking at 113 t in 2006/07 (Fig. 22.1A). Reported catches fell in 2008/09 to just 68.2 t and remained at that level up until 2014/15 when 81.4 t was landed (64 t of Bluethroat Wrasse, 17.3 t of Purple Wrasse, 0.05 t undefined Wrasse). The decline in catches prior to the most recent year was largely due to a decline in the use of fish traps as a result of the prohibition on the use of abalone gut as bait. This prohibition was a response to the appearance of the abalone viral ganglioneuritis in Victoria and forced fishers to seek alternative but less effective baits. Catches, effort and catch rates subsequently declined for fish traps, particularly in the southeast (Fig. 22.1) where fish traps had been the dominant fishing method. By contrast, hand-line catch and effort has remained relatively stable since that time.

It is important to note that Wrasse caught and used as bait in rock lobster pots are not included in the catches outlined above as historically they have been underreported. In 2014, the total recorded catch from the rock lobster fishery was just 351 kg.

With Bluethroat Wrasse being more susceptible to line methods and Purple Wrasse more vulnerable to trap capture, Bluethroat Wrasse are now taken in larger quantities in the live fishery. Gillnets account for the bulk of the remaining catch (< 4 t) but because survival in nets is poor, graball caught Wrasse are rarely marketed live.

Recreational catches were estimated at 13.6 t in 2000/01 (Lyle 2005) and 10.3 t in 2007/08 (Lyle et al. 2009) and 6.4 t in 2012/13 (Lyle et al. 2014b), representing around 10% of the total Tasmanian catch. Further, Bluethroat wrasse are a reasonably common by-catch of recreational gillnet fishers and a recent study showed that they have a moderate to low post-release survival, particularly when gillnets are deployed for > 4 hours (Lyle et al. 2014a).

Catch rate trends imply that Wrasse stocks have not been impacted significantly by the fishery until recent years. Following a gradual increase in catch rates up until the late 2000s, handline catch rates have generally stabilised at an intermediate level since 2008/09. Catch rates for fish traps peaked in 2004/05, but declined since, largely influenced by changes in permissible bait types (Fig. 22.1C).

The broad-scale analyses are, however, generally insensitive to changes in abundance at the level of individual reefs at which the fishery impacts the stocks. Marked regional shifts of effort have occurred in the fishery over the years and may have masked localised depletion, with fishers moving to new or lightly fished areas to maintain catches and catch rates.

Ecological Risk Assessment

In the 2012/13 ERA of the Tasmanian scalefish fishery, fish trapping was considered a low risk to Wrasse species, because fishing effort at the time had reduced due to the banning of the preferred bait for trap fishing (abalone guts). Risks to by-product species such as Leatherjackets were very low due to small levels of catch and the risk to non-retained species and the general ecosystem were assessed as either low or negligible (Bell et al. 2016).

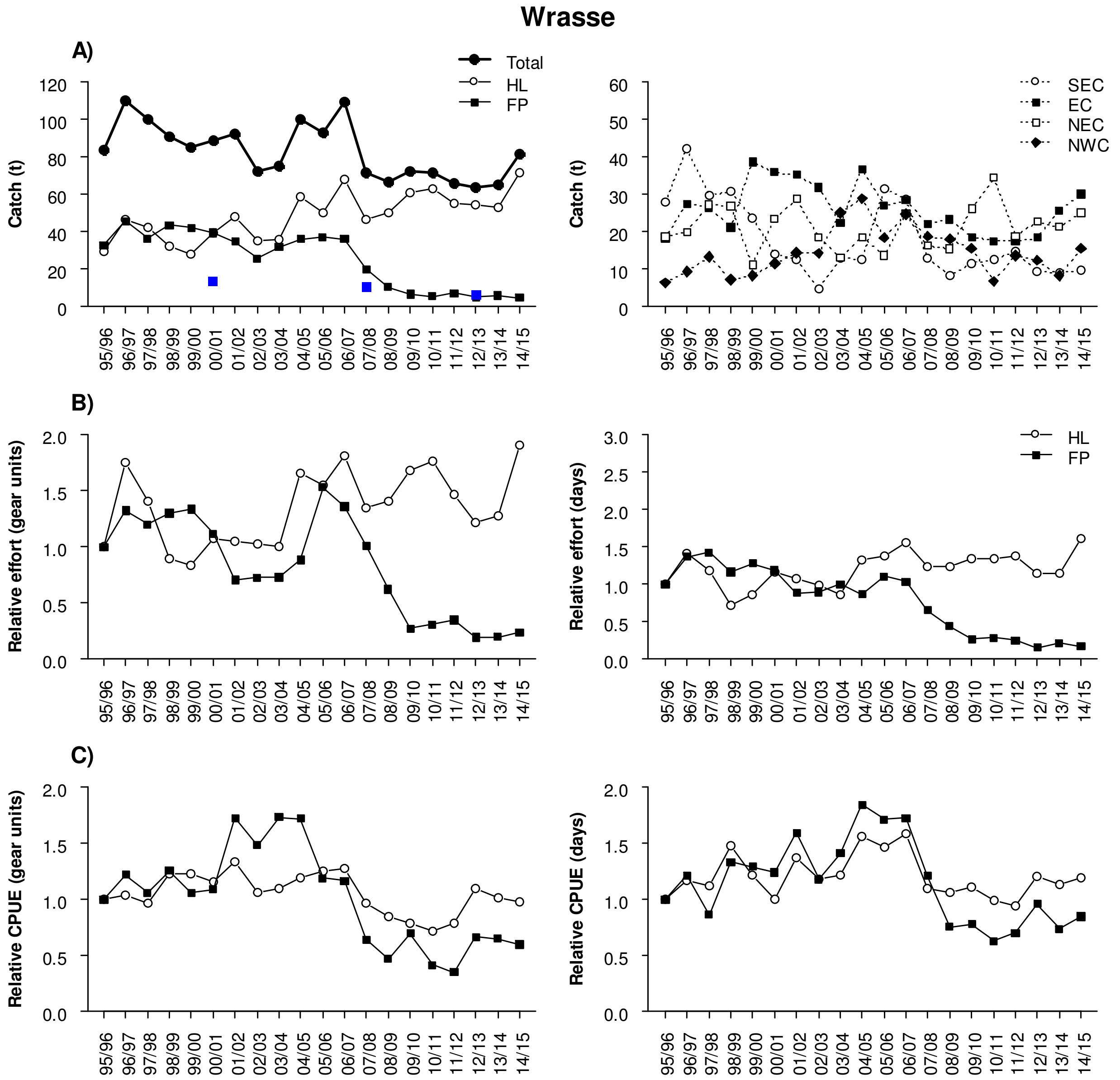


Figure 23.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on gear units (left) and day fished (right) relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 1995/96. HL= hand-line, FP= fish trap, SEC= south east coast, EC= east coast, NEC= northeast coast, NWC = northwest coast.

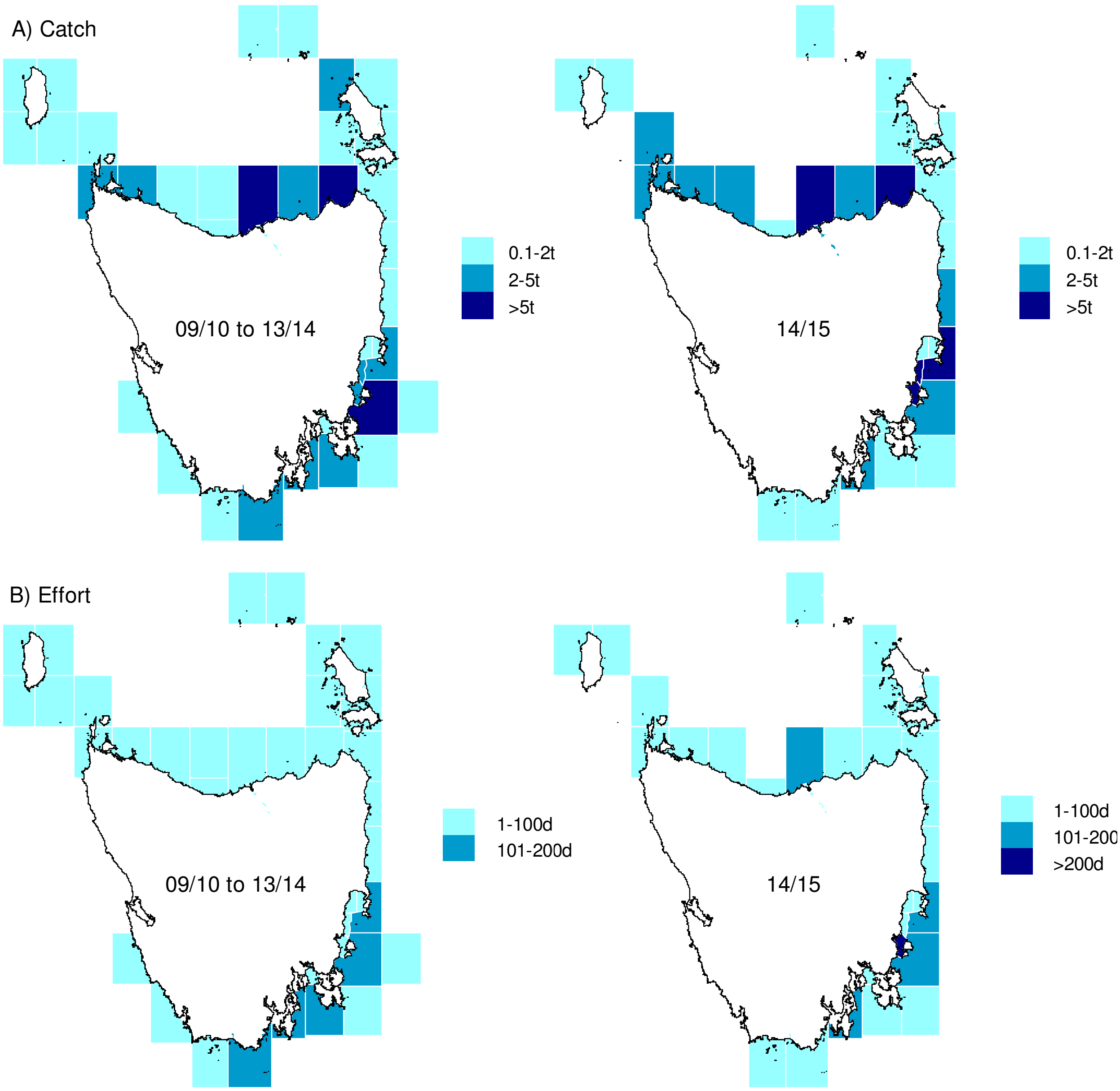


Figure 23.2 (A) Wrasse catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2013/14 (left) and during 2014/15 (right).

Reference points

Performance indicators	Current reference points	Breached?	By how much?
Catch	• Catch > higher catch from the 1990/91 to 1997/98 range (178 t)	No	
	• Catch < lowest catch from the 1990/91 to 1997/98 range (57.2 t)	No	
	• Catch increases by > 30% from previous year (>84.3 t)	No	
	• Catch decreases by > 30% from previous year (<45.4 t)	No	
Effort trend	• Effort >10% of highest level from 1995/96 to 1997/98 (>4464 days fished)	No	
Catch rates trends	• Catch rate < 80% of lowest levels from 1995/96 to 1997/98 (<0.0093 t/days fished)	No	

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (100.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (83.4 t)	Yes	2 t (2.4%)
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (26.7 t)	No	
	• Catch variation from the previous year above the greatest inter-annual decrease from the reference period (37.9 t)	No	
	• Latest recreational catch estimate > recreational catch estimate from the reference period (13.6 t)	No	
	• Proportion of recreational catch to total catch > previous proportion estimate (13.1% in 2007/08)	No	
Biomass	• CPUE< 3rd lowest CPUE value from the reference period (0.0135 t/days fished)	No	
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0014)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status **SUSTAINABLE**

The minimum size limit provides good protection (several years after reaching the size at maturity) for the spawning stock of Purple Wrasse and for female Bluethroat Wrasse. The limit does not, however, provide the same level of protection for male Bluethroat Wrasse which are derived through sex change from mature females, typically at sizes after they have entered the fishery. This, along with the fact that male wrasse are strongly site attached and have higher catchability (being more aggressive than females), suggests that they are vulnerable to fishing. An underwater visual census in 2008, however, showed that wrasse were more abundant in accessible sites (such as areas near boat ramps) compared to other fish and crustaceans, which may indicate a greater resilience to the impact of fishing mortality (Stuart-Smith et al. 2008). Regardless, in extreme situations it is possible that localised heavy fishing pressure could result in ‘sperm shortage’ that could 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 for Wrasse in 2004 may have exacerbated this potential problem. However, there are no clear indications of spawning stock shortages in Tasmania.

As highlighted in previous assessments the banning of the preferred bait for trap fishing in 2008 has dramatically changed fisher’s behaviour and fish traps are now rarely used. This has resulted in Bluethroat Wrasse contributing a greater proportion of the catch than beforehand. Industry reported that there is no acceptable substitute for abalone guts (i.e. no other bait yields the same return) and that trap fishing has become less viable. This is supported by catch rate data in Figure 23.1.

Wrasse were the highest landed species (81 t) in the Tasmanian Scalefish fishery in 2014/15. The majority of the catch in 2014/15 (68 t) was targeted at the live market, which saw a large increase (16 t) in catch from the previous season. Previous assessments have highlighted that increasing catches up to 2006/07 reflected a strong interest in the species, and there were concerns that these levels of fishing mortality were not sustainable, as justified by the decline in catch rates (see Figure 23.1). In 2014/15, hand-line effort was at a similar level to 2006/07 and will need to be closely monitored as there is the potential for localised depletions of legal-sized Wrasse, especially if effort becomes concentrated in particular regions. While there has been this recent increase in fishing effort, catch rates have remained relatively stable for almost a decade providing no evidence that the level of fishing mortality has been too high. Based on this stability, the stock is classified as sustainable.

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Appendix 1- Common and scientific names of species from 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, Gould's	*Nototodarus gouldi*

Appendix 2- Data restriction 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[2].

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.

Commonwealth logbook data:

[2] 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 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.

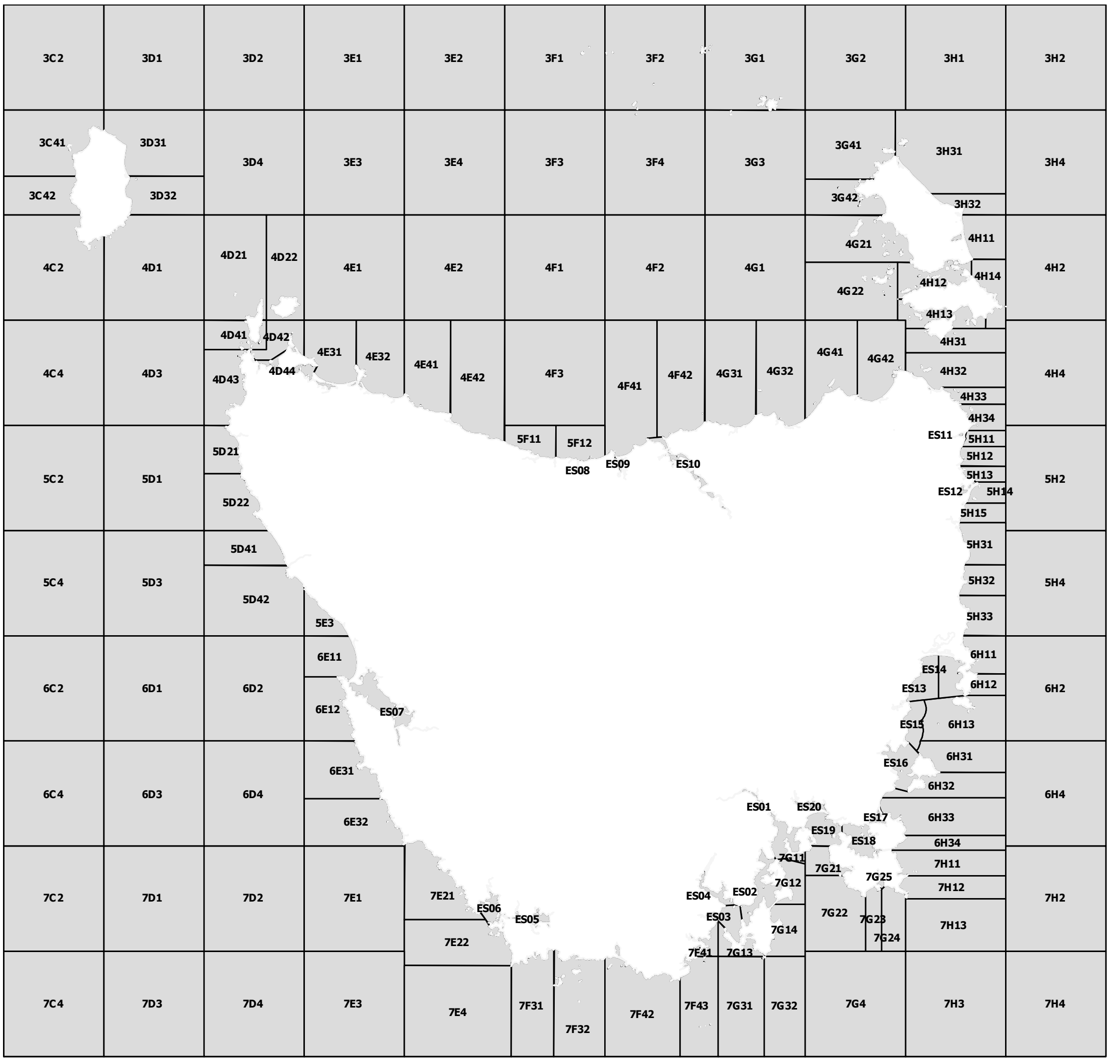

Fig. A1 Numbers for fishing blocks used in calculation of catch figures.

(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.

Appendix 3- Annual Tasmanian scalefish production

Table A.1. Annual 'Tasmanian scalefish and cephalopod production (whole weight in tonnes) by financial year since 1990/91 based on General Fishing Returns and Commonwealth (GN01, GN01A and SSJF) logbook returns. Note that the data includes Commonwealth catches of Striped Trumpeter, Bastard Trumpeter and Gould's Squid in State waters. Data of the most recent years may be incomplete due to late reporting.

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	08/09	09/10	10/11	11/12	12/13	13/14	14/15
Scalefish (excl. small pelagics)																									
Australian Salmon	815.9	651.9	867.0	878.8	682.1	413.2	287.3	475.7	384.7	363.7	485.0	462.1	407.2	167.2	336.5	254.2	114.9	171.5	338.8	372.3	203.5	189.4	331.3	37.7	23.2
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	25.0	10.7	11.7	7.6	5.0	4.0	1.1	1.1	1.7
Boarfish	7.2	9.4	7.6	10.1	9.1	7.3	10.0	6.2	3.2	2.5	3.6	5.5	3.6	4.3	3.6	5.0	4.9	4.6	2.4	2.7	1.9	3.4	2.1	1.0	0.6
Cod	10.0	11.3	11.6	14.5	12.7	18.6	12.8	9.4	9.6	8.7	3.7	3.0	2.2	2.1	1.6	2.0	2.6	2.0	3.3	2.6	2.8	2.3	2.0	2.0	2.0
Flathead	165.3	118.1	98.8	121.4	91.1	57.9	51.8	62.7	50.5	60.2	63.1	52.1	40.8	31.2	74.7	91.9	59.3	73.1	52.6	77.3	55.7	62.1	40.2	31.1	36.3
Flounder	44.0	36.8	31.8	27.3	27.1	33.4	29.4	29.7	25.2	18.6	12.3	13.0	10.9	14.9	14.7	10.9	12.5	6.3	4.9	5.2	5.2	4.0	2.0	2.1	1.5
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	45.8	23.6	60.7	49.3	43.2	53.0	51.5	34.3	33.8
Gurnard	20.5	19.0	19.3	19.3	14.0	13.5	10.4	9.1	7.0	9.5	7.4	5.3	9.7	6.8	6.1	5.1	5.6	4.4	2.6	1.5	2.1	1.1	1.1	0.6	1.9
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	8.7	4.7	5.2	3.0	2.8	2.2	2.4	2.9	2.0
Ling	5.1	13.6	30.0	41.6	33.2	15.0	13.3	8.3	4.3	1.8	1.2	0.9	0.4	0.8	0.7	0.4	0.4	0.4	0.1	0.1	0.1	0.1	0.1	1.2	0.0
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	2.0	2.2	1.0	0.5	0.2	0.2	0.3	0.2	0.2
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	52.6	36.9	44.6	40.9	40.3	37.9	34.2	30.5
Morwong, jackass	136.9	111.9	83.2	117.6	63.1	27.1	18.7	33.2	17.5	15.7	13.1	14.8	14.4	16.3	17.5	13.1	11.6	4.3	5.2	5.9	3.2	2.8	1.5	1.0	0.8
Morwong, other	3.8	5.6	5.2	13.9	8.1	5.4	7.4	7.4	6.3	1.4	0.6	1.4	1.9	1.2	1.8	1.3	1.3	2.2	1.4	1.2	0.9	0.7	0.7	0.6	0.7
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	1.5	1.9	2.2	1.7	9.2	2.9	4.4
Other	140.2	110.4	97.4	102.0	62.0	26.3	24.2	24.6	17.1	13.6	10.4	10.6	30.1	21.3	25.0	26.8	13.8	8.7	31.6	4.7	2.5	3.5	2.3	2.1	2.3
Snook	10.5	9.5	11.1	12.7	18.8	13.7	15.2	17.7	3.2	4.1	5.9	6.6	6.6	3.7	2.2	2.9	6.6	7.0	8.7	7.9	7.4	6.7	6.3	9.1	9
Trevally	20.6	13.6	12.0	8.3	21.6	8.4	6.0	5.4	6.5	2.7	1.6	4.7	5.9	3.4	3.7	6.3	3.5	8.6	4.5	3.8	1.9	2.1	5.4	4.1	5.6
Trumpeter, bastard	63.3	37.2	34.0	54.8	50.8	60.1	51.8	40.4	47.5	36.2	25.7	23.9	21.0	23.2	18.5	23.4	19.9	18.1	16.0	10.5	9.8	9.4	9.4	8.2	6.8
Trumpeter, striped	74.5	58.2	52.7	56.5	72.4	58.3	79.4	78.1	99.0	95.0	45.5	39.9	36.5	36.9	23.9	19.0	16.9	9.9	10.6	10.8	19.7	20.9	13.0	10.3	20.5
Trumpeter, unspec.	0.7	0.0	0.0	0.4	0.1	0.0	0.1	0.6	3.3	0.0				0.0				0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.3
Warehou, blue	257.6	317.6	187.7	250.1	205.4	82.3	128.4	187.6	272.2	186.1	34.2	66.4	49.3	27.5	19.1	20.0	28.4	24.6	26.6	37.5	10.7	3.8	8.5	5.2	2.8
Warehou, other	0.7	0.4	4.2	8.8	3.4	14.6	15.6	4.2	1.0		0.0	0.1	0.2	0.1	0.8	0.1	0.0	0.1	0.6	0.2	0.0	0.0	0.2	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	35.0	27.0	34.6	16.1	16.5	37.2	2.9
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	100.1	92.9	109.3	71.4	66.3	72.0	71.7	66.0	63.7	62.4	81.4
Total scalefish (excl. small pelagics)	**2441**	**2140**	**2101**	**2310**	**1888**	**1155**	**1165**	**1402**	**1281**	**1129**	**1014**	**1149**	**990.7**	**712.2**	**933.8**	**823.8**	**588**	**553.1**	**728.2**	**750.2**	**528.1**	**495.8**	**608.8**	**291.6**	**271.3**

Table A.1 Continued. Whole weight in tonnes by financial 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	08/09	09/10	10/11	11/12	12/13	13/14	14/15
Small pelagic species																									
Mackerel, jack	6.1	11.1	32.8	48.4	39.7	26.2	19.3	19.7	59.8	13.3	8.6	19.4	19.4	41.1	12.8	6.8	2.6	8.0	788.7	917.0	35.7	56.4	0.2	0.4	5.5
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		0.5	0.5	0.2	5.3	0.2	0.3	0.8	0.1	1.9	4.2	1.1
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		0.3	0.8			10.2	13.2	0.4				0.1	0.0
Redbait	0.0	0.7	0.0	0.8	0.1	0.1			4.0					3.4	1.0	1.4	0.3	156.4	441.4	121.6	15.0	0.1	0.1		
Total small pelagic species	**9.2**	**13.9**	**36.9**	**72.3**	**57.6**	**34.9**	**24.8**	**36.1**	**67.0**	**17.1**	**11.9**	**20.1**	**19.5**	**44.8**	**15.2**	**8.7**	**3.1**	**179.9**	**1243**	**1039.3**	**51.6**	**56.7**	**2.1**	**4.6**	**6.6**
Cephalopod																									
Calamari, southern	8.2	7.5	5.8	9.7	12.6	33.0	19.0	26.6	94.4	84.6	76.6	104.8	108.8	86.8	114.2	44.5	80.2	80.0	77.7	51.1	54.9	50.8	63.9	67.5	75.9
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	0.3	0.1	0.1	0.1	0.2	0.1	0.1
Octopus pallidus[3]	21.2	21.6	31.3	29.8	30.5	58.7	30.2	34.1	61.2	43.2	50.5	31.6	54.5	56.6	70.4	89.9	90.2	92.6	64.5	65.1	92.3	57.9	124.8	100.0	73.1
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	5.8	1.4	16.8	121.3	131.2	516.6	1071.8	0.0	18.7
Total cephalopod	**65.0**	**37.0**	**44.1**	**48.3**	**52.5**	**97.7**	**57.3**	**73.8**	**235.3**	**608.4**	**166.8**	**139.4**	**167.7**	**146.5**	**187.4**	**136.6**	**176.3**	**174.2**	**159.3**	**237.5**	**278.5**	**625.3**	**1260.6**	**167.6**	**167.8**
Sharks[4]																									
Elephant shark						58.0	48.9	21.4	14.7	17.0	16.7	18.4	16.5	10.2	7.6	5.7	9.0	1.8	1.5	2.4	1.3	2.6	1.9	1.4	0.6
Gummy shark						750.5	543.8	348.6	113.4	109.6	53.9	23.5	14.2	24.7	41.6	12.4	12.6	12.6	9.4	9.8	9.3	7.5	7.9	5.9	7.6
Draughtboard shark						0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.7	1.0	0.8	1.3	1.2	0.4	0.3	0.2	0.3	0.0	0.1	0.0	0.0
Sawshark						127.4	74.4	29.2	6.8	3.4	12.3	21.4	20.4	20.6	23.5	5.9	3.4	0.3	0.1	0.1	0.1	0.4	0.0	0.0	0.0
School shark						252.1	171.5	71.7	31.5	11.3	1.7	2.2	1.4	7.0	2.6	0.6	1.8	0.9	0.7	1.8	1.4	1.9	2.1	1.0	1.4
Seven-gilled shark						6.1	4.9	6.1	1.9	10.3	16.3	18.8	7.4	11.5	8.4	3.8	3.7	0.5	2.3	1.1	1.4	1.1	0.8	0.7	1.0
Other shark						26.4	16.1	11.3	6.8	6.5	4.8	5.8	3.6	3.2	1.1	0.6	2.2	0.9	0.7	0.3	0.8	0.5	0.5	0.7	0.9
Total sharks						**1220**	**859.6**	**488.2**	**175.1**	**158.2**	**105.7**	**91.9**	**64.3**	**78.3**	**85.6**	**30.4**	**34.0**	**17.4**	**15.1**	**15.7**	**14.7**	**14.1**	**13.3**	**9.8**	**11.5**

[3] Octopus catches in NWC and NEC were assumed to be *Octopus pallidus* (excluding bycatch in rock lobster traps). Catches can also include *Octopus tetricus*.

[4] 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.

Appendix 4- Annual catch, effort and number of vessels by fishing methods

Table A.2 Total annual catch, effort and number of vessels by fishing methods.

Effort units are defined in Table 1.1.

* Catch data not shown where five or fewer vessels involved.

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
Graball net	95/96	347.0	223553	5437	257
	96/97	382.3	231140	5185	232
	97/98	446.3	231412	5249	216
	98/99	493.3	166505	4689	204
	99/00	359.3	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	154.4	53965	2491	137
	05/06	170.2	51591	2402	123
	06/07	161.2	54070	2432	130
	07/08	151.7	56844	2279	112
	08/09	123.5	45874	1934	95
	09/10	128.7	47049	2022	94
	10/11	96.8	45324	1770	80
	11/12	100.0	40150	1592	73
	12/13	103.4	40564	1548	62
	13/14	99.3	37834	1456	65
	14/15	82.9	31986	1269	57
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	15.3	5982	220	13
	05/06	21.7	5890	191	11
	06/07	16.2	7001	198	11
	07/08	15.2	6397	180	9
	08/09	9.5	4817	152	7
	09/10	9.4	4089	134	7
	10/11	7.1	2281	98	7
	11/12	10.8	4127	152	8
	12/13	12.4	4784	189	10
	13/14	10.1	3342	150	11
	14/15	8.9	3756	140	8
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	2157	376	18
	06/07	19.5	1130	216	18
	07/08	10.6	781	190	14
	08/09	16.0	1212	284	14
	09/10	18.0	1376	270	14
	10/11	16.0	958	227	10
	11/12	22.6	1192	222	9
	12/13	23.3	1209	173	7
	13/14	16.9	1115	147	9
	14/15	12.9	752	118	13

Table A.2 (continued)

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
Beach seine	95/96	469.2	1086	559	53
	96/97	351.7	1354	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	139.2	505	217	25
	07/08	177.6	548	191	14
	08/09	380.5	584	271	12
	09/10	410.3	473	251	15
	10/11	225.2	359	200	12
	11/12	203.7	380	184	11
	12/13	334.3	314	162	11
	13/14	45.0	285	172	15
	14/15	45.5	323	199	14
Danish seine	95/96	*	474	163	2
	96/97	*	360	116	1
	97/98	*	456	133	1
	98/99	*	375	94	1
	99/00	*	515	139	2
	00/01	*	589	152	2
	01/02	*	491	145	2
	02/03	*	354	129	3
	03/04	*	278	127	2
	04/05	*	282	108	2
	05/06	*	418	132	3
	06/07	*	475	157	3
	07/08	*	476	160	3
	08/09	*	381	133	3
	09/10	*	557	181	4
	10/11	*	385	155	5
	11/12	*	260	94	3
	12/13	*	327	112	5
	13/14	*	369	116	3
	14/15	*	211	56	3
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	*	55	75	5
	08/09	*	164	130	3
	09/10	*	170	99	4
	10/11	*	32	32	3
	11/12	*	63	60	3
	12/13	*	106	101	3
	13/14	*	27	27	3
	14/15	13.0	41	35	6

Table A.2 (continued)

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
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	100.5	19953	1803	123
	05/06	82.6	20241	1883	116
	06/07	101.2	20956	2041	125
	07/08	76.7	16871	1674	103
	08/09	79.8	17611	1723	92
	09/10	84.0	17259	1601	90
	10/11	90.4	18081	1664	93
	11/12	81.7	15991	1682	86
	12/13	77.0	12571	1407	81
	13/14	77.5	13244	1365	85
	14/15	105.4	18676	1766	92
Drop-line	95/96	20.0	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	6.0	96	122	28
	07/08	2.2	37	45	15
	08/09	3.1	45	40	18
	09/10	2.4	35	25	7
	10/11	5.9	100	58	16
	11/12	9.2	365	85	14
	12/13	8.6	159	86	12
	13/14	4.3	112	46	9
	14/15	3.6	110	44	8
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	46.8	7409	1222	54
	05/06	44.6	12302	1421	54
	06/07	43.7	10944	1310	47
	07/08	23.1	8272	790	42
	08/09	13.3	5222	550	29
	09/10	9.5	2257	341	23
	10/11	9.0	2712	410	22
	11/12	8.6	2934	338	19
	12/13	6.9	1585	188	15
	13/14	8.7	1649	269	21
	14/15	6.9	2038	212	25

Table A.2 (continued)

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
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	13172	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	11215	765	58
	06/07	69.4	13352	1113	61
	07/08	69.6	15390	1278	44
	08/09	70.1	14997	1071	35
	09/10	47.6	14865	920	37
	10/11	49.3	12932	866	27
	11/12	42.2	11378	753	23
	12/13	66.2	11503	829	26
	13/14	52.2	11154	797	29
	14/15	60.3	14660	900	34
Spear	95/96	14.06	1402.65	368	21
	96/97	19.33	1853.32	464	27
	97/98	16.83	1981.17	483	40
	98/99	19.80	1811.58	452	38
	99/00	19.29	2233.02	475	25
	00/01	14.43	1585.51	355	22
	01/02	13.13	1295.75	279	19
	02/03	10.35	1365.83	247	22
	03/04	10.49	1445.99	289	22
	04/05	13.53	1608.58	357	24
	05/06	7.87	1008.75	271	22
	06/07	14.89	1340.32	346	20
	07/08	7.85	751.66	196	20
	08/09	5.39	858.17	167	14
	09/10	4.99	663.29	168	14
	10/11	4.00	626.08	178	15
	11/12	5.04	621.68	167	12
	12/13	3.27	488.92	126	12
	13/14	3.70	339.34	109	10
	14/15	2.10	265.99	87	11
Troll	95/96	19.6	3497	352	58
	96/97	62.1	9755	600	90
	97/98	76.2	13318	680	83
	98/99	46.1	9307	464	73
	99/00	39.7	6184	421	51
	00/01	36.5	7913	440	49
	01/02	141.1	18669	1007	94
	02/03	82.8	8510	669	74
	03/04	87.7	8995	789	89
	04/05	87.7	6797	758	77
	05/06	63.4	5019	491	54
	06/07	29.2	4664	339	51
	07/08	10.8	2468	125	25
	08/09	18.4	2995	181	27
	09/10	12.3	2487	137	22
	10/11	10.9	2358	110	19
	11/12	10.4	2103	93	11
	12/13	5.1	1622	72	10
	13/14	5.4	2078	79	13
	14/15	5.9	2894	113	12

Table A.2 (continued)

Gear	Year	Catch(t)	Effort#	Days fished	Vessels
Auto squid jig	95/96	*	3000	2	1
	96/97	*	14560	14	3
	97/98	*	3040	8	1
	98/99	*	133728	66	3
	99/00	386.9	899711	369	13
	00/01	28.1	280200	115	10
	01/02	*	10220	7	3
	02/03	*	9000	5	1
	03/04	*	3000	2	1
	04/05	*	500	1	1
	05/06	*	0	0	0
	06/07	*	0	0	0
	07/08	*	2	1	1
	08/09	*	216	12	3
	09/10	*	3329	68	5
	10/11	*	422	7	5
	11/12	515.9	3060	187	13
	12/13	1054.4	11253	245	8
	13/14	*	90	3	1
	14/15	*	19200	11	2
Hand collection	95/96	7.0	1198	433	6
	96/97	*	298	154	5
	97/98	*	261	214	4
	98/99	*	918	267	5
	99/00	*	947	228	3
	00/01	*	1008	272	3
	01/02	*	1185	317	4
	02/03	*	625	160	3
	03/04	*	678	184	3
	04/05	*	400	125	3
	05/06	*	226	97	4
	06/07	*	439	199	5
	07/08	3.9	266	129	10
	08/09	*	122	52	4
	09/10	*	124	55	4
	10/11	5.3	403	135	9
	11/12	*	177	99	3
	12/13	*	244	117	4
	13/14	4.0	352	134	6
	14/15	*	62	29	5