TASMANIAN SCALEFISH FISHERY ASSESSMENT 2015/16

Timothy Emery, Jeremy Lyle and Klaas Hartmann

March 2017

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 2015/16 season that were entered prior to November 2016.

IMAS Fisheries and Aquaculture
Private Bag 49
Hobart TAS 7001
Australia

Email: Klaas.Hartmann@utas.edu.au
Ph: 03 6226 8279, +61 3 6226 8279 (international)
Fax: 03 6227 8035

Contents

Executive Summary iii

1. Fisheries Assessment 1

- Management objectives and strategies 1
  - Major objectives 1
  - Primary strategies 1
- The fishery 1
- Data sources 2
  - Tasmanian General Fishing Returns 2
  - Commonwealth catch returns 2
  - Data analysis 2
  - Recreational fishery 4
- Assessment categories 5
  - Species’ importance 5
  - Reporting levels definitions 5
  - Stock status definitions 7
  - Performance indicators and reference points definitions 8
- Ecological risk assessment 9

2. General fishing trends 10

- Commercial fishing licences 10
- Commercial catch trends 10
  - General production 10
  - Estuarine production 13
- Recreational fishery 15
  - Catch and effort 15
  - Recreational gillnet fishery 16
- Uncertainties and implications for management 17

3. Commercial fishing gear 19

- General effort trends 19
- Automatic squid-jig 20
- Beach seine 21
- Drop-line 22
- Dip-net 23
- Danish seine 24
- Fish trap 25
- Gillnet 26

Hand-line 27
Small mesh net 28
Purse seine 29
Squid jig 30
Spear 31
Trolling 32
Hand collection 33
4. Eastern Australian Salmon 34
5. Barracouta 40
6. Bastard Trumpeter 45
7. Blue Warehou 52
8. Tiger Flathead 59
9. Southern Sand Flathead 65
10. Flounder 76
11. Gould's Squid 82
12. Jack Mackerel 88
13. Jackass Morwong 94
14. Leatherjacket 100
15. Longsnout Boarfish 105
16. Yelloweye Mullet 110
17. Snook 116
18. Eastern School Whiting 121
19. Southern Calamari 127
20. Southern Garfish 135
21. Striped Trumpeter 142
22. Wrasse 151
References 158
Appendix 1- Common and scientific names of species from catch returns 166
Appendix 2- Data restriction and adjustments 167
Appendix 3- Annual Tasmanian scalefish production 169
Appendix 4- Annual catch, effort and number of vessels by fishing methods 171

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 Fishery Management Plan (amended in 2015), provides the management framework for the fishery.

Fishery assessment

Since the early 1990s, annual commercial catches of the major species have generally declined. Total scalefish production (excluding small pelagics and cephalopods) declined from over 1,000 t in the mid-1990s to around 300 t in recent years, due in part to changed targeting practices, the transfer of shark fishery to the Commonwealth and introduction of the Scalefish Fishery 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 harvest for species such as Flathead, Striped Trumpeter, Bastard Trumpeter, Blue Warehou, Flounder, Mullet, Barracouta, Jackass Morwong, Cod, Leatherjacket, and Silver Trevally.

Species assessments

For the current report, available fishery and biological information has been assessed against a series of revised reference points that have been applied for several years, and now formally replace out-dated ones proposed in the original (1998) policy document. In assessing the status of each species, the national stock reporting framework (summarised below) has been adopted. It should be noted that Banded Morwong will be considered in a separate assessment report. This change from previous reports reflects differences in the timetable for setting the annual total allowable catch for Banded Morwong (based on quota year) compared with routine assessment reporting for the other scalefish species (based on financial year).

Stock classification framework

Stock status	Description
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
TRANSITIONAL-RECOVERING	Recovering stock—biomass is recruitment overfished, but management measures are in place to promote stock recovery, and recovery is occurring
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
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
UNDEFINED	Not enough information exists to determine stock status

Species assessments

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 2015/16 were 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.	34
Barracouta *Thyrsites atun*	**UNDEFINED**	Catches of Barracouta have been declining steadily since the mid-2000s due decreased targeted effort resulting from a lack of market opportunities. Catch rates are not considered indicative of stock status and there is insufficient information to confidently classify the stock.	40
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.	45
Blue Warehou *Seriolella brama*	**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 from 2012 and the initiation of a rebuilding strategy in 2008, stocks have shown little evidence of recovery.	52
Tiger Flathead *Platycephalus richardsoni*	**SUSTAINABLE**	This is a Commonwealth-managed 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 despite a recent increase in catches to 64 t, Tasmanian landings are equivalent to just 2% of Commonwealth catch.	59
Sand Flathead *Platycephalus bassensis*	**TRANSITIONAL DEPLETING**	Recreational catches of Sand Flathead dominate landings of this species in Tasmania. Fishery independent surveys suggest relatively low abundances of legal sized fish, particularly in south-eastern Tasmania, with populations subject to heavy fishing pressure. While a recent increase in minimum size limit and reduction in bag limit should benefit stocks, fishing pressure in 2015/16 is likely to cause the stock to become recruitment overfished.	65

Flounder Pleuronectidae family	UNDEFINED	Greenback Flounder constitute the majority of the commercial catches, which remain low 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.	76
Gould's Squid *Nototodarus gouldi*	SUSTAINABLE	This is a Commonwealth-managed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/goulds-squid/). The species is characterised by high inter-annual variability in abundance in State waters, with moderately high catches taken in Tasmanian waters during 2015/16. Dual-endorsed squid boats target their operations in Tasmanian waters during years of high abundance, otherwise the focus of the automatic squid jig fleet is in Commonwealth waters.	82
Jack Mackerel *Trachurus declivis*	SUSTAINABLE	This is a Commonwealth-managed 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 the major operator exiting the fishery.	88
Jackass Morwong *Nemadactylus macropterus*	SUSTAINABLE	This is a Commonwealth-managed species that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/) with very low commercial catches in Tasmania.	94
Leatherjacket *Monacanthidae* family	UNDEFINED	Various species of Leatherjackets occur in coastal waters around Tasmania 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.	100
Longsnout Boarfish *Pentaceropsis recurvirostris*	UNDEFINED	Boarfish are a by-product species with low catches due to the large minimum legal size. There is insufficient information available to confidently classify this stock.	105
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.	110
Snook *Sphyraena novaehollandiae*	UNDEFINED	Snook catches have declined to their lowest historical level in 2015/16. Catch rates are an unreliable estimate of abundance due to the species not being actively targeted. A lack of information as to the biological vulnerability of this species	116

		to fishing means there is insufficient information to confidently classify the status of the stock.	
Eastern School Whiting *Sillago flindersi*	SUSTAINABLE	This is predominately a Commonwealth-managed that is classified as sustainable (see: http://www.afma.gov.au/portfolio-item/eastern-school-whiting/). Tasmanian catches tend to fluctuate due to interstate market demand and the targeting practices of the main operator in Tasmania. Tasmanian landings represent a small fraction (< 5%) of the catch taken by Commonwealth operators.	121
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 north east have continued to rise, 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. While there has been a slight decline in catch rates in north west, there are no indications as yet that the fishing mortality is excessive and likely to cause the stock to become recruitment overfished.	127
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. A lack of recent biological data has prevented any further assessment of this recovery. However, reductions in catches and catch rates suggest that fishing mortality may be too high in some areas; this decline being greatest for beach seine, the main fishing method in terms of landings. Beach seine catch rates have fallen to levels similar to 2006/07 and 2007/08, implying 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.	135
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. As there is not enough biological information to confidently classify the stock, the justification for the previous stock status classification of transitional recovering is no longer appropriate.	142
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.	151

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 that are also taken in state waters by state-licensed 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 General 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.

During 2001, dual endorsed fishers were instructed to report all fishing activities under State jurisdiction in the Tasmanian catch and effort logbooks. This should have removed the necessity to include subsequent Commonwealth catch and effort data into analyses, but it has become apparent that there was some confusion amongst fishers about reporting requirements. For example, catches of species such as Striped Trumpeter taken by Commonwealth operators were not routinely reported in the Tasmanian catch returns. 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 2016.

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).

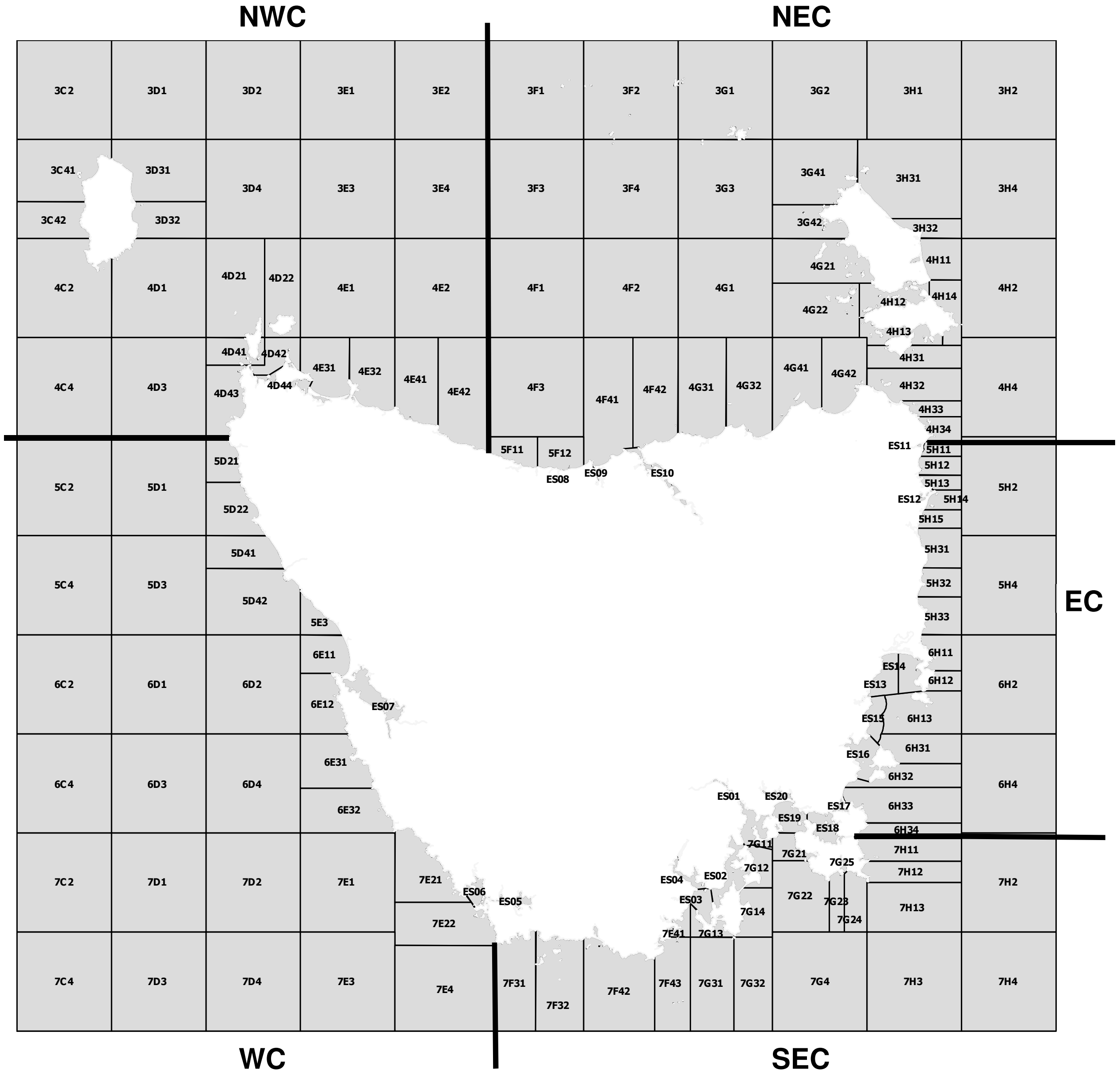


Figure 1.1 Map of Tasmania with the fishing blocks and the assessment regions. SEC is southeast coast, EC is east coast, NEC is northeast coast, NWC is northwest coast, and WC is west coast.

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 2015/16 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.

Assessment categories

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 commercial catch and effort data, which are assessed by calculating fishery performance indicators and comparing them with reference points. For the current assessment, the decision has been taken to only present performance indicators and reference points recommended in recent assessment reports (Emery et al. 2016) as alternatives to those originally proposed in the Scalefish Fishery Management Plan policy document (DPIF 1998).

The 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

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.

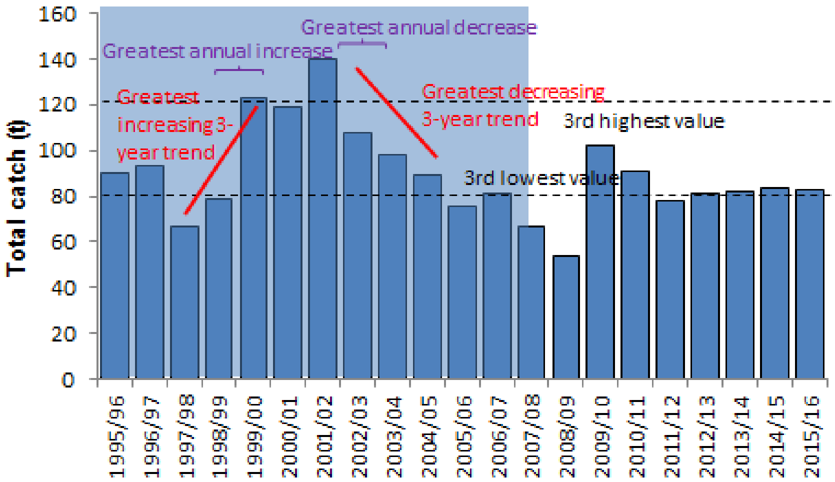


Figure 1.2 Schematic illustration of the application of fishing mortality reference points for medium and minor reporting based on trends in catch. The shaded blue area represents the reference period. Note this figure is for illustrative purposes only.

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

Unlike in previous reports, the Banded Morwong assessment will considered in a separate assessment report. This change from previous reports reflects differences in the timetable for setting the annual total allowable catch for Banded Morwong (based on quota year) compared with routine assessment reporting for the other scalefish species (based on financial year).

Ecological risk assessment

The current assessment incorporates 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

Since 2001 the number of general Scalefish licences has gradually declined from almost 450 to about 280 in 2015, mainly driven by a two-thirds reduction in the number of Scalefish C licences issued (Table 2.1). Up until 2014 between 40-50% of total licence numbers were active each year. In 2015 there was a sharp increase in the number of active licences, in particular amongst scalefish B and C licences, with activity reported by 195 or 69% of scalefish licences, up from 123 or 43% in 2014. This increase was mainly due to a rise in the number of new entrants activating existing licences along with several rock lobster fishers diversifying their operations, particularly among lease holders.

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 Numbers of scalefish licences (FL) (total and active) by type (A, B or C) since 2001 (licence years run from March to February; 2015 is the last complete year covered by this assessment).

Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Licence numbers															
FLA	67	70	70	70	66	66	66	66	65	65	65	65	65	63	63
FLB	165	164	165	165	162	162	160	159	159	158	158	154	154	151	149
FLC	214	205	185	173	152	137	129	120	112	92	86	81	77	72	69
Total	**446**	**439**	**420**	**408**	**380**	**365**	**355**	**345**	**336**	**315**	**309**	**300**	**296**	**286**	**281**
Active licences															
FLA	44	51	48	46	38	43	47	37	33	32	35	28	35	34	42
FLB	104	111	110	109	101	105	105	93	88	84	76	80	67	71	97
FLC	62	63	52	47	34	36	33	23	16	17	17	13	16	18	56
Total	**210**	**225**	**210**	**202**	**173**	**184**	**185**	**153**	**137**	**133**	**128**	**121**	**118**	**123**	**195**

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 cephaolopds) declined from over 1,100 t in the mid-1990s to around 300 t in recent years (Appendix 3, Table A1). The commercial scalefish catch in the current year (343 t) was approximately 50 t higher than in 2014/15, due mainly to increased landings of Australian Salmon, Flathead and Whiting.

When assessing trends within the 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 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.

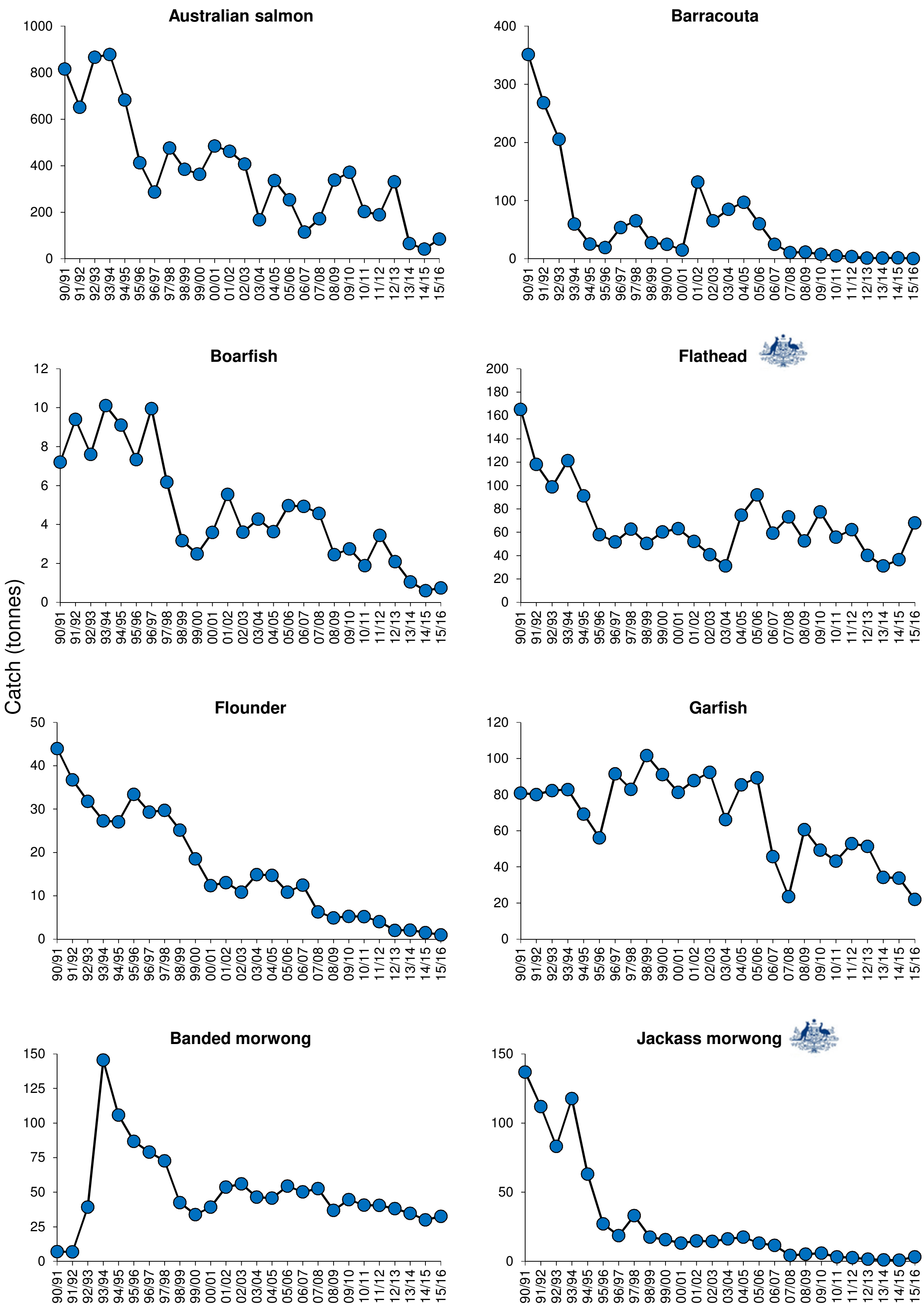


Figure 2.1 Annual catches (t) for selected scalefish species since 1990/91. Note Tiger and Sand Flathead are combined in this figure.

= Significant Commonwealth-managed fisheries

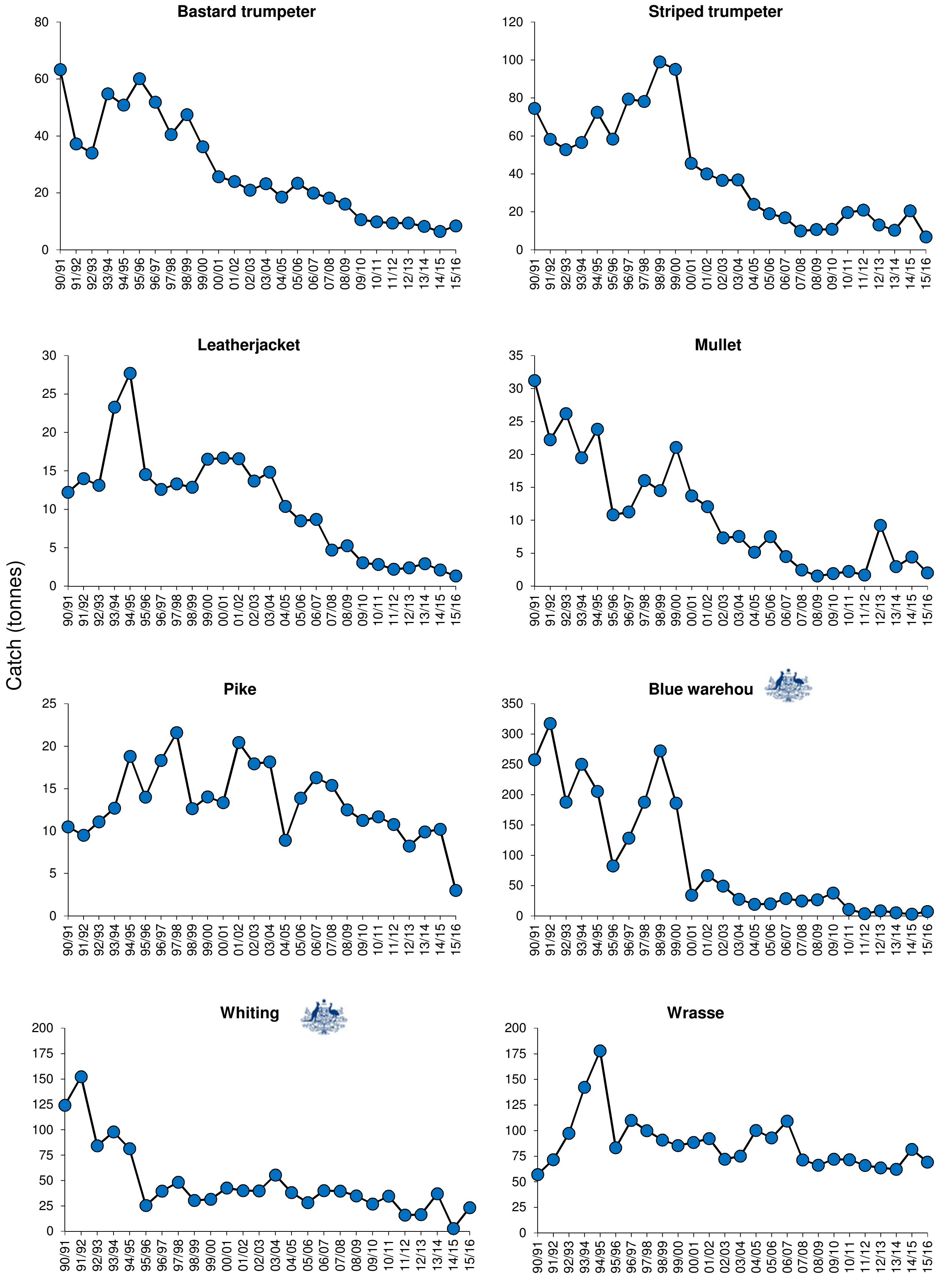


Figure 2.1 Continued.

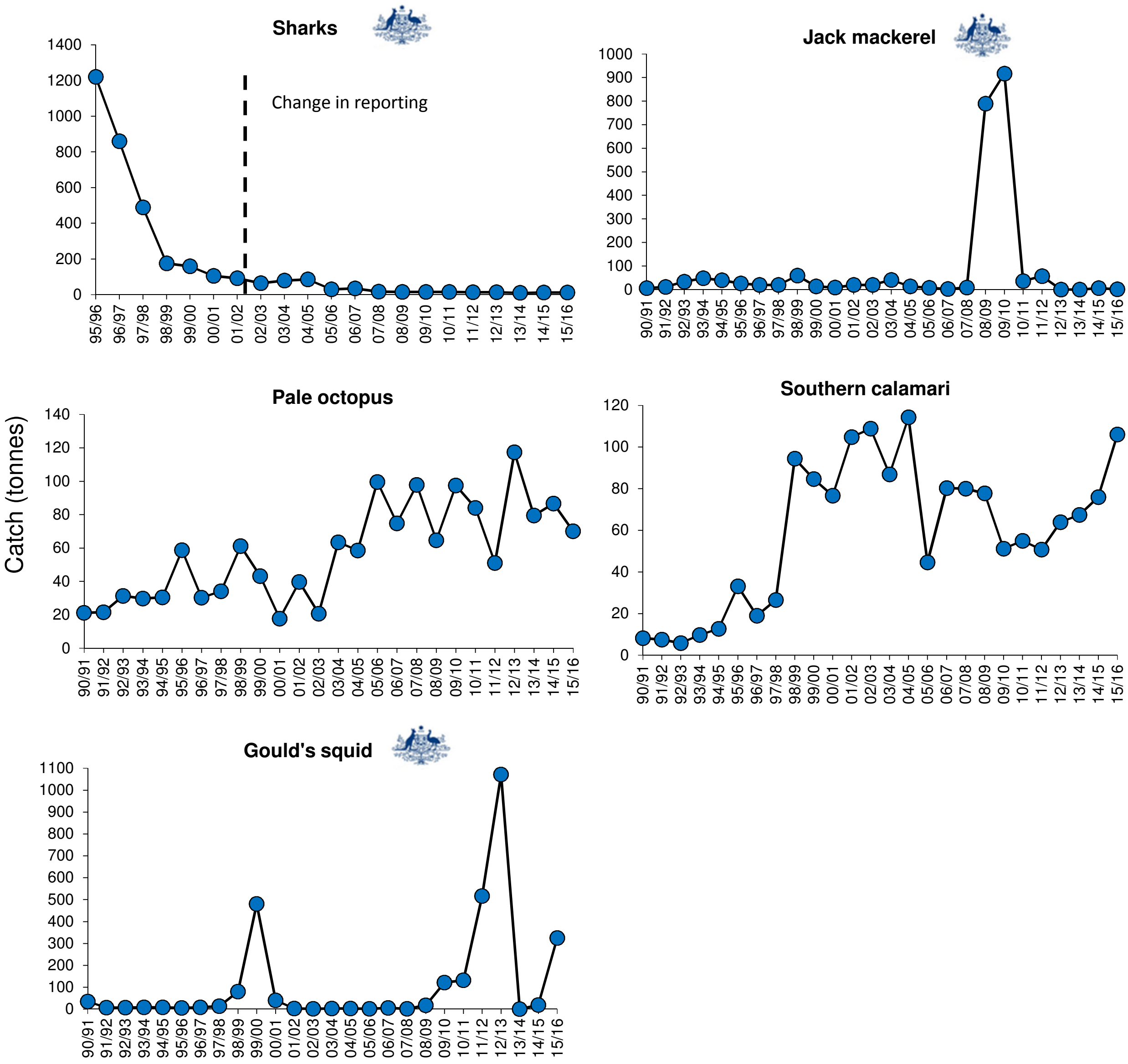


Figure 2.1 Continued.

Estuarine production

Estuarine production (a subset of the whole general fishery) totalled 41.3 t in 2015/16, which was an increase 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 were the main species captured. Port Davey (ES06) and Mersey River (ES08) are restricted to hand-line fishing, which accounts for the minimal catches in recent years. Georges Bay (ES12) and Ansons Bay (ES11) have been closed to commercial Scalefish fishing since 2004 and 2009, respectively.

Table 2.2 Total commercial catches (t) in estuaries around Tasmania (a) by fishing year and (b) by key species in 2015/16

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
15/16	17.5				0.8	10.3		0.1	3.1	5.1	3.8	0.6		41.3
b) By species	**ES01**	**ES06**	**ES07**	**ES08**	**ES09**	**ES10**	**ES11**	**ES12**	**ES17**	**ES18**	**ES19**	**ES20**		**Total**
Australian Salmon					0.07	1.59			0.88	0.04	0.36			2.93
Calamari					0.74	2.50		0.12	0.69	0.85	1.77			6.67
Flathead	0.01					0.07				0.12		0.01		0.22
Flounder						0.01			0.01	0.32	0.09	0.57		1.01
Garfish						0.88				0.05	0.12			1.06
Mullet						0.07			1.44		0.3			1.81
Octopus						0.05				3.48				3.53
Trevally						0.16			0.01	<0.005				0.18
Whiting	17.01					2.30					1.15			20.46
Wrasse	0.49					1.37			0.05	0.03	0.02			1.95

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 graballs (gillnets) 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 7,859 by 2015/16 (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 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	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Graball 1	5615	6290	6685	6709	7477	7401	6960	7695	7313	7408	8054	8677	9185	9172	8960	8162	8248	7995	7765	7887	7070
Graball 2	2612	2678	2683	2426	2652	2515	1841	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Mullet Net	656	684	738	739	879	845	608	754	753	754	816	877	995	1080	922	886	888	890	841	855	789
Total	**8883**	**9652**	**10106**	**9874**	**11008**	**10761**	**9409**	**8449**	**8066**	**8162**	**8870**	**9554**	**10180**	**10252**	**9882**	**9048**	**9136**	**8885**	**8606**	**8742**	**7859**

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.

In the past some fishers 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 an issue in relation to data quality.

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. The 2000/01, 2007/08 and 2012/13 surveys provide critical information about this sector. DPIPWE aims to provide funding to support a statewide survey every five years, the next being scheduled for 2017/18.

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 (Goldsworthy et al. 2003).

3. Commercial fishing gear

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, beach seine, purse seine, gillnet and hand-line effort fell, whereas drop-line, squid-jig and dip-net effort 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 was generally available to most licence-holders).

Since the early 2000s effort for most fishing methods has 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.

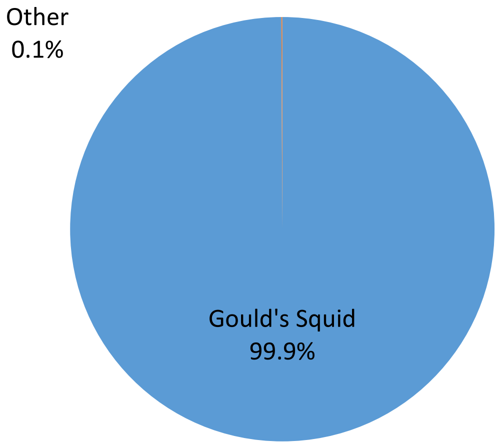


Figure 3.1 Automatic squid jig catch composition for 2015/16.

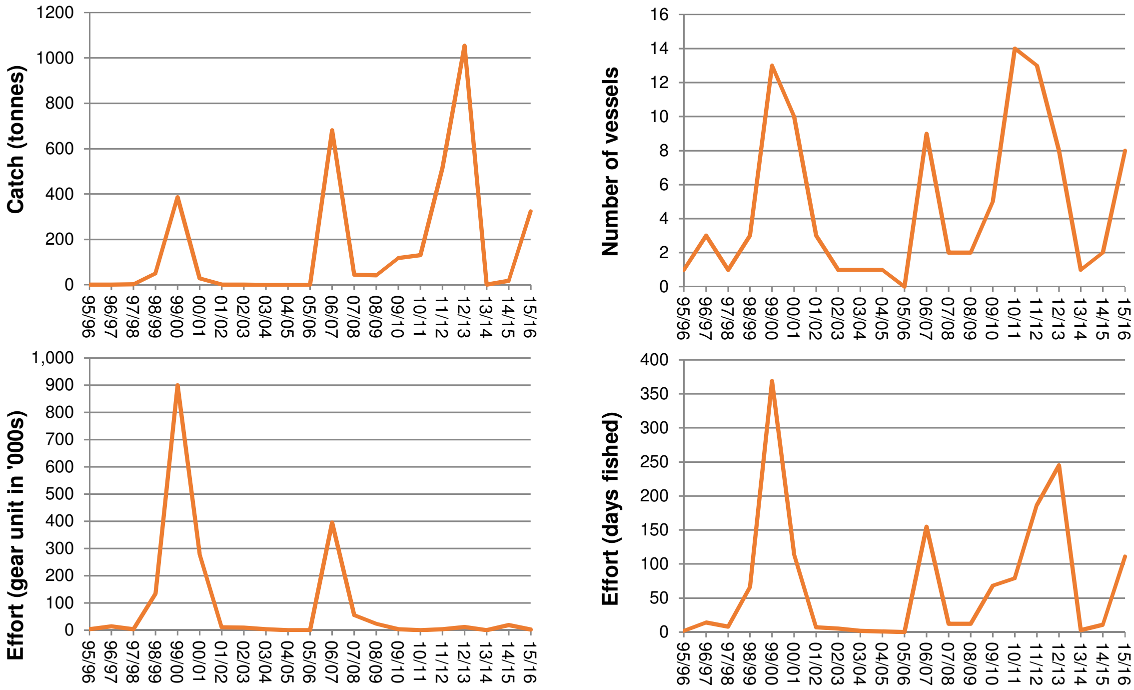


Figure 3.2 Overall catch, number of vessels using the gear, and effort (in gear unit and days fished) for automatic squid-jig.

Beach seine

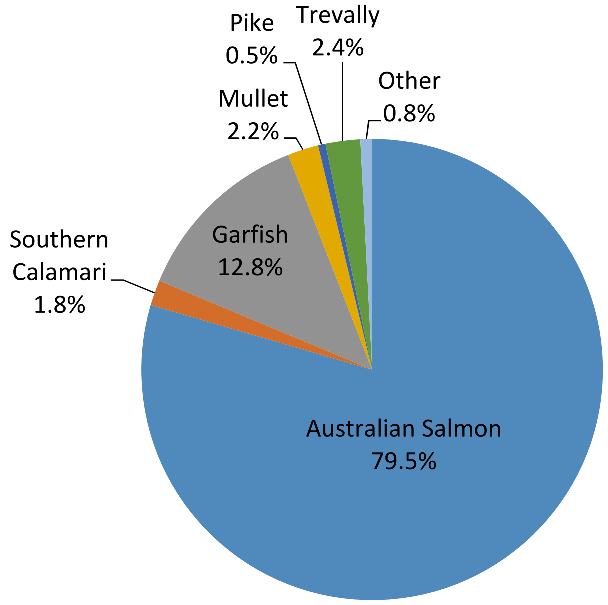


Figure 3.3 Beach seine catch composition for 2015/16

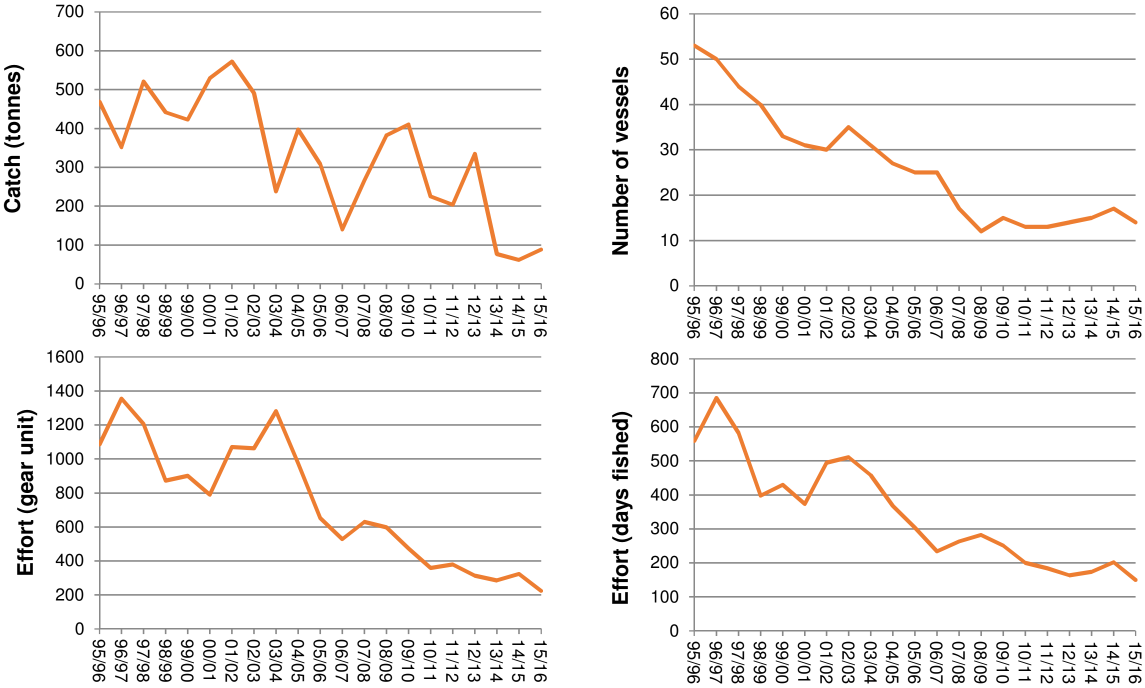


Figure 3.4 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for beach seine.

Drop-line

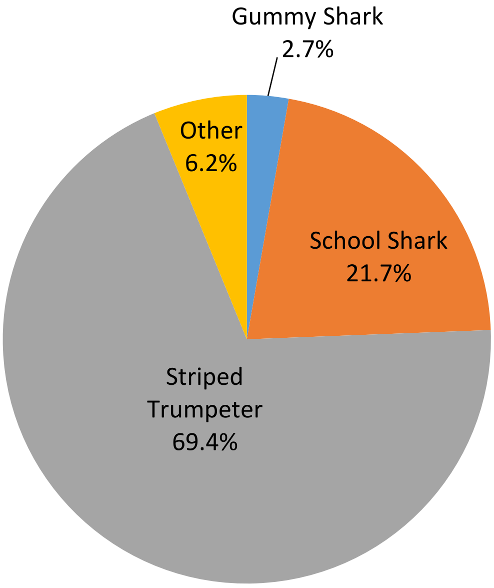


Figure 3.5 Drop-line catch composition for 2015/16.

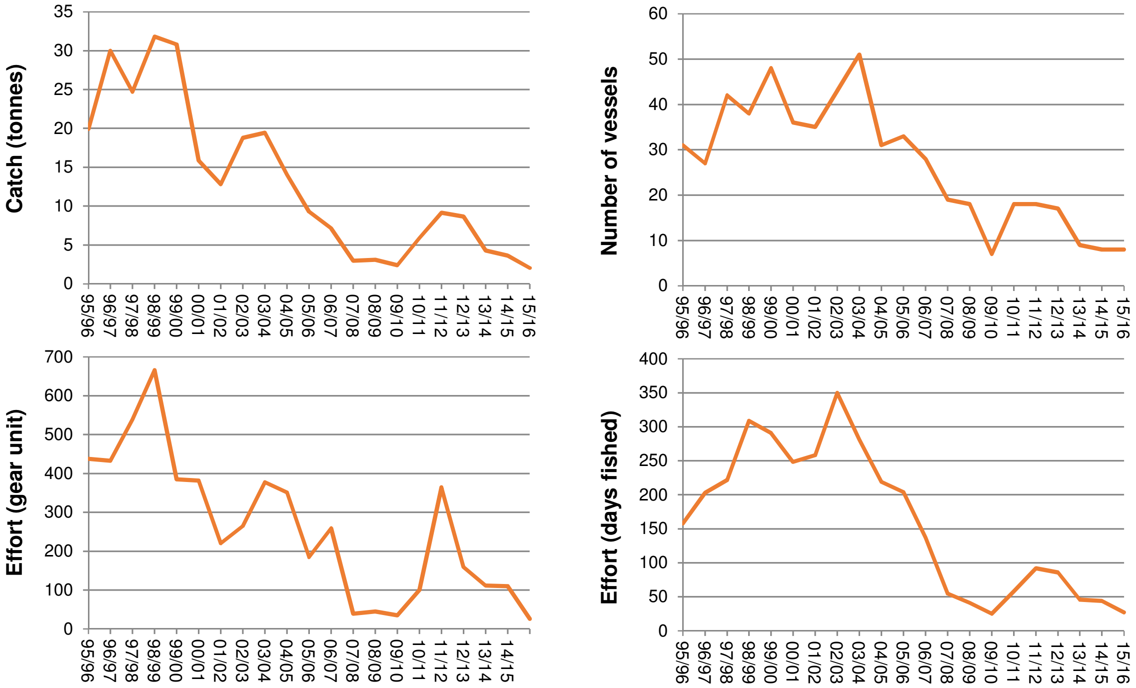


Figure 3.6 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for drop-line. For the purpose of analysis, drop-line catch and effort up to 1998 was restricted to records that indicated a fishing depth of less than 200 m, effectively excluding effort targeting 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

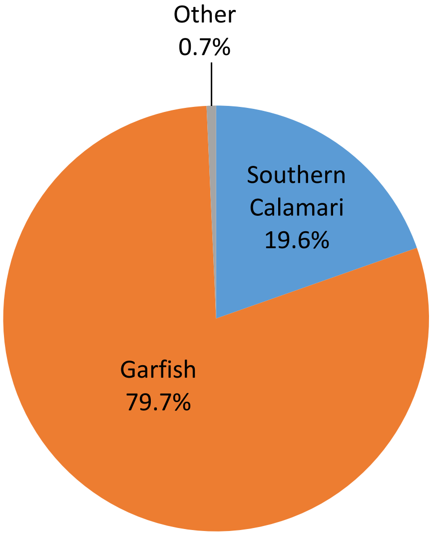


Figure 3.7 Dip-net catch composition for 2015/16.

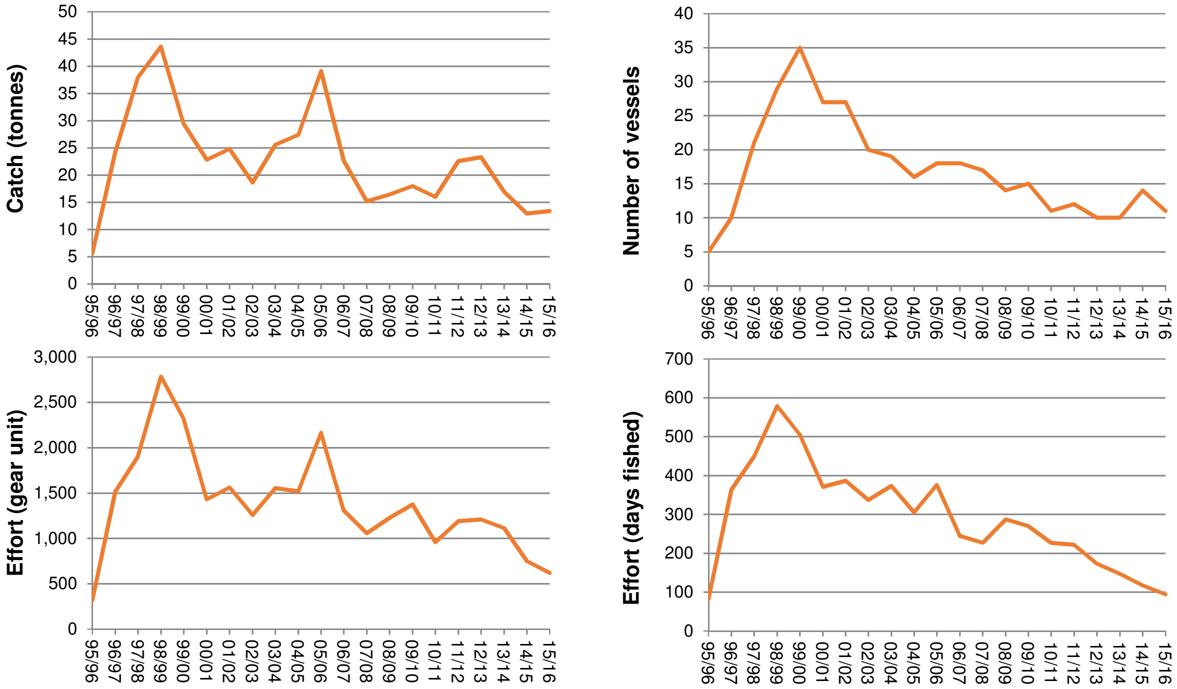


Figure 3.8 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for dip-net .

Danish seine

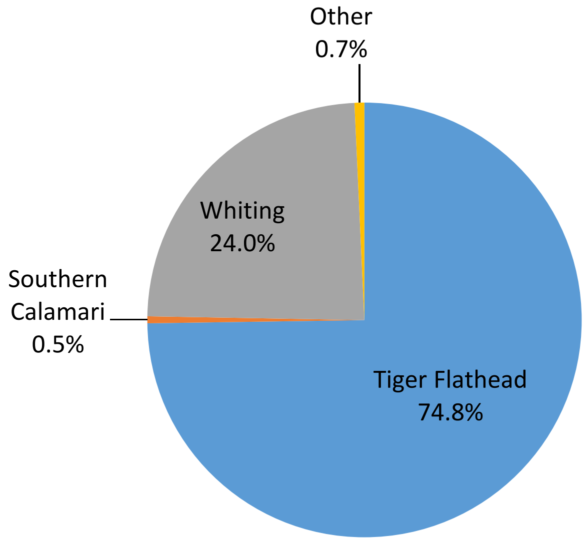


Figure 3.9 Danish seine catch composition for 2015/16.

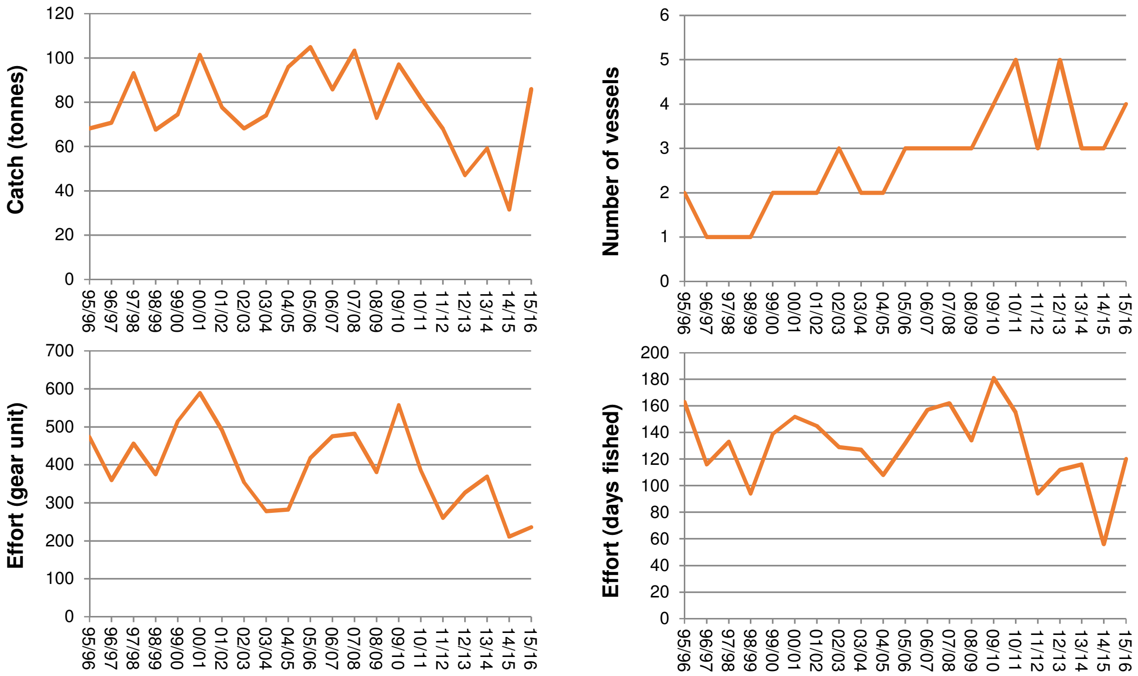


Figure 3.10 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for Danish seine.

Fish trap

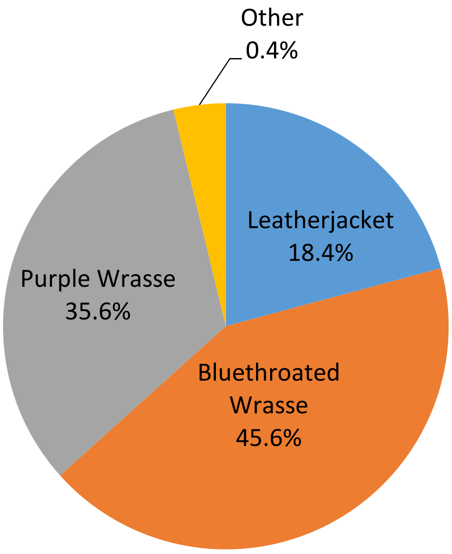


Figure 3.11 Fish trap catch composition for 2015/16.

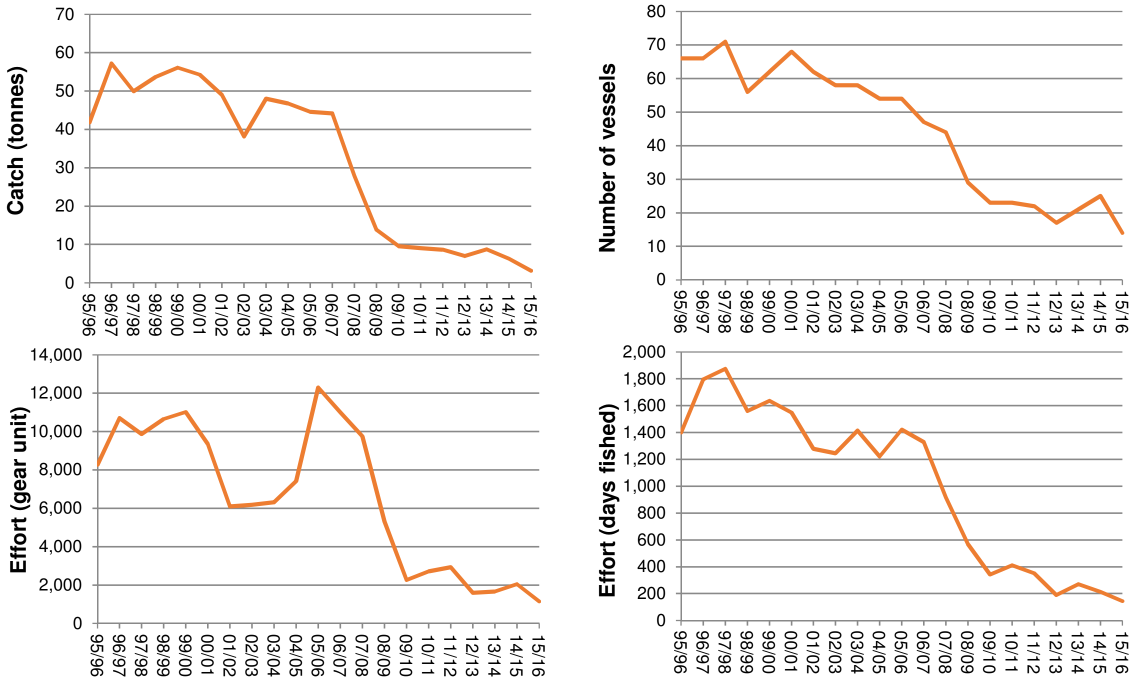


Figure 3.12 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for fish trap.

Gillnet

Gillnets in this analysis include both traditional gillnets (~110 mm mesh size) and 'Banded Morwong' nets (~140 mm mesh size).

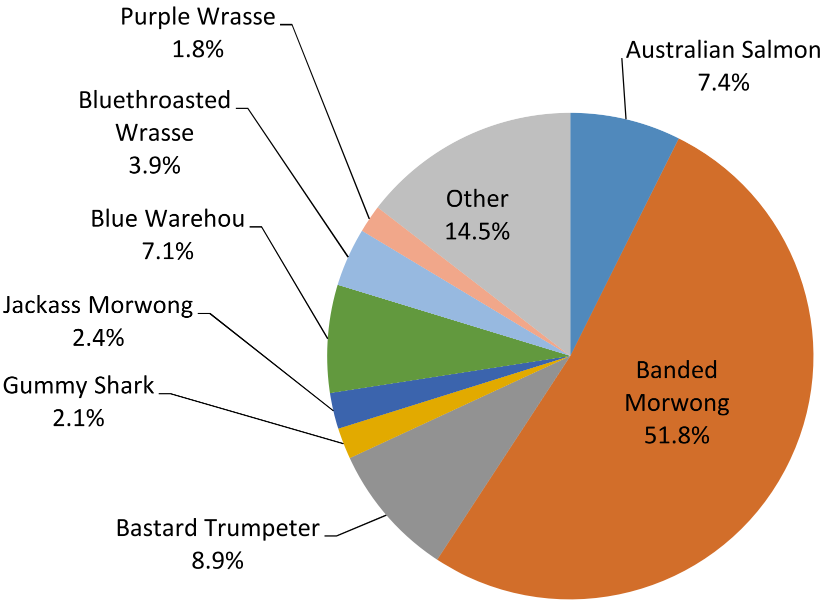


Figure 3.13 Gillnet catch composition for 2015/16

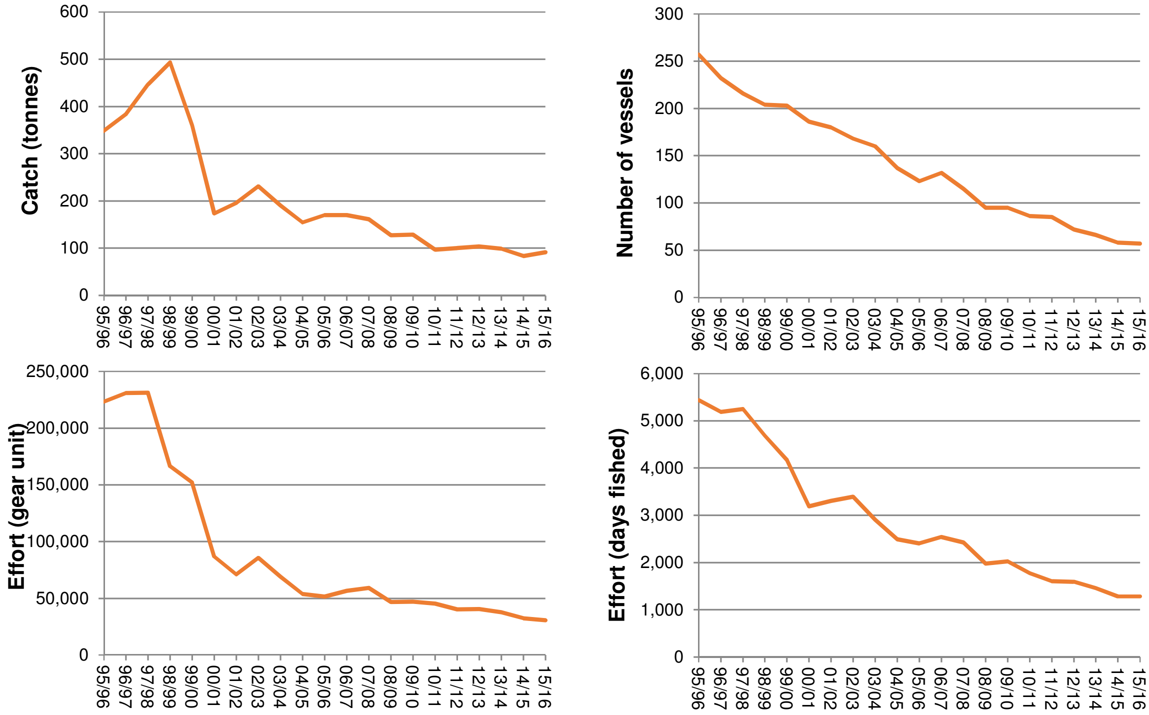


Figure 3.14 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for gillnet.

Hand-line

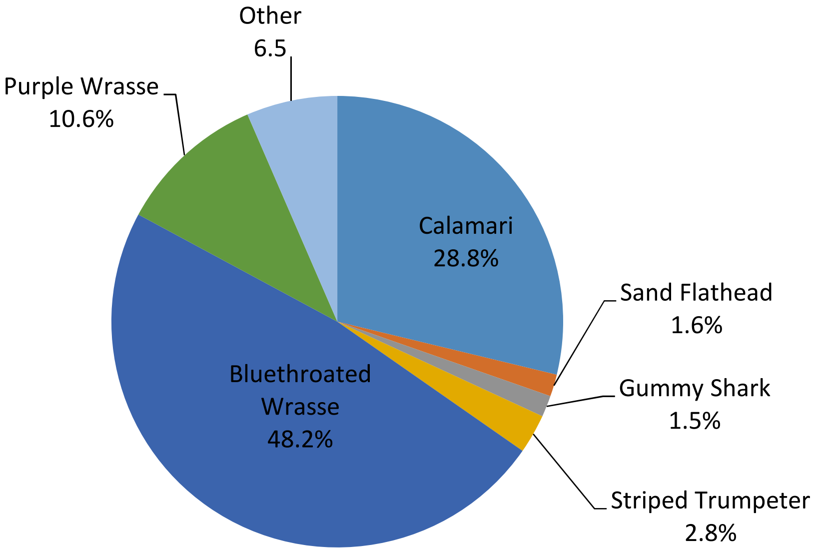


Figure 3.15 Hand-line catch composition for 2015/16.

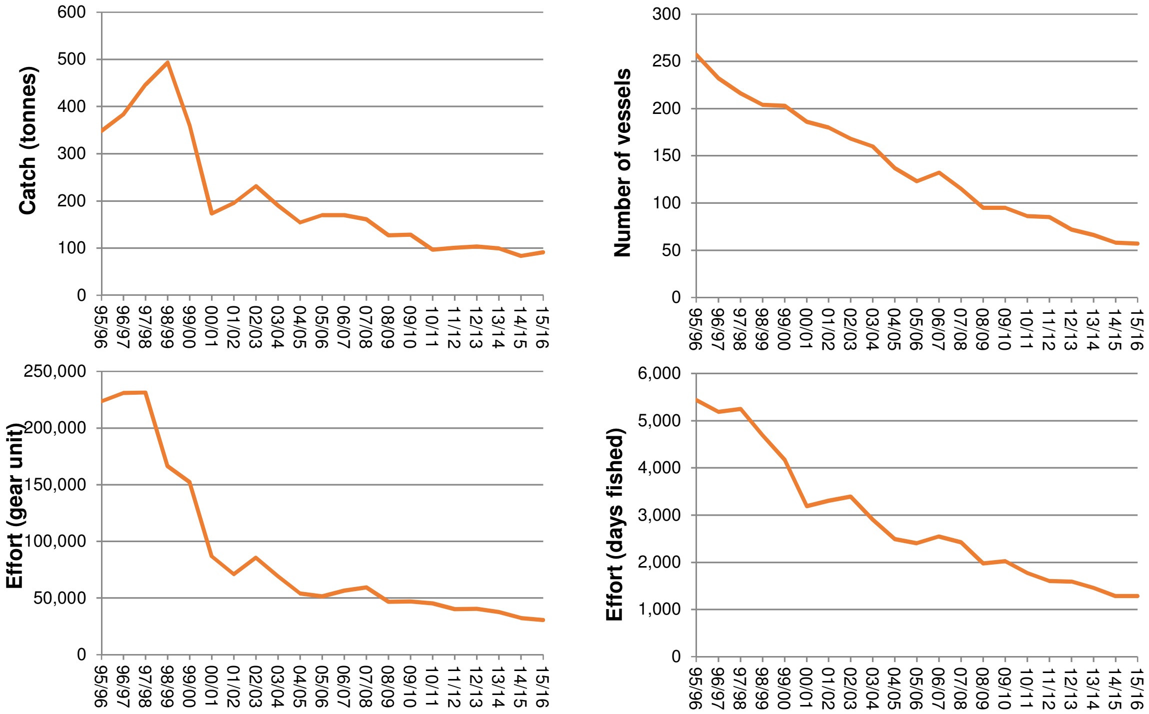


Figure 3.16 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for hand-line.

Small mesh net

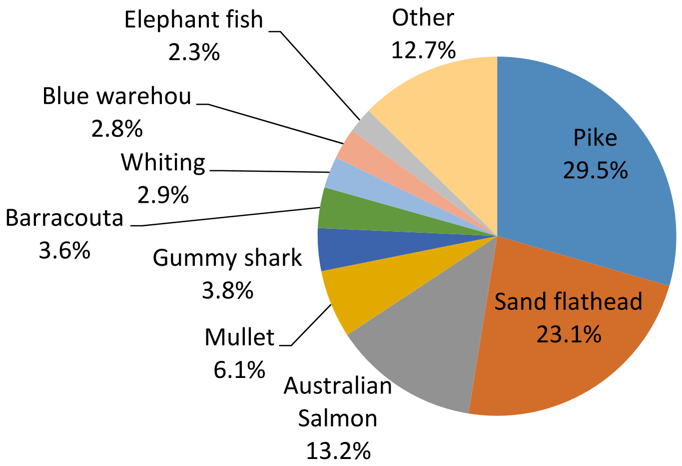


Figure 3.17 Small mesh net catch composition for 2015/16

Figure 3.18 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for small mesh net.

Purse seine

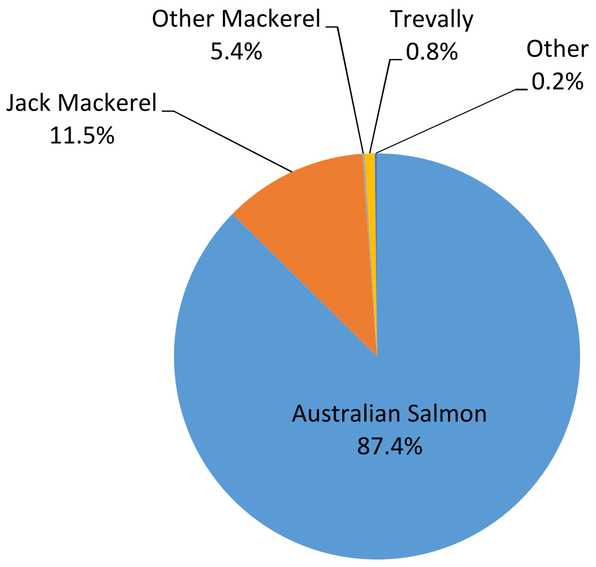


Figure 3.19 Purse seine catch composition for 2015/16.

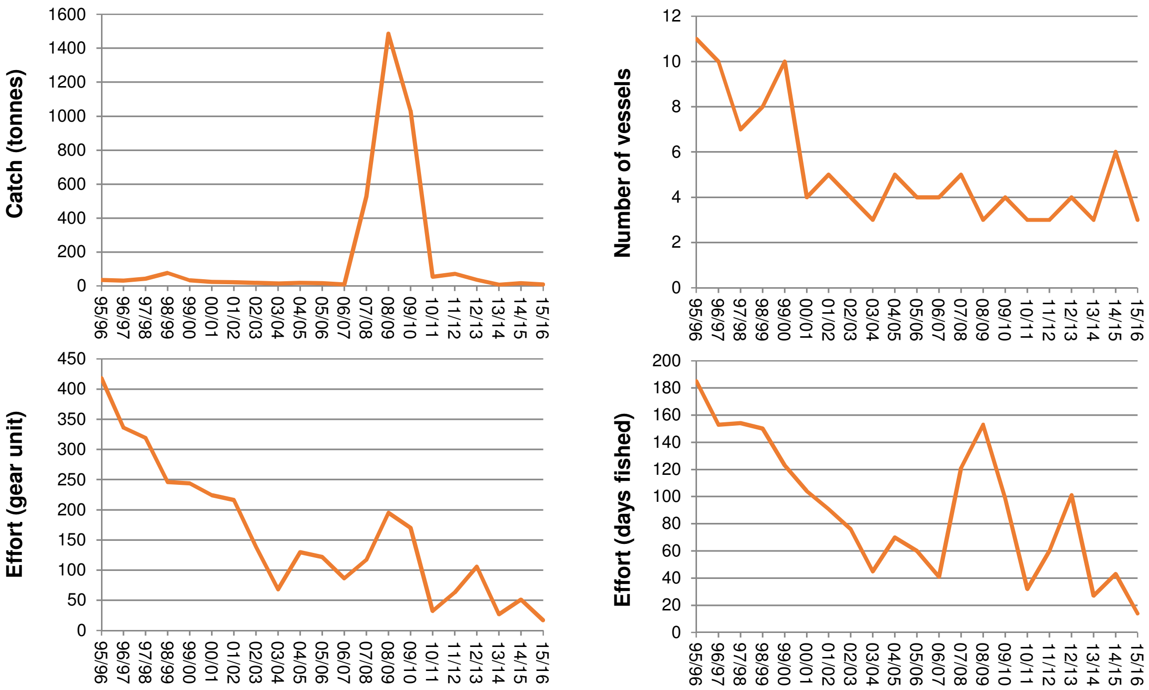


Figure 3.20 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for purse seine.

Squid jig

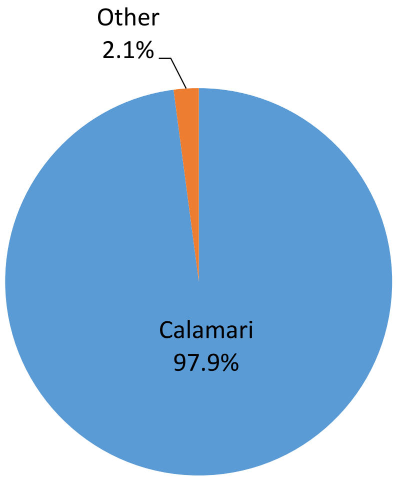


Figure 3.21 Squid jig catch composition for 2015/16.

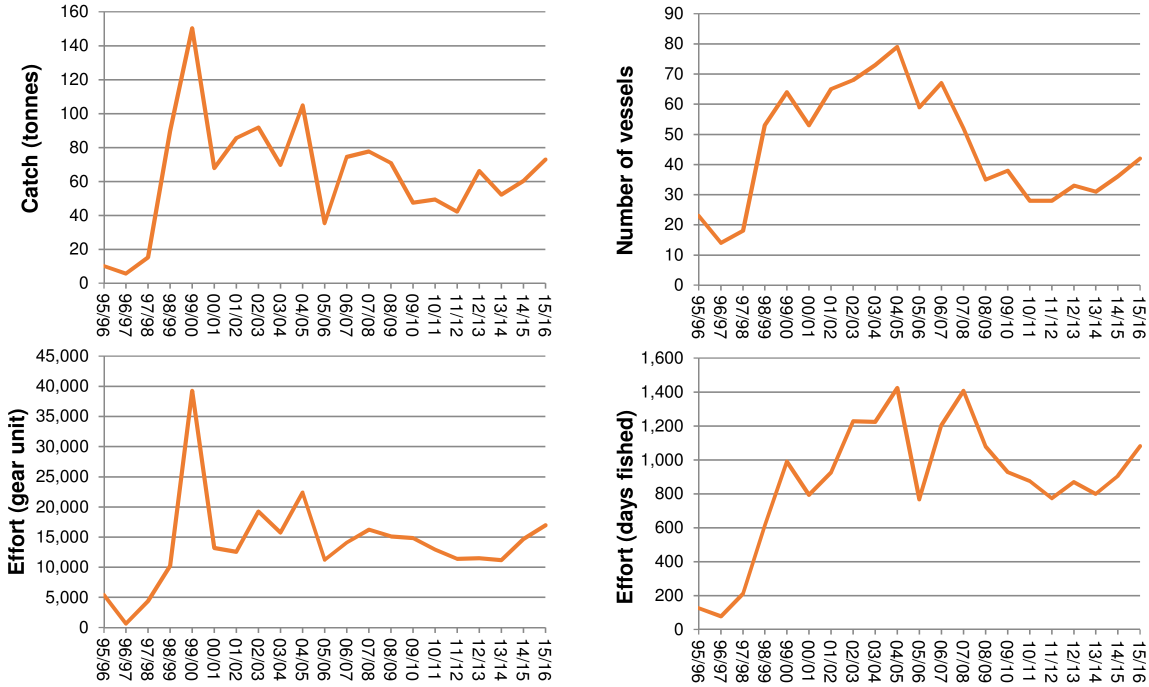


Figure 3.22 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for squid jig.

Spear

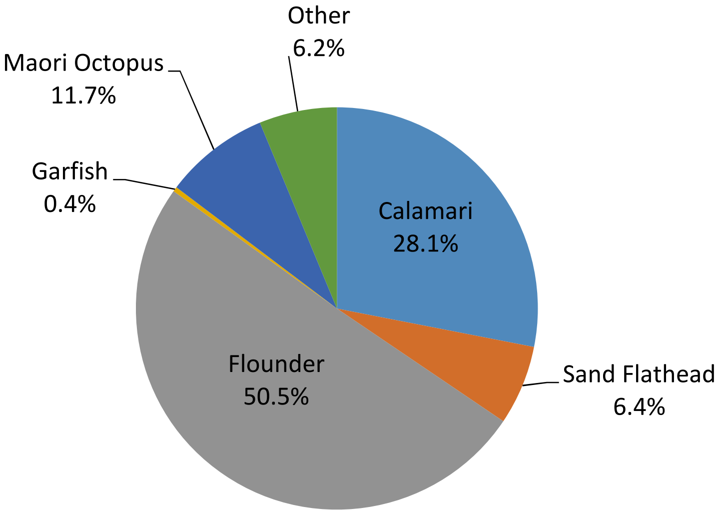


Figure 3.23 Spear catch composition for 2015/16.

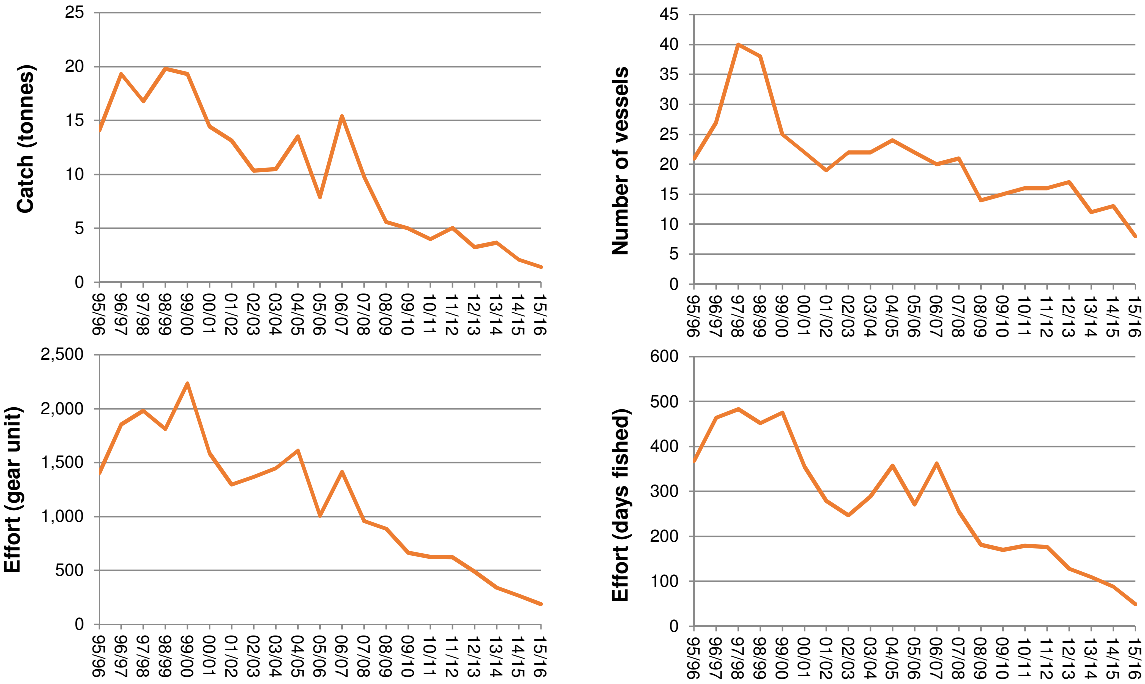


Figure 3.24 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for spear.

Trolling

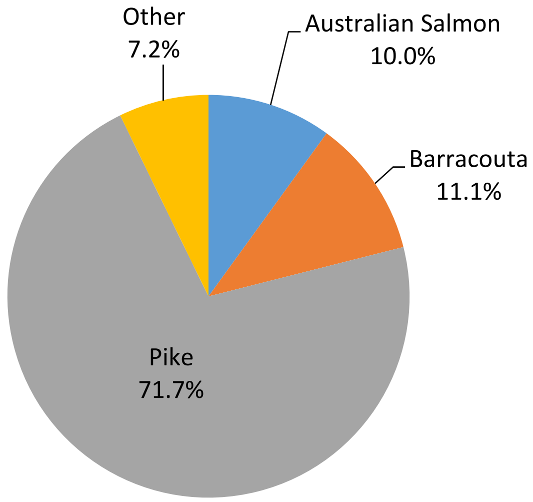


Figure 3.25 Trolling catch composition for 2015/16.

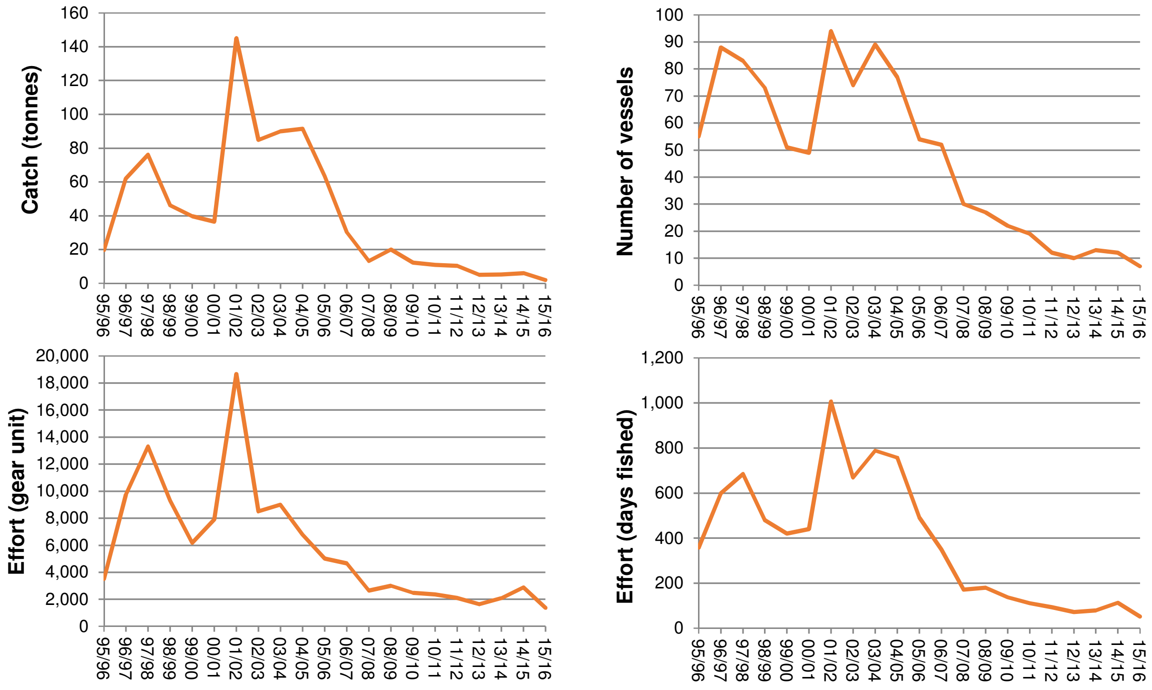


Figure 3.26 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for trolling.

Hand collection

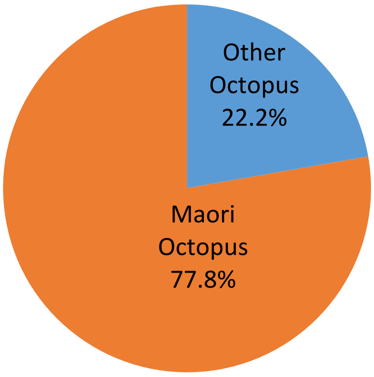


Figure 3.27 Hand collection catch composition for 2015/16.

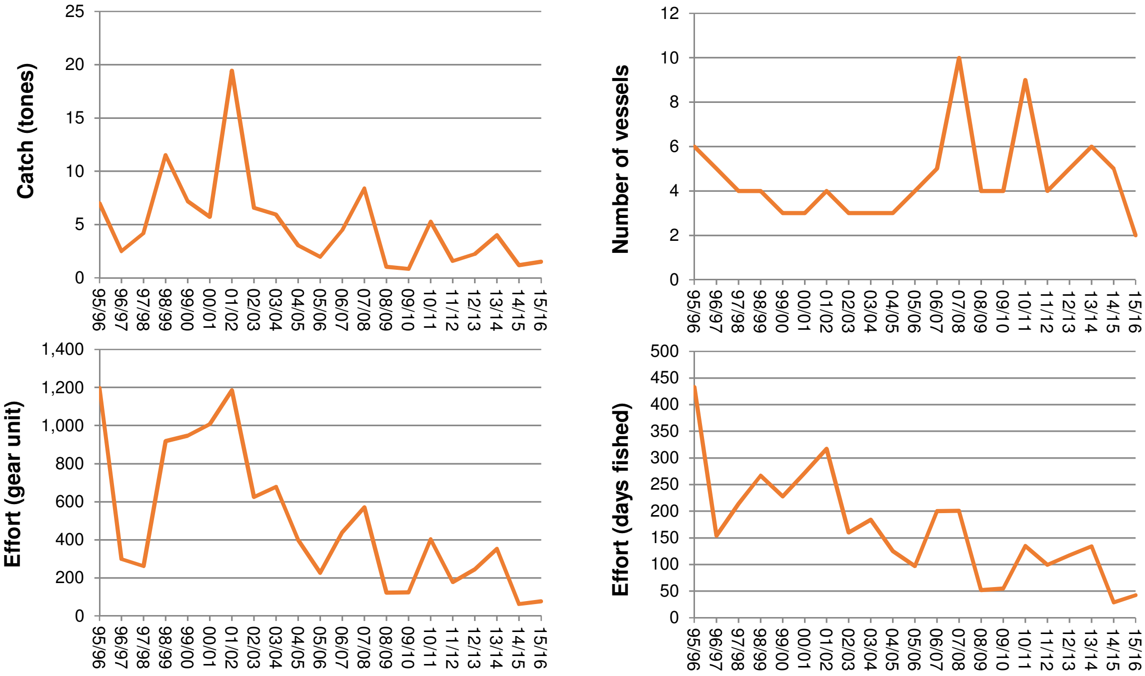
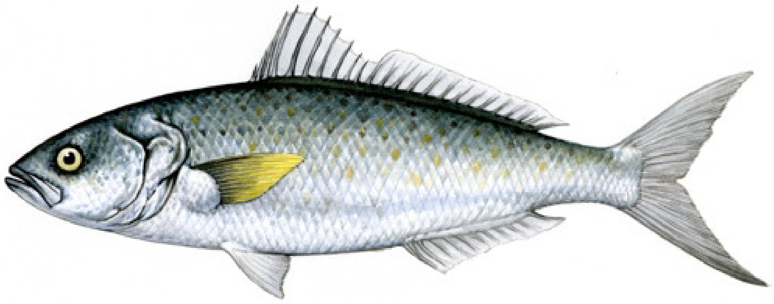


Figure 3.28 Overall catch (t), number of vessels using the gear, and effort (in gear unit and days fished) for hand collection.

4. Eastern Australian Salmon

Arripis trutta

<table>
<tr><td>STOCK STATUS</td><td>SUSTAINABLE</td></tr>
<tr><td colspan="2">Species has a long history of exploitation across south-eastern Australian. Low commercial landings in Tasmania in 2015/16 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.</td></tr>
<tr><td>IMPORTANCE</td><td>Key</td></tr>
<tr><td>STOCK(S)</td><td>Tasmanian Scalefish Fishery</td></tr>
<tr><td>INDICATOR(S)</td><td>Catch, effort and CPUE trends</td></tr>
</table>



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:	Edgar (2008) Frimodt (1995) Stewart et al. (2011)

Sex	L_{∞}		$t_{0\infty}$
Females	65.0	0.24	-0.15
Males	61.3	0.27	-0.13

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. A single company operating up to three vessels has typically accounted for around 85% of landings for the species.

Beach seining accounted for the majority of the catch in 2015/16 (68.8 t) with small quantities landed using purse seine (7.3 t) and gillnet (6.7 t) methods. 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 seines and gillnets are most 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 (330 t) landings for the last few years have been low, with 85.2 t landed in 2015/16 (Fig. 4.1). The low catch in recent years has been due to a dramatic decline in the landings by beach seine fishers that have historically landed the majority of the catch. The majority of catch in 2015/16 was caught on the northeast, with some also caught in the south east (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). Given the low catch and effort since 2012/13 there is no evidence to suggest this level of risk has increased.

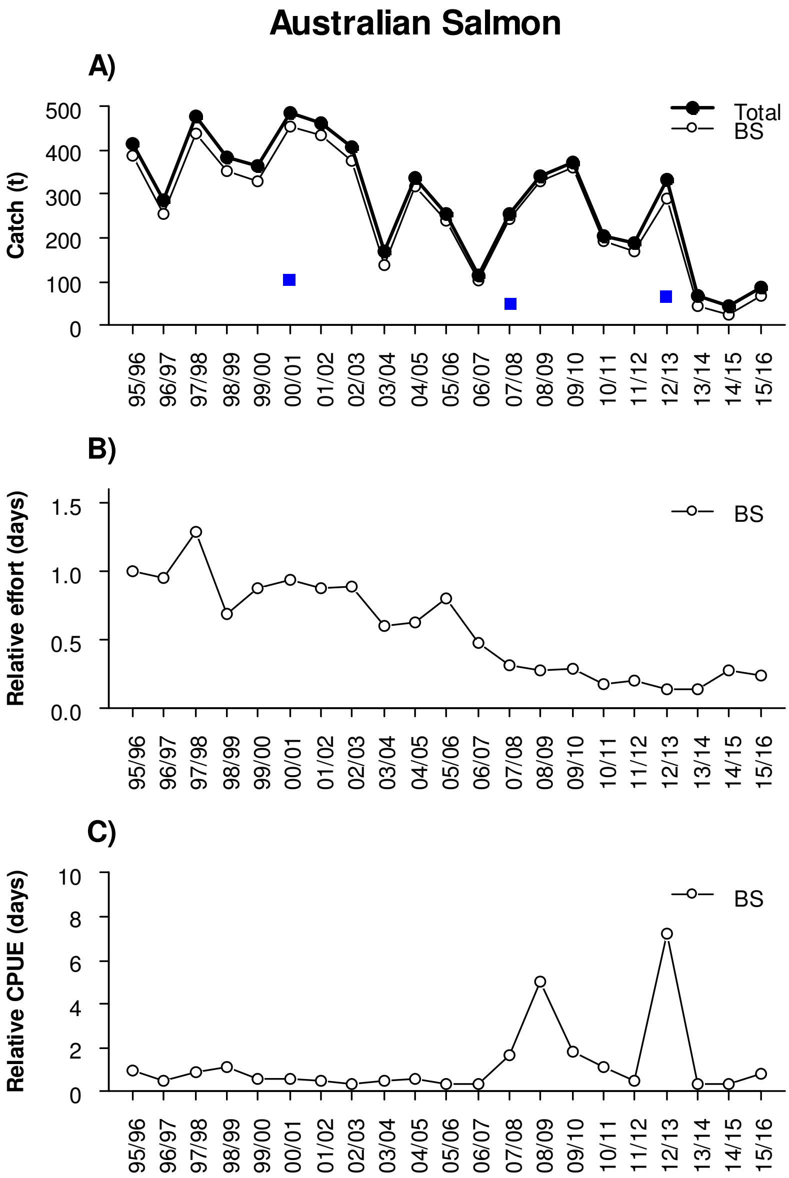
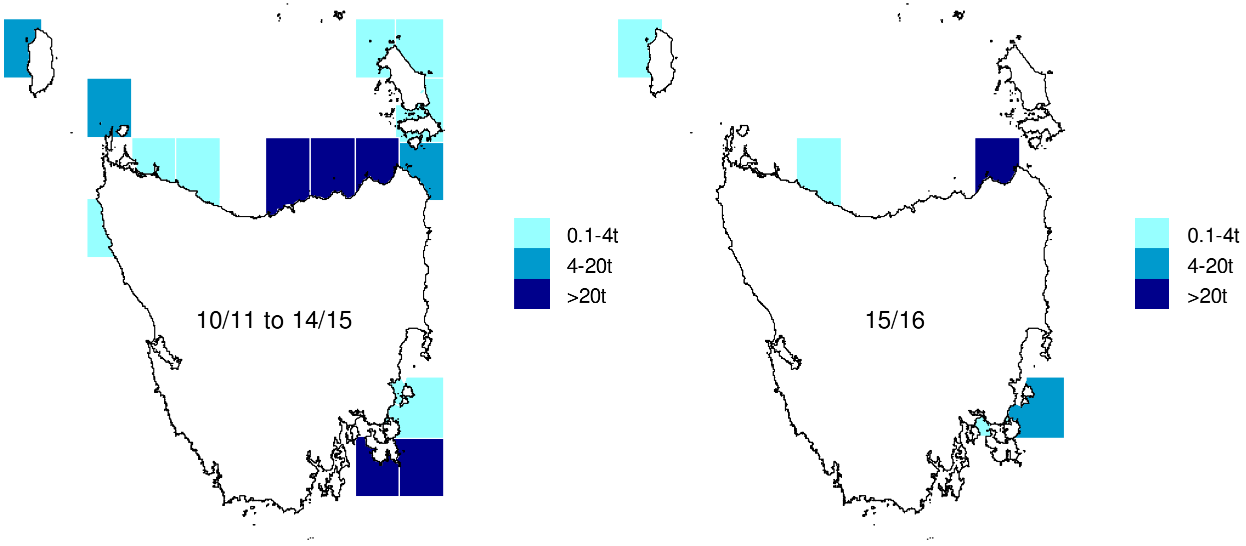


Figure 4.1 A) Annual commercial catch (t) by gear (left) and region (right), and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96.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

A) Catch



B) Effort

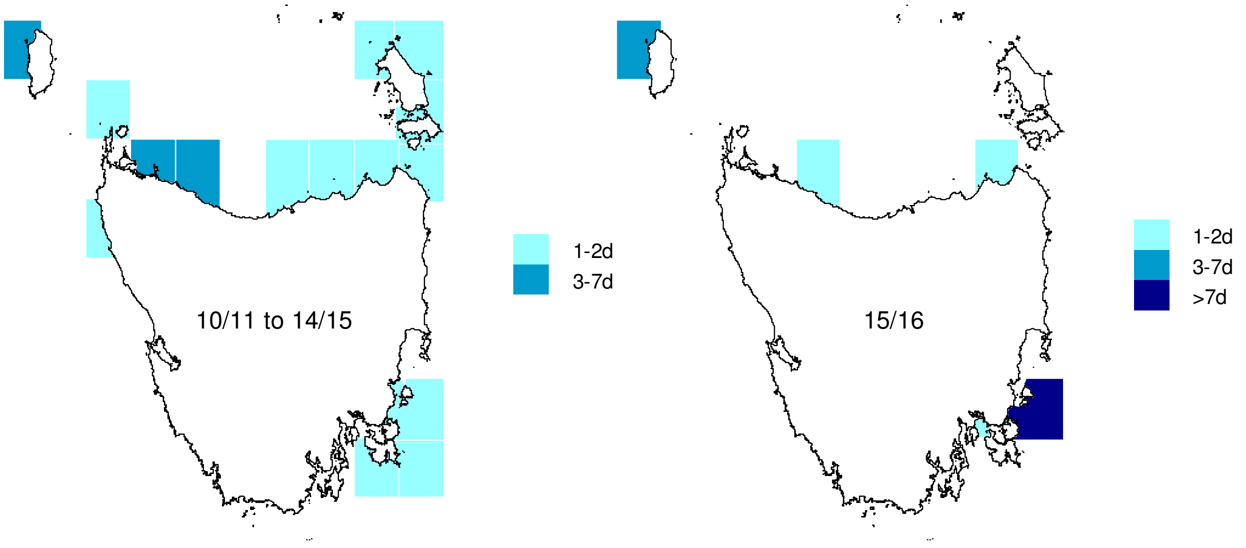


Figure 4.2 (A) Annual Australian Salmon catches (t) and (B) effort (days) by fishing block averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

Given that beach seine catch rates are not a sensitive indicator of stock status due to the schooling behaviour of the species, 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	↓ 168.9t (66.5%)
	• 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**

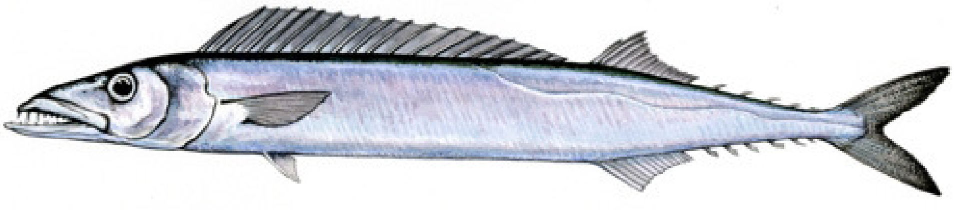
Although the third lowest catch reference point was breached as a result of the low landings in 2015/16, annual production of Australian Salmon is strongly linked to the fishing practices of a single operator who is responsible for the overwhelming majority of landings. During the last three fishing seasons catch and effort for this sector has been at historically low levels, reflecting shifts in targeting species and low market demand for Eastern Australian Salmon as rock lobster bait rather than 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. Barracouta

Thyrsites atun

STOCK STATUS	**UNDEFINED**
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 there is insufficient information to confidently classify the stock.	
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 $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$	Edgar (2008) Nakamura and Parin (1993) Grant et al. (1978)

<table>
<tr><td></td><td>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 :
<table>
<tr><th>Sex</th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr>
<tr><td>Combined</td><td>91</td><td>0.42</td><td>-0.25</td></tr>
</table>
• 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).</td><td>Blackburn (1960)</td></tr>
<tr><td>Maturity</td><td>• Sexual maturity at about 50–60 cm FL and about 2–3 years of age</td><td>Hurst et al. (2012)</td></tr>
<tr><td>Spawning</td><td>• October to March in Tasmania</td><td>Kailola et al. (1993)</td></tr>
<tr><td>Early life history</td><td>• Little data. Eggs are pelagic and juveniles inhabit sheltered waters of southern bays and estuaries.</td><td>Kailola et al. (1993)
Hurst et al. (2012)</td></tr>
<tr><td>Gillnet post release survival</td><td>• NA</td><td></td></tr>
</table>

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 97.3 t in 2004/05 to just 0.4 t in 2015/16 (Fig. 5.1A). Catches and fishing effort were traditionally concentrated off southern Tasmania; however, over the last few fishing seasons catch and effort was concentrated off the north coast (Fig. 5.2).

After the peak in the early 2000s, effort declined and has stabilised since 2007/08 at a low level (Fig. 5.1B). Catch rates have been relatively stable over time but were at their lowest levels in 2015/16 (Fig. 5.1C); 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). Since 2012/13 there has been minimal catch of Barracouta and the risk is still considered negligible.

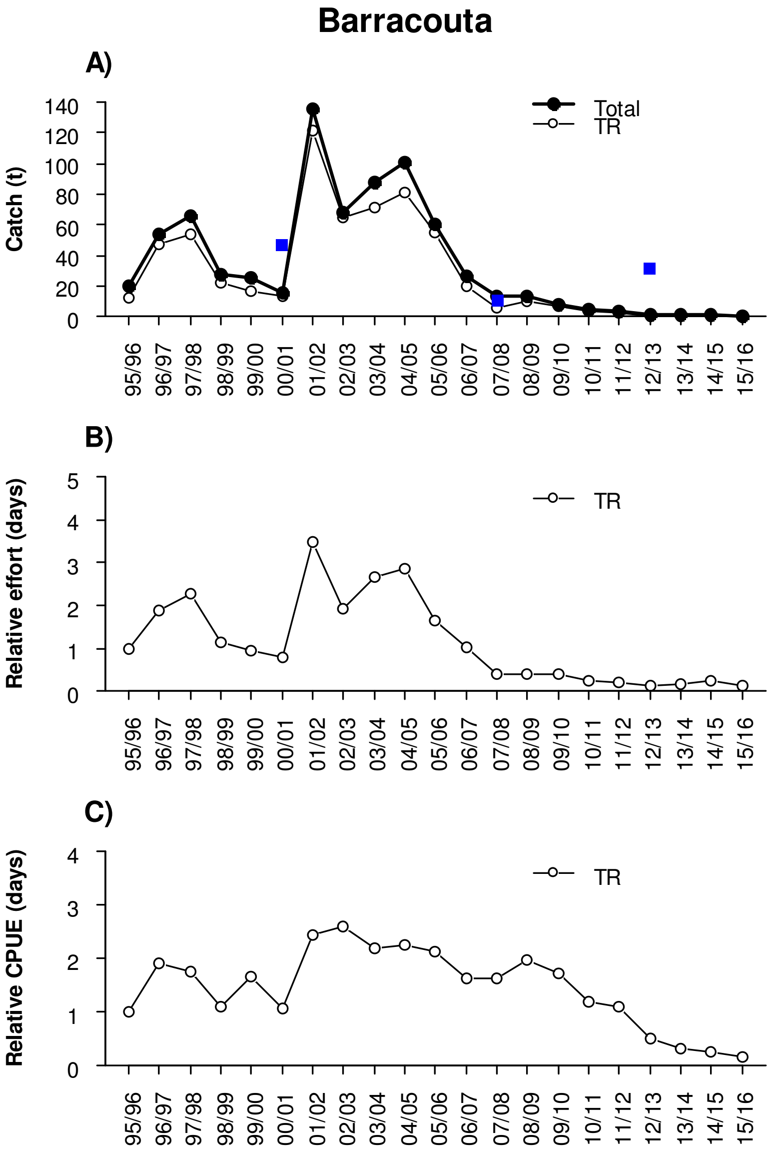
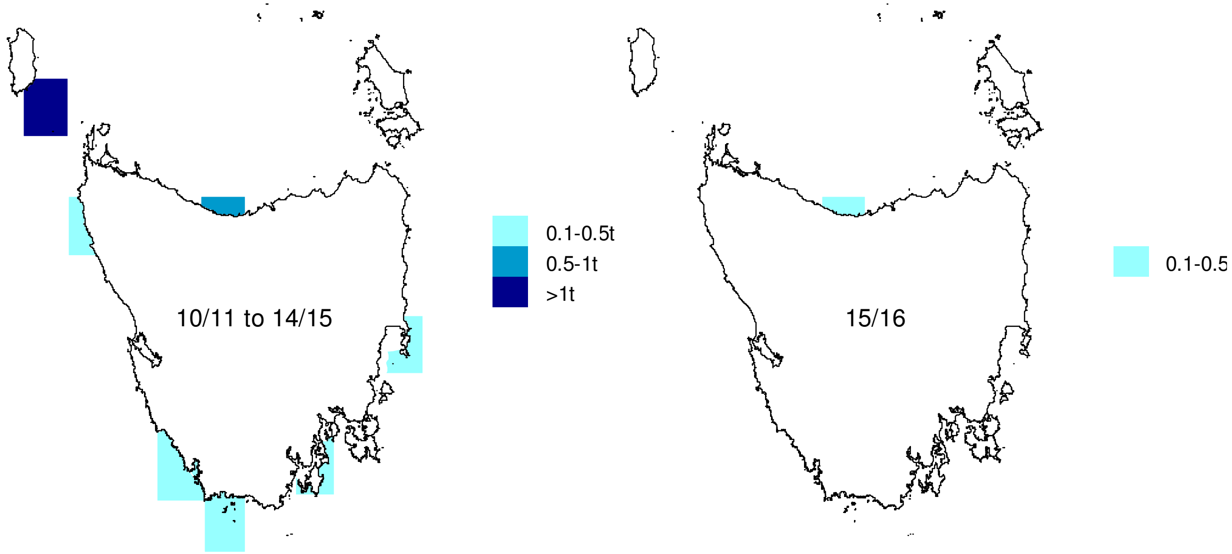
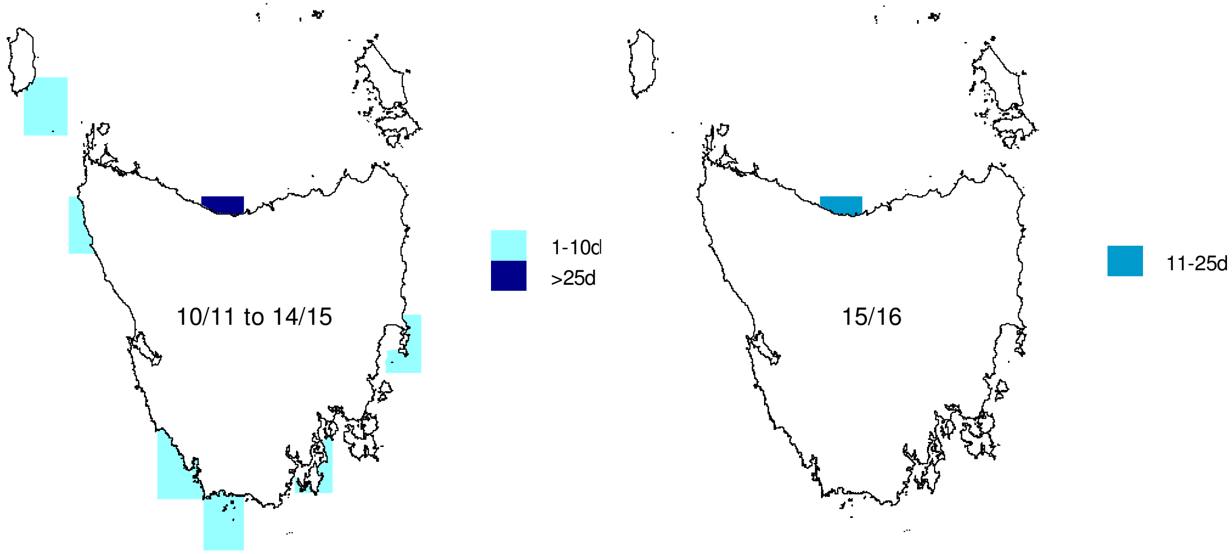


Figure 5.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. TR= troll.



A) Catch



B) Effort

Figure 5.2 (A) Barracouta catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (87.5 t)	No	
	• Catch < 3rd lowest catch value from the reference period (25.0 t)	Yes	↓ 24.6 t (98.3%)
	• 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 (-0.0091)	No	
Stock stress	• Significant change in the size/age composition of commercial catches	Not assessed	
	• Significant numbers of unhealthy fish landed	No	

Stock status

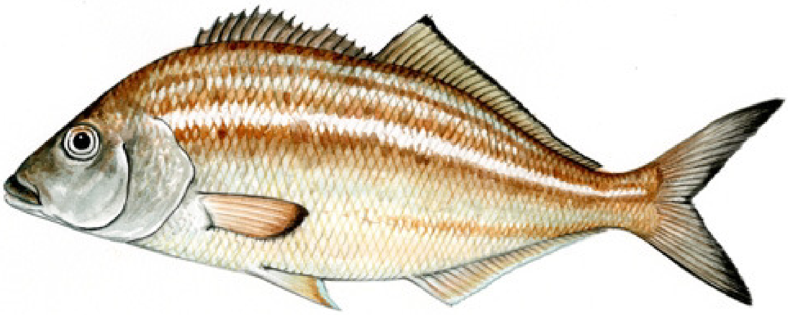
UNDEFINED

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, there is insufficient information to confidently classify this stock.

6. 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 $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$	Edgar (2008) Gomon et al.(2008)

<table>
<tr><td></td><td>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 :<table><tr><th><i>Sex</i></th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr><tr><td>Combined</td><td>59.4</td><td>0.144</td><td>-2.9</td></tr></table></td><td>Murphy and Lyle (1999)</td></tr>
<tr><td>Maturity</td><td>• Sexual maturity at sizes >45 cm and ages > 4 years.</td><td>Murphy and Lyle (1999)</td></tr>
<tr><td>Spawning</td><td>• Believed to spawn in late winter</td><td>Murphy and Lyle (1999)</td></tr>
<tr><td>Early life history</td><td>• Small juveniles settle from the plankton on reefs in large numbers at intervals of several years.</td><td>Edgar (2008)</td></tr>
<tr><td>Recruitment</td><td>• Variable. No-stock recruitment relationship established.</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>• High: 95 – 83% depending on gillnet soak duration</td><td>Lyle et al (2014a)</td></tr>
</table>

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 gillnet. 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	Gillnet
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, rock lobster licence) **Output control:** • Possession limit of 10 and bag limit of 5 individuals for recreational fishers • Trip limit 200 kg for commercial scalefish licence holders • Trip limit of 30 fish for commercial rock lobster licence holders • Legal minimum length (380 mm TL)
MAIN MARKET	Local

Current assessment

Catch, effort and CPUE

Bastard Trumpeter catches have been declining steadily since the mid-1990s and have fluctuated around 8 tonnes since 2009/10, with 8.4 t landed in 2015/16 (Fig. 6.1A). Bastard Trumpeter are taken almost exclusively by gillnet from inshore waters off the east, south and west coasts (Fig. 6.2). 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 gillnet effort has followed a similar downward trend to catches since the mid-1990s (Fig. 6.1B). Daily catch rates have remained relatively stable since 2006/07 at a reduced level (Fig. 6.1C). 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 current fishing pressure is too high (Bell et al. 2016). There is no new information to suggest that this has changed otherwise since then.

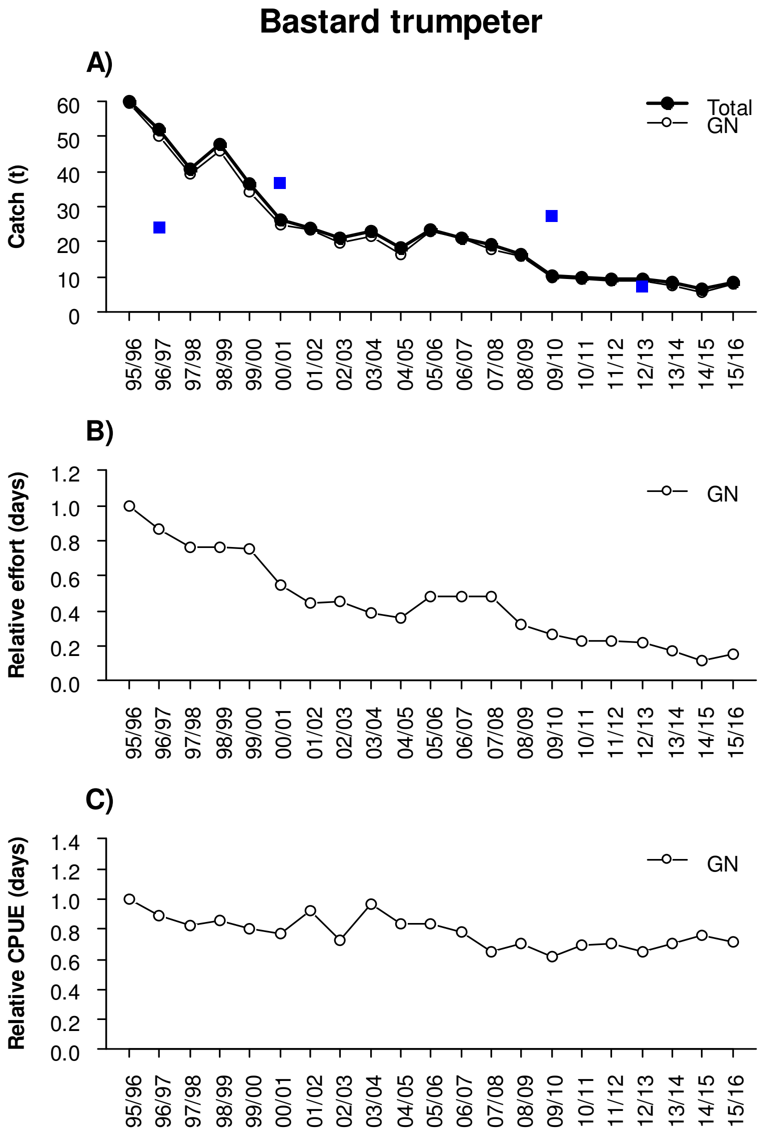
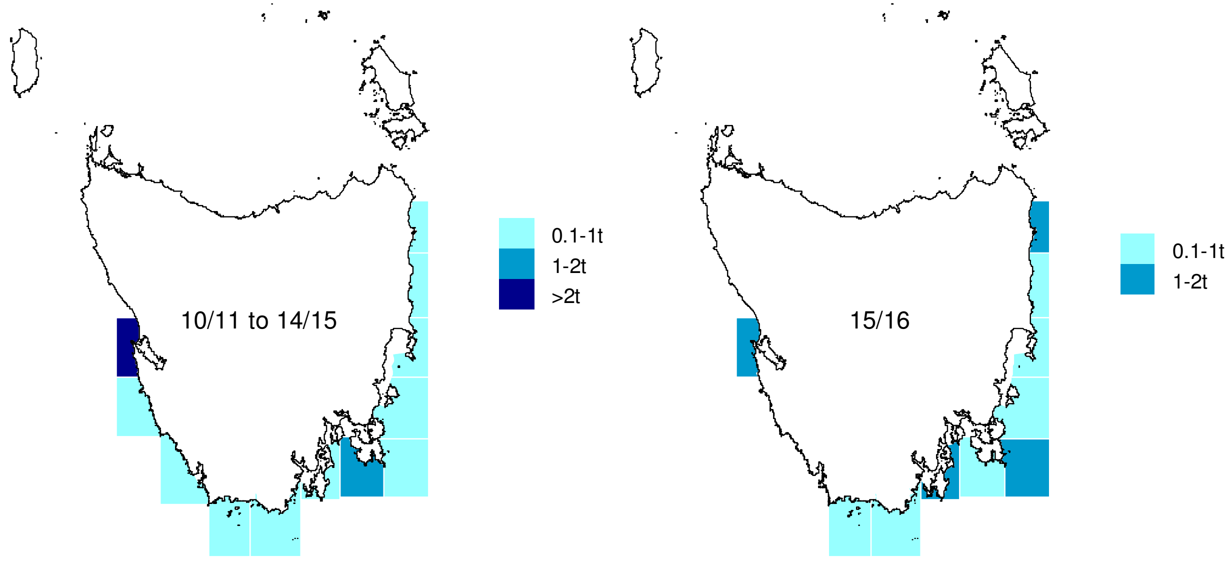


Figure 6.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on days fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. GN= gillnet. Data includes AFMA catch in State waters.

A) Catch



B) Effort

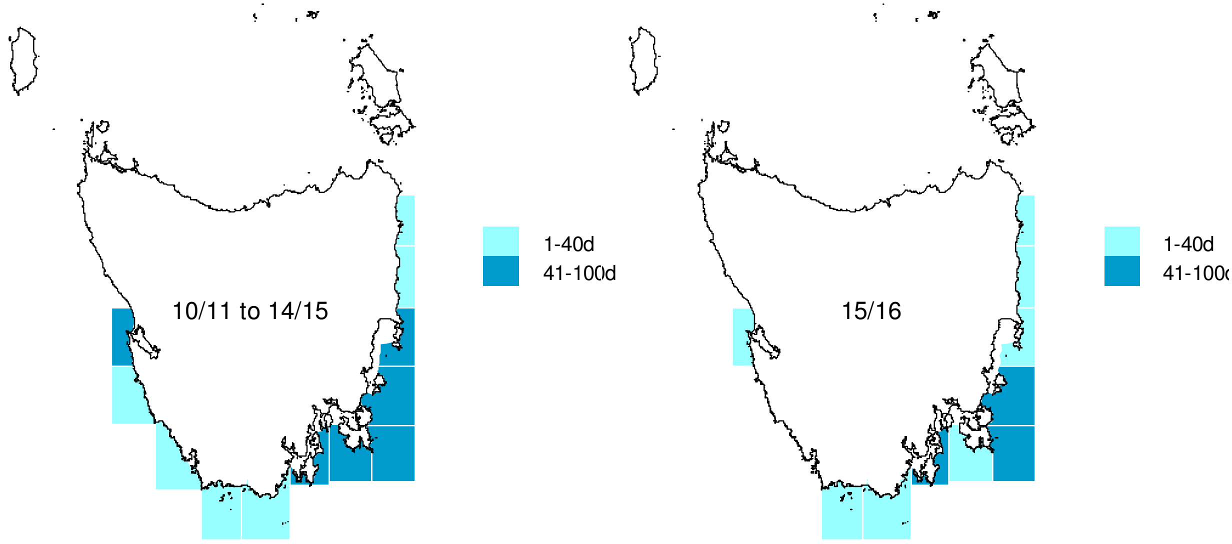


Figure 6.2 (A) Bastard Trumpeter catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right). Data includes AFMA catch in State waters.

Reference points

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	↓ 12.9 t (60.5%)
	- 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 (0.0108 t/days fished)	Yes	0.0011 t/day fished (↓ 10.2%)
	- 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 low catches in 2015/16, the lowest catch and catch rate reference points were breached. As Bastard Trumpeter is a by-product species, 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. On board observations suggest that legal sized Bastard Trumpeter are sometimes discarded by Banded Morwong fishers but survivability remains high. Given the majority of gillnet effort is now targeted at Banded Morwong using larger mesh sizes than those used historically to target Bastard Trumpeter, both catch and catch rate trends may be confounded and not representative of population status. 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 (Emery et al. 2016). Studies have demonstrated significantly higher abundances of Bastard Trumpeter in unfished marine reserves relative to fished sites around Tasmania (Edgar and Barrett 1999), which in combination with the fact that commercial and recreational fisheries are based entirely on juveniles, suggests that recruitment as well as growth overfishing may be occurring.

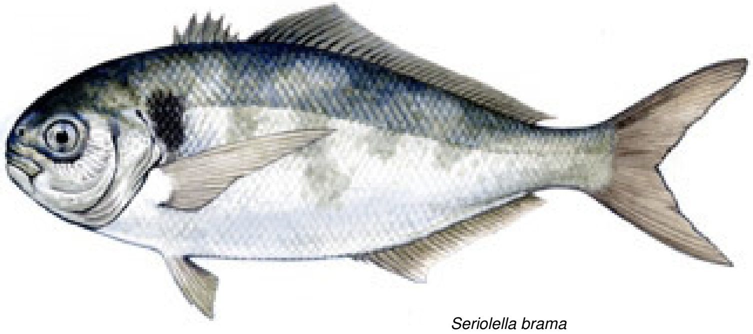
It is worth noting that the stabilisation of the catch since 2009/10 corresponds to the introduction of several management measures for the species (increase in the minimum legal size, introduction of commercial trip limits and reduction in recreational bag and possession limits). However, the current 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 about increasing the minimum size limit to recover stocks this would effectively close down the current commercial and recreational fisheries for the species. Further reductions in the recreational bag limit for this species were introduced in 2015.

Given the continued reduction in catches, 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.

7. Blue Warehou

Seriolella brama

STOCK STATUS	**OVERFISHED**
This is predominately a Commonwealth-managed species that is classified as overfished by AFMA (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 in 2008, 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)

<table>
<tr><td>Natural mortality</td><td>• Estimated between M=0.30 and M=0.45.</td><td>Knuckey and Sivakumaran (2001)</td></tr>
<tr><td>Maximum age</td><td>• Up to 15 years</td><td>AFMA (2012)</td></tr>
<tr><td>Growth</td><td>• Maximum length: 90 cm
• Maximum weight: 4 kg
• Growth (in New Zealand) 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:
<table>
<tr><th>***Sex***</th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr>
<tr><td>Combined</td><td>54.65</td><td>0.37</td><td>-0.67</td></tr>
</table>
• 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).</td><td>Gomon et al.(2008)
Frimodt (1995)
BWAG (1998)</td></tr>
<tr><td>Maturity</td><td>• 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.</td><td>Knuckey and Sivakumaran (2001)</td></tr>
<tr><td>Spawning</td><td>• 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</td><td>Bruce et al. (2001b)</td></tr>
<tr><td>Early life history</td><td>• 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</td><td>Bruce et al. (2001b)
Neira et al. (1998)</td></tr>
<tr><td>Recruitment</td><td>• Variable. No-stock recruitment relationship established.</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>• Low: 35%, but small legal minimum length so rarely discarded.</td><td></td></tr>
</table>

Background

Blue Warehou occur seasonally in Tasmanian inshore waters, the region representing the southern-most extent of the species' distribution. The availability of the species 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 gillnets, also small mesh nets, seine nets and hook and line (recreational)
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, rock lobster fishing licence, small mesh gillnet licence, class seine licences) **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 gillnets with lesser quantities taken by small mesh nets and seine (Fig. 7.1A). 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. Catch increased from a historic low of 2.8 t in 2014/15 to 7.4 t in 2015/16. 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 with only 1.9 tonnes in the 2015/16 fishing 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 AFMA as two stocks. The Tasmanian fishery is now mainly centred off the southeast coast and thus probably targets the eastern stock (Fig. 7.2). Historically, catches have also taken off the north and northwest coasts, 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. 7.1A), 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 the increase in commercial gillnet effort and catch rates between 1995/96 and 1998/99 that resulted in an increase in landings, effort has fallen to substantially lower levels and in recent years has remained low (Fig. 7.1B, C), influenced by the limited availability of Blue Warehou in Tasmanian waters. Catch rates stabilized after 2000/01 at a lower level, with minor peaks in 2009/10 and again 2015/16.

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 the depleted stock status (the consequence of historical overfishing) (Bell et al. 2016). There is no new information to suggest that this situation has changed since then. Post-release survival of any by-catch of this species is very low (Lyle et al, 2014).

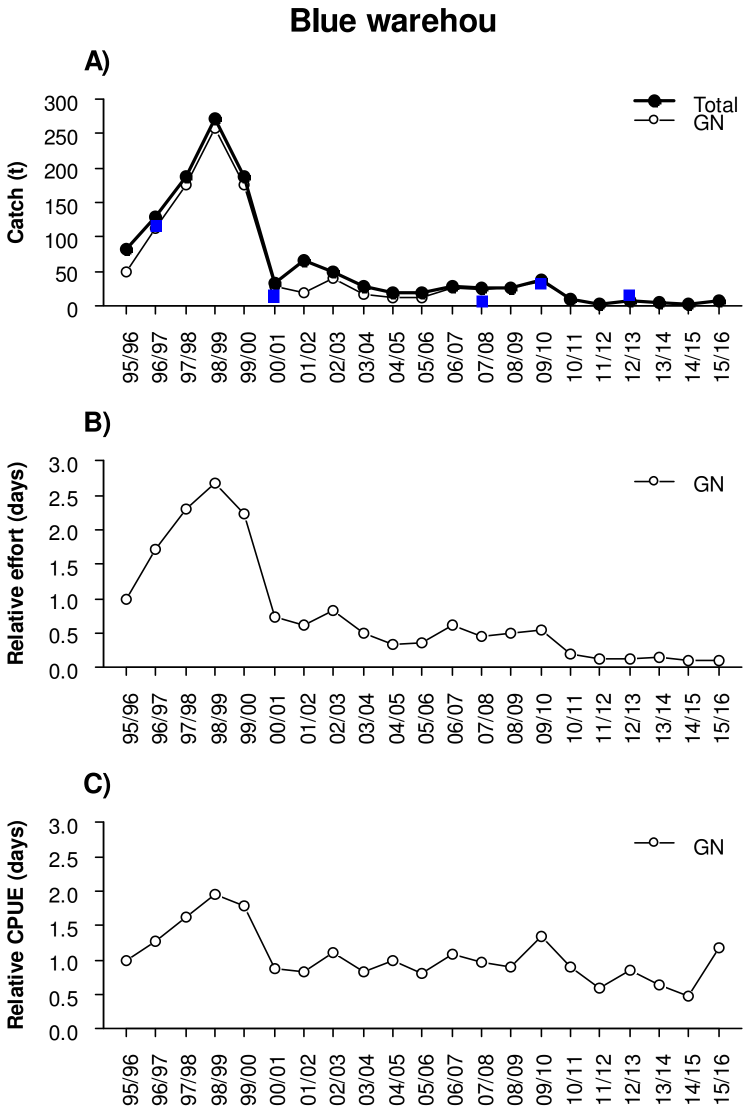
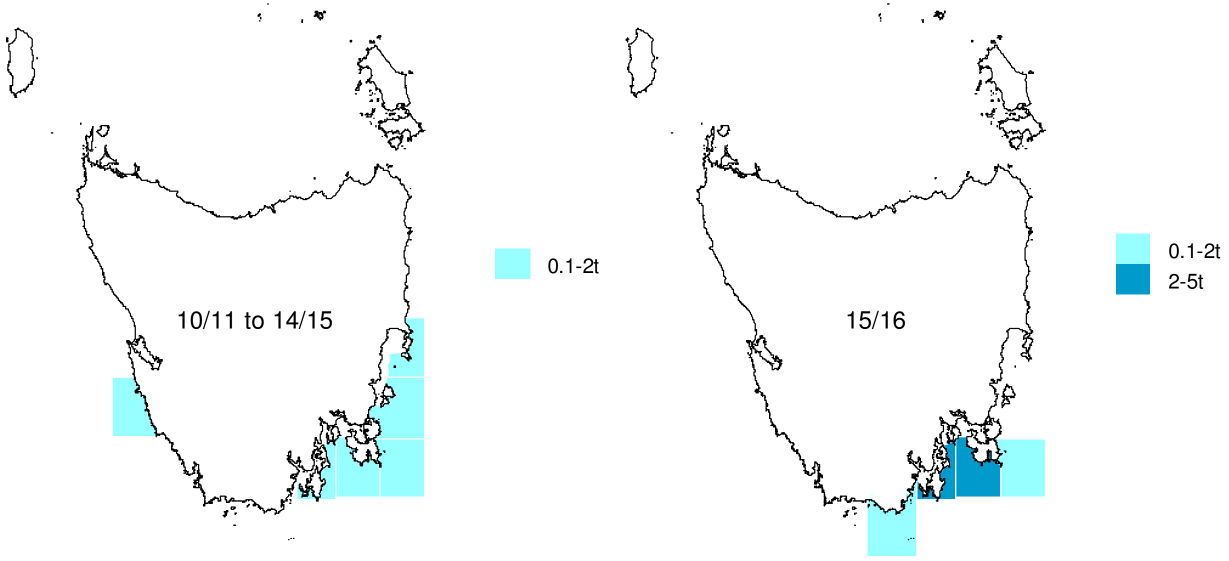


Figure 7.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. GN= gillnet.

A) Catch



B) Effort

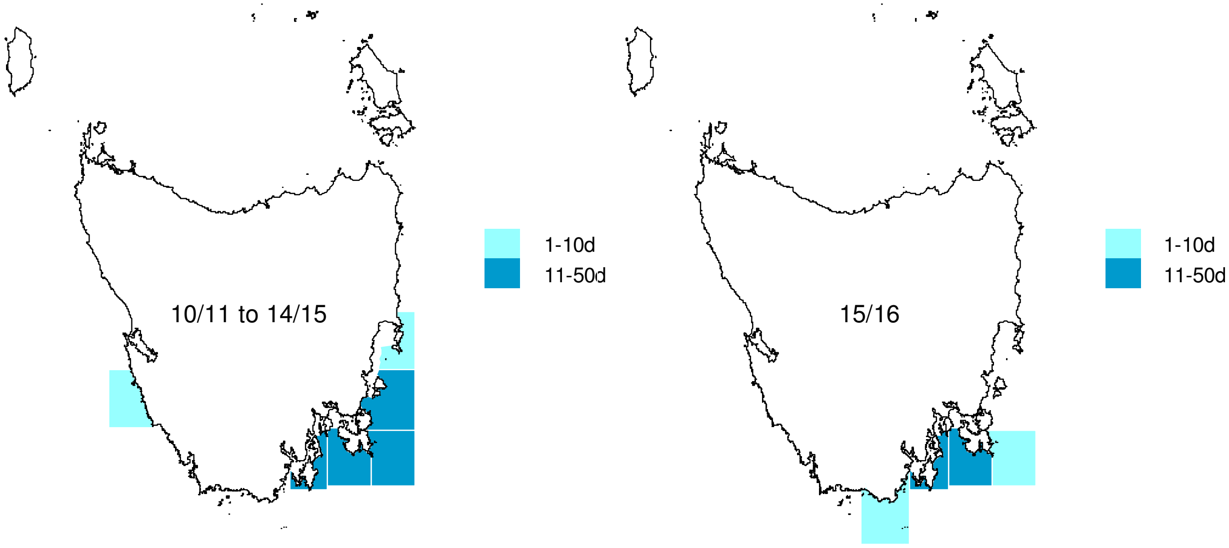


Figure 7.2 (A) Blue Warehou catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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 (187 t)	No	
	• Catch < 3rd lowest catch value from the reference period (27.6 t)	Yes	↓ 20.2 t (73.1%)
	• 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 (152.8 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)	No	
	• Rate of CPUE decline over last 3 years is greater than the largest 3-year CPUE decline during the reference period (-0.0126)	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 decreasing catch of Blue Warehou over the last 20 years is 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 the Tasmanian recreational catch of Blue Warehou now exceeds the catches from Commonwealth and Tasmanian commercial fisheries. 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.

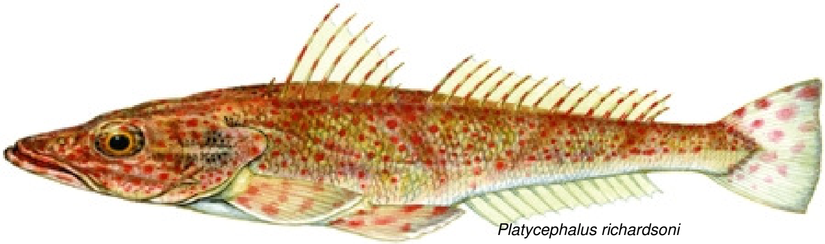
Blue Warehou is under a Commonwealth rebuilding strategy (first introduced in 2008 and later reviewed in 2014), which aims in the first instance to rebuild both east and west stocks to or above the default limit reference biomass point (B_{LIM}) of 20 per cent of the unfished spawning biomass by 2024 (AFMA 2014). Consequently, the Commonwealth Total Allowable Catch (TAC) for Blue Warehou has been progressively reduced since 2003, and was further reduced to 118 t (split 27 t in the east and 91 t in the west) in 2012/13 (AFMA 2012). AFMA considers the reduction in recent catches (just 1.9 t in 2015/16 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 start 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 2016 as overfished (for biomass) and uncertain (for fishing mortality (Patterson et al. 2016). As such, Blue Warehou is assessed as overfished in Tasmanian waters.

8. Tiger Flathead

Platycephalus richardsoni

STOCK STATUS	**SUSTAINABLE**
This is a predominately Commonwealth-managed species that is classified as sustainable by AFMA (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 and while catches have fluctuated between 20-60 tonnes in recent years they have typically represented well under 5% 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 $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$	Edgar (2008) Gomon et al.(2008) Barnes et al. (2011)

<table>
<tr>
<td></td>
<td>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:
<table>
<tr><th><i>Sex</i></th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr>
<tr><td>Females</td><td>750.2</td><td>0.13</td><td>-1.0</td></tr>
<tr><td>Males</td><td>418.9</td><td>0.26</td><td>-1.0</td></tr>
</table>
Length-weight relationship was estimated at $W = 3.25 \text{ x } 10^{-6} L^{3.13}$ for females and males combined where W is weight (g) and L is the total length (mm).</td>
<td></td>
</tr>
<tr><td>Maturity</td><td>Reach sexual maturity at 4-5 years and total length of 30 cm for males and 36 cm for females.</td><td>Fairbridge (1951)</td></tr>
<tr><td>Spawning</td><td>December to February</td><td>Kailola et al. (1993)
Jordan (2001b)</td></tr>
<tr><td>Early life history</td><td>Unknown</td><td>Jordan (2001b)</td></tr>
<tr><td>Recruitment</td><td>No-stock recruitment relationship established</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>Moderate: 50% (all soak durations and including both graball and mullet nets)</td><td>Lyle et al. (2014a)</td></tr>
<tr><td>Rod and-line post release survival</td><td>High: >99% for circle hooks and 94–97% for conventional hooks.</td><td>Lyle et al. (2007)</td></tr>
</table>

Background

Several flathead species occur in Tasmanian waters, with Tiger Flathead dominating commercial catches taken by Danish seine. Since Sand Flathead and Tiger Flathead were not routinely distinguished in commercial catch returns until 2007; species specific catches prior to 2007 have been inferred using the species proportions, by method, for catches taken between 2007/08 and 2011/12. Species specific fishing effort and catch rates are only considered reliable since 2007/08.

Tiger Flathead constitute a minor component of the recreational harvest of flathead (< 10%, Lyle et al. 2014a).

FISHING METHODS	Danish seine
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, Danish seine 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 2015/16 total commercial catch of Tiger Flathead was 64.4 t, up from 23.5 t in 2014/15. As the commercial fishery for Flathead has not undergone major changes in its operations since 1995/96 it was feasible to back calculate catches prior to 2007 (Fig. 8.1). Tiger Flathead landings have been variable over time, fluctuating between 20 and 60 t per annum without an obvious trend (Fig. 8.1 and 8.2).

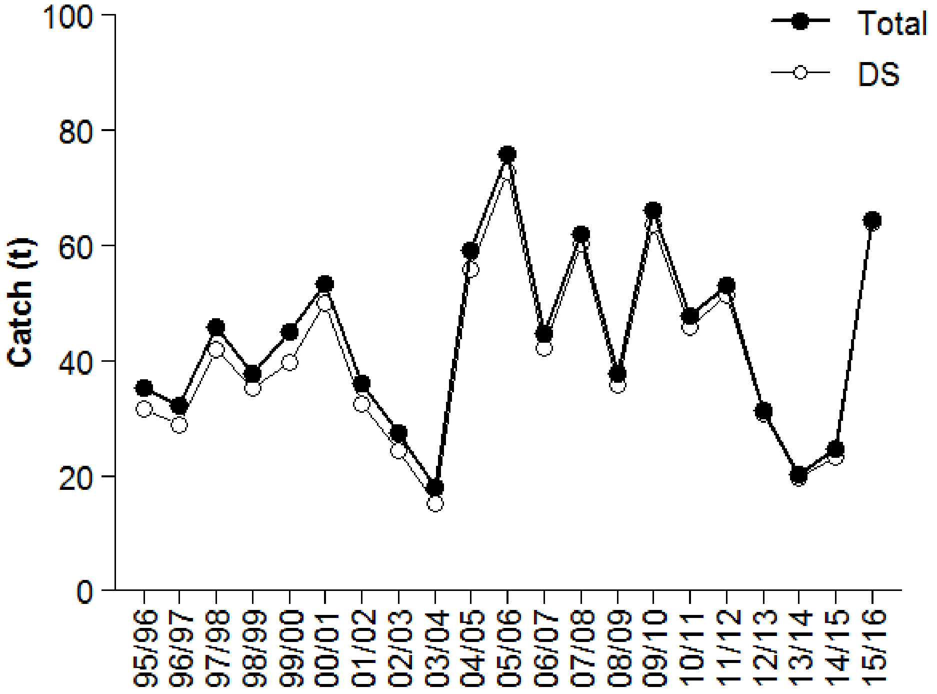


Figure 8.1 Back-calculated annual commercial catch (t) by gear for Tiger Flathead.

Although Danish seine effort in 2015/16 was comparable to that for the previous year the sharp increase in catch rate resulted in a more than doubling of the catch (Fig. 8.2). Danish seine catch rates have fluctuated strongly in recent years and presumably reflect the degree of targeting of the species (Fig. 8.2). Peaks in Danish seine CPUE are influenced by a small number of operators that have primarily targeted Tiger Flathead during those years. Catches in 2015/16 were derived mainly from the southeast and east coasts (Fig. 8.3).

Recreational Flathead catches (predominately Sand and Tiger Flathead) 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).

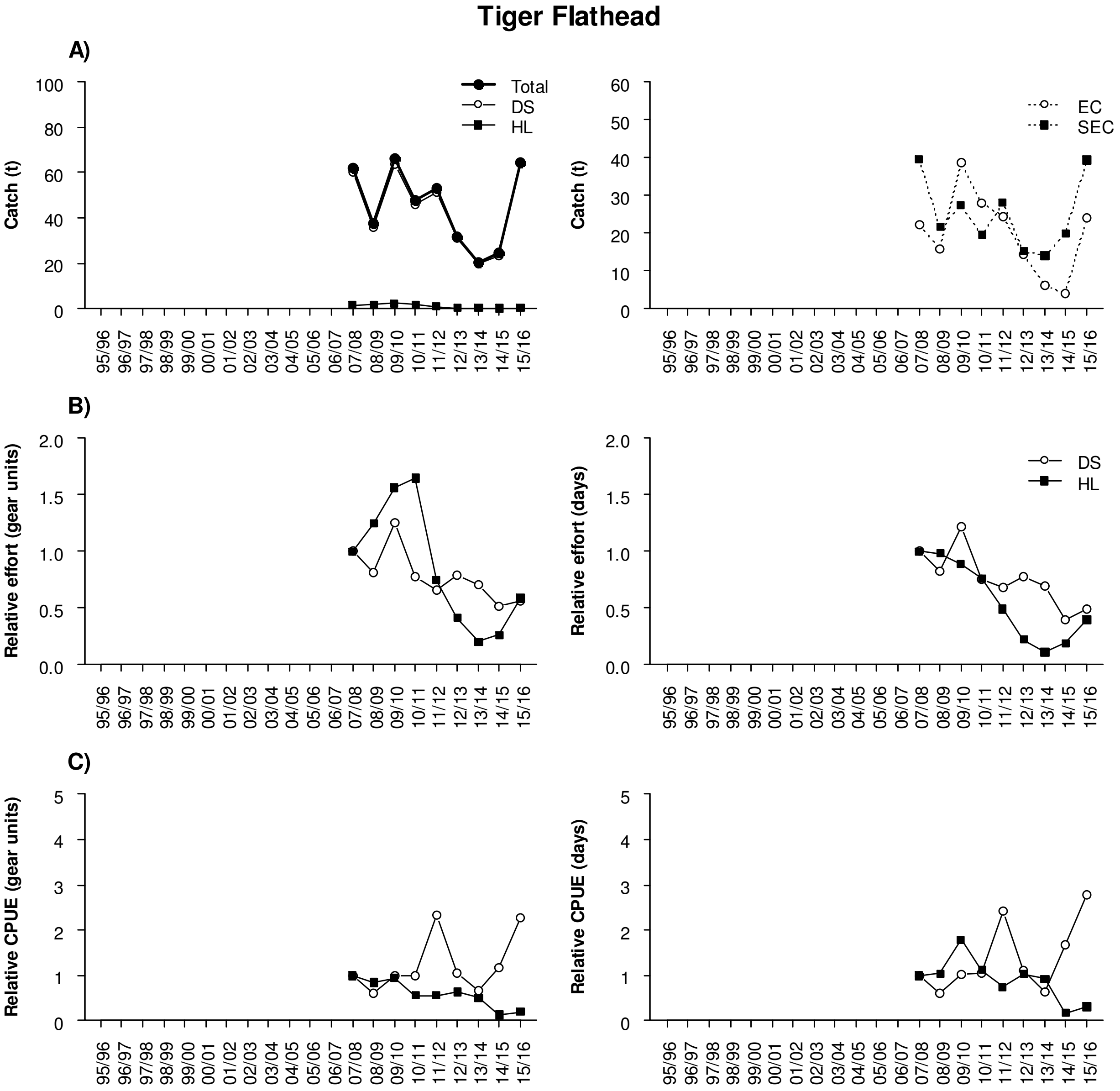
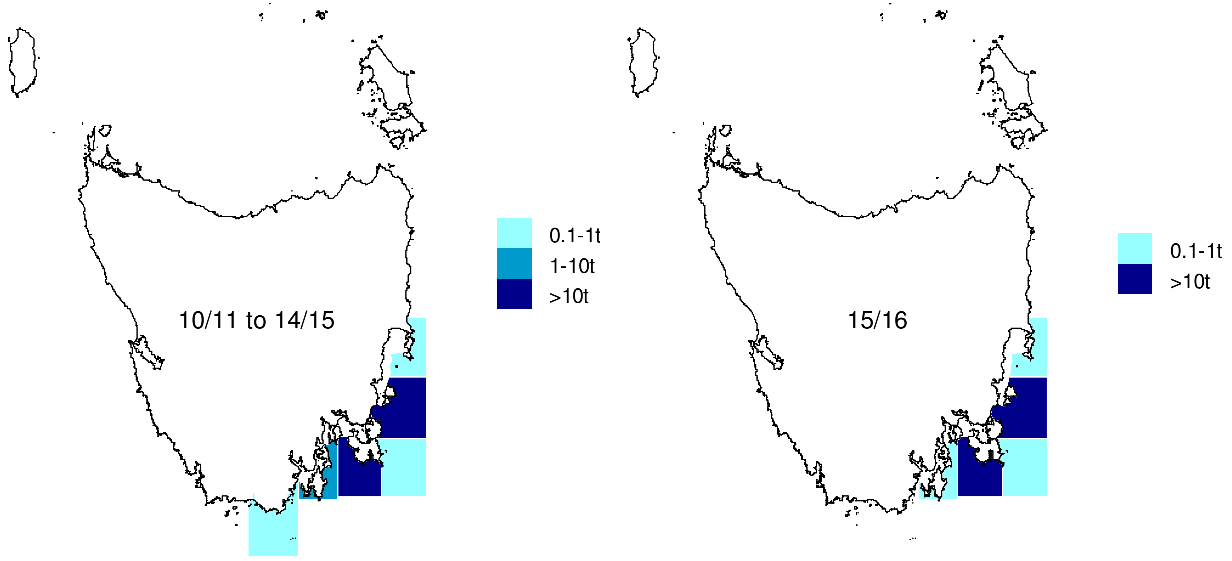


Figure 8.2 A) Tiger Flathead annual commercial catch (t) by gear (left) and region (right). B) Tiger Flathead commercial effort by method based on gear units (left) and day fished (right) relative to 2007/08. C) Tiger Flathead commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 2007/08. DS= Danish seine, HL= hand-line, SEC= southeast coast, EC= east coast.

A) Catch



B) Effort

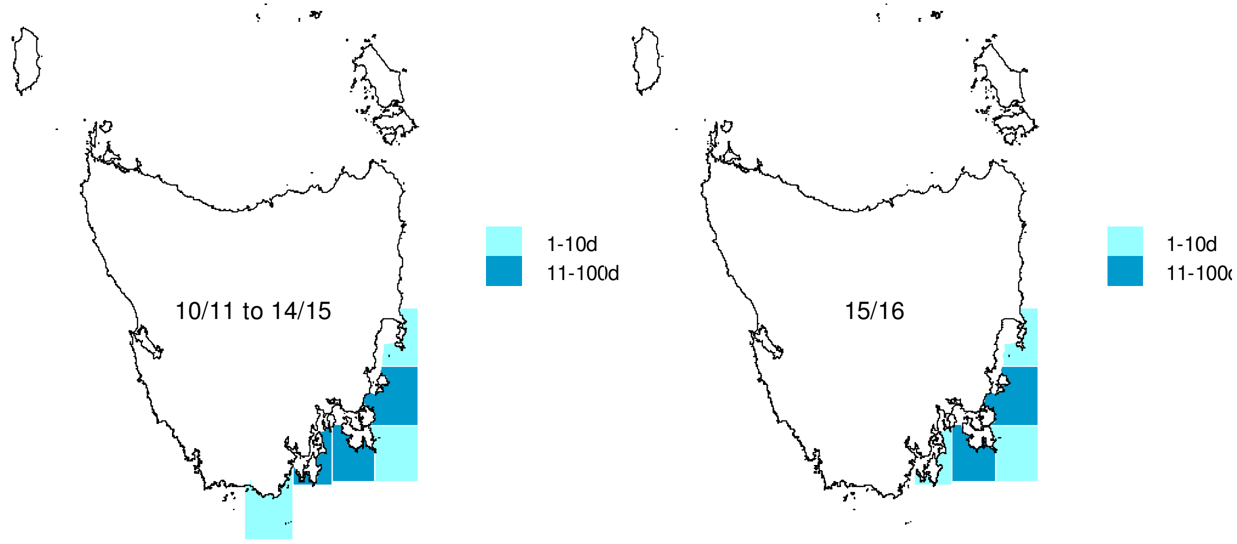


Figure 8.3 (A) Tiger Flathead catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points for Flathead (combined).

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	- Catch > 3rd highest catch value from the reference period (63.1 t)	Yes	↑ 1.3 t (2%)
	- Catch < 3rd lowest catch value from the reference period (50.5 t)	No	
	- Catch variation from the previous year above the greatest inter-annual increase from the reference period (-32.6 t)	Yes	↑ 8.3 t (25.5%)
	- 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)	No	
	- 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	**SUSTAINABLE**

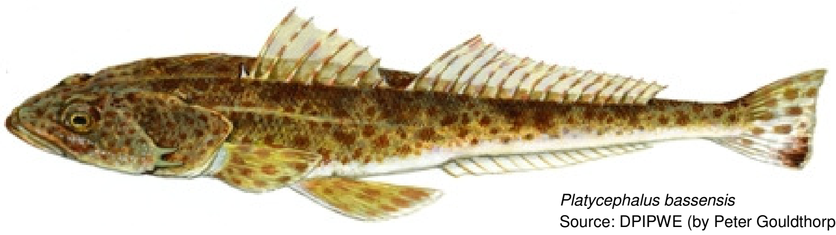
Danish seine catches are highly variable and have tended to be inversely related with catches of School Whiting (refer Fig. 2.1), which are also targeted using the method. Tiger Flathead catches increased to 64.4 tonnes in 2015/16, while School Whiting catches also increased (to 23.4 tonnes), indicative of an overall increase (doubling) in Danish seine effort (days fished) compared with 2014/15 (Fig. 3.10, Table A2). While commercial catches of Tiger Flathead have been maintained at comparable 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 2015 fishing season the total Commonwealth catch of Tiger Flathead was 2,908 t, so the Tasmanian catches only constitute a fraction (around 2%) 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, Patterson et al. 2016). In accordance with the Commonwealth assessment, Tiger Flathead is assessed as sustainable in Tasmanian waters.

While Tiger Flathead constitute a minor component of the recreational Flathead catch, various management changes were introduced in 2015 to improve the sustainability of flatheads in general; 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.

9. Southern Sand Flathead

Platycephalus bassensis

STOCK STATUS	**TRANSITIONAL DEPLETING**
Various 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 2015/16 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.	Edgar (2008) Gomon et al.(2008) Bani (2005) Gomon et al.(2008)

<table>
<tr><td></td><td>Parameters estimates (for Coles Bay) are:<table><tr><th>ex</th><th>L_{∞}</th><th>k</th><th>$t_{0\infty}$</th><th>Year</th></tr><tr><td>Females</td><td>39.01</td><td>0.25</td><td>-1.57</td><td>001/02</td></tr><tr><td></td><td>45.35</td><td>0.15</td><td>-2. 3</td><td>2002/03</td></tr><tr><td>Males</td><td>37.43</td><td>0.21</td><td>-1.76</td><td>2001/02</td></tr><tr><td></td><td>34.40</td><td>0.39</td><td>- .51</td><td>2002/03</td></tr></table></td><td></td></tr>
<tr><td>Maturity</td><td>• 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.</td><td>Bani and Moltschaniwsky (2008)</td></tr>
<tr><td>Spawning</td><td>• From October to March, with a peak from October-December. Spawning occurs throughout their range in southern and eastern Tasmania, including on the shelf.</td><td>Kailola et al. (1993)
Jordan (2001b)</td></tr>
<tr><td>Early life history</td><td>• Settlement occurs over an extended period, between 4 to 14 months after spawning
• Size at settlement around 2.1 cm.</td><td>Jordan (2001b)</td></tr>
<tr><td>Recruitment</td><td>• No-stock recruitment relationship established</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>• Moderate: 50% (all soak durations and including both graball and mullet nets)</td><td>Lyle et al. (2014a)</td></tr>
<tr><td>Rod and line post release survival</td><td>• High: >99% for circle hooks and 94–97% for conventional hooks.</td><td>Lyle et al. (2007)</td></tr>
</table>

Background

Several flathead species occur in Tasmanian waters. Sand Flathead are mainly caught commercially by hand-line, with the species also taken as a by-product in gillnets and Danish seines. Since Sand Flathead and Tiger Flathead were not routinely distinguished in commercial catch returns until 2007 species specific catches prior to 2007 have been inferred using the species proportions, by method, for catches taken between 2007/08 and 2011/12. Species specific fishing effort and catch rates are only considered reliable since 2007/08.

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

FISHING METHODS	Hand-line, rod and reel, and gillnet (Sand Flathead)
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence and Danish seine 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, Norfolk and Frederick Henry 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 2016 represent a range of suitable habitats (including depths) for targeting Sand Flathead and provide wide spatial coverage within the given region.

Size composition

Length frequency histograms from the fishery-independent survey (Fig. 9.1) indicate that the majority of Sand Flathead in the D'Entrecasteaux Channel and Norfolk and Frederick Henry Bay were below the minimum size limits, indicating a low abundance of legal sized fish (Fig. 9.1A and 9.1B). Conversely, in Great Oyster Bay approximately half of the fish were larger than 300 mm in each of the years sampled (Fig. 9.1C).

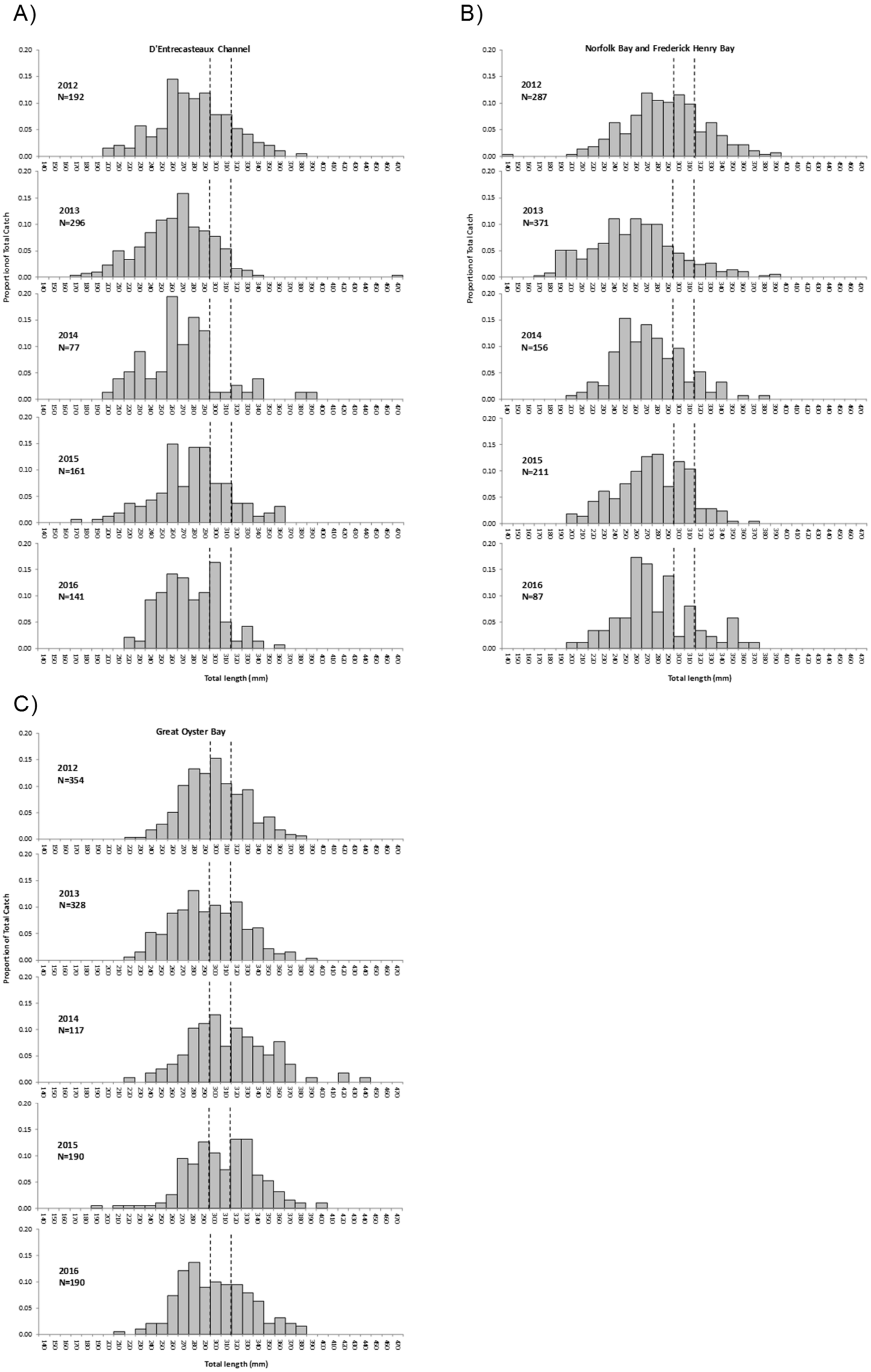


Figure 9.1 Length frequency histograms for Sand Flathead captured in: A) D'Entrecasteaux Channel; B) Norfolk and Frederick Henry Bay; and C) Great Oyster Bay. Dotted lines indicated minimum legal size limits (300 mm applied to 2015, 320 mm thereafter).

Age composition

Age frequency histograms from the fishery-independent survey (Fig. 9.2) indicate that up until 2016 four year olds represented the peak age class of Sand Flathead in the D'Entrecasteaux Channel and Norfolk and Frederick Henry Bay and that the abundance and proportion of females declines rapidly in the older age classes (Fig. 9.2A and 9.2B). The 2016 the modal age class was five year olds, a likely response to the additional protection afforded by the increase in the minimum size limit (to 320 mm) during in 2015. Conversely, in Great Oyster Bay the age structure was strongly influenced by older age classes up until 2016, when there was a sharp reduction in the representation of age classes greater than five year olds (Fig 9.2C). It is unclear whether the poorer representation of the older age classes (i.e. 6+) is indicative of past fishing pressure or an artefact of sampling. If the former the data suggest that the cohorts that have been particularly abundant in the past have now been fished to lower levels and the age composition is more consistent with the other two regions. 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).

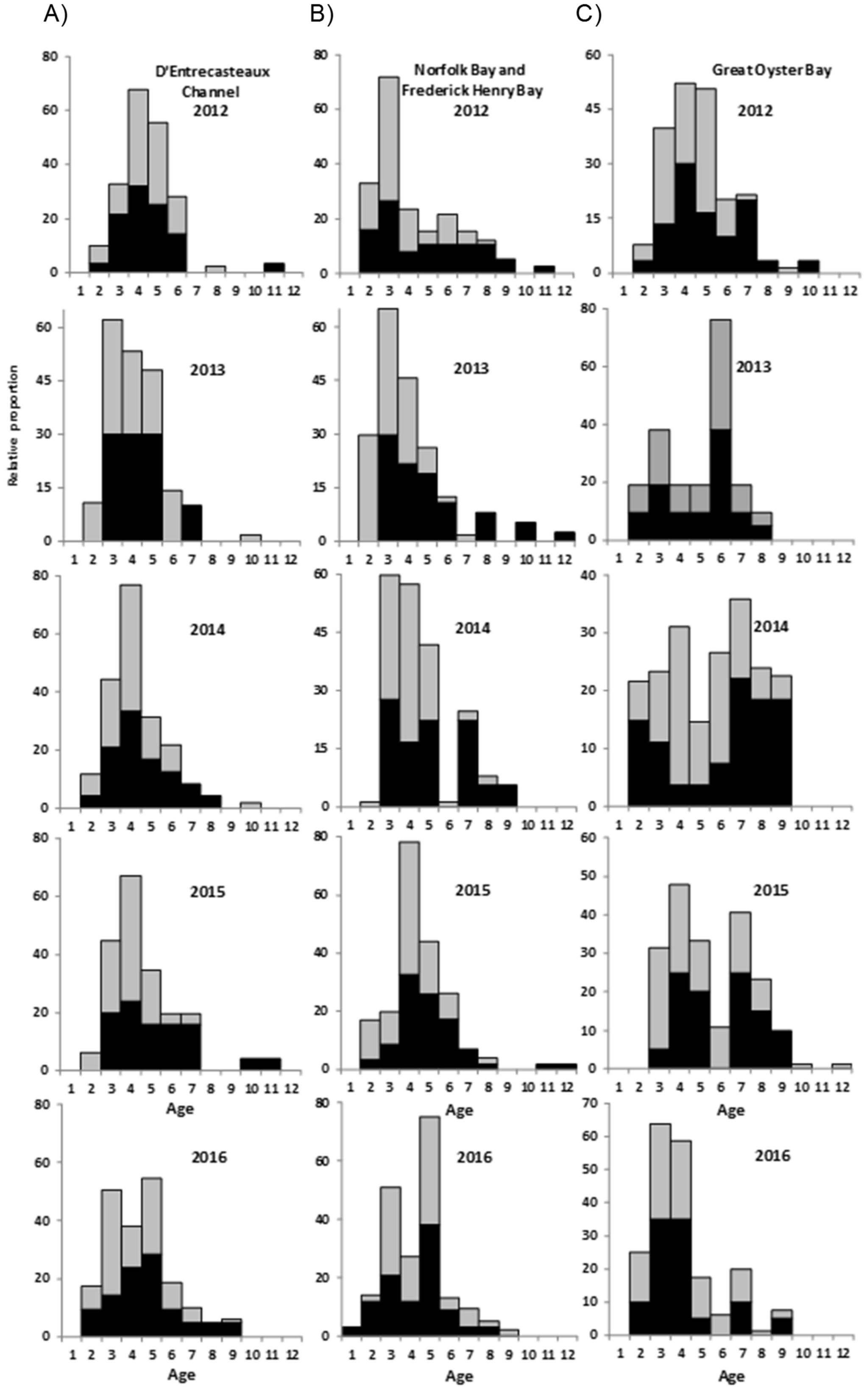


Figure 9.2 Age frequency histograms for aged Sand Flathead for A) D'Entrecasteaux Channel; B) Norfolk Frederick Henry Bay; and C) Great Oyster Bay. The black bars indicate males and grey bars indicate females.

Survey CPUE

Standardised catch rates from the fishery-independent survey suggest that the populations of legal sized Sand Flathead in the D'Entrecasteaux Channel and Great Oyster Bay have stabilised but at a depleted levels compared with 2012 (Fig. 9.3C& D). By contrast, the standardised catch rate in Norfolk-Frederick Henry Bay declined to its lowest level in 2016 implying that further reductions in legal sized abundance may have occurred despite new size and bag limits (Fig. 9.3C). 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).

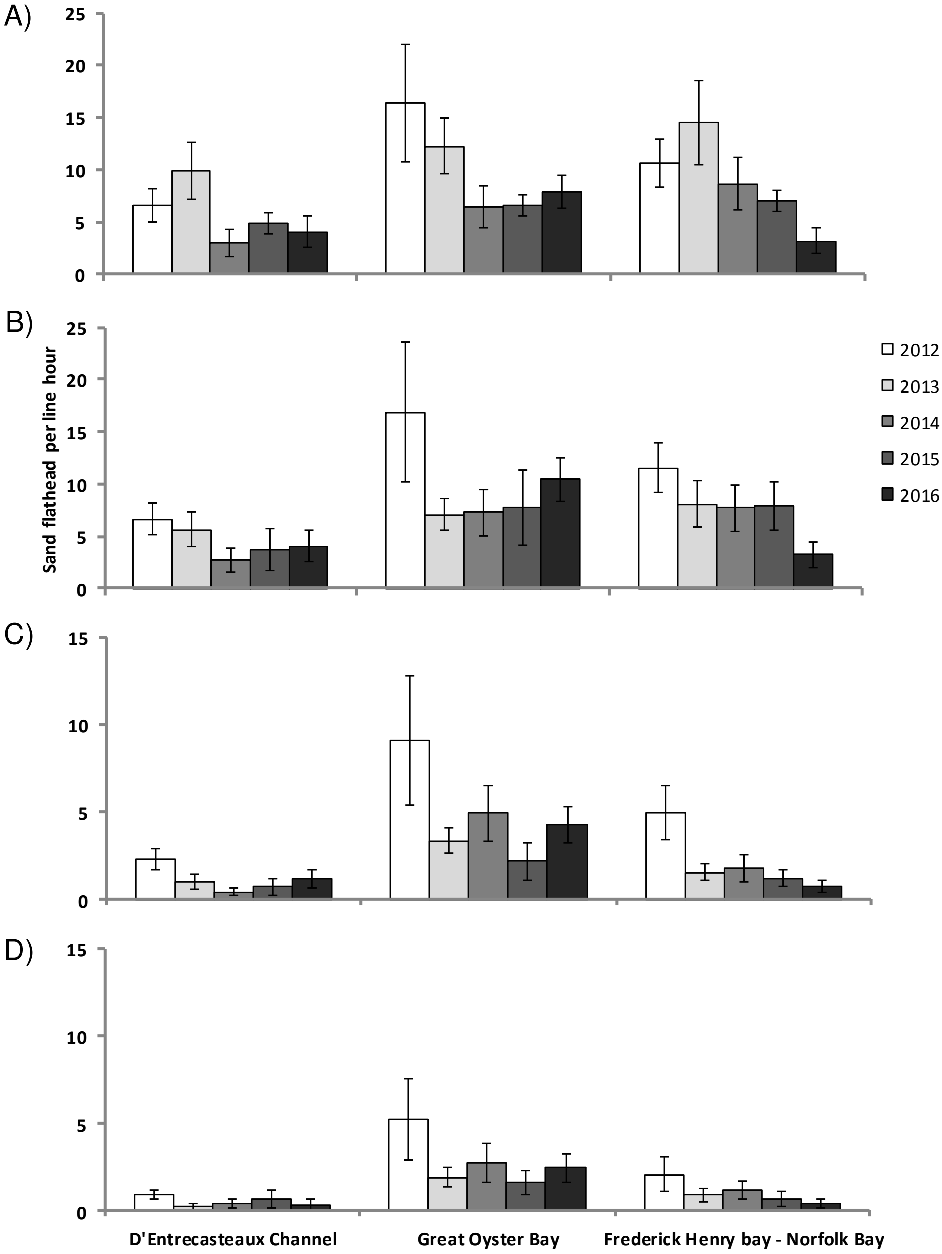


Figure 9.3 Mean catch rates (fish per line hour) by region and year for Sand Flathead: (A) raw catch rates; (B) standardised catch rates; (C) standardised catch rates for fish above the original 300mm MLS, and (D) standardised catch rates for fish above the new 320mm MLS. Error bars represent 95% confidence intervals.

Commercial catch, effort and CPUE

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. 9.4). Sand Flathead catches remained relatively stable between 10 and 15 t per annum until 2008/09 but have generally declined since then to just 2.5 t in 2015/16 (Fig. 9.4 and 9.5).

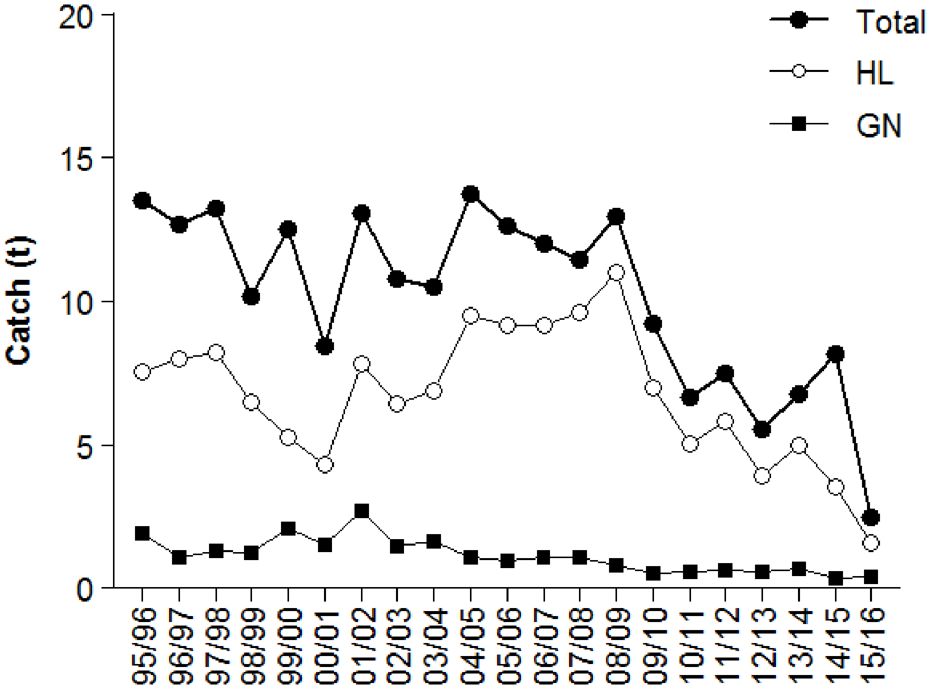


Figure 9.4 Back-calculated annual commercial catch (t) by gear for Sand Flathead. HL = hand line and GN = gillnet (catches taken by other methods are not shown).

Hand-line fishing effort has been relatively stable the last four fishing seasons after significant declines but both catches and catch rate declined (Fig. 9.5). 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 2015/16 were derived mainly from the southeast and east coasts (Fig. 9.6).

Recreational Flathead (all species) 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 flathead species taken by recreational fishers (>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).

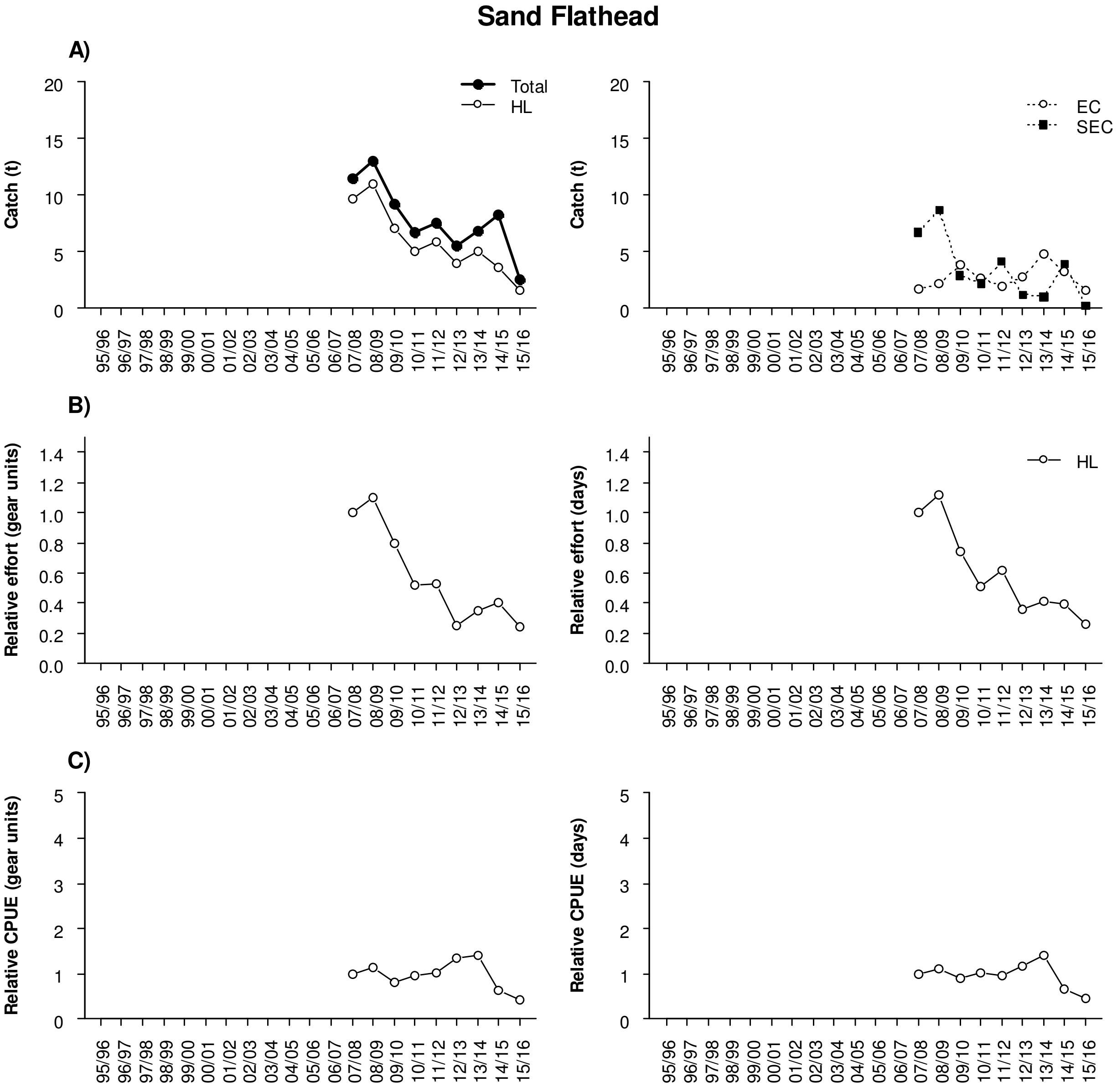


Figure 9.5 A) Sand Flathead annual commercial catch (t) by gear (left) and region (right). B) Sand Flathead commercial effort by method based on gear units (left) and day fished (right) relative to 2007/08. C) Sand Flathead commercial catch per unit effort (CPUE) based on weight per gear unit (left) and weight per day fished (right) relative to 2007/08. HL= hand-line, SEC= southeast coast, EC= east coast.

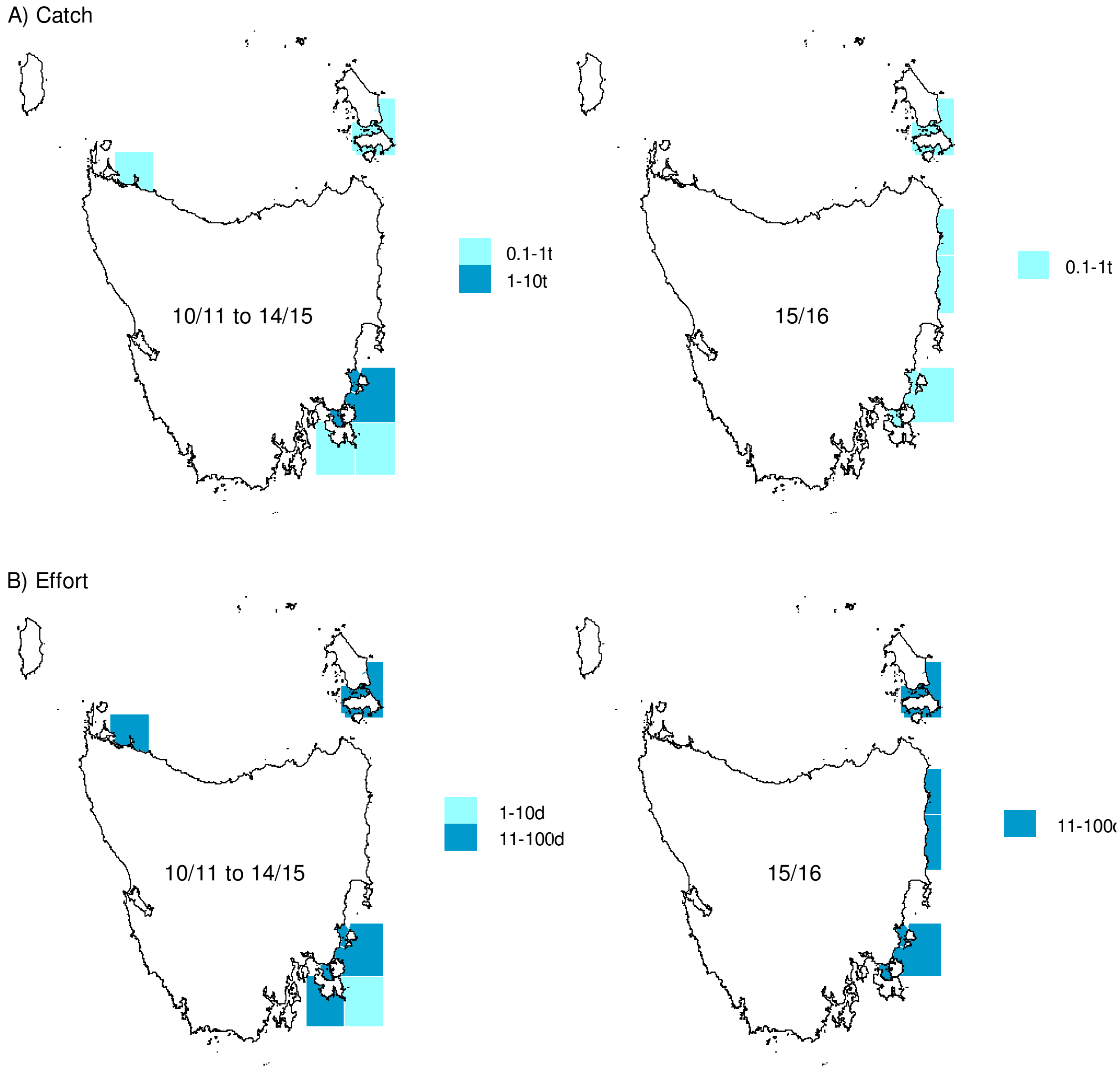


Figure 9.6 (A) Sand Flathead catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points for Flathead (combined)

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (63.1 t)	Yes	1.3 t (2%)
	• Catch < 3rd lowest catch value from the reference period (50.5 t)	No	
	• Catch variation from the previous year above the greatest inter-annual increase from the reference period (-32.6 t)	Yes	8.3 t (25.5%)
	• 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)	No	
	• 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

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.

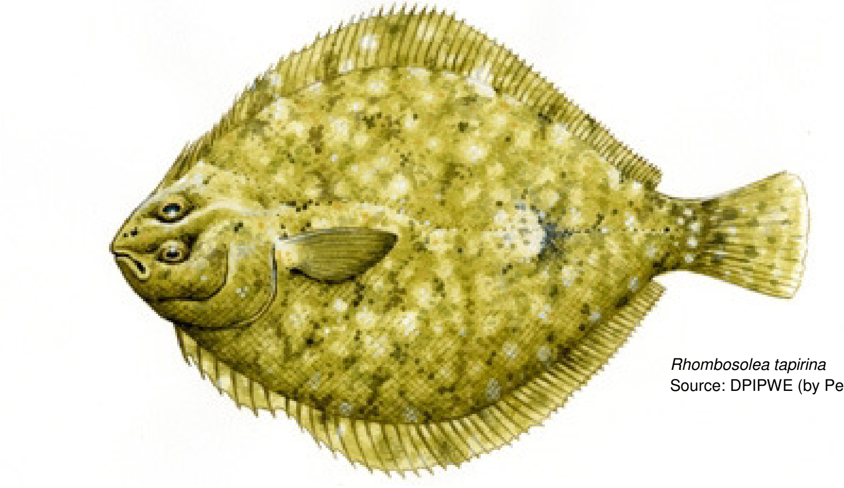
The survey over the last four years has identified a low relative abundance of legal size fish, particularly in the D'Entrecasteaux Channel and Frederick Henry-Norfolk Bay with a higher proportion of older age class males, which is likely a factor of females reaching the minimum size limit faster than slower growing males (Ewing and Lyle 2015). Catch rates suggest that the abundances of legal sized fish in each of the major fishing areas are depleted relative to historic levels.

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.

10. Flounder

Pleuronectidae family

STOCK STATUS	**UNDEFINED**
Greenback Flounder constitute the majority of the commercial catch, which remains low influenced by the ban on overnight gillnetting and limited 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 $L = L_\infty\left(1 - e^{-k(t-t_0)}\right)$	Edgar (2008) Kailola et al. (1993) Sutton et al. (2010)

<table>
<tr>
<td></td>
<td>where <i>L</i> is the fork length (cm), <i>t</i> is the age (years), L_∞ is the average maximum length for the species, <i>k</i> is a constant and t_0 is the (theoretical) age where length equals zero.
Parameters estimates are :
<table>
<tr><th>Sex</th><th>L_∞</th><th>k</th><th>$t_{0\infty}$</th></tr>
<tr><td>Females</td><td>55.82</td><td>0.26</td><td>-1.06</td></tr>
<tr><td>Males</td><td>52.21</td><td>0.24</td><td>-1.32</td></tr>
</table>
• Length-weight relationship was estimated at $W = 0.036\ L^{2.7}$ for females and $W = 0.039\ L^{2.64}$ for males where <i>W</i> is weight (g) and <i>L</i> is the tail length (cm).</td>
<td></td>
</tr>
<tr>
<td>Maturity</td>
<td>• Sexual maturity at about 218.6 mm TL for females and 190 mm TL for males.</td>
<td>Crawford (1984)</td>
</tr>
<tr>
<td>Spawning</td>
<td>• 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 <i>F</i> is the fecundity (in number of eggs) and <i>L</i> is the tail length (cm).
• Pelagic eggs, 0.7-1.0 mm in diameter</td>
<td>Crawford (1984)</td>
</tr>
<tr>
<td>Early life history</td>
<td>• 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.</td>
<td>Edgar (2008)
Crawford (1984, 1986)
Jenkins (1986)</td>
</tr>
<tr>
<td>Recruitment</td>
<td>• No-stock recruitment relationship established.</td>
<td></td>
</tr>
<tr>
<td>Gillnet post release survival</td>
<td>• High: 96.1%</td>
<td>Lyle et al. (2014a)</td>
</tr>
</table>

Background

While the various species of flounder 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 but in small quantities. The main fishing methods used to target flounder are spear and gillnet, however, a 2010 ban on the overnight setting of gillnets in most waters has resulted in a marked reduction in gillnet fishing for flounder.

FISHING METHODS	Spear, gillnet, 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 a historical low of 1 t in 2015/16 (Fig. 10.1A). Since the ban on night netting, Flounder have been caught almost exclusively using spear. Commercial catches have contracted spatially over recent years to Norfolk Bay and the Tamar estuary (Fig. 10.2).

Consistent with the trend in catches, effort for both methods has been declining steadily since the mid-1990s, with gillnet effort currently at minimal levels (Fig. 10.1B). Catch rates for spear have been relatively steady over time, although there has been a general decline in gillnet catch rates (Fig. 10.1C).

Flounder is a relatively important recreational species, and catches for the recreational sector exceed those of the commercial sector (Fig. 10.1A). 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).

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). There is no new information to suggest that this has changed otherwise since then.

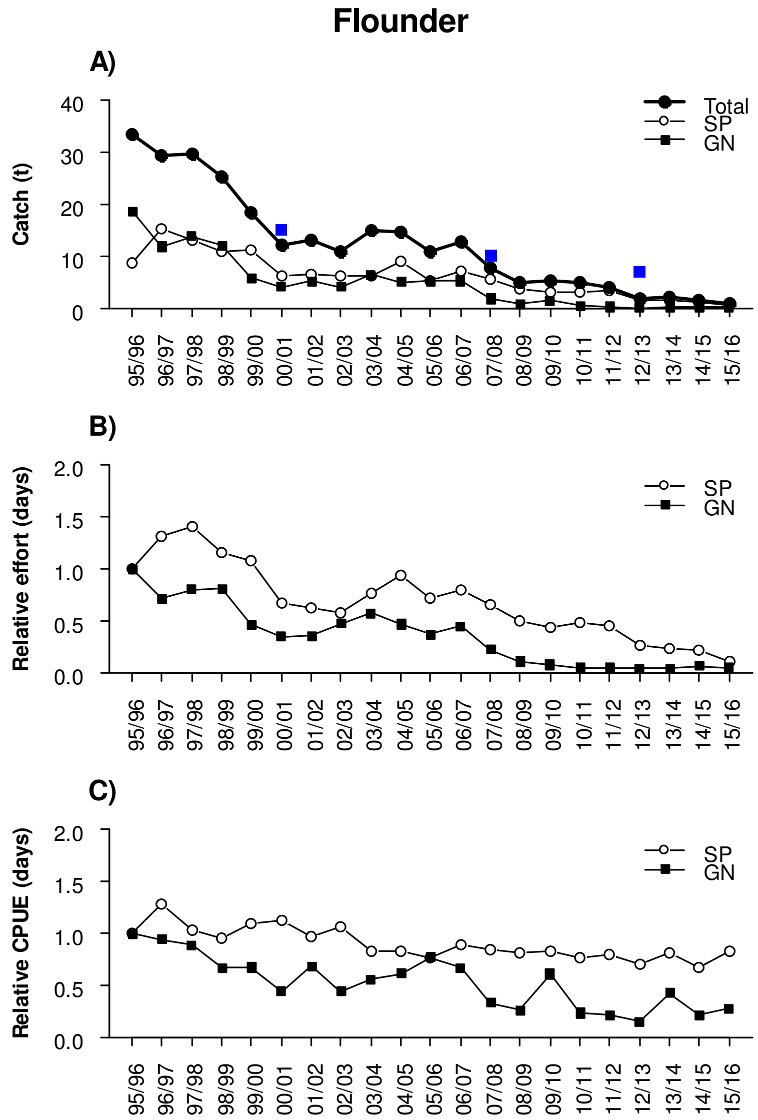
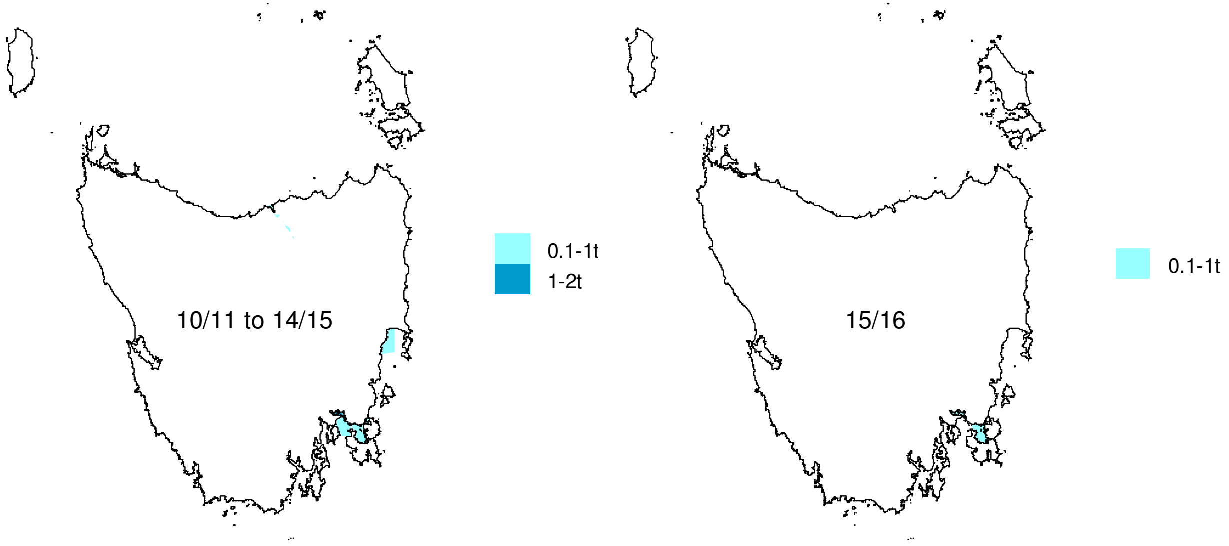


Figure 10.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. SP= spear, GN= gillnet.

A) Catch



B) Effort

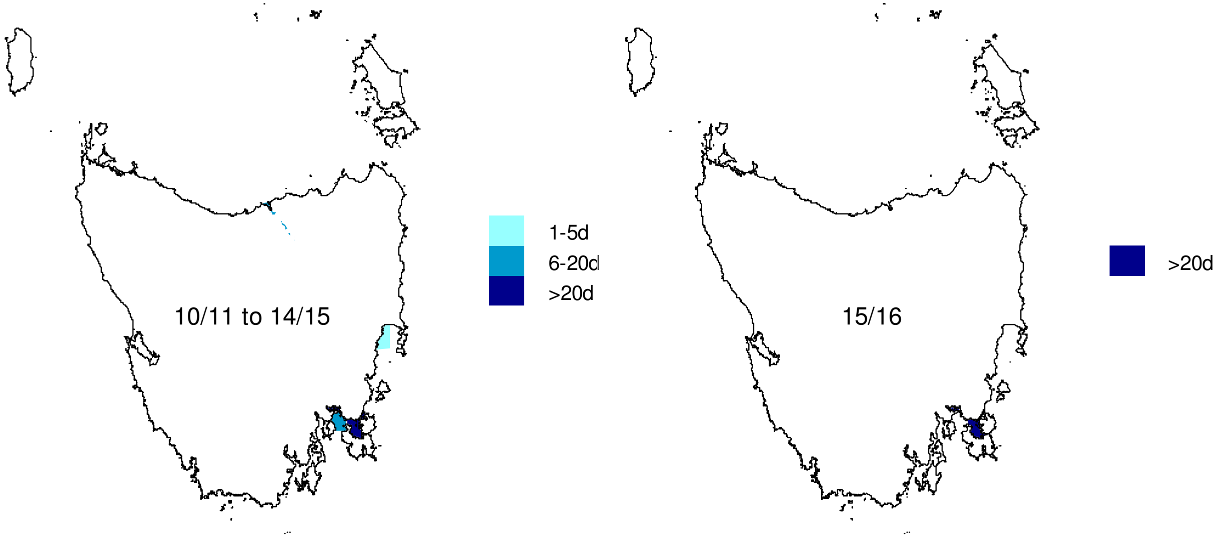


Figure 10.2 (A) Flounder catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 11.3 t (91.5%)
	• 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

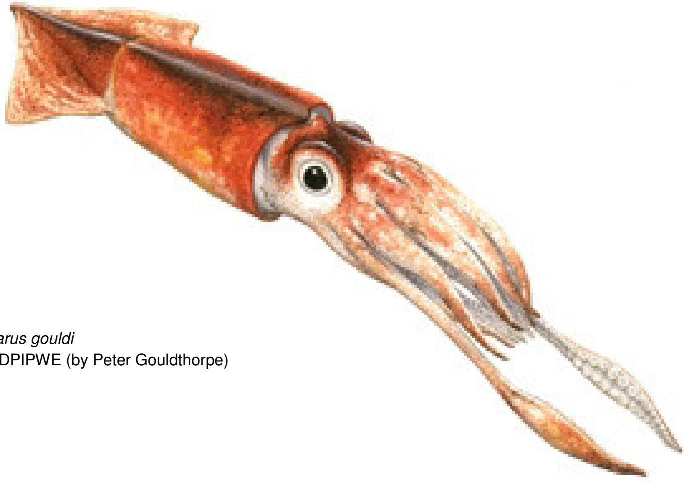
UNDEFINED

The declining flounder catch 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 and catch rates are considered unreliable estimators of trends in abundance. There is insufficient information to confidently classify this stock.

11. Gould's Squid

Nototodarus gouldi

STOCK STATUS	**SUSTAINABLE**
This is a predominately Commonwealth-managed species that is classified as sustainable by AFMA (see: http://www.afma.gov.au/portfolio-item/goulds-squid/). Dual-licensed vessels fish in Tasmanian waters especially in years of peak abundance. The 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 - 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.	Norman and Reid (2000) 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 licensed vessels tend to fish in State waters during 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. 11.1A). Since 1995/96, there have been a few peaks of abundance, notably in 1999/2000, 2011/12, 2012/13 and again in 2015/16. 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). During 2015/16 a total of 325.1 tonnes of Gould's Squid were landed in Tasmanian waters, all but one tonne of which was taken by automatic jig. 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.11.2).

Gould's Squid catches from the recreational sector (Fig. 11.1A) 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. 11.1B).

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. 11.1C).

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 (Bell et al. 2016).

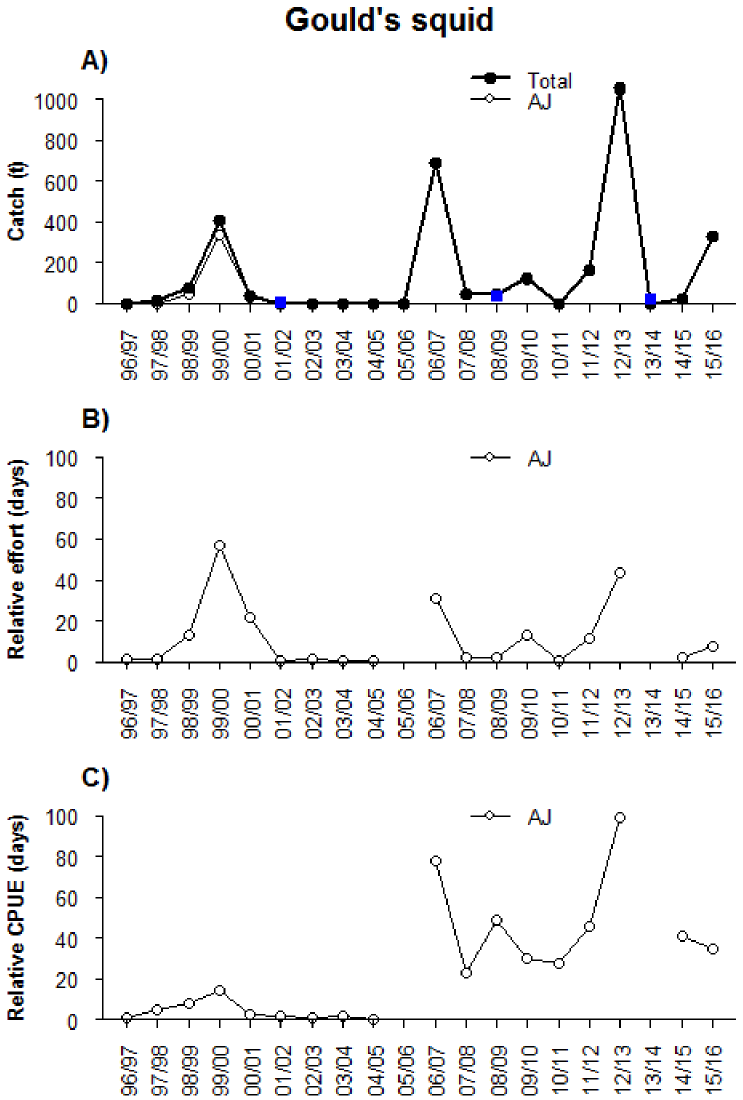


Figure 11.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on days fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished (right) relative to 1995/96. AJ = automatic squid jig. Note: no catch or effort using Automatic squid jig was recorded for 2005/06, 2006/07 or 2013/14.

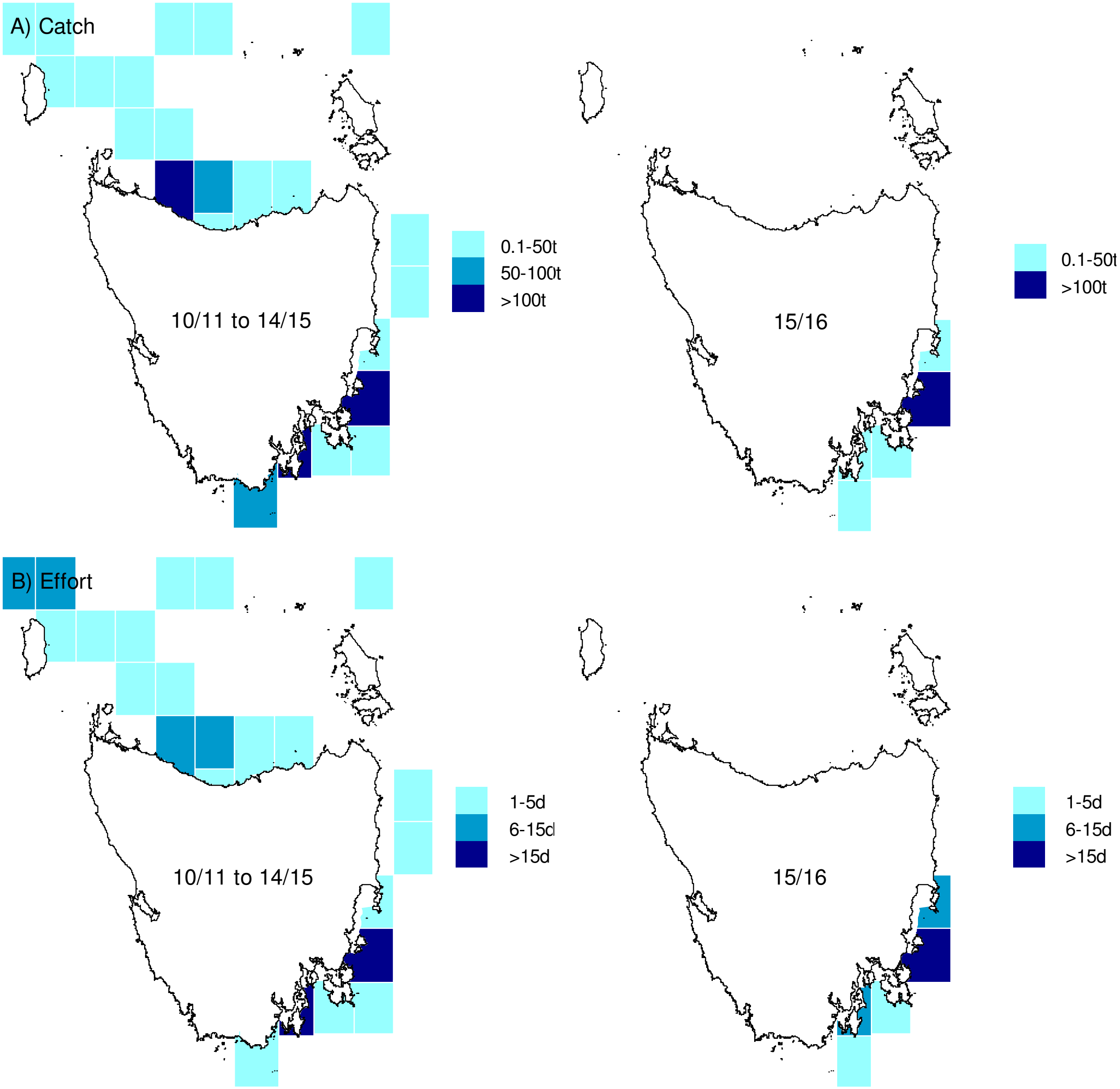


Figure 11.2 (A) Gould's Squid catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right). No notable catch of Gould's Squid was recorded in 2013/14 and the data includes AFMA catch in State waters.

Reference points

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (37.9 t)	Yes	↑ 287.2 t (758%)
	• 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)	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 highest catch was breached, however, relative to years of high squid abundance in Tasmanian waters, 325 tonnes of Gould's Squid landed in 2015/16 represented a moderately high catch. Spatial variability in the distribution and abundance of Gould's Squid is a characteristic of this species and thus the strong inter-annual variability in the Tasmanian fishery needs to be considered in the context of the overall fishery and population status.

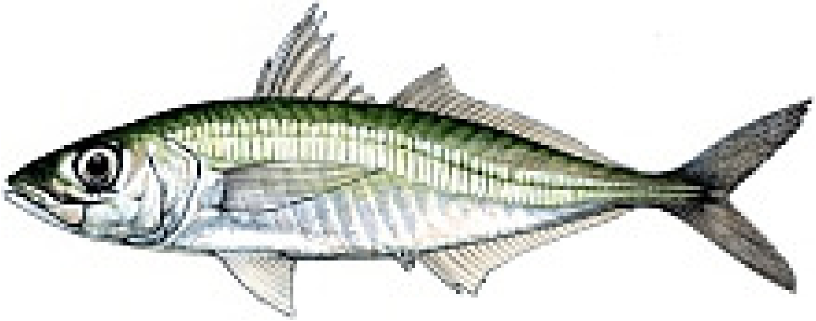
A recreational reference point was also breached, however it is unlikely that the recreational sector poses a threat to the stock as estimated catches remain small in comparison to the commercial sector when Gould's Squid are available in Tasmanian waters and even more so when the Southern Squid-jig 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 2015 Fishery Status Reports (Patterson et al. 2016), 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.

12. Jack Mackerel

Trachurus declivis

STOCK STATUS	**SUSTAINABLE**
This is a predominately Commonwealth-managed species that is classified as sustainable by AFMA (see: http://www.afma.gov.au/portfolio-item/jack-mackerel/). Only minor catches of this species have been taken from Tasmanian waters 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_∞	Paul (2000) Lyle et al. (2000)

<table>
<tr><td></td><td>is the average maximum length for the species, <i>k</i> is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are:
<table><tr><th><i>Sex</i></th><th>L_∞</th><th><i>k</i></th><th>$t_{0\infty}$</th></tr><tr><td>Combined</td><td>36.2</td><td>.267</td><td>-1.21</td></tr></table>
• Length-weight relationship was estimated at $W = 1.46.10^{-8}L^{2.982}$ for both males and females, where <i>W</i> is weight (g) and <i>L</i> is the length (cm).</td><td></td></tr>
<tr><td>Maturity</td><td>• Sexual maturity between 3 and 4 years of age, at sizes around 27 cm and weights around 250 g.</td><td>Webb (1976)</td></tr>
<tr><td>Spawning</td><td>• Occurs over a wide area in Tasmania.
• Between late December and early March
• Pelagic eggs</td><td>Stevens and Hansfeld (1982)</td></tr>
<tr><td>Early life history</td><td>• Larvae carried by inshore currents
• Juveniles inhabit coastal and estuarine waters although they may sometimes be found offshore</td><td>Kailola et al. (1993)
Williams and Pullen (1986)</td></tr>
<tr><td>Recruitment</td><td>• No-stock recruitment relationship established.</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>• NA</td><td></td></tr>
</table>

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, class seine 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. 12.1A). 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. 12.2). Only 1.0 t was recorded in Tasmanian waters in 2015/16. 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. 12.1A.

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. 12.1A).

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. 12.1B). 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. 12.1C). Since that time, landings have been low and there has been no targeted fishing in Tasmanian waters. By contrast, landings increased sharply in the Commonwealth Small Pelagic Fishery with the operation of a large factory trawler.

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). There is no new information to suggest that this has changed otherwise since then.

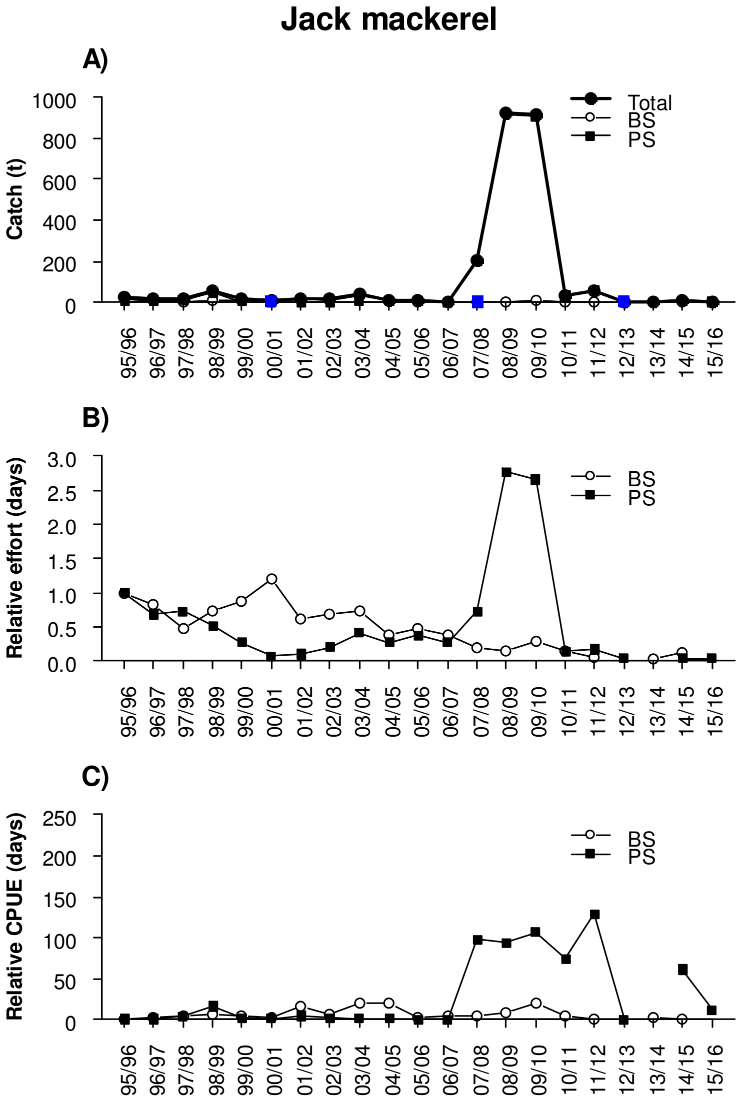
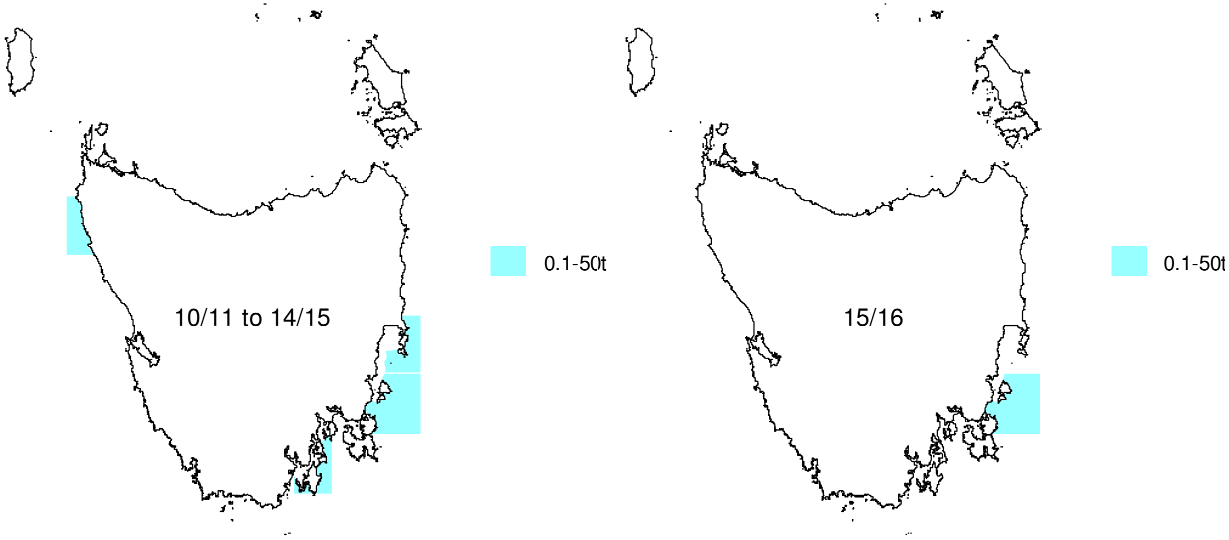


Figure 12.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. BS= beach seine, PS= purse seine. No purse seine catch for Jack Mackerel was reported during 2013/14.

A) Catch



B) Effort

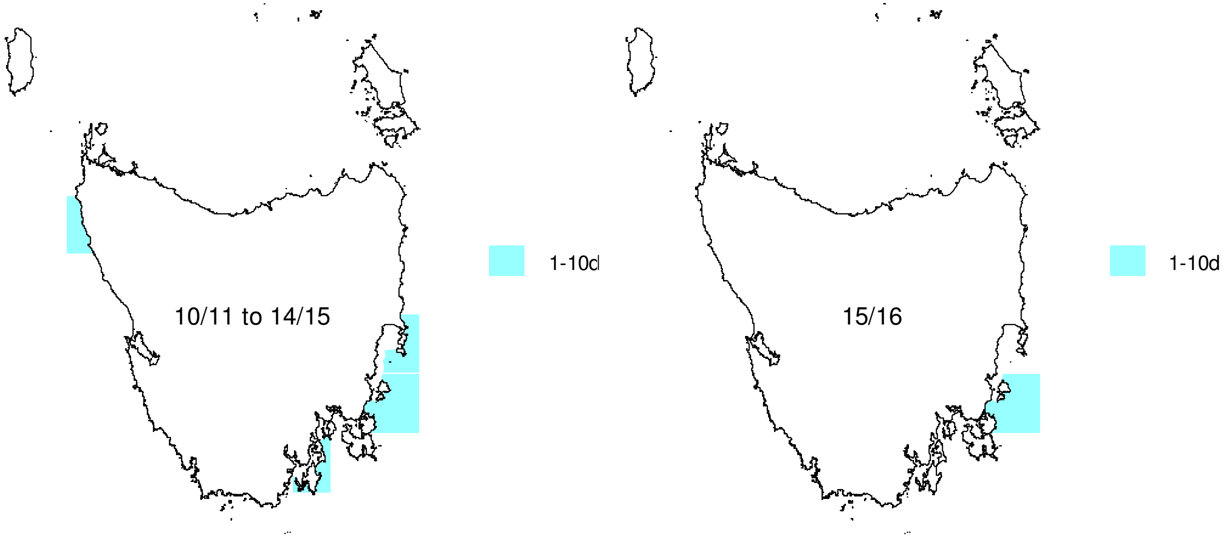


Figure 12.2 (A) Jack Mackerel catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Limit reference points

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 (9.1 t)	Yes	↓ 8.2 t (89.6%)
	• 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

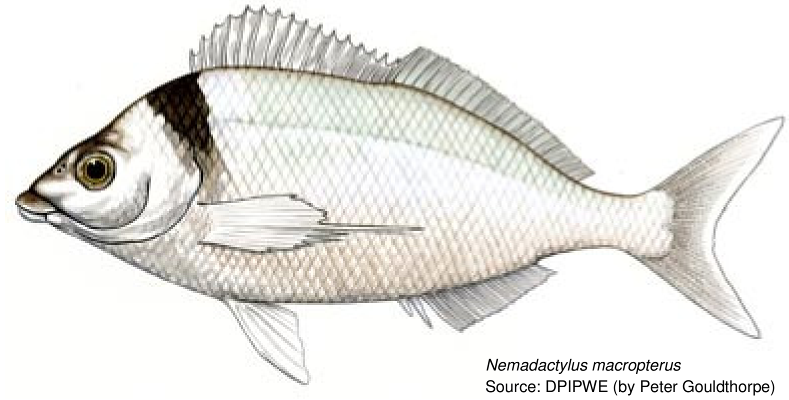
SUSTAINABLE

The reference point for lowest catch was breached due to minimal fishing occurring in 2015/16. The minimal commercial catch in recent years has also meant that the recreational catch is 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 Scientific Panel 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. 2016) and this assessment has been applied to the Tasmanian component of the fishery.

13. Jackass Morwong

Nemadactylus macropterus

STOCK STATUS	**SUSTAINABLE**
This is a Commonwealth-managed 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	Francis (2001) Kailola et al. (1993)

<table>
<tr><td></td><td>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:
<table><tr><th>Sex</th><th>L_∞</th><th>k</th><th>t_0</th></tr><tr><td>Females</td><td>38.4</td><td>0.36</td><td>-0.07</td></tr><tr><td>Males</td><td>36.2</td><td>0.42</td><td>0.15</td></tr></table></td><td>Jordan (2001a)</td></tr>
<tr><td>Maturity</td><td>• Sexual maturity at about 25 cm TL and about 3 years of age</td><td>Edgar (2008)</td></tr>
<tr><td>Spawning</td><td>• 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).</td><td>Lyle and Ford (1993)
Bruce et al. (2001a)</td></tr>
<tr><td>Early life history</td><td>• 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</td><td>Francis (2001)
Bruce et al. (2001a)
Kailola et al. (1993)</td></tr>
<tr><td>Recruitment</td><td>• No-stock recruitment relationship established.</td><td></td></tr>
<tr><td>Gillnet post release survival</td><td>• Moderate: 52%</td><td>Lyle et al (2014a)</td></tr>
</table>

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 gillnetting 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 ceased operations following the introduction of a state-waters ban on otter board trawling ban in 2001. 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 2015 Fishery Status Reports classified this species as not overfished nor subject to overfishing (Patterson et al. 2016). The species was not assessed in the 2016 Status of Australian Fish Stocks report.

FISHING METHODS	Mainly gillnet, 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 3.2 t in 2015/16 (Fig 13.1A). 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. 13.2).

Jackass Morwong is an important recreational species, with catches estimated at higher levels than those of the commercial fishery (Fig. 13.1A). 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 fishing effort has mirrored the declining catches for the species (Fig. 13.1B). Catch rates have declined since the early 2000s but remained stable at a reduced level since 2007/08 (Fig. 13.1C).

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). There is no new information to suggest that this has changed otherwise since then.

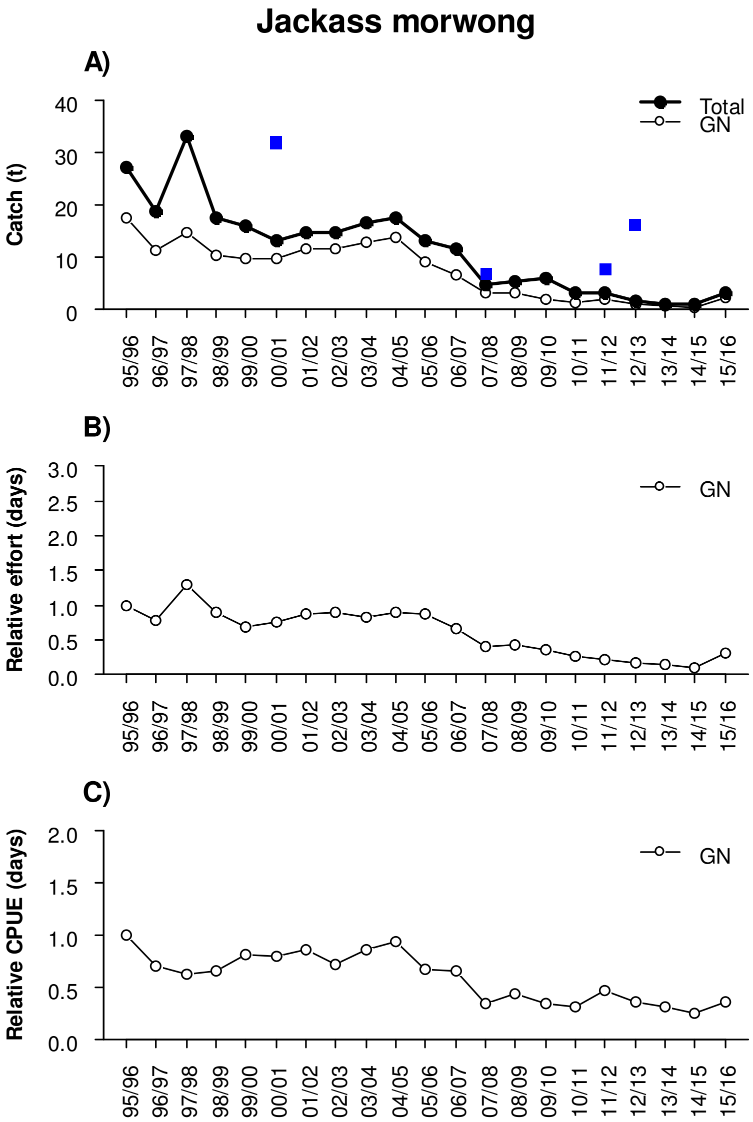
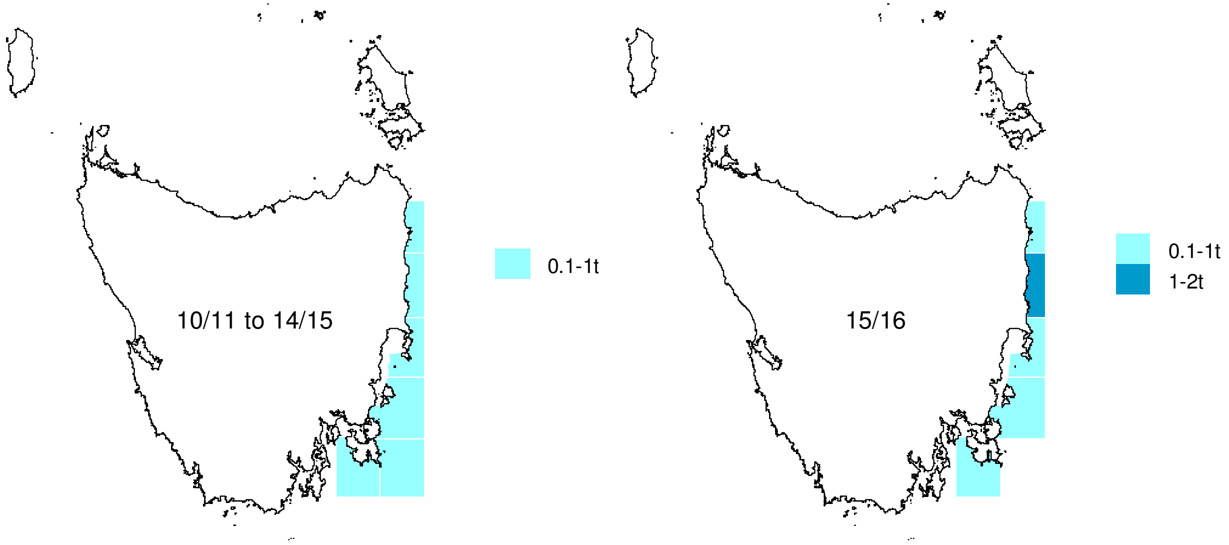


Figure 13.1 A) Annual commercial catch (t) by gear (left) and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. GN= gillnet.

A) Catch



B) Effort

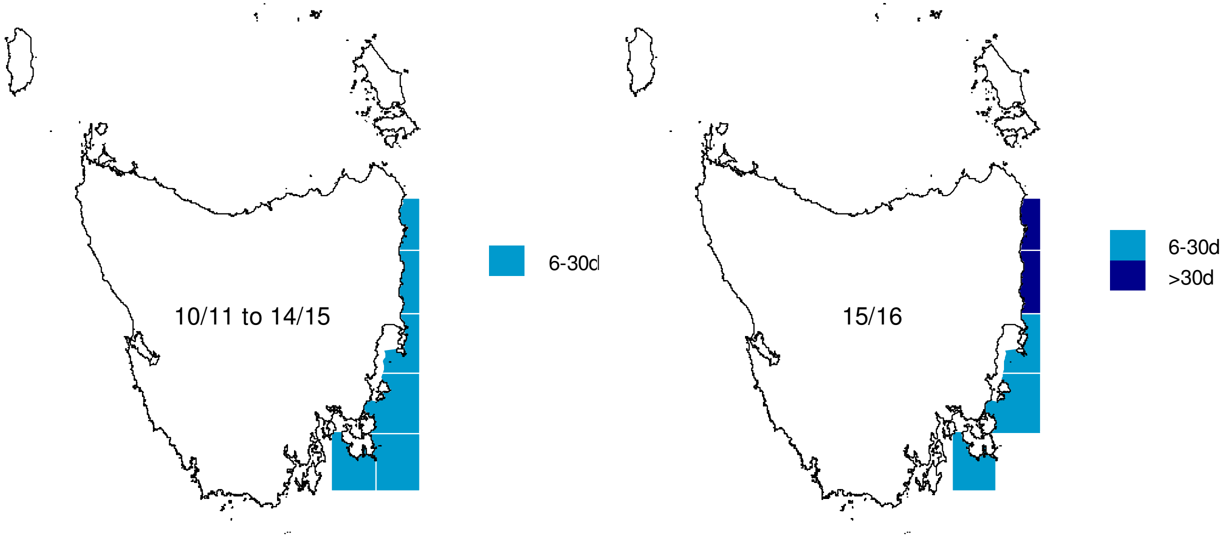


Figure 13.2 (A) Jackass Morwong catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 10.0 t (76.2%)
	• 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

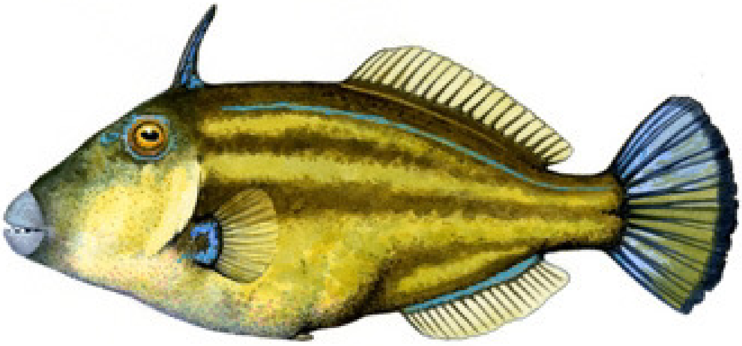
The lowest catch reference point was breached, which reflects the ongoing declining commercial catches in Tasmanian waters. Linked to this decline, one of the recreational indicators was breached, indicating that the proportion of recreational catch to total catch had increased in 2012/13 since the last 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, 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 136 t in 2015/16) 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.

14. 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 gillnet and hand-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence) • Recreational gear licence (gillnet 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 1.3 t in 2015/16 t (Fig. 14.1A). While catches from gillnets have consistently remained at low levels since 1995/96, catches from fish traps have declined over time. Leatherjackets are now primarily caught on the east and southeast coasts (Fig. 14.2).

Leatherjackets are also caught by the recreational sector, with catch estimates in recent surveys at a similar level to commercial catches (Fig. 14.1A). 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 gillnet fishing effort has decreased through time (Fig. 14.1B). 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 days fished have remained relatively stable over time for gillnets, while fluctuating for fish traps (Fig. 14.1C).

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). There is no new information to suggest that this has changed otherwise since then.

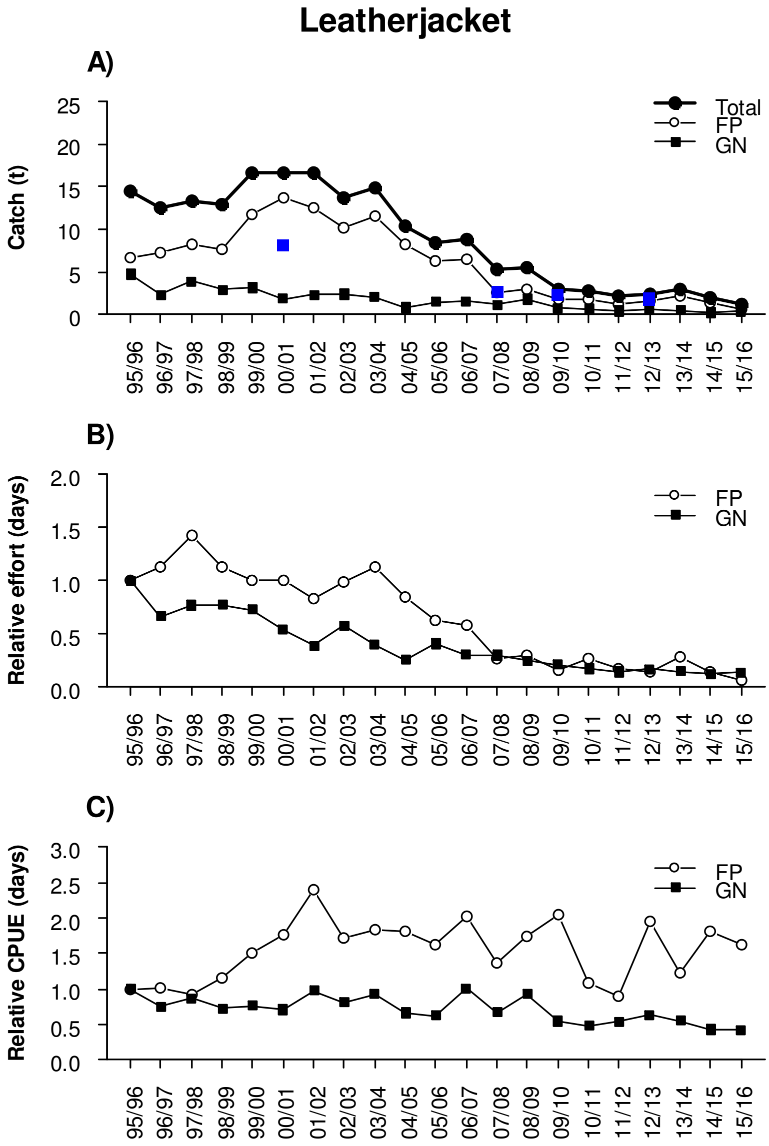
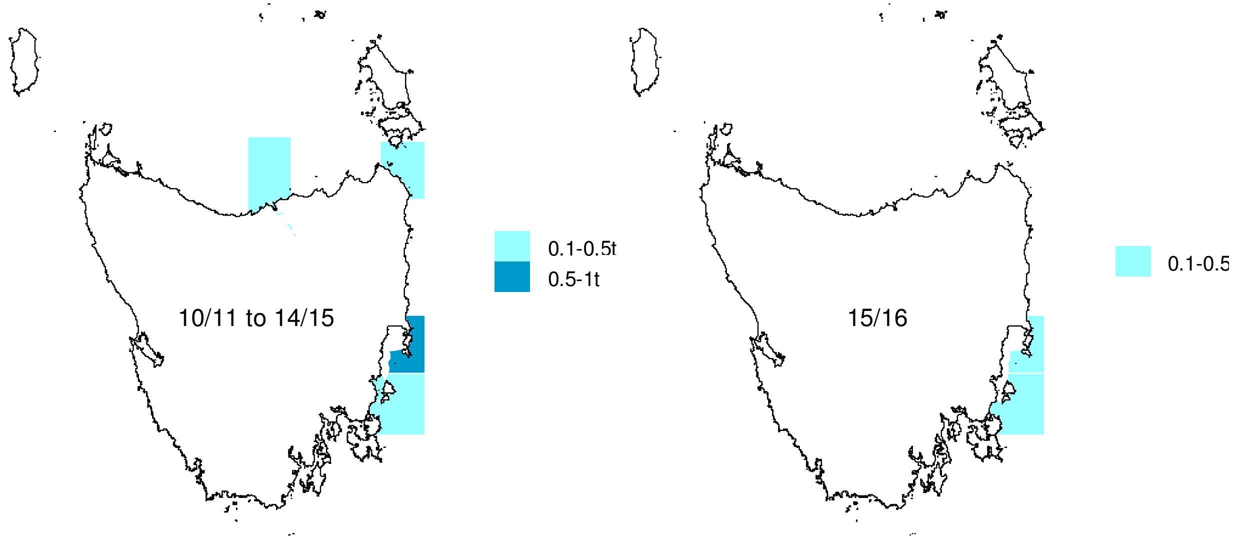


Figure 14.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. FP= fish trap, GN= gillnet.

A) Catch



B) Effort

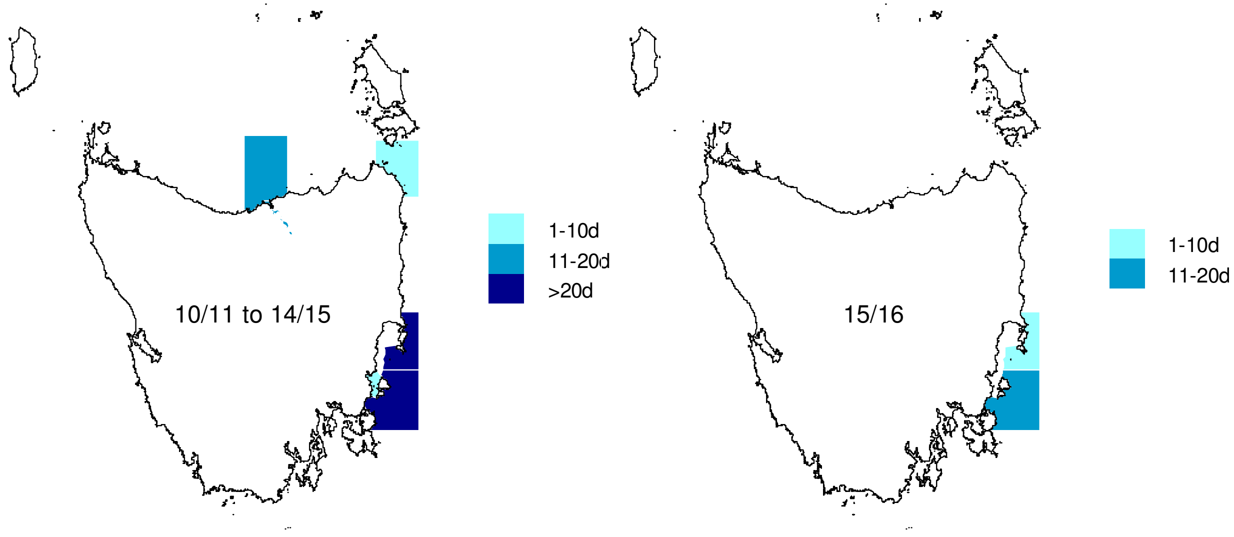


Figure 14.2 (A) Leatherjacket catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 9.1 t (87.8%)
	• 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

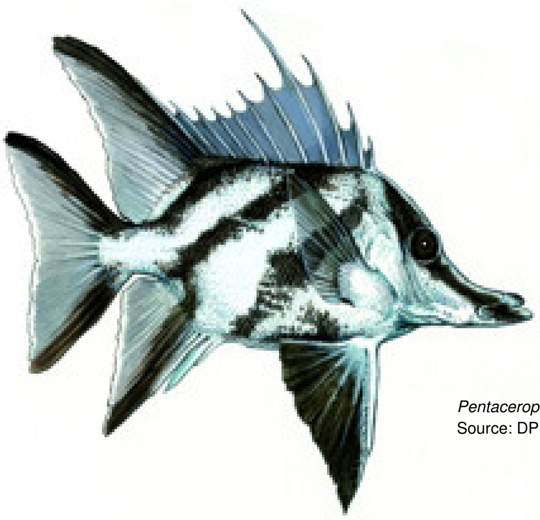
The very low landings in 2015/16 meant that the lowest catch and the proportion of recreational to commercial catch reference points were breached. These decreased catches are, however, the result of a decline in the use of fish traps and a lack of demand and not an indication of relative abundance.

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 insufficient information to confidently classify the status of Leatherjacket stocks.

15. Longsnout Boarfish

Pentaceropsis recurvirostris

STOCK STATUS	**UNDEFINED**
Boarfish are a by-product species with low catches due to the large minimum legal size. There is insufficient information available to confidently classify this stock.	
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 gillnetting. 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	Gillnet, 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 gillnet (Fig. 15.1A). Catches have been declining through time but appear to have stabilised since 2008/09 with landings in 2015/16 of 0.7 t (Fig. 15.1A). Catches are taken exclusively from the east coast (Fig. 15.2). Boarfish are not caught by rod and line and no recreational catch estimates are available for thegillnet 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 gillnet effort has remained stable (Fig. 15.1B). Catch rates have remained relatively stable over time (Fig. 15.1C).

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). There is no new information to suggest that this has changed otherwise since then.

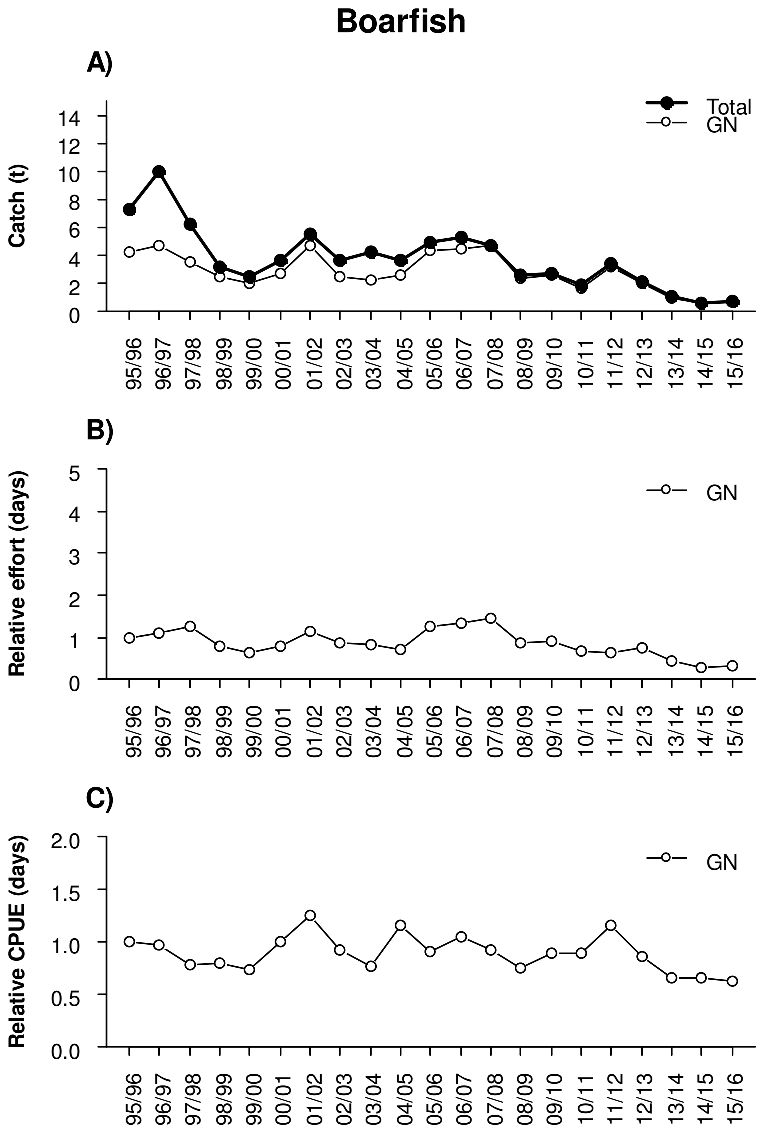
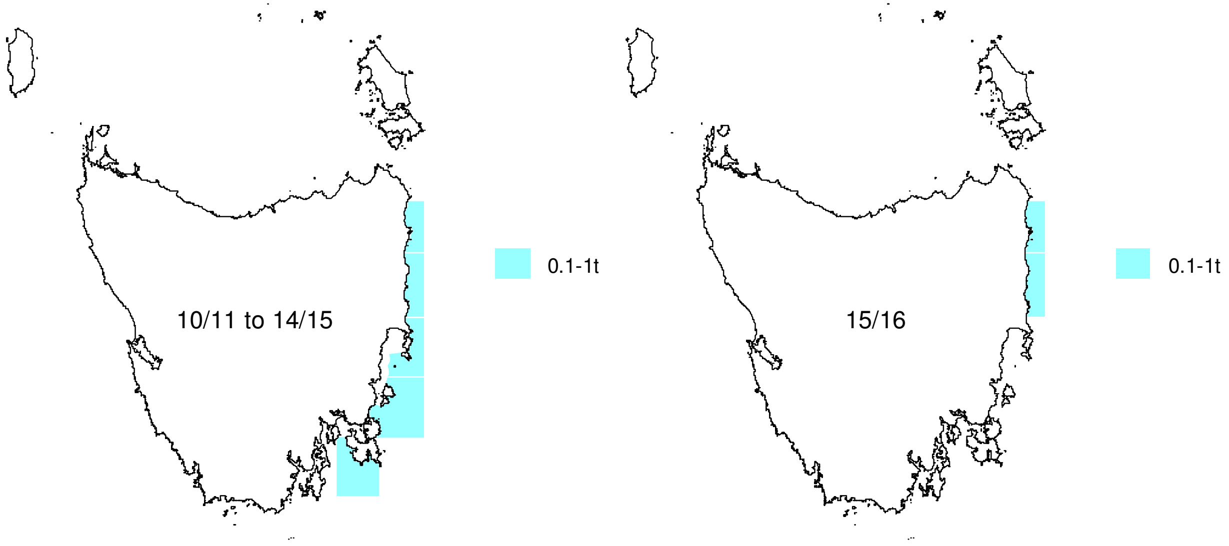
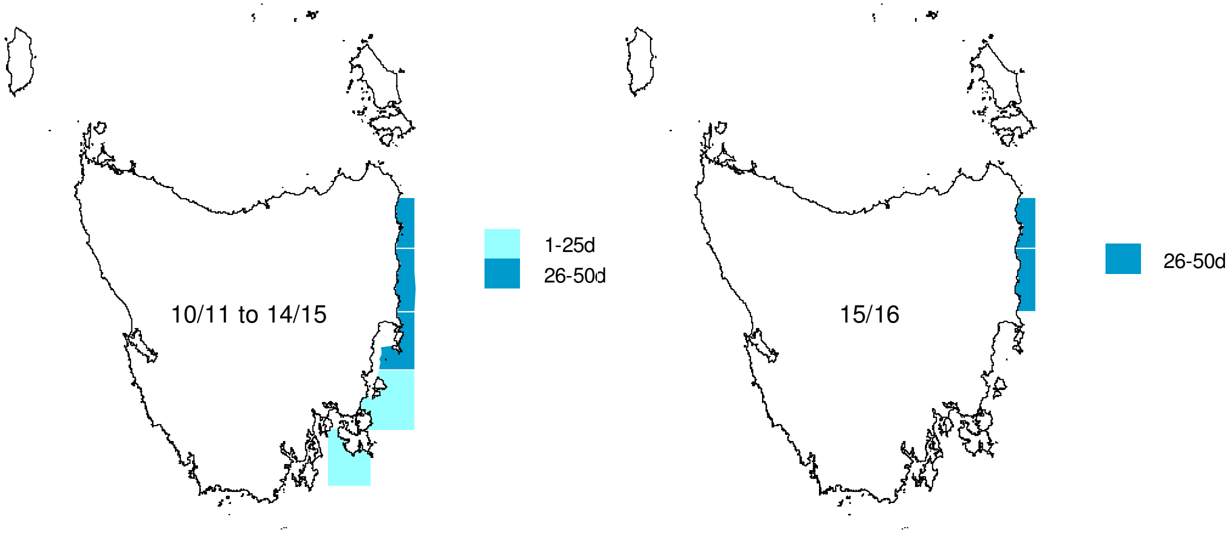


Figure 15.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. GN= gillnet.



A) Catch



B) Effort

Figure 15.2 (A) Boarfish catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 2.9 t (80.7%)
	• 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	

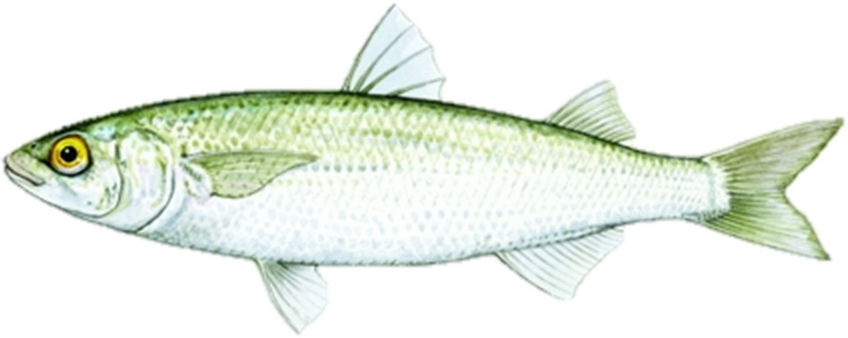
Stock status	**UNDEFINED**

The reference point associated with low catch was breached in 2015/16. Catches are lower now due to reduced gillnetting effort compared with during in the reference period, noting that catch rates have remained relatively stable over time. 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 insufficient information available to confidently classify this stock.

16. 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	Edgar (2008) Curtis and Shima (2005) Gorman (1962)

<table>
<tr><td></td><td>• 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.
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>Last et al. (1983)
Chubb et al. (1981)</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'.

FISHING METHODS	Mostly beach seine, also small mesh net (mullet net for recreational) and purse seine
MANAGEMENT METHODS	**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 – mullet species combined. • Minimum size: 25 cm
MAIN MARKET	Mostly local

Current assessment

Catch, effort and CPUE

Yelloweye 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, with 2.0 t landed in 2015/16 (Fig. 16.1A). Fishing activity was traditionally focussed in the northwest and off the east and southeast coasts but in 20015/16 most of the catch and effort occurred off Flinders Island (Fig. 16.2). Recreational catches of mullet 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. 16.1A).

Beach seine effort was relatively stable until 2005/06 after which it declined rapidly, remaining at low levels (Fig. 16.1B).

Catch rates for beach seining have remained relatively constant over time with a sharp increase in 2012/13 before declining again to average levels, with a slight increase in 2015/16 (Fig. 16.1C).

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). There is no new information to suggest that this has changed otherwise since then.

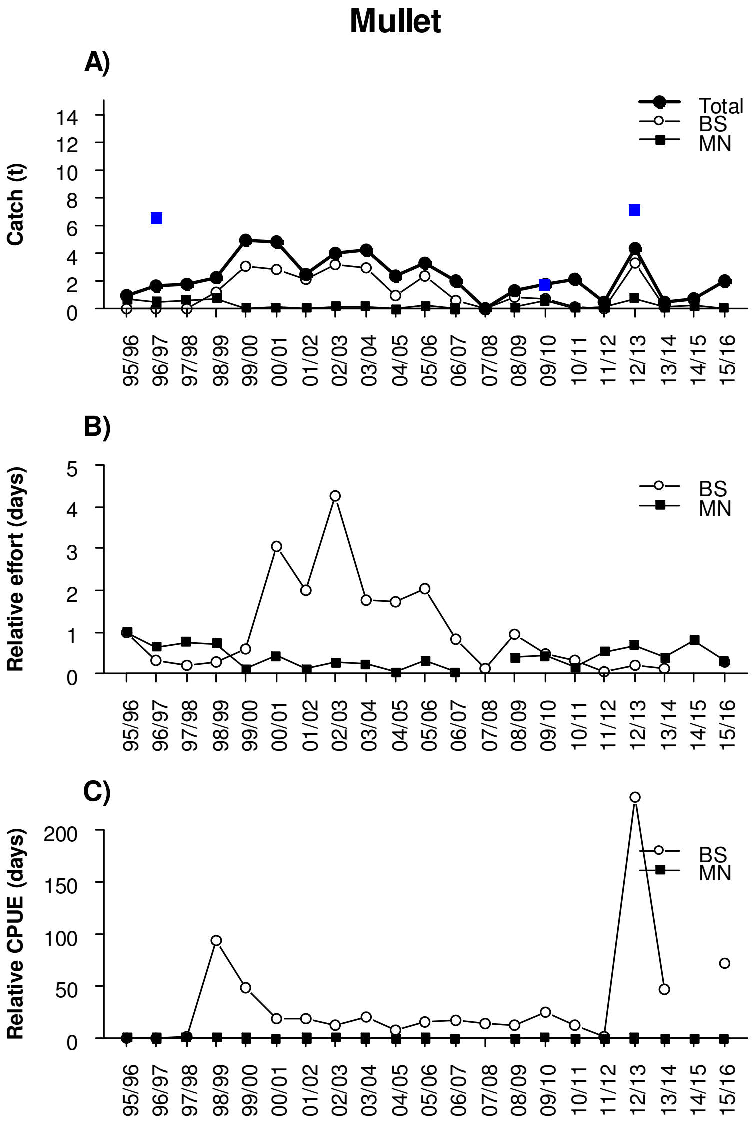
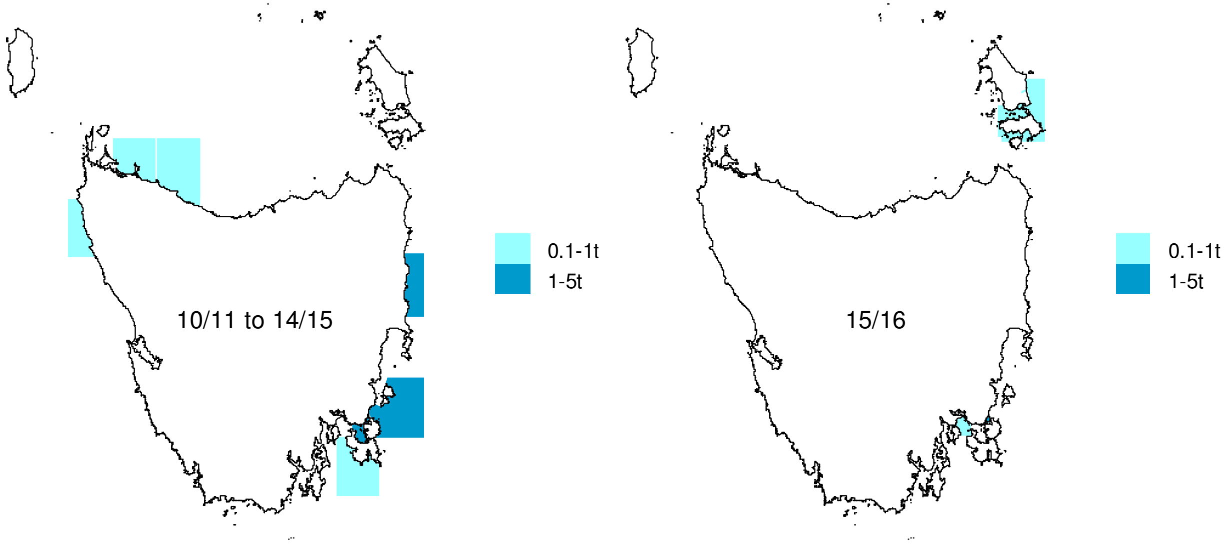


Figure 16.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. BS= beach seine, MN= small mesh net.

A) Catch



B) Effort

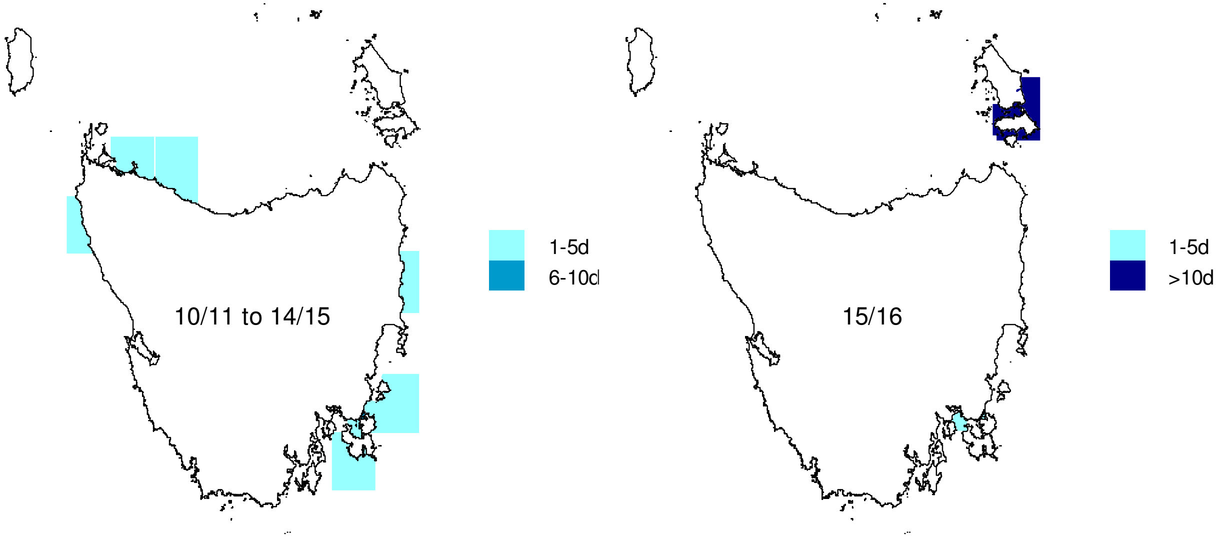


Figure 16.2 (A) Yelloweye Mullet catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (4.2 t)	No	
	• Catch < 3rd lowest catch value from the reference period (1.7 t)	No	
	• 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 (-0.013)	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. 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.

17. Snook

Sphyraena novaehollandiae

STOCK STATUS	**UNDEFINED**
Snook catches have declined to their lowest historical level in 2015/16. Catch rates are an unreliable estimate of abundance due to the species not being actively targeted. 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 gillnetting. 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, gillnet and small mesh net
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, small mesh gillnet 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 averaged around 6 to 9 tonnes before declining in 2015/16 to just 2.4 t (Fig. 17.1A). 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. 17.2).

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 days fished before a return to average levels in 2015/16 (Fig. 17.1B). Beach seine effort has remained stable over time but Snook represent a by-product of this fishing method rather than a target.

Catch rates have been highly variable for troll through time, which is a factor of availability and targeting practices, whereas catch rates for both beach seine and mesh net have been relatively stable (Fig. 17.1C).

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). There is no new information to suggest that this has changed otherwise since then.

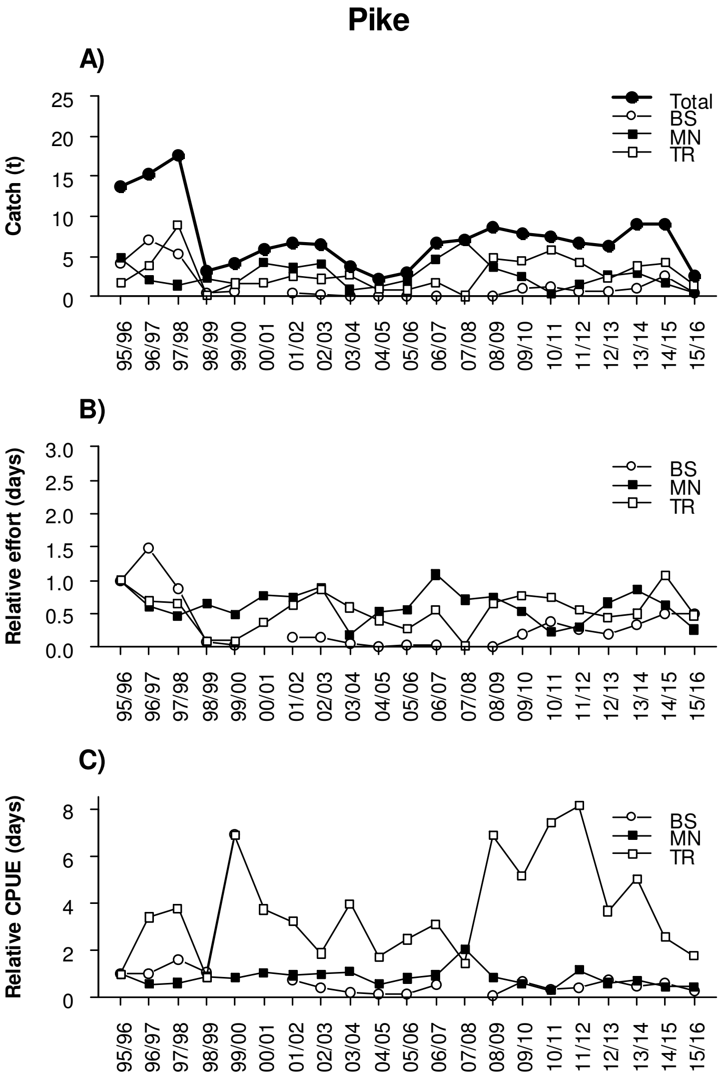


Figure 17.1 A) Annual commercial catch (t) by gear. B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. BS = beach seine, TR = troll, MN = small mesh gillnet.

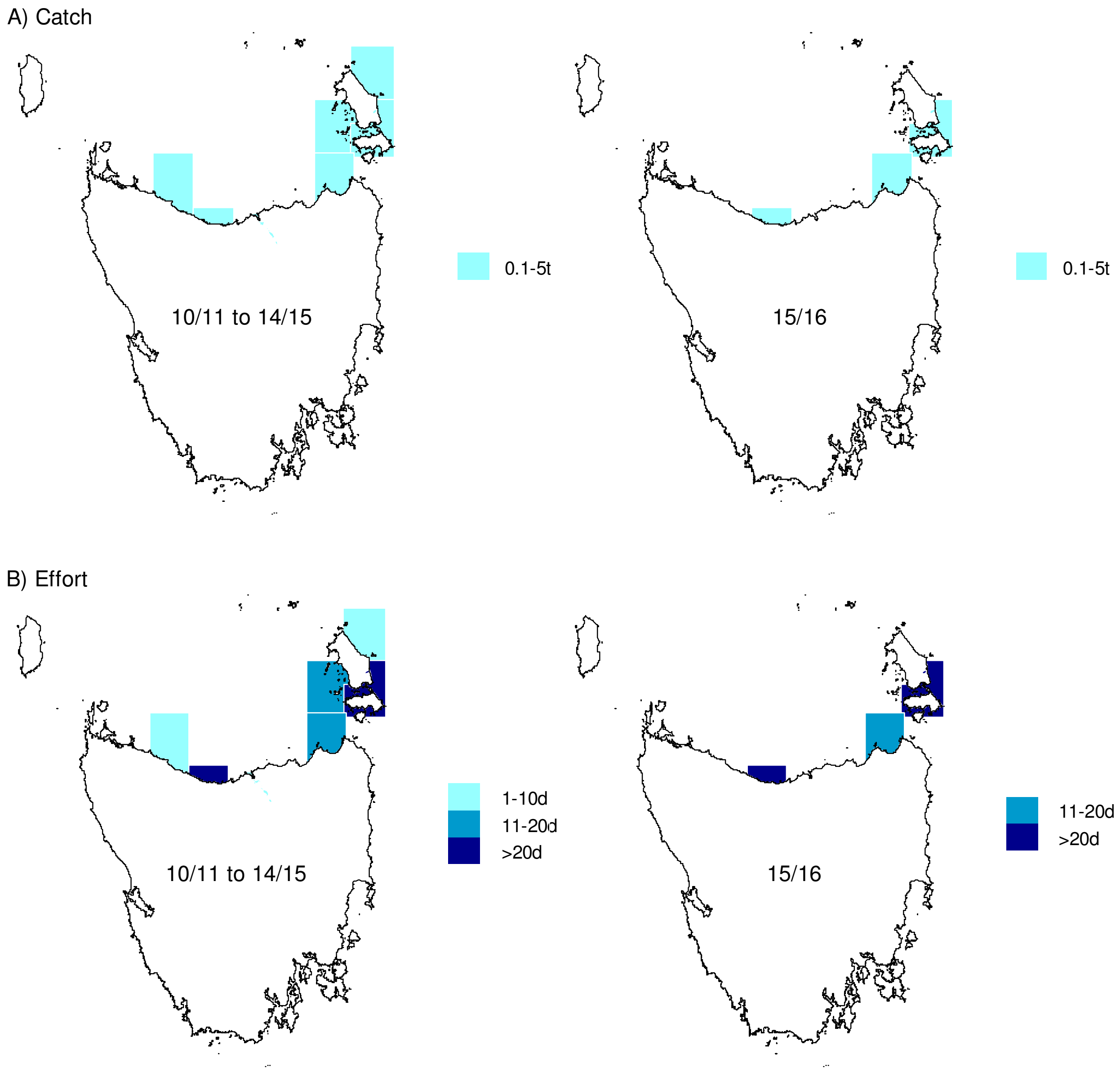


Figure 17.2 (A) Snook catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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)	Yes	↓ 0.6 t (18.9%)
	• 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

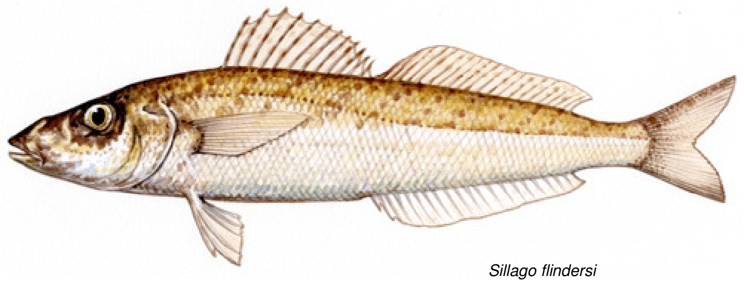
UNDEFINED

The commercial fishery for Snook is relatively small and mainly limited to the northern part of Tasmania. The lowest catch reference point was breached in 2015/16, reflecting a reduction in troll and small mesh effort as fishers switched to increasingly target Southern Calamari. Moreover, the species is rarely targeted recreationally. Catch rates have been variable for both key methods but with some evidence of a decline in recent years. 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 available to confidently classify the status of the stock.

18. Eastern School Whiting

Sillago flindersi

STOCK STATUS	**SUSTAINABLE**
This is a predominately Commonwealth-managed species that is classified as sustainable by AFMA (see: http://www.afma.gov.au/portfolio-item/eastern-school-whiting/). Tasmanian catches fluctuate due to the interstate market demand and species targeting (Tiger Flathead or Eastern School Whiting) by the primary operator. Tasmanian commercial catches represent a small 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	Gomon et al. (2008) Tilzey (1994)

<table>
<tr><td></td><td>species, k is a constant and t_0 is the (theoretical) age where length equals zero. Parameters estimates are:<table><tr><th>Sex</th><th>L_∞</th><th>k</th><th>t_0</th></tr><tr><td>Combined</td><td>23.9</td><td>0.46</td><td>-0.50</td></tr></table></td><td></td></tr>
<tr><td>Maturity</td><td>• Reached at 2 years and a size of 14-16 cm FL</td><td>Hobday and Wankowski (1987)
Burchmore et al. (1988)</td></tr>
<tr><td>Spawning</td><td>• Spring to late summer.
• Females release between 30 000 and 110 000 eggs in total during the season</td><td>Hobday and Wankowski (1987)</td></tr>
<tr><td>Early life history</td><td>• Juveniles inhabit inshore waters.</td><td>FishBase (2013)</td></tr>
<tr><td>Gillnet post release survival</td><td>• NA</td><td></td></tr>
</table>

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

Landings have generally fluctuated between 20 and 50 t per annum since 1998/99, with 23.4 t reported in 2015/16, and are influenced largely by the targeting practices of a single operator (Fig. 18.1A). Catches were concentrated on the southeast coast (in particular the Derwent Estuary) as has historically been the case (Fig. 18.2). 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. 18.1A).

While fishing effort has been slowly decreasing over time there was a small increase in 2015/16 back to 2012/13 levels (Fig. 18.1B). Catch rates by days fished have generally increased since 1995/96, though there are fluctuations (Fig. 18.1C), which are likely caused by changes in target species (i.e. School Whiting versus Tiger Flathead). In 2015/16 catch rates declined to their second lowest level on record.

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). There is no new information to suggest that this has changed otherwise since then.

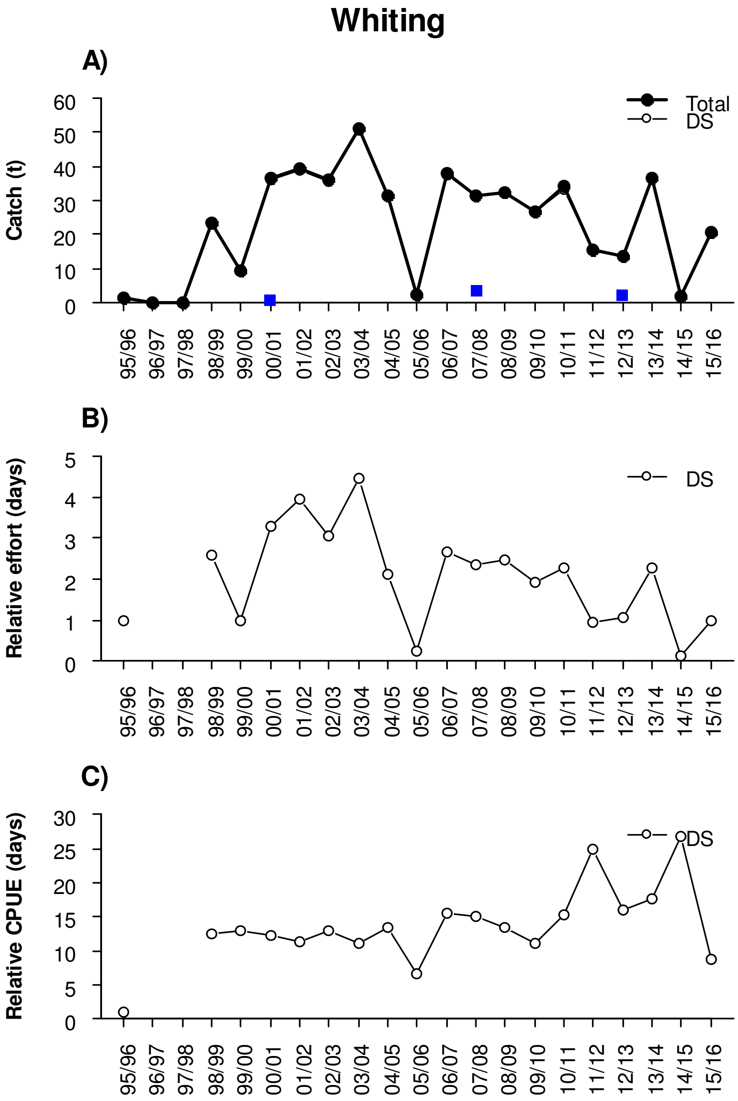
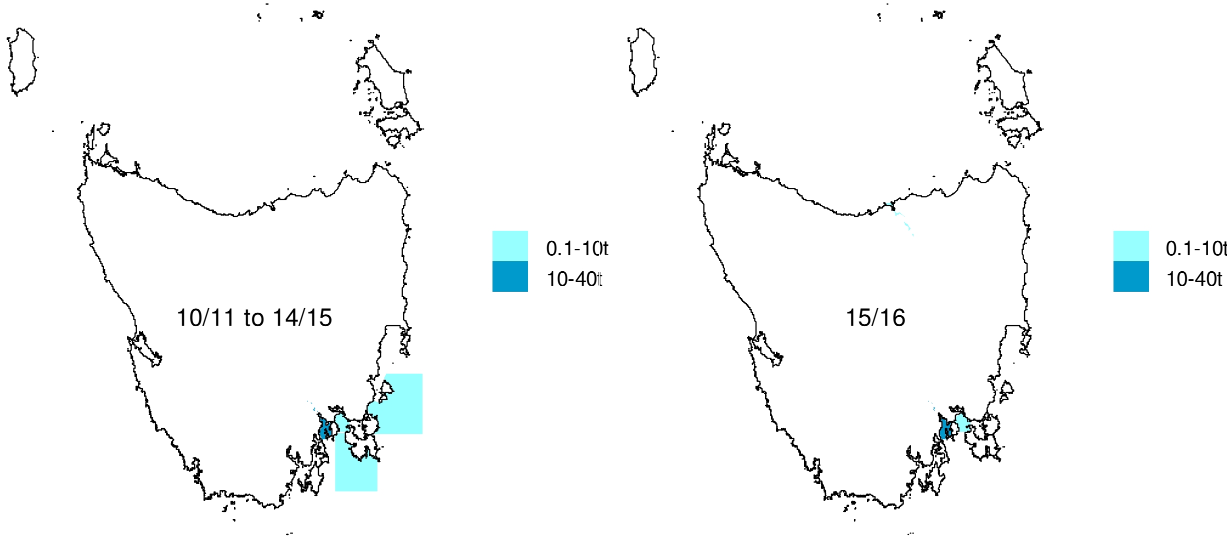


Figure 18.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. DS= Danish seine.

A) Catch



B) Effort

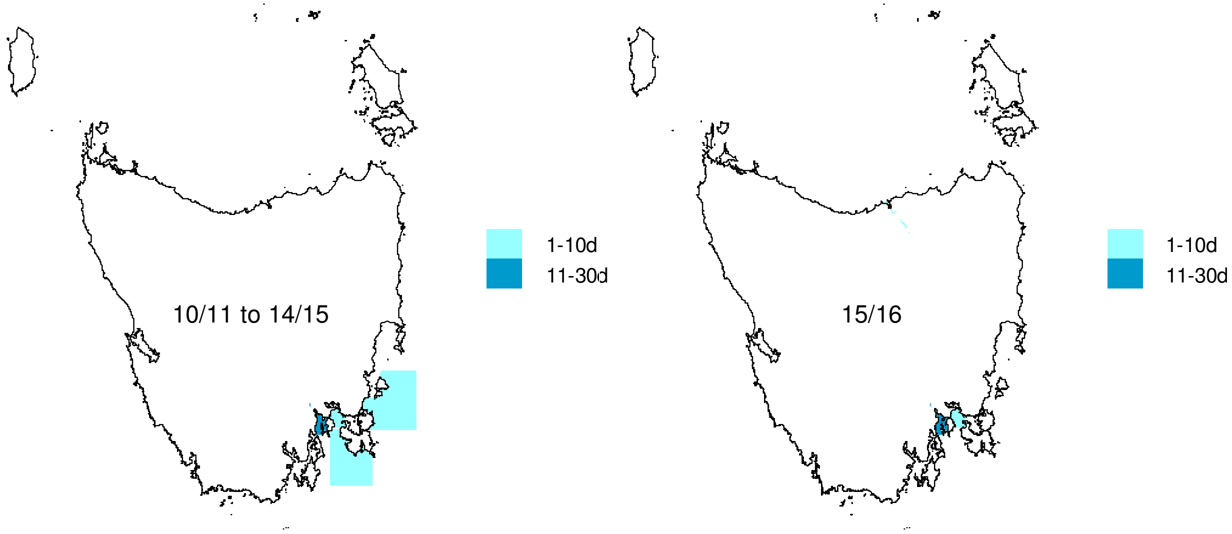


Figure 18.2 (A) School Whiting catches (t) and (B) effort (days) by fishing blocks averaged from 2009/10 to 2014/15 (left) and during 2015/16 (right).

Reference points

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	• Catch > 3rd highest catch value from the reference period (38.1 t)	No	
	• Catch < 3rd lowest catch value from the reference period (1.4 t)	No	
	• 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 (-0.0954)	Yes	0.06 ↓ (62.9%)
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, effort and catch rate 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. Furthermore, the 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).

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 (733 t in 2015/16). 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. 2016) and we have followed this classification in this assessment.

19. Southern Calamari

Sepioteuthis australis

STOCK STATUS	**SUSTAINABLE**
Both commercial and recreational fishing effort in the northern areas of the State have increased to historic highs. Despite this, catch rates in the north east have continued to rise, 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. While there has been a slight decline in catch rates in north west, 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.	Triantafillos & Adams (2001) Triantafillos (2004) Smith *et al.* (2015)

	• A recent, and more thorough, genetic study showed a single stock across southern Australia with Tasmania being particularly important in terms of reproduction.	
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 • 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 holders of a fishing licence (personal) not the holder/operator of a calamari, seine or Danish seine licence • Trip limit of 15 calamari outside SE waters for holders of a fishing licence (rock lobster)
MAIN MARKET	Local and interstate

Current assessment

Catch, effort and CPUE

The total commercial catch of Southern Calamari for 2015/16 was 106 t, which was an increase of 30 t from 2014/15 (Fig. 19.1A). Catches have steadily increased off the northeast coast since 2009/10 (Fig. 19.1B) and off the northwest coast since 2010/11, with current production levels now above those of the Mercury Passage and the southeast coast (Fig. 19.2B and 19.3).

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. 19.1D). However, catch rates in the northwest have declined in the last two seasons. Effort and CPUE in the Great Oyster Bay area and Mercury Passage have remained relatively stable since 2010/11 (Fig. 19.2C and 19.2D)

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. 19.1A), indicating high interest by recreational fishers in the species.

Ecological Risk Assessment

In 2012/13, an environmental risk assessment of the Tasmanian scalefish fishery considered the risks to bycatch, threatened endangered and protected species and habitats from fishing for Southern Calamari using squid jigs as negligible. Changes to the ecosystem and community structure from fishing for Southern Calamari using squid jigs was considered a low risk as opposed to negligible, as they are an important predator and their removal could lead to negative effects on the ecosystem and community structure (Bell et al. 2016). As the commercial and recreational catches of Southern Calamari have continued to rise since 2012/13, it is likely that the overall risk has increased in the northern areas of the State. In response to these concerns a research project on Southern Calamari commenced in the northern areas of the State in 2016 to address deficiencies in stock biological knowledge.

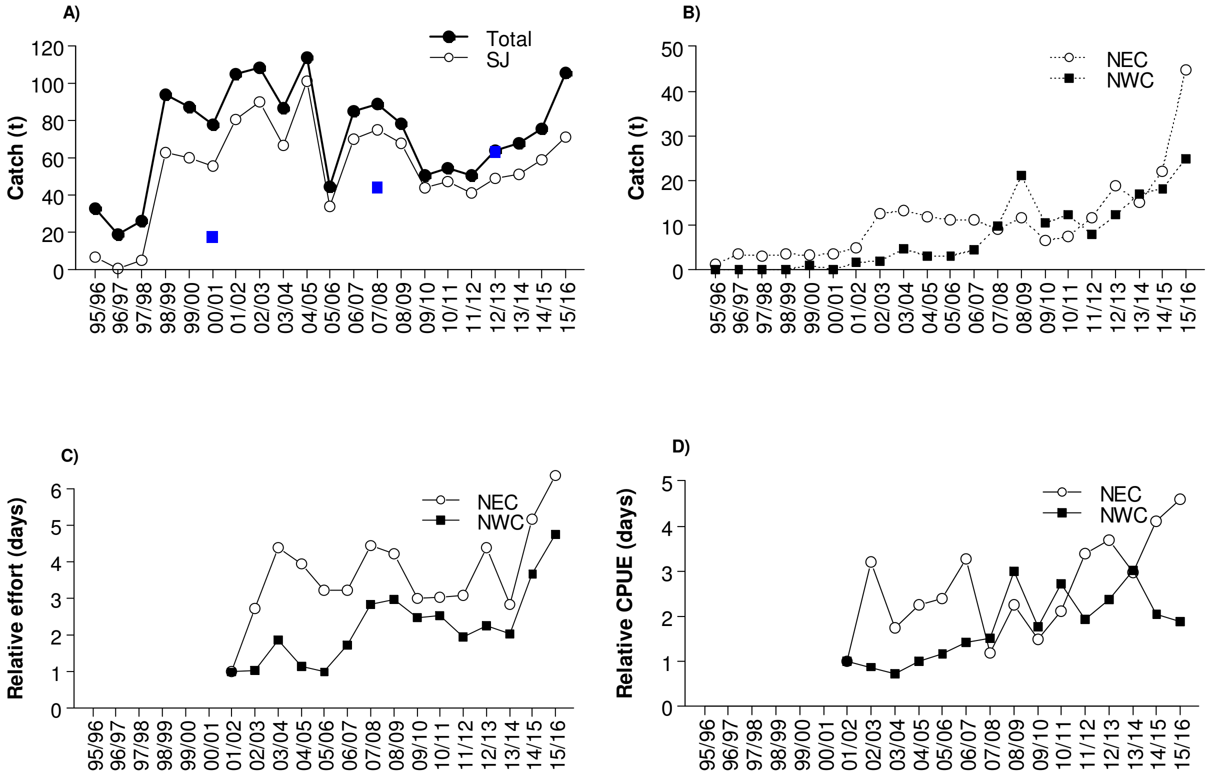


Fig. 19.1 Annual commercial catch (t) by gear (A) and by region (B), and best estimates of recreational catches (single squares); Commercial squid-jig effort based on days fished relative to relative to 2001/02 for NEC and NWC (C); Commercial squid-jig catch per unit effort (CPUE) based on weight per day (D); SJ = squid jig, NWC= northwest coast, NEC= northeast coast.

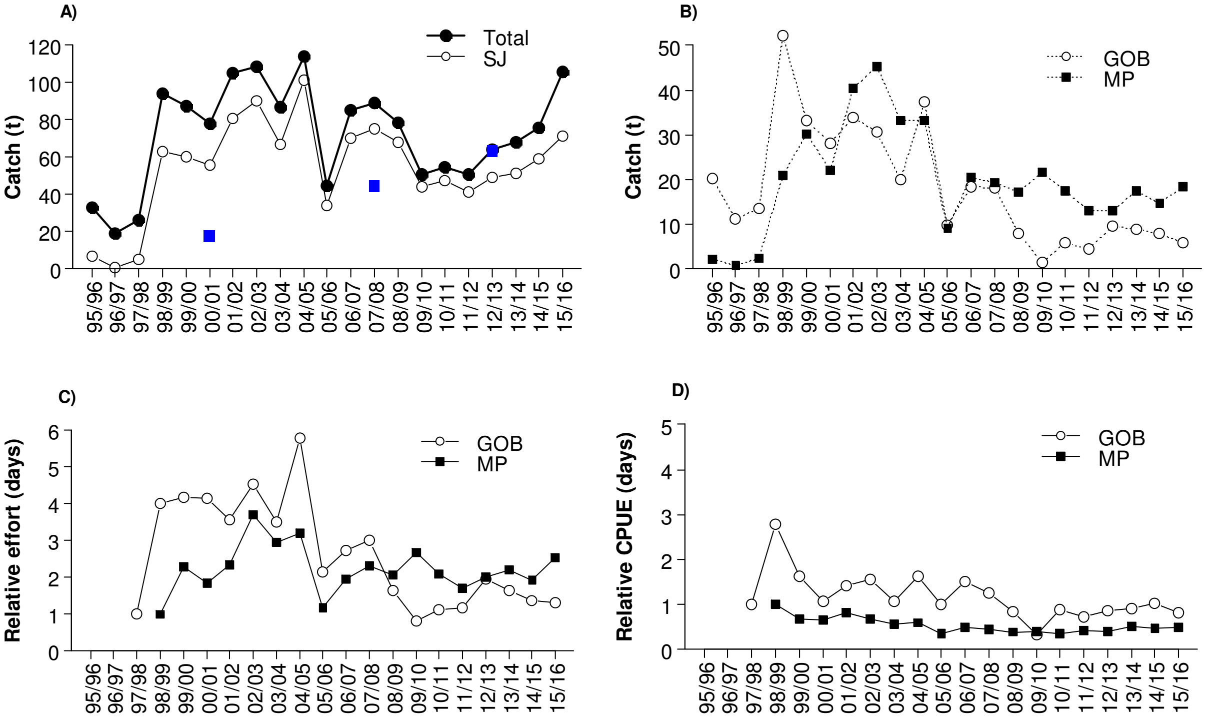
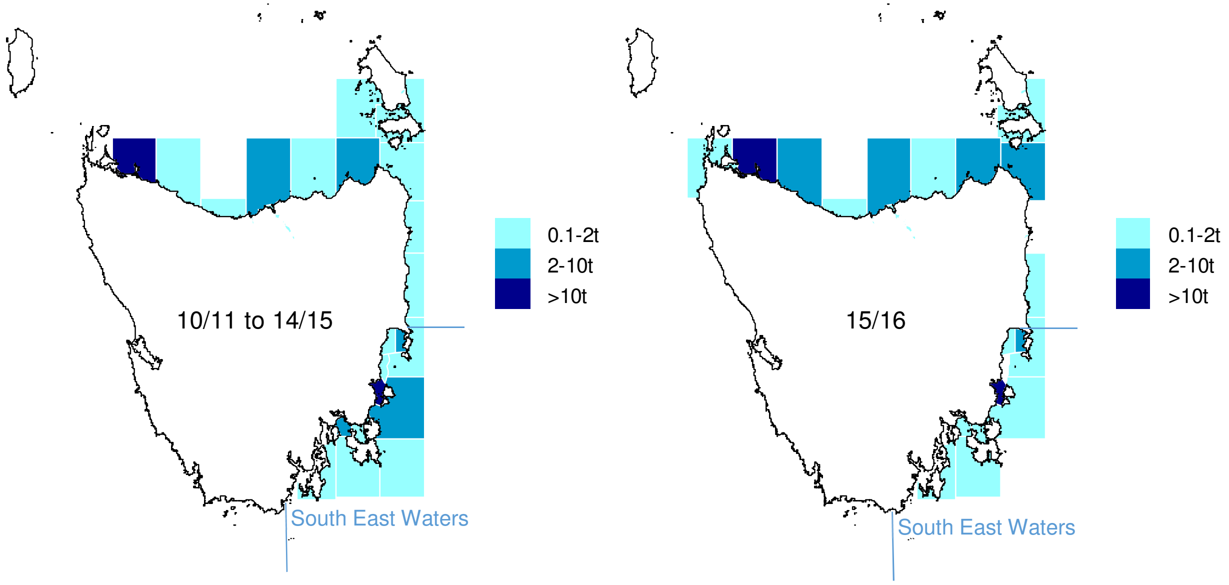


Fig. 19.2 Annual commercial catch (t) by gear (A) and by region (B), and best estimates of recreational catches (single squares); Commercial squid-jig effort based on days fished relative to relative to 1998/99 for MP and 1997/98 for GOB (C); Commercial squid-jig catch per unit effort (CPUE) based on weight per day (D); SJ = squid jig, MP = Mercury Passage, GOB = Great Oyster Bay.

A) Catch



B) Effort

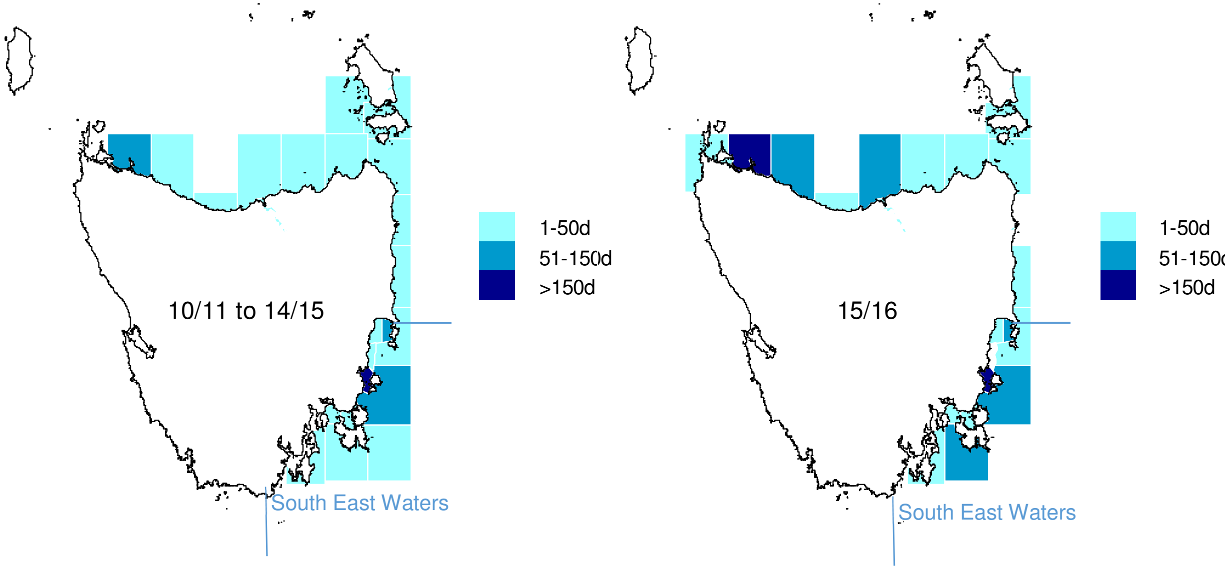


Figure 19.3 (A) Calamari catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right). South East Waters management boundaries are also displayed.

Reference points

Performance indicators	Proposed reference points	Breached?	By how much?
Fishing mortality	- Catch > 3rd highest catch value from the reference period (105.2 t)	Yes	0.8 t (0.8%)
	- 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 catch reference point was just breached in 2015/16 due to ongoing high landings of Southern Calamari from the northern areas of the State. The recreational reference points were also breached in 2012/13 as a result of growing interest in the species from this sector, with the recreational catch now possibly of a similar magnitude to that of the commercial sector. Thus, overall fishing pressure on Southern Calamari from commercial and potentially recreational fishers has increased substantially since 2012/13. The next state-wide recreational fishing survey is scheduled for 2017/18 and will provide insight into recent developments within the recreational sector.

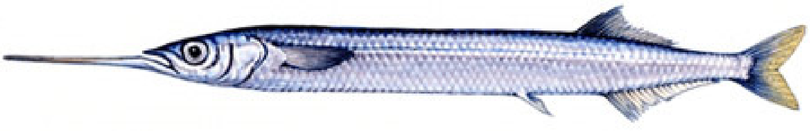
Vulnerability of Calamari to fishing pressure is unclear but probably high because spawning aggregations are targeted and the species has an annual or sub-annual life span that renders the stock susceptible to spawning and/or recruitment failure. The species-specific licence has effectively capped commercial effort in the south east but fishing effort has increased outside of the South East Waters (defined as waters between Whale Head to Lemon Rock for calamari management) in the north east and northwest coasts.

In 2015/16, fishing effort continued to climb to a historic high in both the northeast and northwest 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 in 2016. Despite recent increases in fishing effort catch rates have continued to increase in the northeast whereas they have declined in the northwest during the past two years, potentially indicating that fishing pressure is starting to impact the stock. Catch rates in the southern areas of the State have been relatively stable. While Southern Calamari appears to be vulnerable to intensive fishing pressure there are no clear 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.

20. 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	• Local and interstate

Current assessment

Catch, effort and CPUE

The total commercial catch of Garfish for 2015/16 was 22.0 t, the lowest catch on record and representing the continuation of a general decline in landings that commenced in 2009/10 (Fig. 20.1A). After many years of relative stability in Garfish catches at 80–90 t per annum, catches fell sharply in 2006/07 and 2007/08 before recovering to around 60 t before the current general decline. Catches, both historically and in 2015/16, were concentrated off the northeast coast (Fig. 20.1A and Fig. 20.2A). Historically, there were also moderate landings in the east and southeast, however these have been greatly reduced in recent years (Fig. 20.2A).

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 major commercial gear types has been slowly decreasing through time, reaching historic lows in the current year (Fig. 20.1B).

Catch rates have fluctuated much more strongly over time for beach seine but did peak for both methods in 2012/13 (Fig. 20.1C). Beach seine catch rates have declined steadily since then such that by 2015/16 they were comparable those during the late 2000s, when there were strong concerns about the status of the Southern Garfish stocks. Dip-net catch rates also declined after 2012/13 but have remained generally above the long-term average for the method.

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).

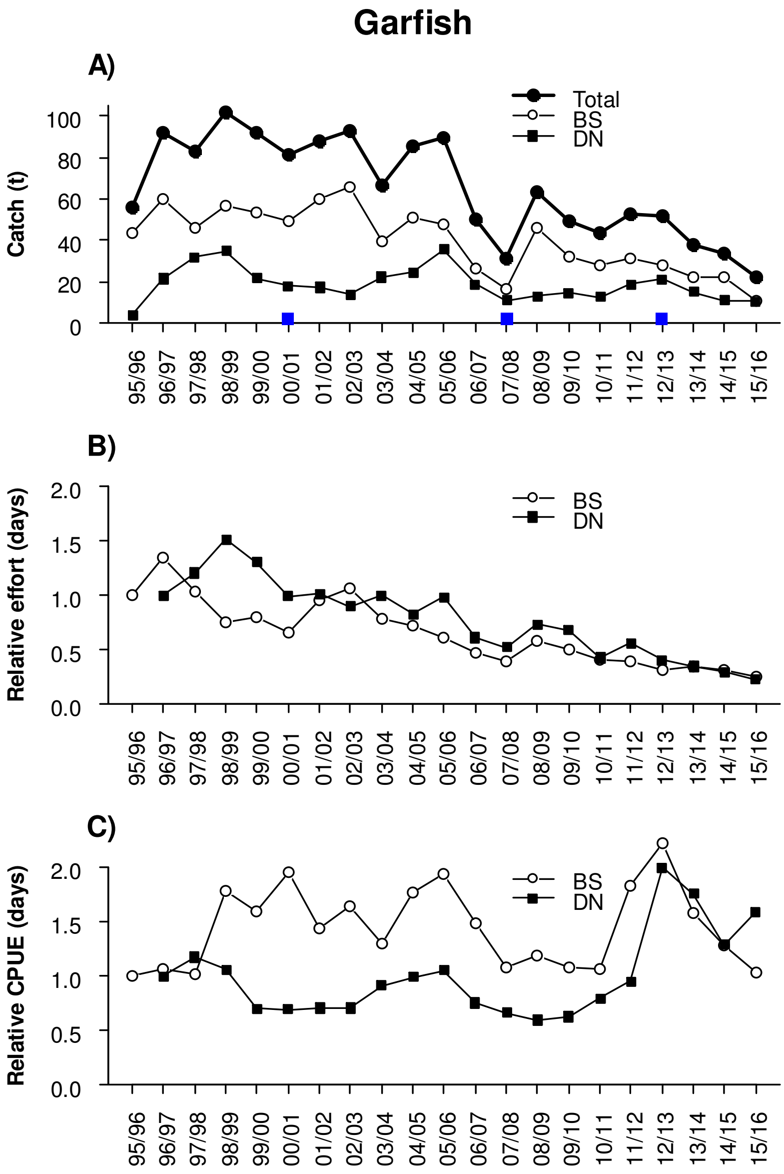
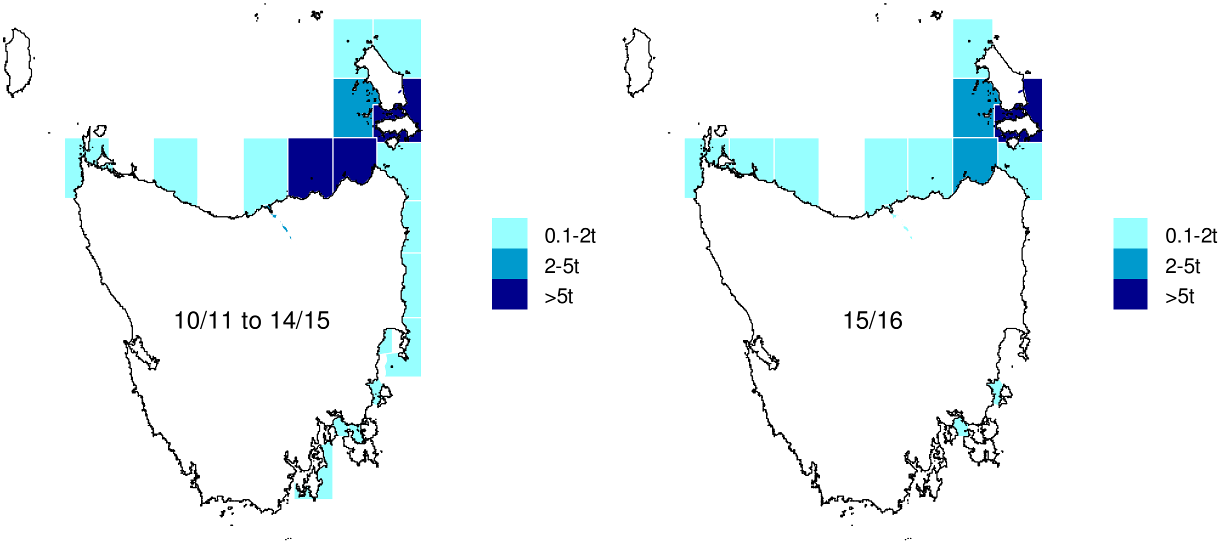


Figure 20.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. BS= beach seine, DN= dip-net.

A) Catch



B) Effort

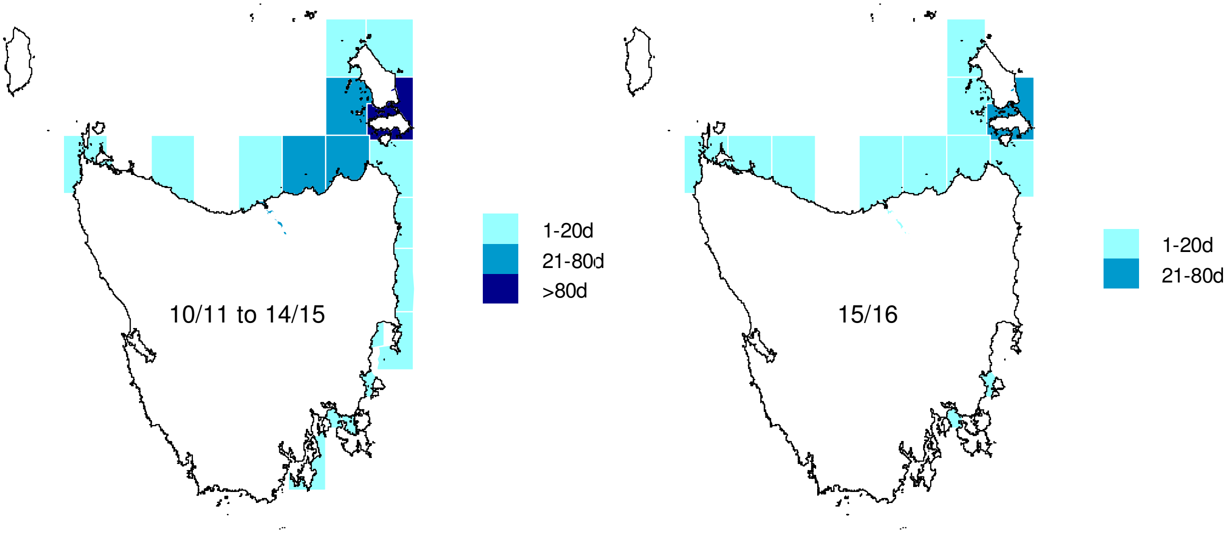


Figure 20.2 (A) Garfish catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 42.2 t (63.7%)
	• 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 the low 2015/16 catch relative to levels prior to 2006/07. Catch rates over the last three fishing seasons have also generally declined, coupled with reductions 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 was presumed indicative of a more general change in population structure resulting 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 past three fishing seasons beach seine 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). 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 to determine whether the size and age structure of the catch has changed since 2012 and could be informative of stock status.

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 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.

21. 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)

<table>
<tr><td>Maximum age</td><td>• Estimated at 43 years.</td><td>Tracey and Lyle (2005)</td></tr>
<tr><td>Growth</td><td>• Maximum length: 1.2 m
• Maximum weight: 25 kg
• 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>Gomon et al.(2008)
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>
</table>

Recruitment	• Highly variable. No-stock recruitment relationship established.	Murphy and Lyle (1999)
Gillnet post release survival	• NA	

Background

Striped Trumpeter has 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 gillnets 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 licensed 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, introduction of a recreational boat 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 or minimum size limit 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) year round.

FISHING METHODS	Mainly hand-line, also gillnet and drop-line
MANAGEMENT METHODS	**Input control:** • Gear licence (Scalefish fishing licence, rock lobster licence) • Temporal closure (Sept–Oct – does not apply to Commonwealth operators) **Output control:** • Trip limit of 250 kg • Trip limit of 150 kg for Commonwealth operators • Bag limit of 4 fish for recreational fishers • Possession limit of 8 fish for recreational fishers • Boat limit of 20 fish for recreational vessels • Minimum size (550 mm TL)
MAIN MARKET	Mainly local

Current assessment

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 21.1. 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 21.1). 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. 21.1A). In 2015/16 catch fell to 6.7 t caused primarily by decreased catches reported in Commonwealth logbooks. The Tasmanian catch in 2015/16 was the lowest reported since records have been kept.

Table 21.1 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.

	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
2015/16	5.9		0.8	6.7

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. 21.1A). 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. 21.1A and 21.2). Since 2009/10, catches in the northwest coast have increased to match those of the southeast.

The observed catch trends reflect the influence of especially strong year classes that entered the fishery between 1995/96 and 1997/98. Increased gillnet 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 gillnet 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. 21.1B). 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. 21.1B).

Drop-line catch rates have remained relatively stable since 2009/10 whereas there has been a slight decline in hand-line catch rates, although both are currently at levels comparable to the mid-1990s (Fig. 21.1C). Gillnet catch rates increased steadily up until 2003/04, despite declining catches during the latter half of the period. The sharp fall in gillnet 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 gillnet 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).

Post release survival is believed to be high in Striped Trumpeter, even when captured from relatively deep water. This is relevant given that bag and trip limits are relatively low and some catch may need to be released.

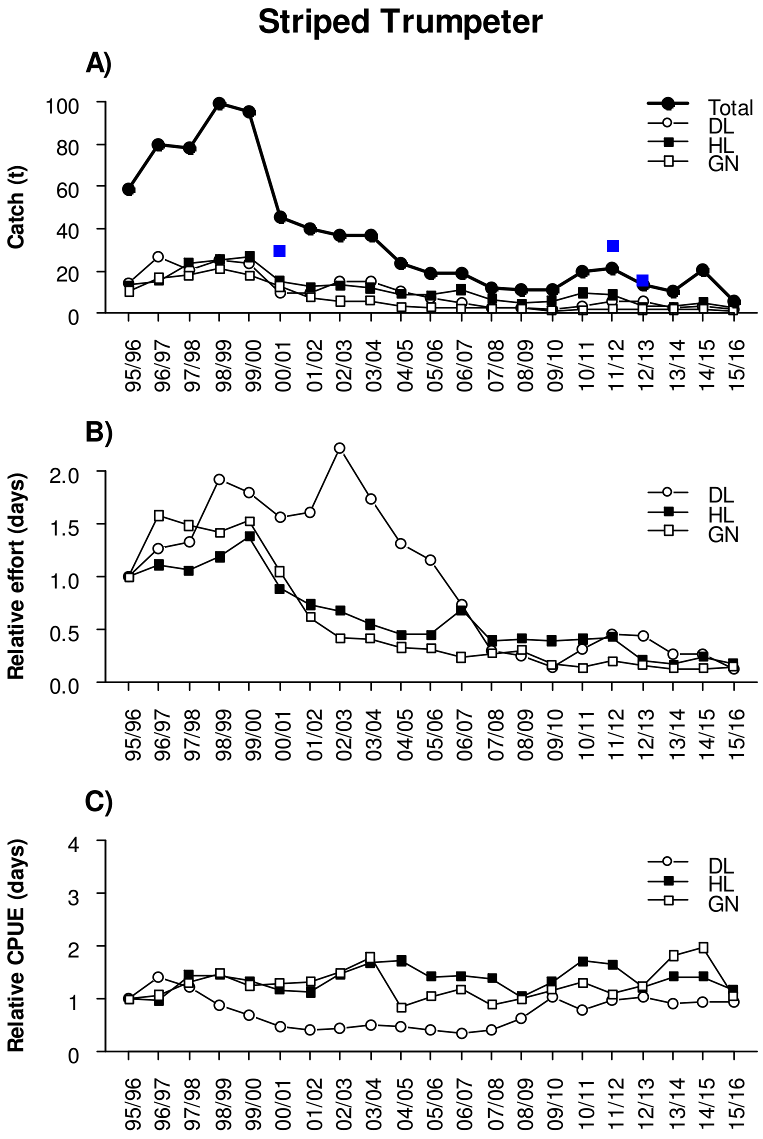
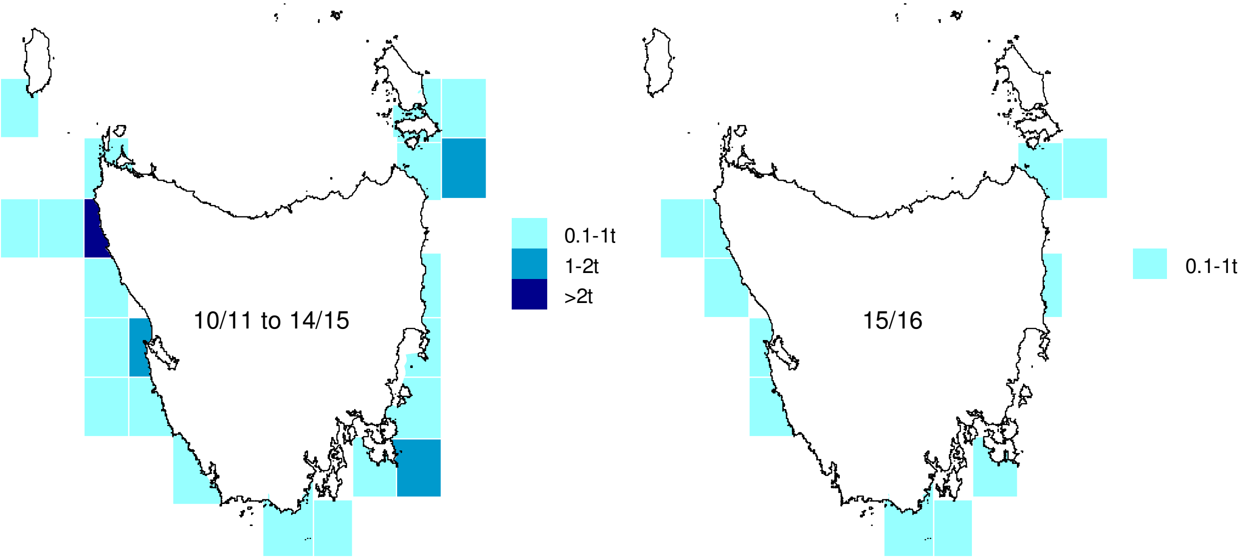


Figure 21.1 A) Annual commercial catch (t) by gear and best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. HL= hand-line, GN= gillnet, DL = drop-line. Data includes Commonwealth catch in State waters.

A) Catch



B) Effort

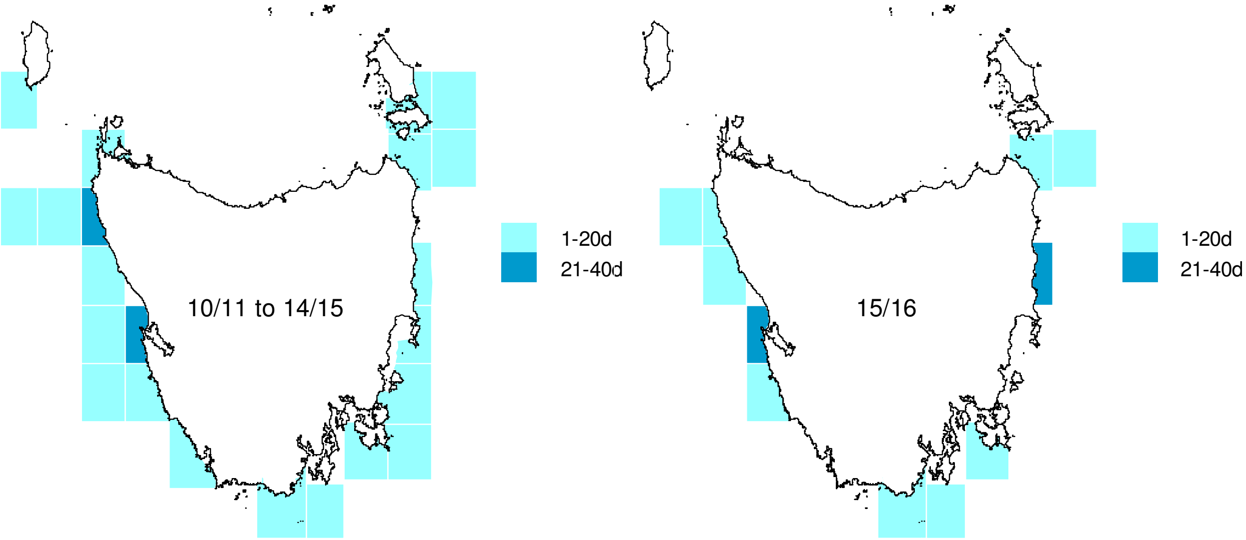


Figure 21.2 (A) Striped Trumpeter catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right). Data includes Commonwealth catch in State waters.

Reference points

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	↓ 17.2 t (72.0%)
	• 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 bag limit of four fish and a boat limit of 20 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. A state-wide survey scheduled in 2017/18 will provide a new recreational catch estimate.

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, although in the most recent year they fell sharply to < 1 t, coincident with the lowest catch on record for 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.

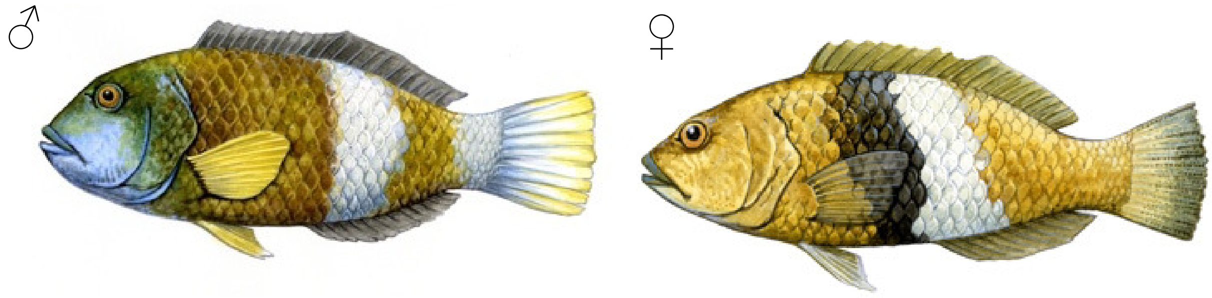
The influx of 4–6 year olds between 2010 and 2012 provided positive signs of population recovery after a prolonged period of low recruitment, which led to the previous stock status of transitional-recovering. The relative strength of these year classes however is not known due to the lack of length and 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.

22. 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.	Barrett (1995b)

	• 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	
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 $L_\infty = 36.12, k = 0.2 \text{ and } t_0 = -0.35$. 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 $L_\infty = 44.7, k = 0.085 \text{ and } t_0 = -3.23$. 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*:*** • Minimum size: 30 cm. • Possession limit of 10 and bag limit of 5 individuals for recreational fishers • Limit of 30kg for landed dead wrasse if not the holder of a wrasse licence
MAIN MARKET	• Interstate (live trade) and local (bait and food).

Current assessment

Catch, effort and CPUE

Wrasse catches fluctuated between 75–110 t between 1995/96 and 2007/08, peaking at 113 t in 2006/07 (Fig. 22.1A). Since 2008/09 catches have been relatively stable at between 60-70 t per annum, with the exception of 2014/15 when 81.4 t was landed. The 2015/16 catch of 69.3 t comprised 54.9 t of Bluethroat Wrasse, 14.4 t of Purple Wrasse. The lower catches since the late 2000s are 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. Wrasse are targeted all around Tasmania, the west coast being the least fished area (Fig. 22.2).

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, gillnet 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).

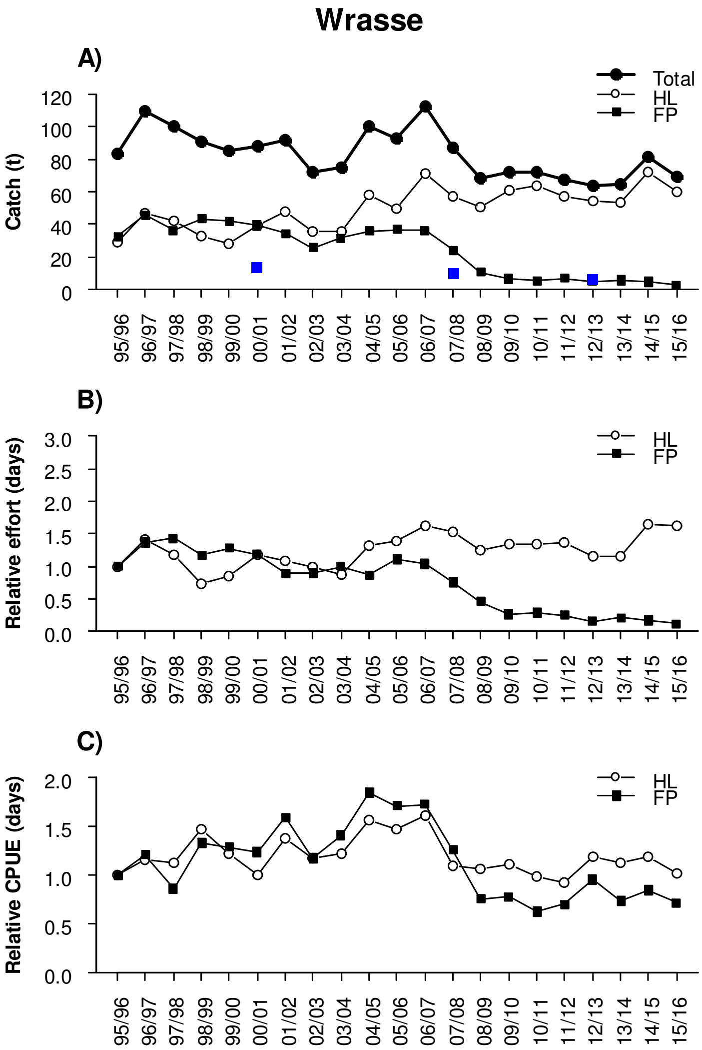


Figure 22.1 A) Annual commercial catch (t) by gear best estimates of recreational catches (blue squares). B) Commercial effort by method based on day fished relative to 1995/96. C) Commercial catch per unit effort (CPUE) based on weight per day fished relative to 1995/96. HL= hand-line, FP= fish trap.

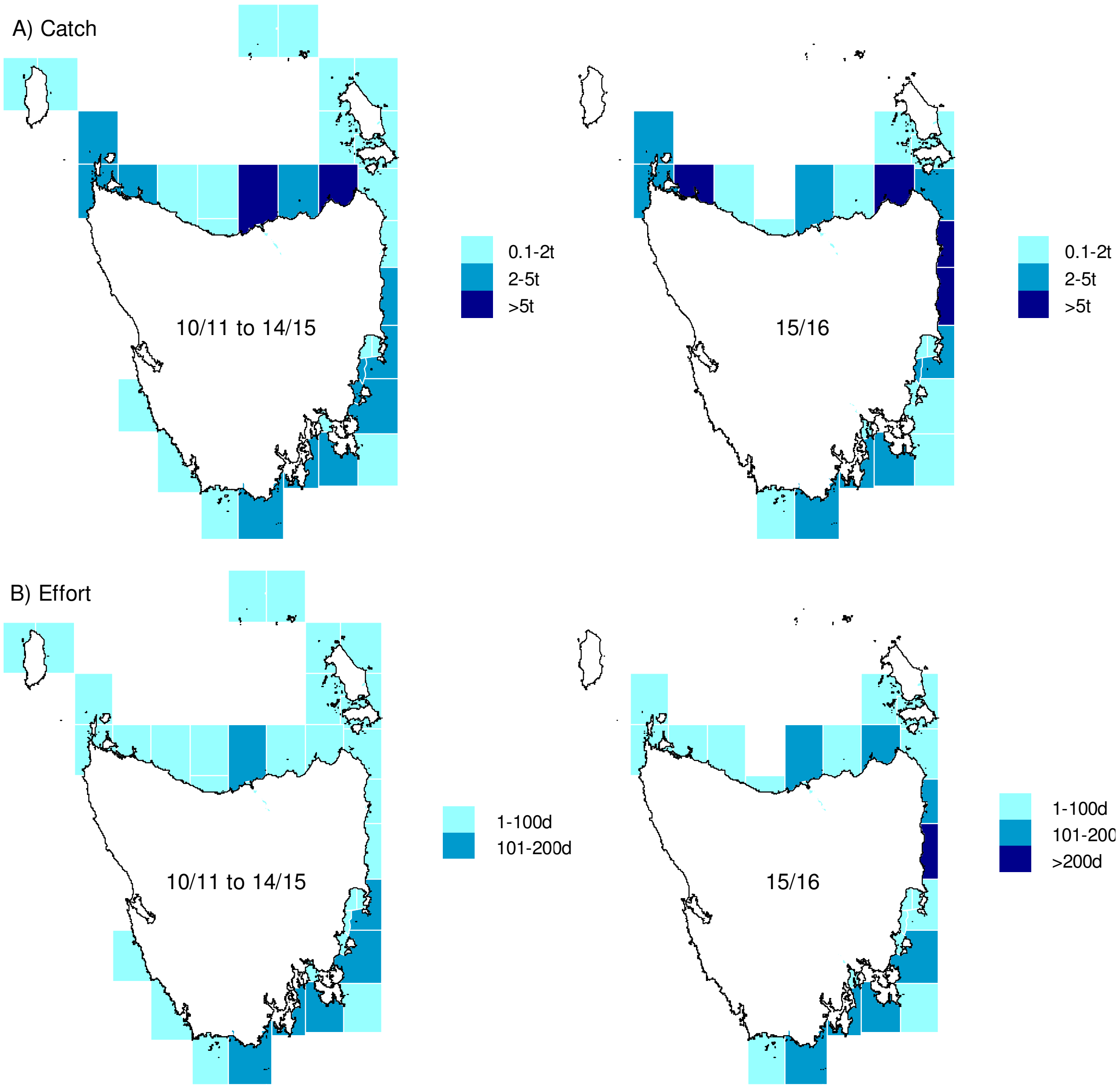


Figure 22.2 (A) Wrasse catches (t) and (B) effort (days) by fishing blocks averaged from 2010/11 to 2014/15 (left) and during 2015/16 (right).

Reference points

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	↓ 14.1 t (16.9%)
	• 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.

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 2015/16, 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.

References

AFMA. 2008. Blue warehou (*Seriolella brama*) stock rebuilding strategy: Southern and Eastern Scalefish and Shark Fishery (SESSF) - December 2008. Australian Fisheries Management Authority, Canberra.

AFMA. 2011. Blue warehou (*Seriolella brama*) stock rebuilding strategy: Southern and Eastern Scalefish and Shark Fishery (SESSF) - Revised July 2011. Australian Fisheries Management Authority, Canberra.

AFMA. 2012. Blue warehou (*Seriolella brama*) stock rebuilding strategy: Southern and Eastern Scalefish and Shark Fishery (SESSF) - Revised April 2012. Australian Fisheries Management Authority, Canberra.

AFMA. 2014. Blue warehou (*Seriolella brama*) Stock Rebuilding Strategy. Australian Fisheries Management Authority, Canberra, ACT.

Annala, J. H. 1994. Report from the Fishery Assessment Plenary, May 1994: stock assessments and yield estimates (unpublished). MAF Fisheries Greta Point library, Wellington

Ayling, G. M., K. C. Wilson, and D. A. Ratkowsky. 1975. Sand flathead (*Platycephalus bassensis*), an indicator species for mercury pollution in Tasmanian waters. Marine Pollution Bulletin **6**:142-144.

Bani, A. 2005. Temporal and spatial variability of the life history characteristics of sand flathead, *Platycephalus bassensis*. University of Tasmania, Hobart.

Bani, A., and N. A. Moltschaniwsky. 2008. Spatio-temporal variability in reproductive ecology of sand flathead, *Platycephalus bassensis*, in three Tasmanian inshore habitats: potential implications for management. Journal of Applied Ichthyology **24**:555-561.

Barnes, L. M., C. A. Gray, and J. E. Williamson. 2011. Divergence of the growth characteristics and longevity of coexisting Platycephalidae (Pisces). Marine and Freshwater Research **62**:1308-1317.

Barrett, N. S. 1995a. Aspects of the biology and ecology of six temperate reef fishes (Families: Labridae and Monacanthidae). University of Tasmania, Hobart.

Barrett, N. S. 1995b. Short- and long-term movement patterns of six temperate reef fishes (Families Labridae and Monacanthidae). Marine and Freshwater Research **46**:853-860.

Bell, J. D., J. Lyle, J. Andre, and K. Hartmann. 2016. Tasmanian scalefish fishery: ecological risk assessment. Institute for Marine and Antarctic Studies, Hobart, Australia.

Bertoni, M. 1995. The reproductive biology and feeding habits of the snook, *Sphyraena novaehollandiae*, in South Australian waters. Southern Fisheries **3**:34-35.

Blackburn, M. 1960. A study of condition (weight for length) of Australian barracouta, *Thyrsites atun* (Auphrasen). Australian Journal of Marine and Freshwater Research **11**:14-41.

Blackburn, M., and P. E. Gartner. 1954. Populations of barracouta, *Thyrsites atun* (Euphrasen), in Australian waters. Australian Journal of Marine and Freshwater Research **5**:411-468.

Bruce, B. D., K. Evans, C. A. Sutton, J. W. Young, and D. M. Furlani. 2001a. Influence of mesoscale oceanographic processes on larval distribution and stock structure in jackass morwong (*Nemadactylus macropterus*: Cheilodactylidae). ICES Journal of Marine Science **58**:1072-1080.

Bruce, B. D., F. J. Neira, and R. W. Bradford. 2001b. Larval distribution and abundance of blue and spotted warehous (*Seriolella brama* and *S. punctata*: Centrolophidae) in southeastern Australia. Marine and Freshwater Research **52**:631-639.

Bull, B., R. I. C. C. Francis, A. Dunn, A. McKenzie, D. J. Gilbert, M. H. Smith, R. Bain, and D. Fu. 2012. CASAL (C++ algorithmic stock assessment laboratory): CASAL user manual v2.30-2012/03/21. The National Institute of Water and Atmospheric Research Ltd, New Zealand.

Bulman, C., F. Althaus, X. He, N. J. Bax, and A. Williams. 2001. Diets and trophic guilds of demersal fishes of the south eastern Australian shelf. Marine and Freshwater Research **52**:537-548.

Bulman, C., S. Condie, J. Findlay, B. Ward, and J. Young. 2008. Management zones from small pelagic fish species stock structure in southern Australian waters. FRDC report 2006/076. CSIRO, Hobart.

Burchmore, J. J., D. A. Pollard, M. J. Middleton, J. D. Bell, and B. C. Pease. 1988. Biology of four species of whiting (Pisces: *Sillaginidae*) in Botany Bay, New South Wales. Australian Journal of Marine and Freshwater Research **39**: 709-727..

Butcher, A. R., and A. R. Hagedoorn. 2003. Age, growth and mortality estimates of stout whiting, *Sillago robusta* Stead (Sillaginidae), from Southern Queensland, Australia. Asian Fisheries Science **16**: 215-228.

Buxton, C. D., J. M. Semmens, E. Forbes, J. M. Lyle, N. S. Barrett, and M. J. Phelan. 2010. Spatial management of reef fisheries and ecosystems: understanding the importance of movement Tasmanian Aquaculture and Fisheries Institute, Hobart.

BWAG. 1998. Stock assessment report: Blue warehou 1998. Australian Fisheries Management Authority, Canberra.

Chubb, C. F., I. C. Potter, C. J. Grant, R. C. J. Lenanton, and J. Wallace. 1981. Age structure, growth rates and movements of sea mullet, *Mugil cephalus* L. and yellow-eye mullet, *Aldrichetta forsteri* (Valenciennes), in the Swan-Avon River System, Western Australia. Australian Journal of Marine and Freshwater Research **32**:605-628.

Coleman, N., and M. Mobley. 1984. Diets of commercially exploited fish from Bass Strait and adjacent Victorian waters, South-eastern Australia. Australian Journal of Marine and Freshwater Research **35**:549-560.

Crawford, C. M. 1984. An ecological study of Tasmanian flounder. University of Tasmania, Hobart.

Crawford, C. M. 1986. Development of eggs and larvae of the flounders *Rhombosolea tapirina* and *Ammotretis rostratus* (Pisces: Pleuronectidae). Journal of Fish Biology **29**:325-334.

Curtis, T. D., and J. S. Shima. 2005. Geographic and sex specific variation in growth of yellow eyed mullet, *Aldrichetta forsteri*, from estuaries around New Zealand. New Zealand Journal of Marine and Freshwater Research **39**:1277-1285.

Denny, C. M., and D. R. Schiel. 2001. Feeding ecology of the banded wrasse *Notolabrus fucicola* (Labridae) in southern New Zealand: prey items, seasonal differences, and ontogenetic variation. New Zealand Journal of Marine and Freshwater Research **35**:925-933.

Dixon, P. I. 1987. Stock identification and discrimination of commercially important whitings in Australian waters using genetic (FIRTA 83/16): Final Report. University of New South Wales, Centre for Marine Science.

DPIF. 1998. Scalefish Fishery: Policy Document. Tasmanian Department of Primary Industry and Fisheries, Hobart.

Dunning, M. C. 1998. Zoogeography of arrow squids (Cephalopoda: Ommastrephidae) in the Coral and Tasman Seas, southwest Pacific. Pages 435-453 *in* N. A. Voss, M. Vecchione,

R. B. Toll, and M. J. Sweeney, editors. Systematics and Biogeography of Cephalopods. Smithsonian Institution Press, Washington D.C.

Dunning, M. C., and E. C. Förch. 1998. A review of the systematics, distribution and biology of arrow squids of the genus *Nototodarus* Pfeffer, 1912 (Cephalopoda, Ommastrephidae). Pages 393-404 *in* N. A. Voss, M. Vecchione, R. B. Toll, and M. J. Sweeney, editors. Systematics and Biogeography of Cephalopods. Smithsonian Institution Press, Washington D.C.

Edgar, G. D. 2008. Australian marine life: the plants and animals of temperate waters. New Holland Publishers, Sydney.

Edgar, G. J. 1997. Australian marine life: the plants and animals of temperate waters. Reed Books, Melbourne.

Edgar, G. J., and N. S. Barrett. 1999. Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. Journal of Experimental Marine Biology and Ecology **242**:107-144.

Edgar, G. J., N. S. Barrett, and A. J. Morton. 2004. Patterns of fish movement on eastern Tasmanian rocky reefs. Environmental Biology of Fishes **70**:273-284.

Elliott, N. G., and R. D. Ward. 1994. Enzyme variation in jackass morwong, *Nemadactylus macropterus* (Schneider 1801) (Teleostei: Cheilodactylidae) from Australian and New Zealand waters. Australian Journal of Marine and Freshwater Research **45**:51-67.

Emery, T., Lyle, J. and Hartmann, K. 2016. Tasmanian Scalefish fishery assessment 2014/15. Institute for Marine and Antarctic Studies, Hobart.

Ewing, G., and J. Lyle. 2015. Low-cost monitoring regime to assess relative abundance and population characteristics of sand flathead. Institute for Marine and Antarctic Studies, Hobart, Tasmania.

Fairbridge, W. S. 1951. The New South Wales tiger flathead, *Neoplatycephalus macrodon* (Ogilby). I. Biology and age determination. Australian Journal of Marine and Freshwater Research **2**:117-178.

Ferguson, G. 2006. Fisheries biology of the greenback flounder *Rhombosolea tapirina* (Günther 1862) (Teleostei: Pleuronectidae) in South Australia. SARDI Aquatic Sciences Publication No. RD06/0008-1. South Australian Research and Development Institute (Aquatic Sciences), Adelaide.

FishBase. 2013. Monacanthidae. Accessed 30/09/2013.

Flood, M., I. Stobutzki, J. Andrews, C. Ashby, G. Begg, R. Fletcher, C. Gardner, L. Georgeson, S. Hansen, K. Hartmann, P. Hone, P. Horvat, L. Maloney, B. McDonald, A. Moore, A. Roelofs, K. Sainsbury, T. Saunders, T. Smith, C. Stewardson, J. Stewart, and B. Wise. 2014. Status of key Australian fish stocks reports 2014. Fisheries Research and Development Corporation, Canberra, ACT.

Flood, M., I. Stobutzki, J. Andrews, G. Begg, R. Fletcher, C. Gardner, J. Kemp, A. Moore, A. O'Brien, R. Quinn, J. Roach, K. R. Rowling, K. Sainsbury, T. Saunders, T. Ward, and M. Winning. 2012. Status of key Australian fish stocks reports 2012. Fisheries Research and Development Corporation, Canberra. Francis, M. 2001. Coastal fishes of New Zealand. Reed Publishing, Auckland.

Frimodt, C. 1995. Multilingual illustrated guide to the world's commercial coldwater fish. Wiley- Blackwell, Oxford.

Gavrilov, G. M., and N. P. Markina. 1979. The feeding ecology of fishes of the genus *Seriolella* (fam. Nomeidae) on the New Zealand plateau. Journal of Ichthyology **19**:128-135.

Godfriaux, B. L. 1974. Food of tarakihi in western Bay of Plenty and Tasman Bay, New Zealand. New Zealand Journal of Marine and Freshwater Research **8**:111-153.

Goldworthy, S. D., C. Bulman, X. He, J. Larcombe, and C. Littnan. 2003. Trophic interactions between marine mammals and Australian fisheries: ecosystem approach. Pages 62-99 *in* N. Gales, M. Hindell, and R. Kirkwood, editors. Marine mammals: fisheries, tourism and management issues. CSIRO Publishing, Collingwood, Victoria.

Gomon, M., D. Bray, and R. Kuiter. 2008. Fishes of Australia's southern coast. Reed New Holland. Gorman, T. B. S. 1962. Yellow-eyed mullet *Aldrichetta forsteri* Cuvier and Valenciennes in Lake Ellesmere.

Grant, C. J., T. R. Cowper, and D. D. Reid. 1978. Age and growth of snoek, *Leionura atun* (Euphrasen), in south-eastern Australian waters. Australian Journal of Marine and Freshwater Research **29**:435-444.

Grant, E. M. 1991. Grant's Fishes of Australia. E.M. Grant Pty. Ltd., Queensland.

Grewe, P. M., A. J. Smolenski, and R. D. Ward. 1994. Mitochondrial DNA variation in jackass morwong, Nemadactylus macropterus (Teleostei: Cheilodactylidae) from Australian and New Zealand waters. Canadian Journal of Fisheries and Aquatic Sciences **51**:1101-1109.

Hardwood, N. J., and M. P. Lokman. 2006. Fecundity of banded wrasse (*Notolabrus fucicola*) from Otago, Southern New Zealand. New Zealand Journal of Marine and Freshwater Research **40**:467-476.

Harries, D. N., and R. L. Croome. 1989. A review of past and present inshore gill netting in Tasmania with particular reference to the bastard trumpeter, Latridopsis forsteri Castelnau. papers and Proceedings of the Royal Society of Tasmania **123**:97-110.

Harries, D. N., and P. S. Lake. 1985. Aspects of the biology of inshore populations of Bastard Trumpeter, *Latridopsis forsteri* (Castleneau, 1872) in Tasmanian waters. Tasmanian Fisheries Research **27**:19-43.

Hartmann, K., and J. M. Lyle. 2011. Tasmanian Scalefish Fishery-2009/10. Tasmanian Aquaculture and Fisheries Institute, Hobart.

Henry, G. W., and J. M. Lyle. 2003. National recreational and indigenous fishing survey. Final report to FRDC. Project No 99/158. Canberra

Hobday, D. K., and J. W. J. Wankowski. 1987. School whiting Sillago bassensis flindersi: reproduction and fecundity in eastern Bass Strait, Australia. Internal Report 153. Victorian Department of Conservation, Forests and Lands. Fisheries Division.

Hurst, R. J., S. L. Ballara, and D. MacGibbon. 2012. Fishery characterisation and standardised CPUE analyses for barracouta,*Thyrsites atun*, (Euphrasen, 1791) (Gempylidae),1989–90 to 2007–08. New Zealand Fisheries Assessment Report 2012/12 NIWA, Wellington.

Hutchinson, W. 1993. The reproductive biology and induced spawning of striped trumpeter, *Latris lineata*. University of Tasmania, Hobart.

Jackson, G. D., B. McGrath Steer, S. Wotherspoon, and A. J. Hobday. 2003. Variation in age, growth and maturity in the Australian arrow squid *Nototodarus gouldi* over time and space-what is the pattern? Marine Ecology Progress Series **264**:57-71.

Jackson, G. D., R. K. O'Dor, and Y. Andrade. 2005a. First tests of hybrid acoustic/archival tags on squid and cuttlefish. Marine and Freshwater Research **56**:425-430.

Jackson, G. D., S. Wotherspoon, and B. L. McGrath-Steer. 2005b. Temporal population dynamics in arrow squid *Nototodarus gouldi* in southern Australian waters. Marine Biology **146**:975-983.

Jenkins, G. P. 1986. Composition, seasonality and distribution of ichthyoplankton in Port Phillip Bay, Victoria. Australian Journal of Marine and Freshwater Research **37**:507-520.

Jones, G. K. 1990. Growth and mortality in a lighthly fished population of garfish (*Hyporhamphus melanochir*), in Baird Bay, South Australia. Transactions of the Royal Society of South Australia **114**:37-45.

Jones, G. K., Q. Ye, S. Ayvazian, and P. Coutin. 2002. Fisheries ecology and habitat ecology of southern sea garfish (*Hyporhampus melanochir*) in southern Australian waters. South Australian Research and Development Institute.

Jordan, A. R. 2001a. Age, growth and spatial and interannual trends in age composition of jackass morwong, *Nemadactylus macropterus*, in Tasmania. Marine and Freshwater Research **52**:641-660.

Jordan, A. R. 2001b. Reproductive biology, early life-history and settlement distribution of sand flathead (*Platycephalus bassensis*) in Tasmania. Marine and Freshwater Research **52**:589-601.

Jordan, A. R., D. M. Mills, G. Ewing, and J. M. Lyle. 1998. Assessment of inshore habitats around Tasmania for life-history stages of commercial finfish species. Tasmanian Aquaculture and Fisheries Institute, Hobart.

Kailola, P. J., M. J. Williams, P. C. Stewart, R. E. Reichelt, A. McNee, and C. Grieve. 1993. Australian fisheries resources. Bureau of Resource Sciences, Canberra.

Klaer, N. 2010. Tiger flathead (*Neoplatycephalus richardsoni*) stock assessment based on data up to 2009. CSIRO, Hobart.

Klumpp, D. W., and P. D. Nichols. 1983. Nutrition of the southern sea garfish (*Hyporhamhus melanochir*): gut passage rate and daily consumption of two food types and assimilation of seagrass components. Marine Ecology Progress Series **12**:207-216.

Knuckey, I. A., and K. P. Sivakumaran. 2001. Reproductive characteristics and per-recruit analyses of blue warehou (*Seriolella brama*): implications for the south-east fishery of Australia. Marine and Freshwater Research **52**:575-587.

Last, P. R., E. O. G. Scott, and F. H. Talbot. 1983. Fishes of Tasmania. Tasmanian Fisheries Development Authority Hobart.

Lyle, J. M. 1999. Licensed recreational fishing and an evaluation of recall biases in the estimation of recreational catch and effort. Final Report to the Marine Recreational Fishing Council Tasmanian Aquaculture and Fisheries Institute, Hobart.

Lyle, J. M. 2000. Assessment of the licensed recreational fishery of Tasmania (Phase 2). Final Report to FRDC. Project 96/161. Tasmanian Aquaculture and Fisheries Institute Hobart.

Lyle, J. M. 2005. 2000/01 survey of recreational fishing in Tasmania. Tasmanian Aquaculture and Fisheries Institute, Hobart.

Lyle, J. M., J. D. Bell, B. M. Chuwen, N. S. Barrett, S. R. Tracey, and C. D. Buxton. 2014a. Assessing the impacts of gillnetting in Tasmania: Implications for by-catch and biodiversity. Institure for Marine and Antarctic Studies, Hobart, Tasmania.

Lyle, J. M., and W. B. Ford. 1993. Review of trawl research 1979–1987, with summaries of biological information for the major species, with summaries of biological information for the major species. Technical Report 46. Department of Sea Fisheries, Tasmania, Hobart.

Lyle, J. M., and A. R. Jordan. 1999. Tasmanian scalefish fishery assessment- 1998. Tasmanian Aquaculture and Fisheries Institute, Hobart.

Lyle, J. M., K. Krusic-Golub, and A. K. Morison. 2000. Age and growth of jack mackerel and the age structure of the jack mackerel purse seine catch. FRDC project no 1995/034. TAFI, Hobart.

Lyle, J. M., N. Moltschaniwskyj, A. J. Morton, I. W. Brown, and D. Mayer. 2007. Effects of hooking damage and hook type on post-release survival of sand flathead (*Platycephalus bassensis*). Marine and Freshwater Research **58**:445-453.

Lyle, J. M., and R. Murphy. 2001. Long distance migration of striped trumpeter. Fishing Today **14**:6.

Lyle, J. M., K. E. Stark, and S. R. Tracey. 2014b. 2012-13 survey of recreational fishing in Tasmania. Institute for Marine and Antarctic Studies, Hobart, Tasmania.

Lyle, J. M., and S. R. Tracey. 2012. Recreational gillnetting in Tasmania – an evaluation of fishing practices and catch and effort. Report to FishWise. IMAS, Hobart.

Lyle, J. M., S. R. Tracey, K. E. Stark, and S. Wotherspoon. 2009. 2007-08 survey of recreational fishing in Tasmania. Tasmanian Aquaculture and Fisheries Institute, Hobart.

Machida, S. 1983. A brief review of the squid survey by Hoyo Maru No. 67 in southeast Australian waters in 1979/80. Memoirs of the National Museum Victoria **44**:291-295.

May, J. L., and J. G. H. Maxwell. 1986. Trawl fish from temperate waters of Australia. CSIRO Division of Fisheries Research, Hobart.

Moltschaniwskyj, N. A., and G. T. Pecl. 2003. Small-scale spatial and temporal patterns of egg production by the temperate loliginid squid *Sepioteuthis australis*. Marine Biology **142**:509-516.

Morison, A. K., I. A. Knuckey, C. A. Simpfendorfer, and R. C. Buckworth. 2012. 2011 Stock assessment summaries for the South East Scalefish and Shark Fishery. Southern and Eastern Scalefish and Shark Fishery Assessment Group, AFMA.

Murphy, R., and J. M. Lyle. 1999. Impact of gillnet fishing on inshore temperate reef fished, with particular reference to banded morwong. Final report to FRDC, project No. 95/145.Tasmanian Aquaculture and Fisheries Institute, Hobart.

Nakamura, I., and N. V. Parin. 1993. FAO Species Catalogue. Vol. 15. Snake mackerels and cutlassfishes of the world (families Gempylidae and Trichiuridae). An annotated and illustrated catalogue of the snake mackerels, snoeks, escolars, gemfishes, sackfishes, domine, oilfish, cutlassfishes,. scabbardfishes, hairtails, and frostfishes known to date. FAO.

Neira, F. J., A. G. Miskiewicz, and T. Trnski. 1998. Larvae of temperate Australian fishes: laboratory guide for larval fish identification. University of Western Australia Press.

Nichols, D. S., D. Williams, G. A. Dunstan, P. D. Nichols, and J. K. Volkman. 1994. Fatty acid composition of Antarctic and temperate fish of commercial interest. Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology **107**:357-363.

Norman, M. 2000. Cephalopods, a world guide. ConchBooks, Hackenheim.

Norman, M., and A. Reid. 2000. A guide to squid, cuttlefish and octopuses of Australasia. CSIRO Publishing/The Gould League of Australia, Collingwood/Moorabbin

O'Shea, S., K. S. Bolstad, and P. A. Ritchie. 2004. First records of egg masses of *Nototodarus gouldi* McCoy, 1888 (Mollusca: Cephalopoda: Ommastrephidae), with comments on eggmass susceptibility to damage by fisheries trawl. New Zealand Journal of Zoology **31**:161-166.

O'Sullivan, D., and J. M. Cullen. 1983. Food of the Squid *Nototodarus gouldi* in Bass Strait. Australian Journal of Marine and Freshwater Research **34**:261-285.

Parker, S., and D. Fu. 2011. Age composition of the commercial tarakihi (*Nemadactylus macropterus*) catch in quota management area TAR 2 in fishery year 2009-2010. New Zealand Fisheries Assessment Report 2011/59.

Patterson, H., L. Georgeson, I. Stobutzki, and R. Curtotti. 2015. Fishery status reports 2015. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Patterson, H., R. Noriega, L. Georgeson, I, Stobutzki and R. Curtotti. 2016, Fishery status reports 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Paul, L. J. 2000. New Zealand fishes. Identification, natural history and fisheries. Reed Publishing, Auckland.

Paul, L. T., and P. R. Taylor. 1998. A summary of the biology, recreational and commercial landings, and stock assessment of yellow-eyed mullet, *Aldrichetta forsteri* (Cuvier and Valenciennes, 1836) (Mugiloidei: Mugilidae). New Zealand Fisheries Assessment Research Document 98/17, NIWA, Wellington.

Pecl, G. T. 2000. Comparative life-history of tropical and temperate *Sepioteuthis* squids in Australian waters. PhD Thesis, James Cook University, Townsville.

Pecl, G. T. 2004. The *in situ* relationships between season of hatching, growth and condition in the southern calamary, *Sepioteuthis australis*. Marine and Freshwater Research **55**:429-438.

Pecl, G. T., and N. A. Moltschaniwsky. 2006. Life history of a short-lived squid (*Sepioteuthis australis*): resource allocation as a function of size, growth, maturation, and hatching season. ICES Journal of Marine Science **63**:995-1004.

Pecl, G. T., N. A. Moltschaniwskyj, S. R. Tracey, and A. R. Jordan. 2004. Inter-annual plasticity of squid life-history and population structure: ecological and management implications. Oecologia (Berlin) **139**:515-524.

Pecl, G. T., S. R. Tracey, J. M. Semmens, and G. D. Jackson. 2006. Use of acoustic telemetry for spatial management of *Sepioteuthis australis*, a highly mobile inshore squid species. Marine Ecology Progress Series **328**:1-15.

Richardson, B. J. 1982. Geographical distribution of electrophoretically detected protein variation in Australian commercial fishes. II: Jackass morwong, *Cheilodactylus macropterus* (Bloch and Schneider). Australian Journal of Marine and Freshwater Research, 33: 927–931. **33**:927-931.

Robinson, N., A. Skinner, L. Sethuraman, H. McPartlan, N. Murray, I. Knuckey, D. C. Smith, J. Hindell, and S. Talman. 2008. Genetic stock structure of blue-eye trevalla (*Hyperoglyphe antarctica*) and warehous (*Seriolella brama* and *Seriolella punctata*) in south-eastern Australian waters. Marine and Freshwater Research **59**:502-514.

Rowling, K. R. 1994. Tiger flathead, Neoplatycephalus richardsoni. Pages 124-136 *in* R. D. J. Tilzey, editor. The South East Fishery: a scientific review with reference to quota management. Bureau of Resource Sciences, Australian Government Print Service, Canberra.

Ruwald, F. P. 1992. Larval feeding trials with striped trumpeter, *Latris lineata.in* D. A. Hancock, editor. Larval biology. Australian Society for Fish Biology Workshop, Hobart, 20 August 1991. Bureau of Rural Resources Proceedings, AGPS, Canberra.

Ruwald, F. P., L. D. Searle, and L. A. Oates. 1991. A preliminary investigation into the spawning and larval rearing of striped trumpeter, *Latris lineata*.

Sahlqvist, P., and M. Skirtun. 2011. Southern Squid Fishery.*in* J. Woodhams, I. Stobutzki, S. Vieira, R. Curtotti, and G. Begg, editors. Fisheries Status Reports 2010: status of fish stocks and fisheries managed by the Australian Government. Australian Bureau of Agriculture and Resource Economics and Sciences, Canberra.

Schnute, J. T., and L. J. Richards. 1990. A unified approach to the analysis of fish growth, maturity, and survivorship data. Canadian Journal of Fisheries and Aquatic Sciences **47**:24-40.

Scott, T. D., C. J. M. Glover, and R. V. Southcott. 1974. The marine and freshwater fishes of South Australia, 2nd ed. Government Printer, South Australia.

SFAC. 2015. Scalefish fishery advisory committee (SFAC) minutes No. 59, 26 November 2015. Page 38 *in* P. Department of Primary Industries, Water and the Environment, editor. Hobart.

Shepherd, S. A., and P. S. Clarkson. 2001. Diet, feeding behaviour, activity and predation of the temperate blue-throated wrasse, *Notolabrus tetricus*. Marine and Freshwater Research **52**:311-322.

Smith, D. C. 1994. Blue warehou. Page 360 *in* R. D. J. Tilzey, editor. The South East Fishery: a scientific review with particular reference to quota management. Bureau of Resource Sciences, Parkes.

Smith, D. C., I. Montgomery, K. P. Sivakumaran, K. Krusic-Golub, K. Smith, and R. Hodge. 2003. The fisheries biology of bluethroat wrasse (*Notolabrus tetricus*) in Victorian waters. FRDC Report No. 97/128. Marine and Freshwater Institute, Victoria, Australia.

Smith, H. K. 1983. Fishery and Biology of *Nototodarus gouldi* (McCoy, 1888) in western Bass Strait. Memoirs of the National Museum Victoria **44**:285-290.

Smith, T. M., C. P. Green, and C. D. H. Sherman. 2015. Patterns of connectivity and population structure of the southern calamary *Sepioteuthis australis* in southern Australia. Marine and Freshwater Research **66**:942-947.

St Hill, J. L. 1996. Aspects of the biology of southern sea garfish, *Hyporhamphus malanochir*, in Tasmanian waters. University of Tasmania, Hobart.

Stark, K. E. 2008. Ecology of the arrow squid (*Nototodarus gouldi*) in southeastern Australian waters: a multi-scale investigation of spatial and temporal variability. PhD Thesis, University of Tasmania, Hobart.

Steer, M. A., N. A. Moltschaniwskyj, and F. C. Gowland. 2002. Temporal variability in embryonic development and mortality in the southern calamary *Sepioteuthis australis*: a field assessment. Marine Ecology Progress Series **243**:143-150.

Steer, M. A., N. A. Moltschaniwskyj, D. S. Nichols, and M. Miller. 2004. The role of temperature and maternal ration in embryo survival: using the dumpling squid *Euprymna tasmanica* as a model. Journal of Experimental Marine Biology and Ecology **307**:73-89.

Stevens, J. D., and H. F. Hansfeld. 1982. Age determination and mortality estimates on an unexploited population of Jack mackerel *Trachurus declivis* (Jenyns, 1841) from southeast Australia. Report No 148., CSIRO Marine Laboratories, Cronulla.

Stewart, J., J. Hughes, J. McAllister, J. M. Lyle, and M. MacDonald. 2011. Australian salmon (*Arripis trutta*): population structure, reproduction, diet and composition of commercial and recreational catches. Fisheries Final Report Series No. 129. Industry & Investment NSW.

Stuart-Smith, R. D., N. S. Barrett, C. M. Crawford, S. D. Frusher, D. G. Stevenson, and G. J. Edgar. 2008. Spatial patterns in impacts of fishing on temperate rocky reefs: Are fish abundance and mean size related to proximity to fisher access points? Journal of Experimental Marine Biology and Ecology **365**:116-125.

Sutton, C. P., D. J. MacGibbon, and D. W. Stevens. 2010. Age and growth of greenback flounder (*Rhombosolea tapirina*) from southern New Zealand. New Zealand Fisheries Assessment Report 2010/48. NIWA, Wellington.

Thresher, R. E., C. H. Proctor, J. S. Gunn, and I. R. Harrowfield. 1994. An evaluation of electronprobe microanalysis of otoliths for stock identification of nursery areas in a southern temperate groundfish, *Nemadactylus macropterus* (Cheilodactylidae). Fishery Bulletin **92**:817-840.

Tilzey, R. D. J. 1994. The South East fishery: a scientific review with particular reference to quota management. Bureau of Resources Sciences, Australia.

Tilzey, R. D. J., M. Zann-Schuster, N. L. Klaer, and M. J. Williams. 1990. The South East Trawl Fishery: biological synopses and catch distributions for seven major commercial fish species.

Tracey, S. R., and J. M. Lyle. 2005. Age validation, growth modeling and mortality estimates for striped trumpeter (*Latris lineata*) from south-eastern Australia: making the most of patchy data. Fishery Bulletin **103**:169-182.

Tracey, S. R., J. M. Lyle, G. Ewing, P., K. Hartmann, and A. Mapleston. 2013. Offshore recreational fishing in Tasmania 2011/12. Institute for Marine and Antarctic Studies, Hobart.

Tracey, S. R., J. M. Lyle, and M. Haddon. 2007a. Reproductive biology and per-recruit analyses of striped trumpeter (*Latris lineata*) from Tasmania, Australia: implications for management. Fisheries Research **84**:358-367.

Tracey, S. R., A. J. Smolenski, and J. M. Lyle. 2007b. Genetic structuring of *Latris lineata* at localized and transoceanic scales. Marine Biology **152**:119-128.

Triantafillos, L. 2004. Effects of genetic and environmental factors on growth of southern calamary, *Sepioteuthis australis*, from southern Australia and northern New Zealand. Marine and Freshwater Research **55**:439-446.

Triantafillos, L., and M. Adams. 2001. Allozyme analysis reveals a complex population structure in the southern calamary *Sepioteuthis australis* from Australia and New Zealand. Marine Ecology Progress Series **212**:193-209.

Triantafillos, L., G. D. Jackson, M. Adams, and B. McGrath Steer. 2004. An allozyme investigation of the stock structure of arrow squid *Nototodarus gouldi* (Cephalopoda:Ommastrephidae) from Australia. ICES Journal of Marine Science **61**:829-835.

Uozumi, Y. 1998. Fishery biology of arrow squids, *Nototodarus gouldi* and *N. sloanii* in New Zealand Waters. Bulletin of the National Research Institute of Far Seas Fisheries **35**:1-111.

van den Enden, T., R. W. G. White, and N. G. Elliott. 2000. Genetic variation in the greenback flounder *Rhombosolea tapirina* Günther (Teleostei, Pleuronectidae) and the implications for aquaculture. Marine and Freshwater Research **51**:23-33.

Ward, T. M., O. Burnell, A. Ivey, J. Carroll, J. Keane, J. Lyle, and S. Sexton. 2015. Summer spawning patterns and preliminary Daily Egg Production Method survey of Jack Mackerel and Australian Sardine off the East Coast. South Australian Research and Development Institute (Aquatic Sciences).

Wayte, S. E. 2013. Management implications of including a climate-induced recruitment shift in the stock assessment for jackass morwong (*Nemadactylus macropterus*) in southeastern Australia. Fisheries Research **142**:47-55.

Webb, B. F. 1976. Aspects of the biology of jack mackerel *Trachurus declivis* (Jenyns) from south east Australian waters. Tasmanian Fisheries Research **10**:1-17.

Welsford, D. C. 2003. Early life-history, settlement dynamics and growth of the temperate wrasse, *Notolabrus fucicola* (Richardson 1840), on the east coast of Tasmania. PhD thesis. University of Tasmania, Hobart.

Williams, H., and G. Pullen. 1986. A synopsis of biological data on the jack mackerel *Trachurus declivis* Jenyns. Tasmanian Department of Sea Fisheries Technical Report 10. 34 p.

Woodhams, J., S. Vieira, and I. Stobutzki. 2012. Fishery status reports 2011. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Woodhams, J., S. Vieira, and I. Stobutzki. 2013. Fishery status reports 2012. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Ziegler, P. E. 2012. Fishing tactics and fleet structure of the small-scale coastal scalefish fishery in Tasmania, Australia. Fisheries Research **134-136**:52-63.

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:

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

---

[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.

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.

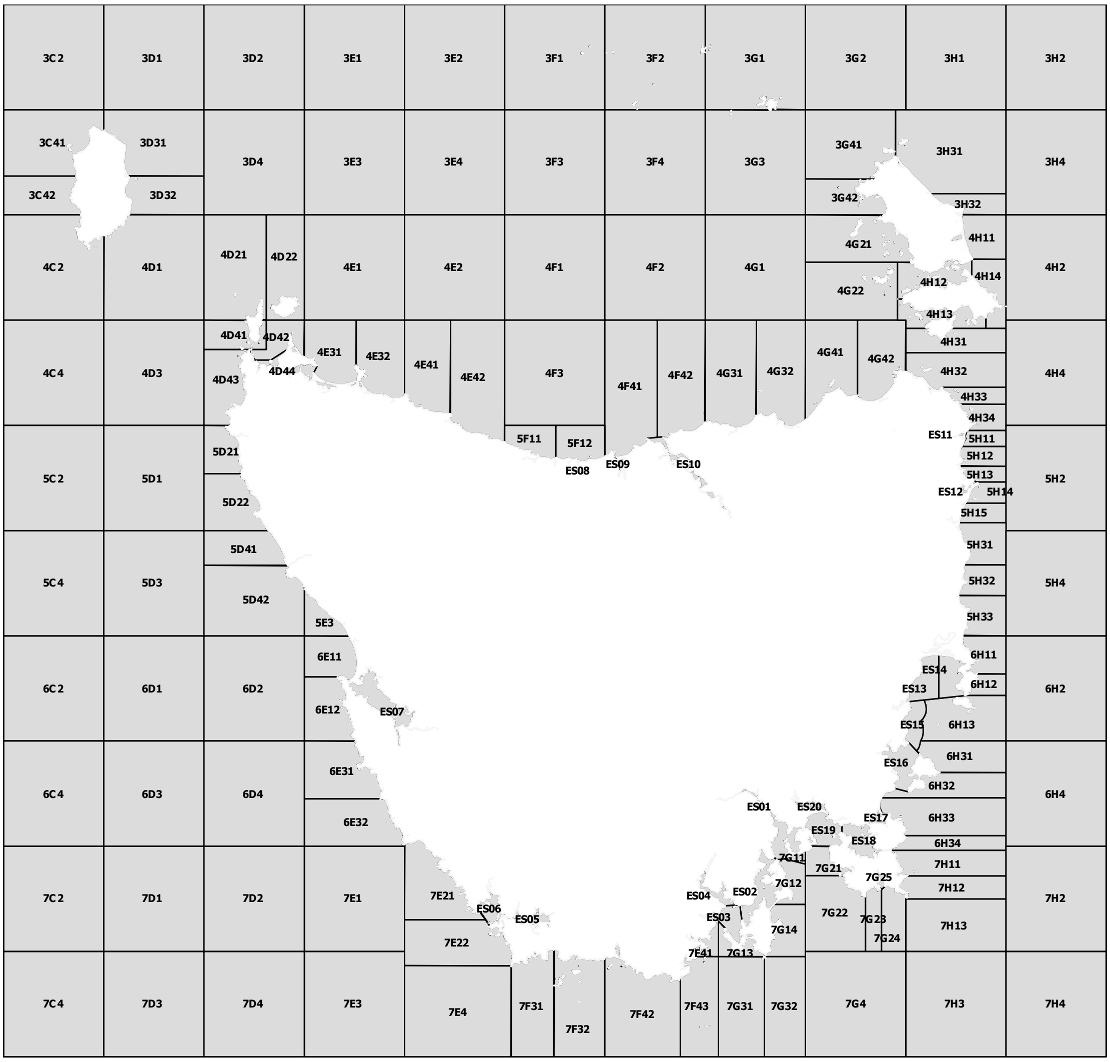


Fig. A1 Numbers for fishing blocks used in calculation of catch figures.

(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 1995/96 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.

Species	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	15/16
Scalefish (excl. small pelagics)																					
Australian Salmon	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	65.6	42.2	85.2
Barracouta	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	1.12	1.7	0.4
Boarfish	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	1.04	0.6	0.7
Cod	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	1.5
Flathead	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	36.5	68.0
Flounder	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	1.0
Garfish	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	22.0
Gurnard	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	2.1
Leatherjacket	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	2.1	1.3
Ling	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	0.1
Marblefish	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	0.3	0.3
Morwong, banded	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	38.1	34.7	30.0	32.5
Morwong, jackass	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	0.9	3.2
Morwong, other	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	0.3
Mullet	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	2.0
Other	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	1.2
Snook	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	8.2	9.9	10.2	3.0
Trevally	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	2.8
Trumpeter, bastard	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	6.4	8.4
Trumpeter, striped	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	6.7
Trumpeter, unspec.	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	0.2
Warehou, blue	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	7.4
Warehou, other	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	0.3
Whiting	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	23.4
Wrasse	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	81.6	69.3
Total scalefish	**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**	**610.9**	**321.0**	**291.3**	**343.4**

Table A.1 Continued. Whole weight in tonnes by financial year

Species	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	15/16
Small pelagic species																					
Mackerel, jack	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	1.0
Mackerel, other	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	0.2
Pilchard/Anchovy	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	0.0
Redbait	0.1			4.0					3.4	1.0	1.4	0.3	156.4	441.4	121.6	15.0	0.1	0.1			0.0
Total small pelagic species	**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**	**1.2**
Cephalopod																					
Calamari, southern	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	106.0
Cuttlefish	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	0.0
Octopus pallidus[3]	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	70.1
Squid, Gould's	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	325.1
Total cephalopod	**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**	**501.2**
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	0.24
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	8.01
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	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	0.03
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	1.09
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	1.01
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	0.84
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**	**11.2**

---

[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
Gillnet	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	66
	14/15	83.4	32337	1284	58
	15/16	91.3	30651	1284	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	9.2	3756	146	9
	15/16	4.8	1263	71	10
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	10
	14/15	12.9	752	118	14
	15/16	13.4	620	95	11

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	77.1	285	174	15
	14/15	61.9	323	202	17
	15/16	88.6	225	150	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
	15/16	*	236	120	4
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	15.7	51	43	6
	15/16	*	17	14	3

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	105.7	18729	1803	94
	15/16	101.7	20282	1824	90
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
	15/16	2.0	26	27	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	6.3	2038	212	25
	15/16	3.1	1142	144	14

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	869	33
	13/14	52.2	11154	799	31
	14/15	60.4	14672	905	36
	15/16	72.9	16961	1081	42
Spear	95/96	14.1	1403	368	21
	96/97	19.3	1853	464	27
	97/98	16.8	1981	483	40
	98/99	19.8	1812	452	38
	99/00	19.3	2233	475	25
	00/01	14.4	1586	355	22
	01/02	13.1	1296	279	19
	02/03	10.4	1366	247	22
	03/04	10.5	1446	289	22
	04/05	13.5	1609	357	24
	05/06	7.8	1009	271	22
	06/07	15.4	1414	346	20
	07/08	9.8	957	196	20
	08/09	5.6	886	167	14
	09/10	5.0	663	170	15
	10/11	4.0	626	179	16
	11/12	5.0	622	176	16
	12/13	3.3	489	128	17
	13/14	3.7	339	109	12
	14/15	2.1	266	88	13
	15/16	1.4	188	49	8
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	12
	12/13	5.1	1622	72	10
	13/14	5.4	2078	79	13
	14/15	5.9	2894	113	12
	15/16	2.0	1376	52	7

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
	15/16	324.1	1916	111	8
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
	15/16	*	77	42	2