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Executive Summary

The recent National Recreational Fishing Survey (NRFS) has highlighted the importance of recreational fishing to Tasmania, finding that almost one in three Tasmanians fished at least once during the 12 months prior to May 2000. In 2000/01 a total of 0.8 million fisher days of effort yielded a retained catch of 2.6 million finfish, along with other taxa, representing a diverse range of species groups.

The NRFS, and other recent studies, has clearly identified the most important species within the recreational fishery, and, as recreational fishing pressure is likely to remain high in the future, it was considered timely to review the status and knowledge of the key species. In doing so important biological parameters and fisheries are examined, as well as highlighting current knowledge gaps and identifying future research needs. Bream, flathead, flounder, Australian salmon, trumpeter and blue warehou were identified as key groups on the basis of harvest levels (taking into account interannual variation in the availability of some species), or status as highly targeted or 'icon' species.

Current knowledge was assessed in relation to a number of biological parameters; size at maturity, spawning season, fecundity, diet, age and growth, movement and stock status. Information has been obtained from a variety of sources, including published and unpublished reports and observations.

Across the species, most prior research attention has been directed at age and growth studies. Estimates of biomass were only available for flathead, however this was for a limited area of the state and in the case of sand flathead did not provide coverage of shallow inshore waters where the species is common. A quantitative assessment of stock status is only available for blue warehou, which have been classified as overfished, largely the result of commercial fishing activities in Commonwealth waters.

Black bream
Black bream are most common in estuarine waters along the southern and central-western Australian coast. Most research effort has been conducted interstate. As bream is highly variable throughout its range, it is unknown how applicable this research is to Tasmanian populations. It is likely that bream move upstream to spawn in spring and summer in Tasmanian waters. They are opportunistic feeders consuming mostly benthic invertebrates. They are capable of reaching 60 cm length, 4 kg weight and live to over 20 years, with considerable individual variation in length with age. Bream have limited coastal movement, and apparently rarely move between estuaries. In Tasmania, only recreational fishers may catch bream. Stock status is unknown.

Flathead
Sand and tiger flathead are restricted to estuarine and coastal waters along the southern and south-eastern Australian coast. Spawning occurs in shallow inshore and coastal waters during spring and summer for sand flathead and summer for tiger flathead. Both species are active foragers and ambush predators, consuming small fish with sand flathead also consuming invertebrates. Sand flathead reach over 50 cm and 3 kg weight and live for almost 20 years. Tiger flathead can reach 65 cm and 17 years, with females growing larger than males. As they grow and mature, sand flathead extend their usage of habitats from coastal and estuarine areas to include deeper mid-shelf waters, but other apparent seasonal movements by this species are not well understood. In Tasmania, tiger flathead move inshore to spawn, however little else is known about movement. Sand flathead dominate the recreational catch in Tasmania while tiger flathead are the main flathead species taken by the commercial fishery. Stock status is unknown.

Flounder
Greenback and long-snouted flounder are found on soft bottoms in estuaries and inshore coastal waters along the southern Australian coast. Knowledge of flounder biology and ecology is limited. Both species are known to feed on benthic invertebrates, and move into deeper coastal waters in winter and spring to spawn. Greenback flounder may reach 45 cm length and 600 g weight, long-snouted flounder reach 34 cm. Flounder support minor commercial and recreational fisheries throughout south-eastern Australia. Stock status is unknown.

Australian salmon
There are two species of Australian salmon, the eastern and western Australian salmon, both of which are found in Tasmanian waters. Juveniles occur over soft substrates in shallow coastal waters, while larger fish move into exposed coastal waters. Some information is available about their biology, however there has been little recent research. It appears that spawning does not occur in Tasmanian waters, rather, both species migrate to spawning grounds off the mainland coast. Western Australian salmon feed predominantly on pelagic clupeoid fishes, whereas eastern Australian salmon consume krill. Western Australian salmon may reach 96 cm length, 10.5 kg weight and live to 9 years. Eastern Australian salmon may reach 89 cm length, 7 kg weight and live to 10 years. Other than spawning migrations, knowledge of other movements is limited. Australian salmon are important commercial and recreational species that are currently heavily exploited throughout their distributional range. Stock status is unknown.

Trumpeter
Striped trumpeter are found along the southern Australian coast, whereas the bastard trumpeter is restricted to the southern coast of Australia. Knowledge of the biology and ecology of trumpeters is limited. Both species live on shallow reefs as juveniles, with adults moving offshore to deeper reefs. Trumpeters consume small invertebrates, with striped trumpeter also feeding on fish and cephalopods. Bastard trumpeter can grow to 65 cm length and over 4 kg weight. Striped trumpeter can grow to 1.2 m length, 25 kg weight, and live for over 40 years. Juvenile striped trumpeter tend to remain around shallow reefs, whereas larger fish move offshore. There is evidence of marked recruitment variability in trumpeter with particularly strong cohorts for both species spawned in 1993. Both trumpeter species form the basis of significant commercial and recreational fisheries. Stock status is unknown.

Blue warehou
Blue warehou are found along the south-east coast of Australia. They are generally an offshore pelagic species, however in Tasmania they are found seasonally in shallow inshore waters. With the exception of diet and movement, their biology has been relatively well studied. In southern Tasmania, spawning occurs in offshore waters in early spring. In New Zealand, blue warehou eat zooplankton. They can reach 76 cm length, 7kg weight and may live up to 10 years. They are a highly mobile species that supports important commercial and recreational fisheries. The stock has been assessed as overfished.

Research needs
This review has highlighted that generally little is known about the life history and resource status of many of the key recreational species. Understanding the effects of fishing and status of the fish stocks and their role in the broader ecosystem requires at least a basic understanding of the fisheries, population dynamics and life history of species.

Size and possession limits apply for each of the key species and, as a consequence, recreational fishers may have to release some of their catch. In addition there is a growing trend towards catch-and-release amongst recreational fishers. Therefore, it is important to have an understanding of post release survival and factors that might enhance survival rate.

Issues of access and resource sharing between recreational and commercial sectors are arising within some fisheries. There is, however, little information available on the comparative impacts of the two sectors on stocks and the competitive interactions that occur between sectors.

The recent move towards ecosystem based fisheries management has highlighted the need for an understanding of the broader ecosystem, as well as the target species. Whilst fishing is an important factor, there are also a number of other impacts that can effect fish populations, such as oceanographic variability, climate change, pollution and habitat degradation. Little is currently known about how these factors might affect fish populations.

Table of Contents

1. Introduction

A number of recent studies (Lyle and Smith, 1998; Lyle, 2000; Henry and Lyle, 2003; Lyle, 2005) have shown the importance of recreational fishing in Tasmania in terms of participation, effort and catch. Most recently, the 2000/01 National Recreational Fishing Survey (NRFS) provided comprehensive catch, effort and economic information at national, state and regional scales. The NRFS established that participation rates are high, with almost one in three Tasmanians fishing at least once in the 12 months prior to May 2000, and over $50 million of expenditure directly attributable to recreational fishing during 2000/01. Over that period, a total of 0.8 million person days of fishing effort in marine and estuarine waters was expended, and almost 2.4 million finfish across a diverse range of species groups were harvested.

A wide range of methods are used to catch fish and shellfish by recreational fishers in Tasmania, but these can be broadly grouped into line, pot and trap, net, dive collection and miscellaneous methods (including hand collection and pump) (Henry and Lyle, 2003). Important recreational fisheries exist for abalone and rock lobster, however, unlike most finfish species, there is considerable information about the biology (Tarbath et al., 2002; Gardner et al., 2004) and recreational fisheries (Forward and Lyle, 2002; Lyle and Morton, 2004) for these species. Finfish are predominantly targeted by line and nets, with some also taken by spear. No specific licence is required for taking finfish, however a licence is required for some gear types (gillnets and beach seines) and an inland fisheries licence is required in freshwater and the upper reaches of some estuaries. Possession limits and size limits[1] also apply to many species.

There have been a number of reviews of the biology of Tasmanian scalefish (Lyle and Ford, 1993; Anon., 1994; Jordan, 1997). Their focus, however, has been determined by species important to the commercial sector, although some species also have importance to the recreational sector. Previous reviews were completed when little information was available about the recreational fishery in Tasmania, and recent research, most notably the 2000/01 National Survey, suggests that recreational fishing pressure on some species is high and may potentially increase. Little is known about the life history of many species, making it difficult to determine the effectiveness of current management controls. For these reasons it was considered timely to review existing knowledge of Tasmania's key recreational finfish species.

What is perceived as an important finfish species is likely to vary widely between fishers, and between regions of the state. It should also be noted that the occurrence of some species in Tasmanian waters is highly variable between years. For example, harvest numbers of blue warehou were low during 2000/01, however in 1997 it was the most important species caught in recreational gillnets, with gillnet harvest estimated to be over 4 times larger than the combined gillnet and line catch for 2000/01 (Henry and Lyle, 2003; Lyle, 2005). Six species groups; bream, flathead, flounder, Australian salmon, trumpeter and warehou were selected for review, on the basis of levels of harvest and status as targeted or 'icon' species. These species groups accounted for almost 80% of the total recreational catch (excluding freshwater fish) in 2000/01. By

[1] Recently reviewed as part of the 2004 review Scalefish Fishery Management Plan

number, flathead and Australian salmon were the two most captured species groups, with flounder and bream in the top 10, and both species of trumpeter in the top 20 (Henry and Lyle, 2003). As mentioned previously the catch of warehou was low in 2000/01, but it has been included in this review on the basis of previous catch levels and high profile amongst recreational fishers.

2. Methods

Current knowledge of key recreational finfish species was assessed in relation to a number of biological parameters; namely size at maturity, spawning season, fecundity, diet, age and growth, movement and stock status. Information has been obtained from published research, technical and fisheries reports as well as personal communication from TAFI scientists.

For each species, commercial and recreational catch data are provided. Commercial catch data is provided for the years 1970/71 to 2002/03 from General Fishing Returns (Tasmanian commercial catch and effort data), as well as data from Commonwealth logbooks for dual endorsed operators fishing in Tasmanian waters and for species managed under Tasmanian jurisdiction (i.e. striped and bastard trumpeter).

Recreational fishery catch data is summarised from previous surveys, most notably the 2000/01 National Survey, with regional information on catch (using the 9 regions shown in Fig. 1), size composition, fishing platform and fishing method.

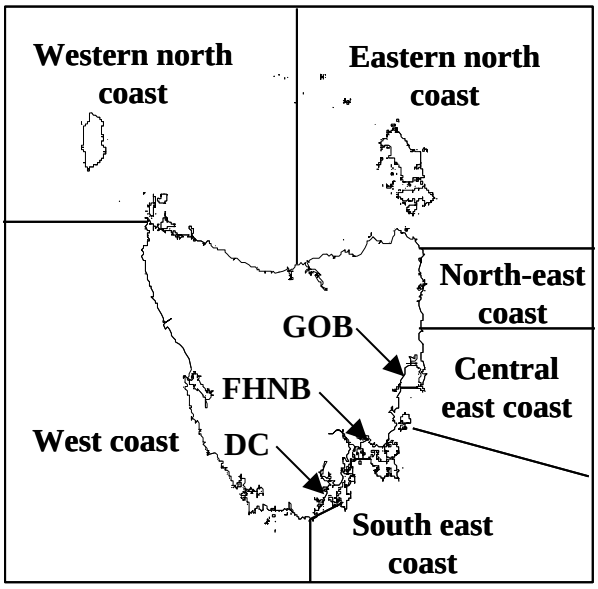

Fig. 1. Map of Tasmania showing fishing regions used to report recreational catch. Note: Abbreviated regions are Great Oyster Bay (GOB), Frederick Henry and Norfolk Bay (FHNB), and Derwent-Channel (DC).

3. Black Bream

3.1. Taxonomy

Black bream (*Acanthopagrus butcheri*), along with snapper (*Chrysophrys auratus*), are the only members of the Sparidae family found in Tasmanian waters. Other Australian members of the sparid family include yellow-fin bream (*A. australis*), western yellowfin bream (*A. latus),* pikey bream (*A. berda),* north-west black bream (*A. palmaris),* and tarwhine (*Rhabdosargus sarba*).

3.2. Distribution and Habitat

Black bream are distributed from Shark Bay in Western Australia along the south coast to Mallacoota in Victoria, and around Tasmania (predominantly the north and east coasts) (Gomon et al., 1994) (Fig. 2).

Black bream are most common in estuarine waters, but are also encountered in coastal marine areas. In the higher reaches of estuaries bream are found in deep pools and associated with structure, such as submerged logs (Norriss et al., 2002). In Victoria, seagrass is an important habitat for juvenile bream, acting as a nursery by providing food and cover (Edgar and Shaw, 1995a). A survey of seagrass habitats in Tasmania, however, only reported low bream numbers (Jordan et al., 1998). In coastal marine waters, bream prefer sheltered habitats such as protected embayments and are often associated with the structure provided by marinas and jetties (Lenanton et al., 1999).

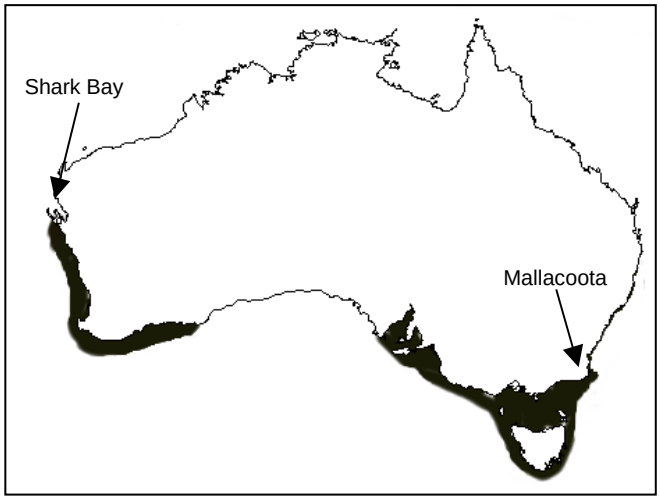

Fig. 2. Distribution of black bream in Australia

3.3. Lifecycle and biology

3.3.1. Spawning

Reported size and age of maturity varies considerably in black bream. In different estuaries in Victoria and Western Australia, age at first spawning can range from 1-4 years, with 50% maturity occurring from 130-220 mm (Norriss et al., 2002). Size at maturity information is not available for Tasmania.

The reproductive biology of black bream is currently poorly described, with evidence of protogynous hermaphroditism (where large females change sex) (Norriss et al., 2002), individual sexes and simultaneous hermaphroditism (Sarre, 1999). Bream are multiple, extended period spawners, with spawning occurring over a wide temporal and spatial range (Norriss et al., 2002). In Tasmanian and Victorian estuaries spawning occurs in spring and summer (Haddy and Pankhurst, 1998; Walker and Neira, 2001).

Bream can be reproductively active over a wide range of environmental conditions, spawning in water temperatures ranging from 15 - 28^{o}C (Haddy and Pankhurst, 1998; Sarre and Potter, 1999; Walker and Neira, 2001). There is evidence to suggest that spawning may be triggered by the re-establishment of the salt wedge after flooding events (Sarre and Potter, 1999). Spawning at this time may also coincide with localised peaks in abundance of important prey items for larvae. For example, Newton (1996) found the greatest number of black bream larvae in the Hopkins River estuary (Victoria) during November, coinciding with the re-establishment of calanoid copepod populations after flooding. Spawning has been reported to occur in the upper, middle and lower sections of estuaries (Sarre, 1999). Dependence on flooding events for successful spawning of bream has been cited as an explanation for missing year classes (Hobday and Moran, 1983).

Fecundity information is not available for Tasmania, but in South Australia a 206 mm fish yielded 235,000 eggs (Harbison, 1973), and in the Swan River (Western Australia), the average fecundity was 1,580,000 eggs, with a 470 mm bream recording the estimated total fecundity of 7,090,000 eggs (Sarre and Potter, 1999).

3.3.2. Early life stages

Bream eggs are pelagic, with larvae around 1.7 mm long at hatching (Neira et al., 1998). The duration and dispersal of eggs and larvae during the planktonic phase is unknown, however it is thought to be restricted to the natal estuary (Newton, 1996). In the Gippsland Lakes, Victoria, young of the year began to settle in shallow, brackish waters, at about 13 mm body length (Walker and Neira, 2001). Recently settled black bream (15 mm) have been captured over rocky bottom near the upper limit of the Little Swanport estuary on the east coast of Tasmania (Sakabe, R.[1], pers. comm.).

[1] Sakabe, R. PhD Candidate, Marine Research Laboratories, Tasmanian Aquaculture and Fisheries Institute.

3.3.3. Diet

Black bream are opportunistic feeders with a variable diet that reflects the relative abundance of suitable prey items. They consume bivalve molluscs, polychaetes, crustaceans (particularly crabs and amphipods) and small fish (particularly gobies), but also eat algae (Sarre et al., 2000; Norriss et al., 2002). Bream exhibit a shift in diet with size. Juveniles consume more small soft-bodied and/or thin-shelled prey, i.e amphipods, small bivalve molluscs and polychaetes, while adults consume larger prey, such as large bivalve molluscs, crabs and fish (Sarre et al., 2000). The diet of bream in Tasmania has not been studied but anecdotally appears to be broadly similar to that for mainland populations.

3.3.4. Age and growth

Black bream are capable of reaching 600 mm length, 4 kg weight and may live over 20 years (Gomon et al., 1994; Sarre and Potter, 2000). However, individuals greater than 450 mm or 2 kg are rare (Last et al., 1983; Sarre and Potter, 2000). In the Swan River, Western Australia, two year old fish were approximately 200 mm, and 4 year olds approximately 300 mm, although there was considerable variation in length with age (Sarre, 1999).

Growth rates are strongly dependant on age and season, with fastest growth in the first six to eight years, and during summer. During winter, reduced temperatures and increased rainfall slow growth markedly (Sarre and Potter, 2000). Age and growth in Tasmanian populations is unknown.

3.3.5. Movement

Tagging programs in other Australian States have shown that bream have limited coastal movement. They rarely move between estuaries, and have the ability to complete their lifecycle within an estuary, something that appears to be unique amongst members of the Sparidae worldwide (Walker and Neira, 2001). Within estuary movement is not well understood, except for the upstream movement of spawning fish in late spring/summer (see 3.3.1 Spawning) (Norriss et al., 2002; Sakabe, R., pers.comm.).

Separate stocks exist between Victoria and southern New South Wales and along the southern Western Australian coast (Norriss et al., 2002). Movement of bream within and between estuaries in Tasmania is currently being studied at TAFI.

3.4. Fisheries

3.4.1. Overview

Black bream are fished throughout their distributional range and constitute a valuable commercial and important recreational fish species in south-eastern Australia (Walker and Neira, 2001).

3.4.2. Commercial Fishery

Commercial fisheries for black bream exist in Victoria, South Australia and Western Australia, where combined catches have exceeded 500 t in some years (Kailola et al., 1993). It is illegal to sell bream commercially in Tasmania.

3.4.3. Recreational Fishery

Bream are highly prized by recreational fishers in Tasmania, with an estimated statewide catch of over 76,500 bream during 2000/01, almost 45,000 (60%) of which were retained (Fig. 3, Appendix A). Almost 80% of the retained catch was taken from estuarine waters located on the east and south–east coasts, with 38% derived from the Great Oyster Bay area and a further quarter from the Derwent-Channel region. The north-east coast accounted for 12% and the north coast 22% of the state's total catch. Reflecting the estuarine distribution of the species, shore based catches dominated, accounting for almost three quarters of the total number of fish caught. The vast majority of the bream catch (>95 %) was taken by line fishing; largely by bait fishing; lure fishing was a very minor capture method in Tasmania (Appendix A). There were also relatively minor quantities (2%) of bream taken by gillnet.

Catch sampling conducted during 2000/01 revealed that the retained bream catch ranged between 21 and 42 cm fork length (FL), with a mode between 29-32 cm and an average length of 30 cm (equivalent weight of 640 g) (Fig. 3) (Lyle et al., 2002). The size composition of shore and boat based catches were generally similar with the exception that few fish less than 25 cm were retained by boat based anglers (Lyle et al., 2002). Adherence to minimum size limits (25 cm total length, equivalent to about 23 cm FL) was good for bream, with less than 3% of the retained catch being undersized.

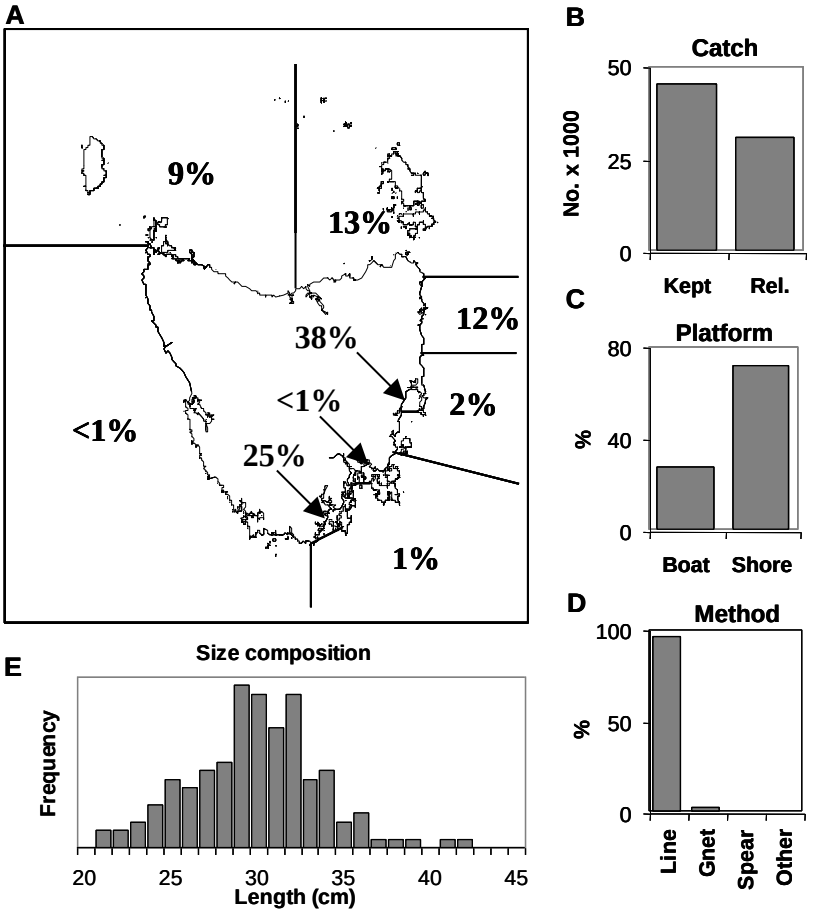

Fig. 3. Key characteristics of the Tasmanian recreational catch of black bream based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet); E – size composition of retained catch based on creel surveys.

3.5. Stock Status

In Tasmania, the recreational sector alone exploits bream stocks, and it is only through recent surveys that we have gained information on the catch. In addition, very little is known about the life history and population dynamics of black bream in Tasmania, and there is no stock biomass estimate or other information available on which to assess stock status. While the effectiveness of current size and possession limits in protecting bream populations from over-exploitation are uncertain, increased recreational fishing effort, the result of growth in fisher numbers coupled with increased awareness of bream as a quality angling species, is likely to result in increased pressure on bream stocks. Furthermore, movement of bream between estuaries is apparently limited, and recruitment can be highly variable, making them susceptible to localised depletion from concentrated fishing effort. There is a need to describe key biological parameters for bream populations and evaluate the appropriateness of current management arrangements in relation to resource sustainability.

4. Flatheads

4.3. Taxonomy

Six species of flathead are found in Tasmanian waters; sand flathead *(Platycephalus bassensis)*, tiger flathead *(Neoplatycephalus richardsoni)*, toothy flathead (*N. aurimaculatus*), southern blue-spotted (yank) flathead (*P. speculator*), rock flathead (*P. laevigatus*), and deepwater flathead (*P. conatus*) (Last et al., 1983; Edgar, 1997). Dusky flathead (*P. fuscus*) also occur off the north coast in relatively small numbers. Sand flathead dominate the recreational catch in Tasmania, with tiger flathead of secondary importance (Henry and Lyle, 2003). Recreational fishers only occassionally catch the other flathead species.

4.4. Distribution and Habitat

Sand flathead are found from Jervis Bay in New South Wales to Bremer Bay in Western Australia, but are most common in southern New South Wales, Victoria and Tasmania (Gomon et al., 1994; Edgar, 1997) (Fig. 4A). They are found in both estuarine and coastal waters (to depths of 100 m) but are most common in shallow coastal waters (<65 m) on sandy to muddy substrates, including seagrass (*Heterozostera)* habitats (Jordan, 1997; 1999).

Tiger flathead are distributed from Coffs Harbour in northern New South Wales around the southeast of Australia to Portland in Victoria, including Tasmania (Kailola et al., 1993; Gomon et al., 1994) (Fig. 4B). The species is found on sandy and muddy substrates in depths of 10-400 m, but are most common in 30-170 m (Kailola et al., 1993; Kuiter, 1993; Gomon et al., 1994; Jordan, 1997). Larger, mature fish dominate in outer shelf waters deeper than 100m off eastern and southern Tasmania (Jordan, 1997).

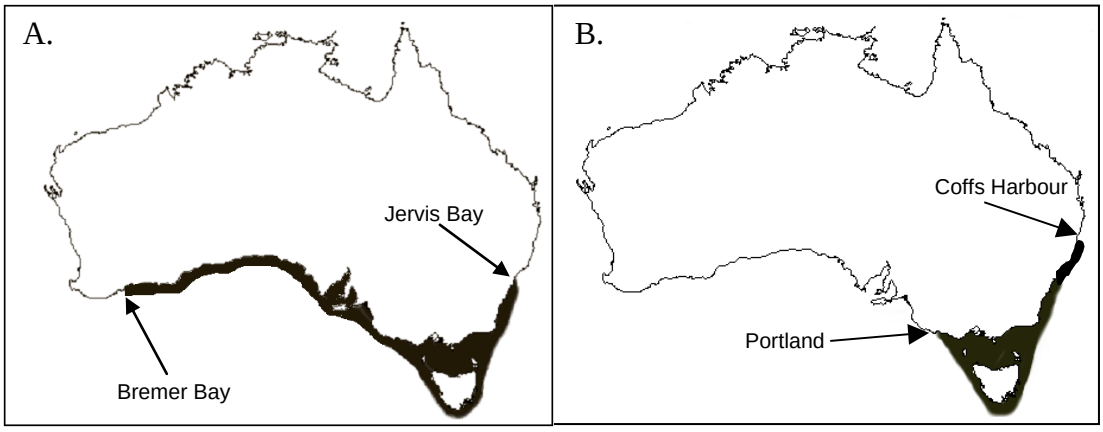

Fig. 4. Distribution of A. sand flathead and B. tiger flathead in Australia.

4.5. Lifecycle and biology

4.5.1. Spawning

Around 50% of sand flathead are mature at 21 cm and 23 cm for males and females respectively (approx. 3 years of age), with all fish sexually mature by 30 cm (approx. 7-8 years for males and 5 years for females) (Jordan, 1999; de Deuge, 2003). Spawning in Tasmania occurs in estuaries, coastal and inner continental shelf waters over an extended period lasting from October to March, although most spawning activity occurs between October and December (Jordan, 1999; 2001). In Victoria, fish spawn earlier in the year (between August and October), a pattern attributed to the timing of seasonal peaks in water temperature and productivity (Jordan, 1999). Fecundity of sand flathead is not known.

In eastern Bass Strait, tiger flathead reach sexual maturity at approximately 30 cm for females and 25 cm for males, corresponding to around 3-5 years old (Hobday and Wankowski, 1987; Jordan, 1997). Spawning occurs between October and May in New South Wales and December and February in eastern Bass Strait and southern and eastern Tasmania (Hobday and Wankowski, 1987; Jordan, 1997). The location of spawning is unknown, however more large large mature fish are found in inshore waters inshore waters during the spawning period (Fairbridge, 1951; Kailola et al., 1993; Jordan, 1997). In eastern Bass Strait, females are estimated to have a total annual fecundity of 0.3 million eggs for 30 cm fish and up to 1.5 million eggs in 50 cm individuals (Hobday and Wankowski, 1987).

4.5.2. Egg and Larval stage

Flathead eggs are pelagic and spherical, 0.8-1.2 mm in diameter (Neira et al., 1998). Larvae of sand flathead have been recorded from inshore shelf waters, and coastal embayments such as Fredrick Henry Bay in Tasmania and Port Phillip Bay in Victoria (Jordan, 2001; Bruce and Bradford, 2002). The duration of the larval period of sand flathead is unknown, but settlement occurs throughout most of the year, probably as a result of the protracted spawning season (Jordan, 2001). Sand flathead settle at approximately 2 cm, metamorphosing and developing adult colouration shortly afterwards (Jordan, 2001). Initial settlement occurs exclusively in sub-tidal unvegetated habitats, with some post-settlement movement into seagrass (*Heterozostera*) beds occurring at around 7 cm length (approximately 3-5 months old) (Jordan, 1999). Larval recruitment is variable, and may be the result of variability in productivity of inshore waters influencing larval survival (Jordan, 1999).

Little is known about the juvenile biology of tiger flathead. They are assumed to occupy shallow inshore waters, and small juveniles have been recorded in Frederick Henry Bay (Ford and Lyle, 1992). Small numbers of larger juveniles of 16-18 cm, assumed to be 1+ years old, have been recorded in inner shelf trawl samples in autumn off southern and eastern Tasmania (Jordan, 1997)

4.5.3. Diet

Flathead will actively forage, and also ambush prey, lying partly concealed in mud or sand and lunging out to catch passing prey. They are also occasional scavengers (Kailola et al., 1993).

Sand flathead are an important predator of small demersal fishes over unvegetated habitats, eating whiting, mullet, hardyheads and gobies. They also consume crabs, prawns and other small crustaceans, octopus, squid and polychaete worms (Coleman and Mobley, 1984; Kailola et al., 1993; Edgar and Shaw, 1995b).

Tiger flathead have a swim bladder allowing them to forage higher in the water column than other flathead species. They feed mainly on small fish such as silversides (*Argentina australiae),* three-spined cardinalfish (*Apogonops anomalus*), silverbelly (*Parequula melbournensis*) and little conger eel (*Gnathophis habenata*) (Coleman and Mobley, 1984; Kailola et al., 1993).

4.5.4. Age and growth

Sand flathead are capable of reaching 53 cm, 3.1 kg weight and may live as long as 17 years for males and 16 years for females (Gomon et al., 1994; Jordan et al., 1998). Initial growth is relatively rapid but slows appreciably at around 3 years (approx. 22-25 cm), consistent with the onset of maturity (Jordan, 1999). Size at age is highly variable for both males and females, with 30 cm fish ranging from 4 to 11 years old (Jordan, 1999; de Deuge, 2003).

Tiger flathead are capable of reaching 57 cm, 14 years for males and 65 cm, 17 years for females, although in Tasmania fish above 50 cm are rare (Fairbridge, 1951; Ford and Lyle, 1992; Morison, 1996; Jordan, 1997). Southern and eastern Tasmanian stocks are characterised by a higher proportion of old fish (> 9 years) than those from eastern Bass Strait (Jordan, 1997). They grow rapidly until 2-3 years of age, however growth rates are variable, with fish reaching 30 cm anywhere between 2 and 5 years old (Jordan, 1997).

4.5.5. Movement

Juvenile sand flathead are rare in deeper inner and mid shelf waters, indicating that populations of sand flathead found in these areas are sustained by some movements of fish into deeper waters as they mature (Jordan, 1999). Decreases in catch rates by demersal trawlers of sand flathead in inner and mid shelf waters during summer and autumn on the south east and east coast of Tasmania have been attributed to either movements inshore during these seasons, or a change in behaviour affecting catchability (Jordan, 1997; 1999).

While no genetic studies have been conducted, tagging and morphometric studies indicate a single tiger flathead stock along the east coast of Australia, suggesting considerable mixing throughout the species range (Fairbridge, 1951; Kailola et al., 1993; Jordan, 1997). Large individuals (> 45 cm) move into shallower inner shelf water waters during summer (Jordan, 1997). This movement has only been reported in Tasmania. For the rest of the year, average fish size increases with depth (Rowling, 1994; Jordan, 1997).

4.6. Fisheries

4.6.1. Overview

Both flathead species support important recreational and commercial fisheries. In Tasmania, sand flathead dominate the recreational catch, and tiger flathead the commercial flathead catch (Jordan, 1997).

4.6.2. Commercial Fishery

Flathead are taken primarily by Danish seine and otter trawlers along the southern New South Wales coast, through eastern Bass Strait, several Victorian bays and inlets, and in Tasmania off the east and south-east coasts (Jordan, 1994a; Rowling, 1994).

The commercial catch of flathead taken from Tasmanian waters has fluctuated between about 30 and 150 tonnes since 1970, with a general decline in production between the early to mid 1990s, and general stability since, at around 50 tonnes per annum (Fig. 5). A reduction in inshore trawl fishing effort since 1990 and prohibition of demersal otter board trawling in State waters since 2001 have been major factors in the decline in the flathead catch. While tiger flathead are believed to dominate catches, the species of flathead is rarely recorded on catch returns and thus there is uncertainty as to total removals at the species level.

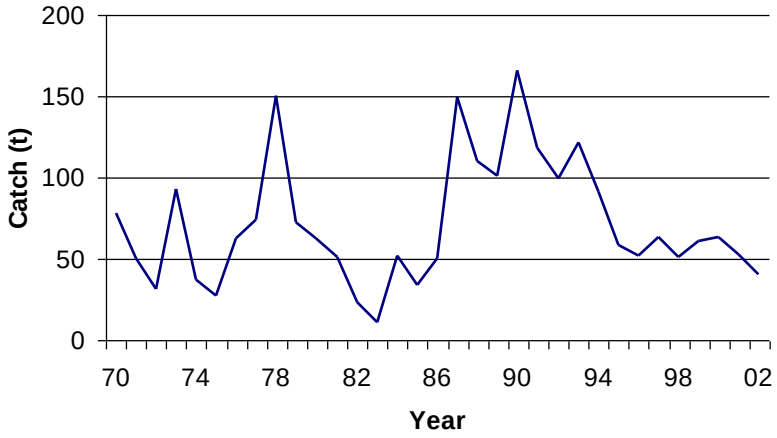

Fig. 5. Tasmanian commercial catch of flathead between 1970/71 and 2002/03 (based on General Fishing Returns).

4.6.3. Recreational Fishery

Flathead are the most frequently caught species by recreational fishers in Tasmania, with an estimated 2.1 million flathead caught during 2000/01, of which 1,378,000 (about 65%) were retained (Fig. 6, Appendix A). Sand flathead comprised 93% of the flathead that were identified to species and tiger flathead almost exclusively made up the balance. Henry and Lyle (2003) estimated that the retained recreational flathead catch in Tasmania was 360 tonnes in 2000/01, some six times greater than the commercial take from state waters. Given that the vast majority of the recreational catch was sand flathead, it would appear that interactions between fishing sectors for flathead are relatively minor.

Flathead catches were concentrated off the east and south-east coasts, in particular in Great Oyster Bay (25%), the Derwent-Channel (19%) and Fredrick Henry-Norfolk Bays (15%) (Fig. 6, Appendix A). The south-east, central east and combined north coast regions each contributed 12% of the total catch. Flathead catches were rarely reported from the west coast. Over 90% of the flathead catch was taken by boat based anglers and line fishing was the primary (99%) capture method, with bait fishing accounting for at least 85% of the catch (Appendix A). Fishing with lures for flathead was relatively rare in Tasmania.

In Tasmania, the minimum legal size limit for flathead is 30 cm. Creel surveys conducted during 2000/01 (Fig. 6) (Lyle *et al*. 2002) and in 1997/98 (Lyle and Campbell 1999) revealed that significant proportions of the sand flathead catches were undersized; just over 30% in 2000/01 and over 40% in 1997/98. These observations indicated poor adherence to size limits and imply that had size limits been observed the released proportion of the catch would have been substantially higher than suggested by the National Survey. Sand flathead size composition was characterised by a single mode between 30-33 cm, with an average length of 32 cm (approximately 250 g), and few fish larger than about 45 cm, the largest individual observed being 53 cm (Fig. 6E). Lyle et al. (2002) found that shore-based catches were comprised of smaller fish than boat-based catches, with about 55% of the shore-based catch numbers below the legal minimum size compared to about 28% for boat-based catches.

Tiger flathead were generally larger than sand flathead, with few individuals measuring less than 35 cm observed and a maximum size of 52 cm (Fig. 6F). The average length of 39 cm (480 g) in 2000/01 compared with 42 cm (650 g) for the 1997/98 sample, which also included individuals of up to 66 cm (Lyle et al., 2002).

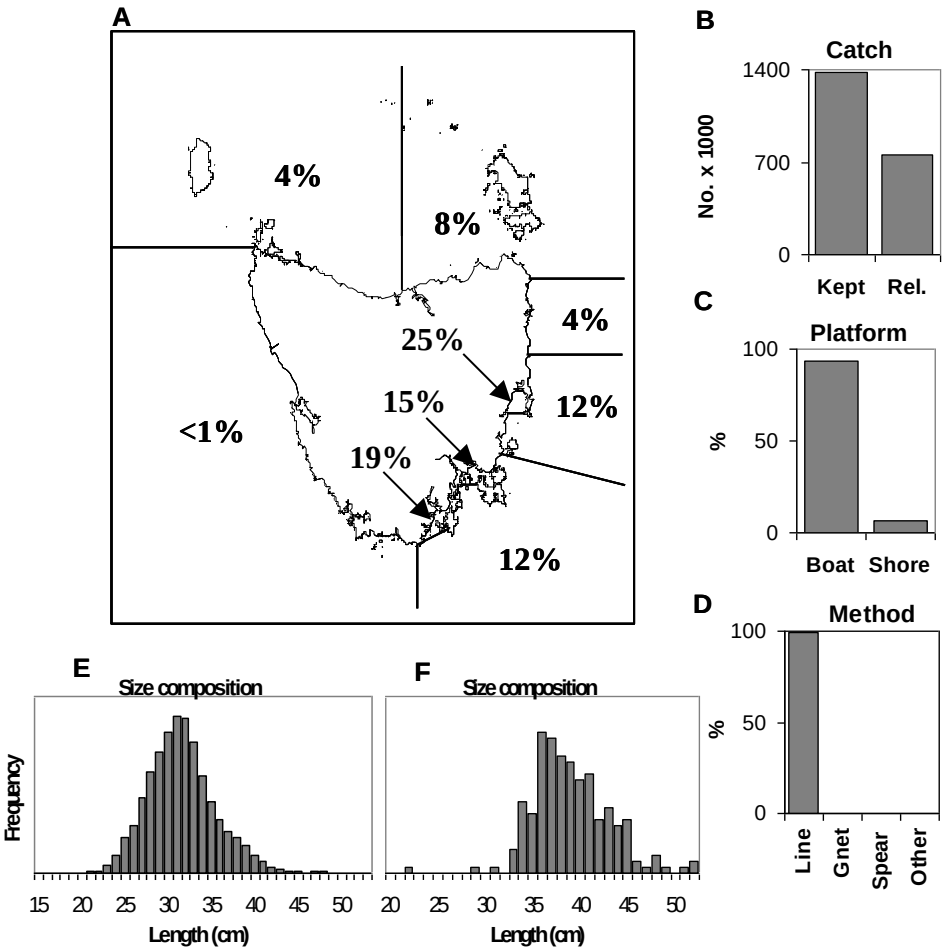

Fig. 6. Key characteristics of the Tasmanian recreational catch of flathead based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet); E – size composition of the sand flathead catch based on creel surveys; F – size composition of the tiger flathead catch based on creel surveys.

4.7. Stock status

Flathead are a common and widespread species, supporting important recreational and commercial fisheries. Competition between sectors for stocks is relatively limited since recreational fishers predominantly harvest sand flathead (mostly in the bays and estuaries), and commercial fishers generally target tiger flathead (mostly in coastal waters).

Stock status for sand flathead is unknown, however, the large recreational harvest (almost 1.4 million fish), the uncertain fate of released fish, and the significant proportion of the catch being undersize, are all causes for concern. The tiger flathead stock is probably fully fished, with evidence that stocks in eastern Bass Strait have been declining since the late 1980's (Caton, 2003). The lower mortality rates and higher

maximum ages for tiger flathead reported by Jordan (1997) suggests that exploitation may have had a lesser impact on tiger flathead in southern and eastern Tasmania.

The current recreational minimum size limit (30 cm TL) appears to be adequate to provide protection for immature sand flathead, however not all tiger flathead are mature upon reaching the fishery.

Jordan (1997) provided estimates of biomass for sand and tiger flathead on the shelf in southern and eastern Tasmania, noting that they were likely to be significant underestimates. Estimates were found to be extremely variable depending on season, and ranged from a high of 249 tonnes in summer 1993 to a low of 46 tonnes in winter 1994 for tiger flathead, and 30 tonnes in winter 1993 to less than 1 tonne in autumn of 1993 and 1994 for sand flathead (Jordan, 1997).

5. Flounders

5.3. Taxonomy

Seven species of right-eye flounders (Pleuronectidae) are found in Tasmanian waters (Last et al., 1983). Of these, the greenback flounder (*Rhombosolea tapirina*) and long-snouted flounder *(Ammotretis rostratus)* comprise the majority of the recreational and commercial flounder catch in Tasmania.

5.4. Distribution and Habitat

Greenback and long-snouted flounder are distributed from southern New South Wales to southern Western Australia, including Tasmania, with the greenback flounder also found in New Zealand (Last et al., 1983) (Fig. 7).

Long-snouted and greenback flounder are most abundant in estuaries, marine embayments and inshore coastal waters where they are found on sandy or muddy bottoms to 100 m depth (Last et al., 1983; Kailola et al., 1993; Jordan et al., 1998). Juvenile greenback flounder also occur in low numbers on seagrass beds (Connolly, 1994; Jordan et al., 1998). Habitat is partitioned between the species, with long-snouted flounder more abundant on the coarse and medium grain sand associated with the mouths of estuaries, and greenback flounder more abundant on the fine sand found on large sheltered sand flats (Crawford, 1984). Greenback flounder sexually partition habitat, with females most abundant in shallow water (5-10 m depth), and males found in deeper water (10-25 m depth) (Crawford, 1984).

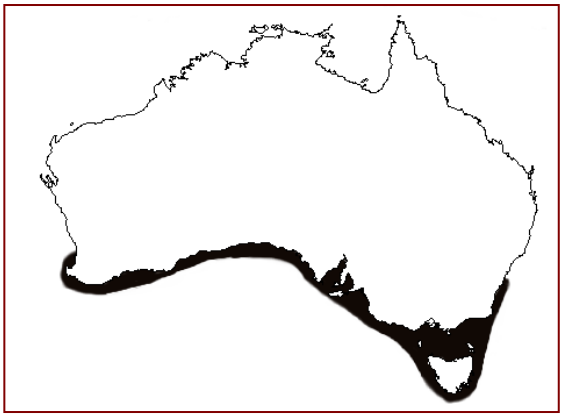

Fig. 7. Distribution of long-snouted and greenback flounder in Australia.

5.5. Lifecycle and biology

5.5.1. Spawning

There is little information on size of maturity for Tasmanian flounders, apart from the observation that greenback flounder are mature at between 19-30 cm (Kailola et al., 1993), and that 60% of greenback flounder females were mature by 24 cm length (Kurth, 1957 in Crawford, 1984).

Long-snouted and greenback flounder are prolonged serial spawners (i.e. continually produce eggs over a season), making fecundity estimates difficult to obtain. Most spawning occurs from June to October (Crawford, 1984). Total fecundity appears to be high, with estimates of over 820,000 eggs in a 25 cm greenback flounder and over 437,000 eggs in a 25 cm long-snouted flounder (Jordan, 1994b). Both species are thought to move into deeper water to spawn (Crawford, 1984).

5.5.2. Egg and larval stage

Greenback flounder larvae spend up to 30 days in the plankton, settling at a length of around 6 mm (Jenkins et al., 1993). Larvae are weak swimmers, and rely on water currents or wind-induced surface water movements to drift inshore to settle (Crawford, 1984).

During late winter to early summer newly-metamorphosed greenback and long-snouted flounder settle on estuarine sand flats. Substrate type and salinity preferences appear to be the major determinants of their distribution (Burchmore, 1982).

5.5.3. Diet

Juvenile long-snouted and greenback flounder are daytime feeders, whereas adult greenback flounder feed predominantly on benthic invertebrates at night as the rising tide covers shallow mud banks (Kailola et al., 1993). Juveniles of both species consume amphipods and polychaetes whereas adults feed on polychaetes and molluscs (Crawford, 1984). In Victoria, juvenile greenback flounder grow at faster rates in areas of higher food supply (Jenkins et al., 1993).

5.5.4. Age and growth

The greenback flounder is the largest flounder found in Tasmanian waters, reaching 45 cm length and 600 g weight (Last et al., 1983), however they are mostly less than 30 cm (Jordan et al., 1998). Long-snouted flounder reach maximum lengths of 34 cm (Last et al., 1983). Length and weight for age is not available for the flounder species.

5.5.5. Movement

There is little information on movement for greenback and long-snouted flounder, apart from apparent offshore movement associated with spawning (Crawford, 1984).

5.6. Fisheries

5.6.1. Overview

Flounder support commercial and recreational fisheries in south-eastern Australia with approximately 140 t p.a. harvested commercially throughout the region (Kailola et al., 1993).

5.6.2. Commercial Fishery

Tasmanian catches rose sharply in the late 1980s from less than 20 tonnes p.a. to over 40 tonnes but have since declined steadily to just 10 t in 2002/03 (Fig. 8). The main capture methods are spear and gillnet, and while spear catch rates have remained relatively stable since the mid 1990s gillnet catch rates have generally declined over this period (Lyle et al., 2004). Although the species of flounder caught is not routinely distinguished in catch returns, greenback flounder are believed to comprise the majority of the catch.

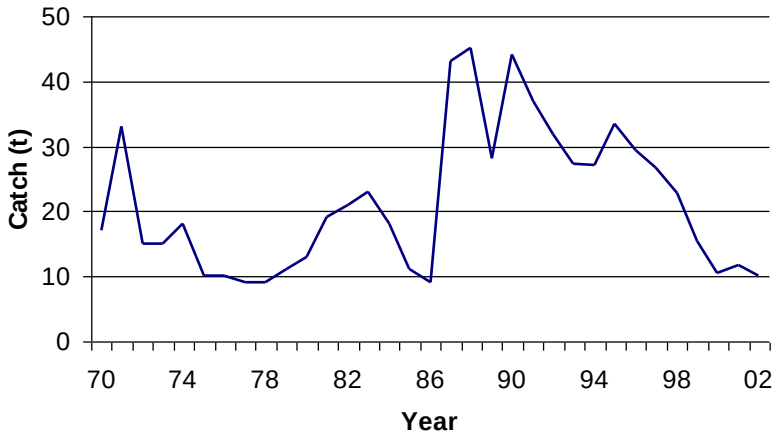

Fig. 8. Tasmanian commercial catch of flounder between 1970/71 and 2002/03 (based on General Fishing Returns).

5.6.3. Recreational Fishery

During 2000/01 an estimated 75,000 flounder were caught by recreational fishers in Tasmania, over 71,000 (95%) were retained (Fig. 9, Appendix A). Catches were concentrated in Derwent-Channel (35%) and Fredrick Henry-Norfolk Bay (24%), followed by the eastern north coast (17%), west coast (11%) and south-east (9%). Catches elsewhere were very minor. Fishing with spears (from the surface and generally at night using lights) was the dominant capture method, accounting for over 80% of the recreational catch. Gillnets contributed a further 15% and beach seine nets the bulk of the remainder. Line fishing was a very minor method of capture. Fishing was largely conducted from the shore (63% of the catch), reflecting the common practice of wading and using hand spears to target the species.

A minimum size limit of 25 cm TL applies for flounder in Tasmania. Insufficient flounder were sampled during the 2000/01 creel surveys to present size frequency information, but those greenback flounder that were examined ranged between 22-33 cm TL, with a mean size of 30 cm TL (Lyle et al., 2002). Creel surveys conduced during 1997/98 revealed that greenback flounder catches ranged between 20-37 cm TL, with a strong mode at 27 cm and average size of about 27 cm (Lyle and Campbell, 1999).

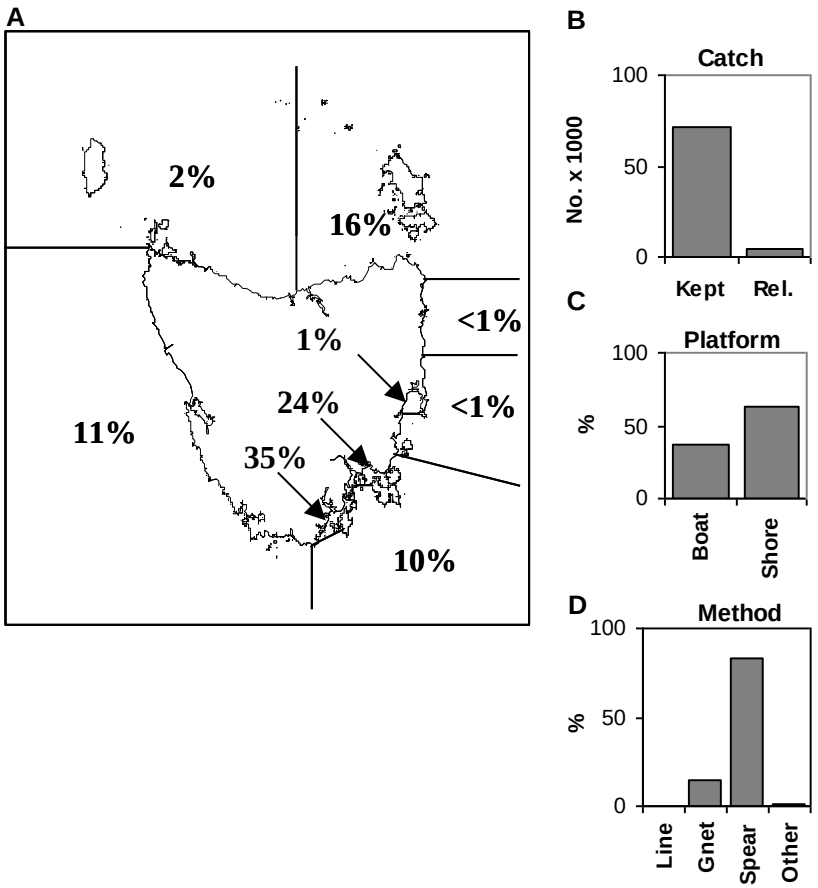

Fig. 9. Key characteristics of the Tasmanian recreational catch of flounder based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet)

5.7. Stock status

Very little is known about the life history and population dynamics of flounders in Tasmania and there is no biomass estimate, or other information available on which to assess stock status. There is a need to describe key biological parameters for flounder populations and evaluate the appropriateness of current management arrangements in relation to resource sustainability. Size at maturity information is particularly important because the scarce information available indicates that not all flounder are mature at 25 cm TL, the current recreational minimum size limit.

6. Australian Salmon

6.3. Taxonomy

Two species of Australian salmon, eastern (*Arripis trutta*) and western (*A. truttaceus*) are found in Tasmanian waters. They are externally similar and only recently distinguished as species (Gomon et al., 1994). In Victoria and Tasmania, where the two species overlap, identification is only possible through counts of gill rakers on the first arch, the eastern species having 33-40 gill rakers, and the western species 25-31 gill rakers (Gomon et al., 1994).

6.4. Distribution and Habitat

Western Australian salmon are found from Geraldton in Western Australia, and throughout South Australia, Tasmania and Victoria (east to Lakes Entrance) (Gomon et al., 1994; Hutchins and Swainston, 1996) (Fig. 10). Eastern Australian salmon are distributed from Tweed Heads in New South Wales to Port Phillip Bay in Victoria, and Tasmania (Gomon et al., 1994; Hutchins and Swainston, 1996). They are also found in New Zealand where the species is known as kahawai.

Juvenile Australian salmon are found over soft substrates in shallow coastal waters (Robertson, 1982). Larger fish of both species move into exposed, coastal waters, such as rocky headlands, near reefs and the surf zone of ocean beaches (Kailola et al., 1993). In Victoria and Tasmania, where both species are present, they may form mixed or single species schools (Pullen, 1994), and can form surface aggregations. Western Australian salmon have been caught to 80 m depth (Kailola et al., 1993).

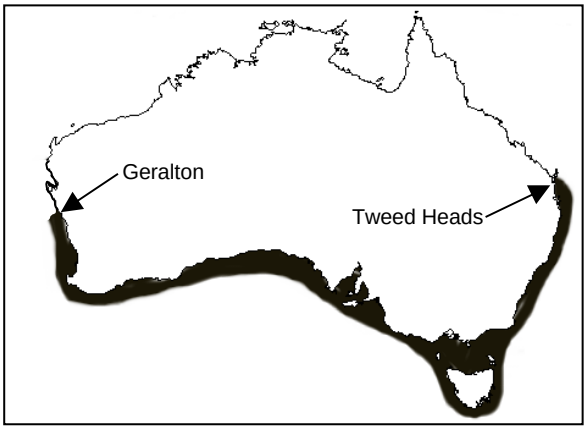

Fig. 10. Distribution of Australian salmon in Australia.

6.5. Lifecycle and biology

6.5.1. Spawning

Western Australian salmon mature at 4-6 years of age and 50 cm length, whereas eastern Australian salmon mature at around 4 years and 39 cm (Stanley and Malcolm, 1977; Stanley, 1978; Pullen, 1994). Spawning apparently does not occur in waters adjacent to Tasmania, with both species migrating to spawning grounds off the mainland coast. Adult western Australian salmon migrate to the southern coast of Western Australia (east of Albany), spawning from February to June near headlands (Stanley, 1980). Mature eastern Australian salmon move north from Tasmania and east from central Victoria to the waters between Lakes Entrance and Bermagui to spawn between November and February (Stanley, 1980; Pullen, 1994).

There is no information on fecundity for either species.

6.5.2. Egg and larval stage

Australian salmon eggs are pelagic and spherical (Neira et al., 1998). There is no information on the length of the larval period for either species. Western Australian salmon eggs and larvae drift eastwards into South Australia via the Leeuwin current. Juveniles (4-8 cm FL) appear in Tasmania between August and October (Pullen, 1994). Eastern Australian salmon eggs, larvae and juveniles drift and migrate from the spawning grounds off south-eastern Australia to Tasmanian and Victorian waters during autumn and winter, potentially exploiting the south flowing East Australian Current (Nicholls, 1973). Juveniles (3+ cm FL) appear in inshore sheltered Tasmanian waters from January to September (Pullen, 1994; Jordan et al., 1998).

6.5.3. Diet

The difference in the number of gill rakers between the species, western Australian salmon have fewer and shorter gill rakers, is thought to reflect fundamental differences in diet (Kailola et al., 1993; Hoedt and Dimmlich, 1994). As juveniles, western Australian salmon consume benthic crustaceans and fish, whereas eastern Australian salmon feed on prey in the water column such as insects, small squid, crustacean larvae and worms (Robertson, 1982). Juvenile western Australian salmon can be significant predators of juvenile fish and other commercial fish species over seagrass (Hindell et al., 2000). As adults, western Australian salmon feed predominantly on larger prey such as pelagic clupeoid fishes (particularly the pilchard *Sardinops sagax)*, whereas eastern Australian salmon consume plankton, in particular krill (*Nyctiphanes australis)* (Stanley, 1980; Hoedt and Dimmlich, 1994).

6.5.4. Age and growth

Western Australian salmon grow faster and obtain larger sizes than eastern Australian salmon (Nicholls, 1973). Western Australian salmon reach 96 cm length, 10.5 kg weight and 9 years of age, with growth slower in Victoria and Tasmania, than in western populations (Cappo, 1987; Edgar, 1997). Eastern Australian salmon live for around 10 years and can reach 89 cm length and 7 kg weight (Stanley, 1980; Hutchins and Swainston, 1996). In New Zealand, however, fish 20 years old have been reported with growth rates highly variable (Bradford, 2001).

6.5.5. Movement

As a fast swimming pelagic fish, long distance movements by salmon are commonplace, as evidenced by the scale of spawning migrations for both species. Knowledge of other movements is limited, however, Hoedt and Dimmlich (1994) found that movement of western Australian salmon in Western Port Bay, Victoria was related to the seasonal migrations and life cycles of anchovy (*Engraulis australis)*, pilchard (*Sardinops sagax*) and, to a lesser extent, sandy sprat (*Hyperlophus vittatus*).

6.6. Fisheries

6.6.1. Overview

Australian salmon are important commercial and recreational species that are currently heavily exploited along the southern Australian coast (Hoedt and Dimmlich, 1994).

6.6.2. Commercial Fishery

Australian salmon have a long history of exploitation in Tasmania, with commercial landings averaging over 600 tonnes since 1970. Catches have exceeded 1000 tonnes (1974/75 and 1988/89) but recent annual production levels have tended to fluctuate between 350-450 tonnes (Fig. 11). Beach seining accounts for the bulk of the catch and to a large extent the size of landings are linked to market demand, specifically the bait market, and are thus probably not a good indicator of stock status (Lyle et al., 2004).

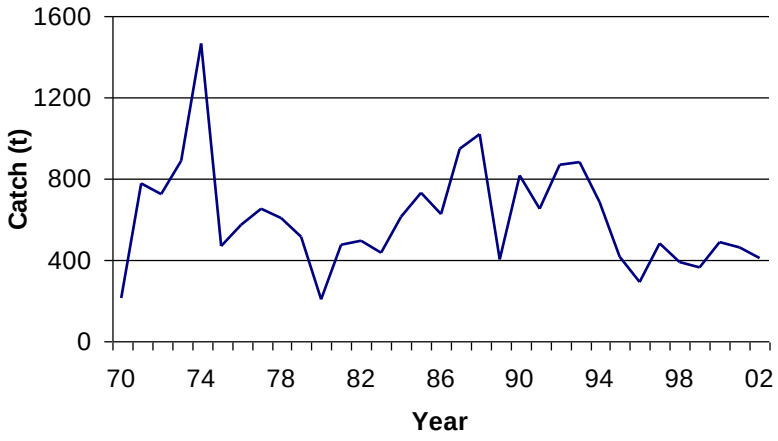

Fig. 11. Tasmanian commercial catch of Australian salmon between 1970/71 and 2002/03 (based on General Fishing Returns).

6.6.3. Recreational Fishery

Australian salmon were the second most frequently captured scalefish species by recreational fishers in Tasmania during 2000/01, with almost 423,000 caught, of which 314,000 (74%) were retained (Fig. 12, Appendix A). Species composition is unknown, but surveys during the 1970's found that both species were taken by recreational fishers (Pullen, 1994). Catches were greatest from the western north (27% of the total) and west (26%) coasts. The eastern north (17%) and north-east (11%) coasts were of secondary importance while catches from other regions were relatively minor. Line fishing methods accounted for 95% of the catch with both bait and lure fishing being important (Appendix A). The remainder of the catch was taken by gillnet and beach seine methods. Boat-based angling contributed 60% of the retained catch, with shore-based fishing also significant at 40%.

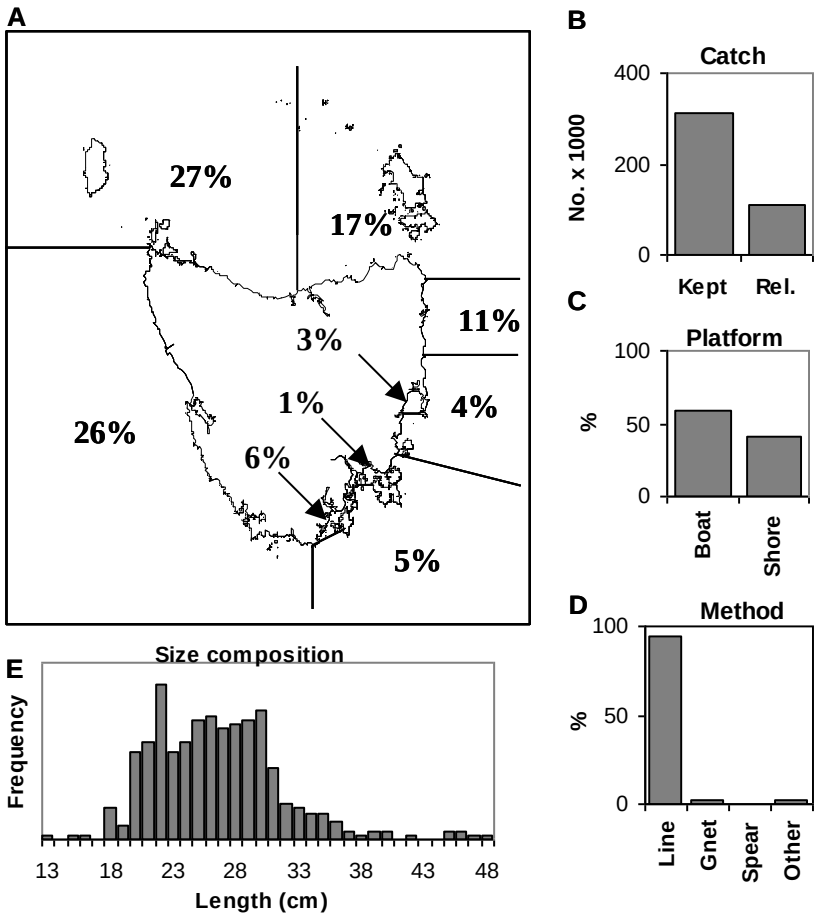

Fig. 12. Key characteristics of the Tasmanian recreational catch of Australian salmon based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet); E – size composition of retained catch based on creel surveys.

A minimum size limit of 20 cm TL (equivalent to about 18 cm FL), which is well below the size at maturity, applies in Tasmania. Creel surveys conducted during 2000/01 showed that recreational fishers took a wide range of sizes, with the majority of fish in the 20 and 35 cm size range but with some individuals up to 48 cm (Fig 12). The average length of 27 cm (354 g) compared with 32 cm for surveys conducted during 1997/98 (Lyle and Campbell, 1999). The 1997/98 surveys recorded fish up to 57 cm, substantially larger than observed during 2000/01. Lyle et al. (2002) observed that, on average, boat caught Australian salmon were slightly larger than shore caught fish, 27 cm and 26 cm, respectively. Overall, only a very small proportion of the retained catch was below the minimum legal size limit.

6.7. Stock status

Australian salmon are a common species, supporting important recreational and commercial fisheries. For the most part the two sectors use different methods, commercial operators mostly beach seine, and recreational fishers line methods. There is, however, the potential for competition between sectors for Australian salmon stocks, particularly in the north of the state, where much of the catch is taken.

Due to sustained commercial catch levels the stock is thought to be stable, however, no stock biomass estimate or formal assessment is available (Smith and Heran, 2001). The large recreational harvest (314, 000 fish) and the fact that the majority of fish are immature (the recreational minimum size limit of 20 cm being dramatically smaller than the estimated size of maturity of 50 cm and 39 cm for western and eastern Australian salmon, respectively), however, are causes for concern. Due to the migratory nature of Australian Salmon, effective management must involve other states.

7. Trumpeters

7.3. Taxonomy

Trumpeters (Family Latridae) belong to a small Southern Hemisphere family of which three species, bastard trumpeter (*Latridopsis forsteri*), striped trumpeter (*Latris lineata*) and real bastard trumpeter (*Mendosoma lineatum*) are found in Tasmanian waters (Last et al. 1983). Bastard and striped trumpeter support important commercial and recreational fisheries in Tasmania. Real bastard trumpeter are only occasionally caught and thus have little fisheries significance.

7.4. Distribution and Habitat

Bastard trumpeter are distributed from Sydney in New South Wales to Kangaroo Island in South Australia, including Tasmania (Fig. 13A), and also occur in New Zealand (Last et al., 1983; Gomon et al., 1994; Edgar, 1997). They are found on reefs to 160 m depth. Juveniles tend to school while adults are solitary. Juveniles and sub-adult fish inhabit shallow inshore reefs, whereas larger fish apparently move offshore onto deep (> 50 m) reefs.

Striped trumpeter are found throughout southern Australia, from Montague Island in New South Wales to southern Western Australia, including Tasmania (Gomon et al., 1994; Edgar, 1997)(Fig. 13B). The species is also found in New Zealand, the St Paul and Amsterdam Islands in the southern Indian Ocean and the Tristan da Cunha Group and Gough Island in the southern Atlantic Ocean (Gomon et al., 1994; Edgar, 1997; Lyle and Hodgson, 2001). They are found on reefs to at least 300 m depth (Gomon et al., 1994). In southern Tasmania, juveniles occur on shallow reefs to 5 m, with larger fish moving offshore onto deep reef areas (Tracey and Lyle, 2005).

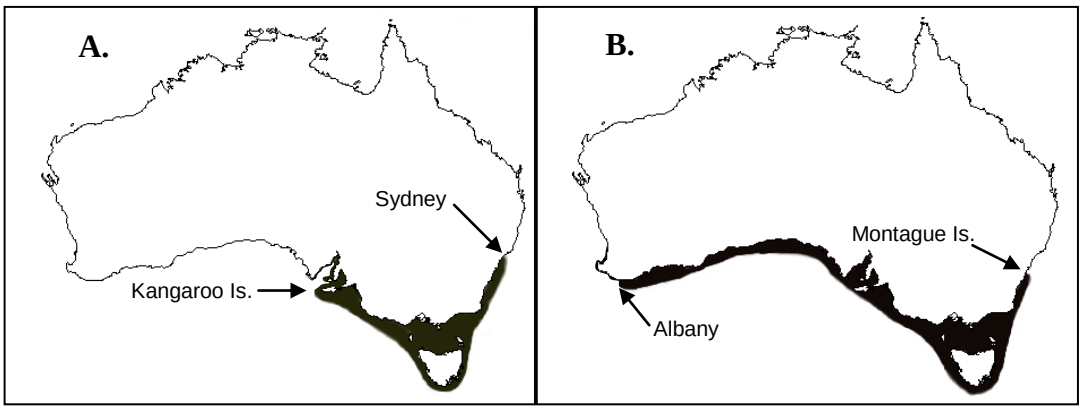

Fig. 13. Distribution of A. bastard trumpeter and B. striped trumpeter in Australia

7.5. Lifecycle and biology

7.5.1. Spawning

Harries and Lake (1985) inferred that bastard trumpeter reach sexual maturity at about 45 cm length and 5 years of age, although they did not examine any mature individuals. Spawning apparently occurs in late winter, although little is known as only a small number of sexually mature fish have been observed (Lyle, 1994). Johnston (1882 in Harries and Lake, 1985) reported that mature bastard trumpeter were only found near offshore, rocky reefs 20-130 m in depth.

Size and age at maturity in striped trumpeter is not well understood, although females apparently reach maturity at 44 cm and 5 years of age, compared with males at about 53 cm or 8 years. Spawning occurs from July to early October, commencing earlier at lower latitudes (Ruwald et al., 1991; Neira et al., 1998; Lyle and Hodgson, 2001). They are multiple spawners, capable of producing 100 000 and 400 000 eggs per batch for females weighing 3.2 and 5.2 kg, respectively (Ruwald et al., 1991). Eggs are small (1.3 mm diameter) and pelagic, with larvae hatching at a size of 2.8 to 3.3 mm (Ruwald et al., 1991; Neira et al., 1998).

There is evidence of marked recruitment variability in trumpeter species, with particularly strong cohorts of both species spawned in 1993 (Murphy and Lyle, 1999).

7.5.2. Early life stages

Pelagic juvenile bastard trumpeter, also known as paper fish, are recognized from adults by their silvery dorsal surface, compressed body shape and deepness below the pectoral fins (Neira et al., 1998). They occur in schools and settle on reefs in spring. Fish as small as 16 cm fork length have been sampled from inshore reefs in January (Murphy and Lyle 1999).

Striped trumpeter have a complex early life history with a long planktonic phase of around nine months (Morehead, D. pers. comm.[1]) and an inshore juvenile phase (Tracey and Lyle, 2005). Most larvae have been caught in coastal waters off western Tasmania from September to October (Neira et al., 1998). Small juveniles (around 18 cm fork length) have been caught on shallow reefs off south-eastern Tasmania in January (Murphy and Lyle, 1999).

7.5.3. Diet

Bastard trumpeter feed on a range of small invertebrates (Paulin et al., 1989), in particular amphipods and isopods (Harries and Lake, 1985). The diet of adults is not known but they are likely to be opportunistic carnivores.

[1] Morehead, D. Research Fellow. Marine Research Laboratories, Tasmanian Aquaculture and Fisheries. Institute

Striped trumpeter are opportunistic carnivores, feeding on a range of invertebrates (Paulin et al., 1989), as well as fish and cephalopods (Goldsmid, R. pers. comm.[1])

7.5.4. Age and growth

Bastard trumpeter grow to at least 65 cm length and 4.3 kg weight (Last et al., 1983). Murphy and Lyle (1999) have described the pattern of juvenile growth, with the majority of fish (juveniles) resident on inshore reefs aged less than 5 years old. Very few adult fish have been examined but indications are that maximum ages are in excess of 17 years.

Striped trumpeter grow to 1.2 m length, 25 kg weight and can live in excess of 40 years (Gomon et al., 1994; Tracey and Lyle, 2005). Growth in juveniles is rapid, reaching an average length of around 28 cm after two years and 42 cm after four years, with most growth occurring during summer and autumn (Murphy and Lyle, 1999). Older fish grow significantly more slowly, with a large range in size-at-age in fish over approximately 50 cm.

7.5.5. Movement

Nothing is known about stock structure or potential migrations of bastard trumpeter (Lyle, 1994). Although not conclusive, the lack of mature fish in shallow waters may indicate structuring within the population, with immature fish inshore and adult fish offshore in deeper water (Harries and Lake, 1985). If so, bastard trumpeter would share a similar life history to striped trumpeter and blue moki (*Latridopsis ciliaris),* a closely related New Zealand species. Blue moki mature at about 40-44 cm and 5-6 years, similar to that of the bastard trumpeter, before being recruited to an offshore migratory stock (Francis, 1982).

Juvenile striped trumpeter tend to remain around shallow reefs for several years, with only limited movement, whereas larger fish move offshore where they are capable of travelling extremely long distances (Murphy and Lyle 1999). Several adults have been recorded moving hundreds of kilometres along Australia's eastern seaboard. During 2001 a striped trumpeter tagged off the Tasman Peninsula in 1996 was recaptured off St Paul Island in the Southern Indian Ocean, having travelled a straight line distance of around 5800 km (Lyle and Murphy, 2001). To what extent mixing between distant populations occurs is not known. As nothing is known of the stock structure of striped trumpeter in Australian waters a common stock throughout its range is assumed for management purposes (Lyle and Hodgson, 2001).

[1] Goldsmid, R. Technical Officer. Marine Research Laboratories, Tasmanian Aquaculture and Fisheries. Institute

7.6. Fisheries

7.6.1. Overview

Both bastard and striped trumpeter form the basis of significant commercial and recreational fisheries in southern Australia.

7.6.2. Commercial Fishery

Bastard trumpeter have been exploited commercially in Tasmania since European settlement and concerns were expressed about the status of the resource as early as the 1880's (Lyle, 1994). Catches prior to the mid 1980s were generally below 20 tonnes p.a., but rose to around 60 tonnes by the mid 1990s prior to declining once again to levels of around 20 tonnes (Fig. 14). The fishery is centred around the south-east and east coasts, taking mostly immature fish (Harries and Lake, 1985). They do not readily take hooks, and are caught primarily by gillnet, with minor quantities taken by beach seine and longlines (note: longline catch may have been striped trumpeter that were misidentified) (Lyle, 1994). As bastard trumpeter exhibit strong recruitment variability, trends in catches are variable and difficult to interpret (Lyle and Hodgson, 2001). The recent decline in commercial catch has been accompanied by apparently poor recruitment suggesting that stocks are depressed.

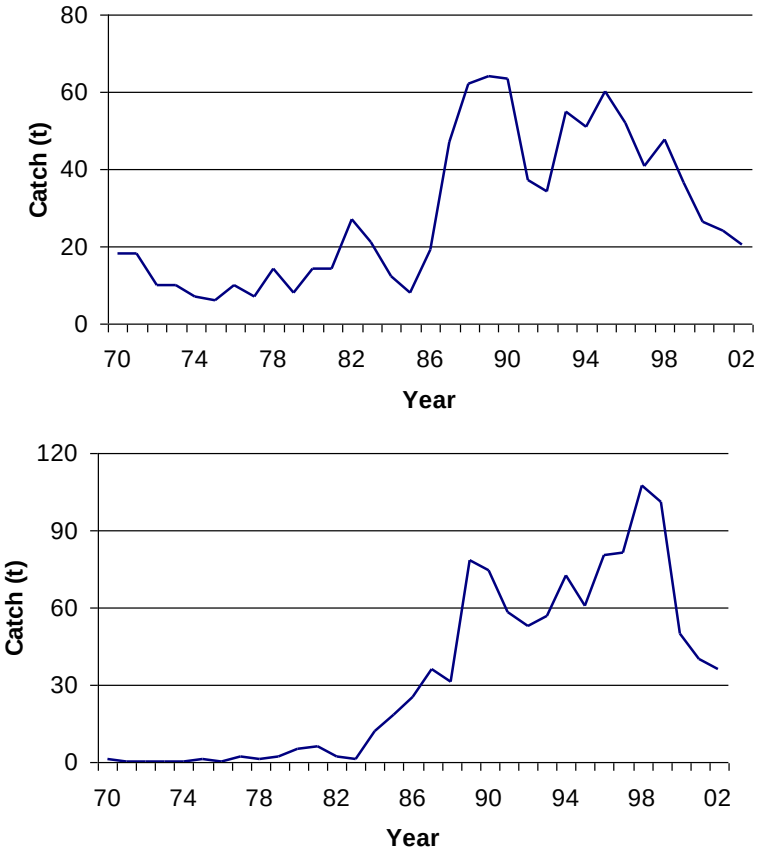

Fig. 14. Tasmanian commercial catch of trumpeters between 1970/71 and 2002/03 (based on General Fishing Returns). Bastard trumpeter (top) and striped trumpeter (bottom).

Prior to the mid 1980s reported striped trumpeter catches were low (< 20 tonnes p.a.). Landings generally increased through to the latter part of the 1990s, peaking at over 100 tonnes, before declining sharply to just 35 tonnes in 2002/03 (Fig. 14). Striped trumpeter catches are concentrated along the east coast, including Flinders Island, as well as off the south and southwest coasts, with limited catches taken off the west coast. As juveniles and adults are predominantly found inshore and offshore respectively, the catch is segregated. Juveniles are primarily caught using gillnets (graball nets) on shallow reefs (5 to 50 m), and adults using hook methods (droplines and handlines) on deeper reefs (80 to 300 m), with a minor by-catch taken in rock lobster pots (Lyle and Hodgson, 2001). In 2000/01 around 11% of the catch was caught by longline and in shark nets, primarily as a by-product of fishing for school and gummy shark (Lyle and Hodgson, 2001). The increase in catches during the latter half of the 1990s reflected the impact of strong 1993 and 1994 cohorts as they moved through the fishery.

7.6.3. Recreational Fishery

In Tasmania, bastard trumpeter is a traditional target species for net fishers whereas striped trumpeter are highly esteemed by line as well as net fishers. During 2000/01 recreational fishers caught an estimated 39,000 bastard trumpeter and 18,000 striped trumpeter, retaining 34,000 (88%) of the former and 17,000 (96%) of the latter (Fig. 15 & 16, Appendix A). Bastard trumpeter catches were largely reported from the south-east (Tasman Peninsula region) (36%) and west coasts (25%), followed in importance by the Derwent-Channel (13%), central east coast (12%) and Frederick Henry-Norfolk Bay (5%) regions. Only relatively small quantities were taken off the north coast (6%) (Fig. 15). By contrast, catches of striped trumpeter were concentrated off the central east (43%) and south-east (35%) coasts, with negligible catches reported from the west coast. The eastern north coast (9%) and to a less extent north-east (5%) and Derwent-Channel (5%) were of secondary importance to the fishery. The vast majority of the bastard trumpeter (95%) were taken by gillnets, very small quantities were taken by line and by spear (2% each) fishing methods. About 70% of the striped trumpeter were caught by line, almost exclusively using bait, the remainder were taken in gillnets (Appendix A). Set-lines accounted for 8% of the total catch, reflecting the practice of fishing with droplines over the deeper reefs.

The Tasmanian recreational fishery for trumpeters is managed by a minimum size limit of 35 cm TL (equivalent to about 30 cm FL) for bastard trumpeter and 45 cm TL (equivalent to about 39 cm FL) for striped trumpeter, well below the size at maturity in both species[1]. Bastard trumpeter sampled during 2000/01 ranged between 29-52 cm FL, with a size distribution characterised by a single broad mode with a peak between 35 and 45 cm and an average length of 40 cm FL (1.2 kg) (Fig. 15). Surveys during 1997/98 indicated greater representation of fish under 30 cm, resulting in a mean length of about 30 cm FL (Lyle and Campbell 1999). Recent poor recruitment of bastard trumpeter has presumably contributed to the downturn in commercial catches and the under-representation of small individuals compared with 1997/98 in the recreational catch. Related to this, less than 1% of the observed sample was below the minimum

[1] The minimum size limit for striped trumpeter was 35 cm TL, but was changed to 45 cm TL as part of the changes to the recreational fishery from the 2004 review Scalefish Fishery Management Plan.

legal size limit, a substantially lower proportion compared with 1997/98 (17%) (Lyle and Campbell, 1999).

Few striped trumpeter were encountered during the 2000/01 creel surveys. Those that were examined ranged between 38-63 cm with an average size of 52 cm (Lyle et al., 2002). A wider size range, measuring 33 to 82 cm FL was observed during the 1997/98 surveys, with a number of modes evident, the main ones being between 40-45 and around 60 cm (Lyle and Campbell, 1999). Graball caught fish were more restricted in size than line caught fish, ranging between 34-62 cm, with an average of 48 cm and 1.7 kg. Line caught fish were slightly larger, averaging 52 cm and 2.2 kg.

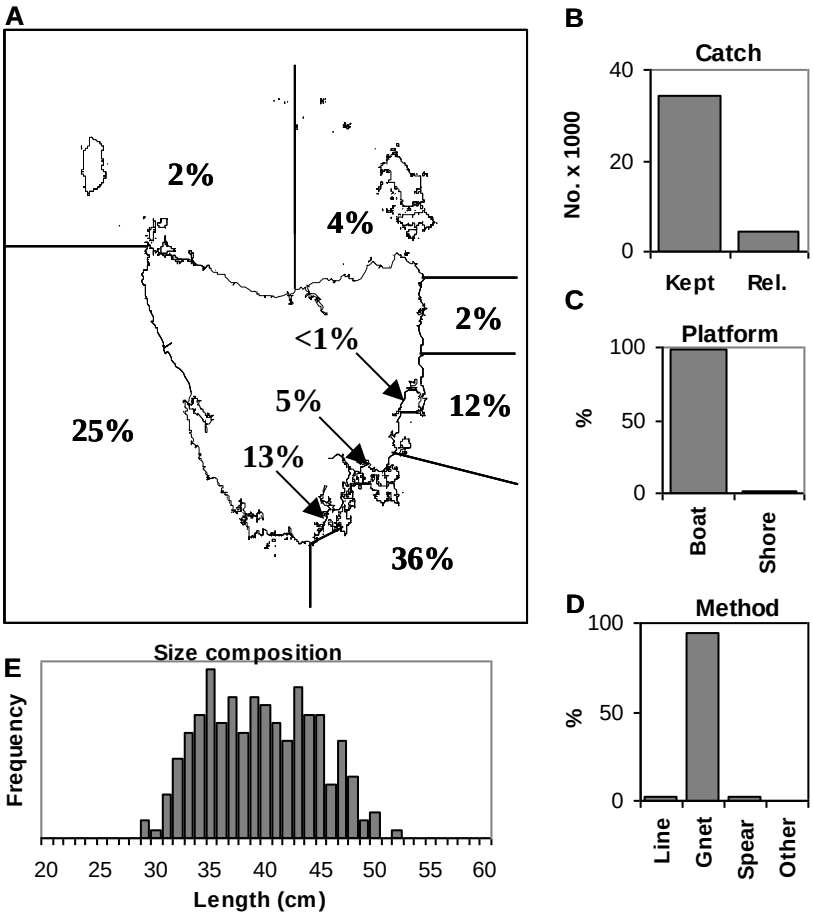

Fig. 15. Key characteristics of the Tasmanian recreational catch of bastard trumpeter based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet); E – size composition of retained catch based on creel surveys.

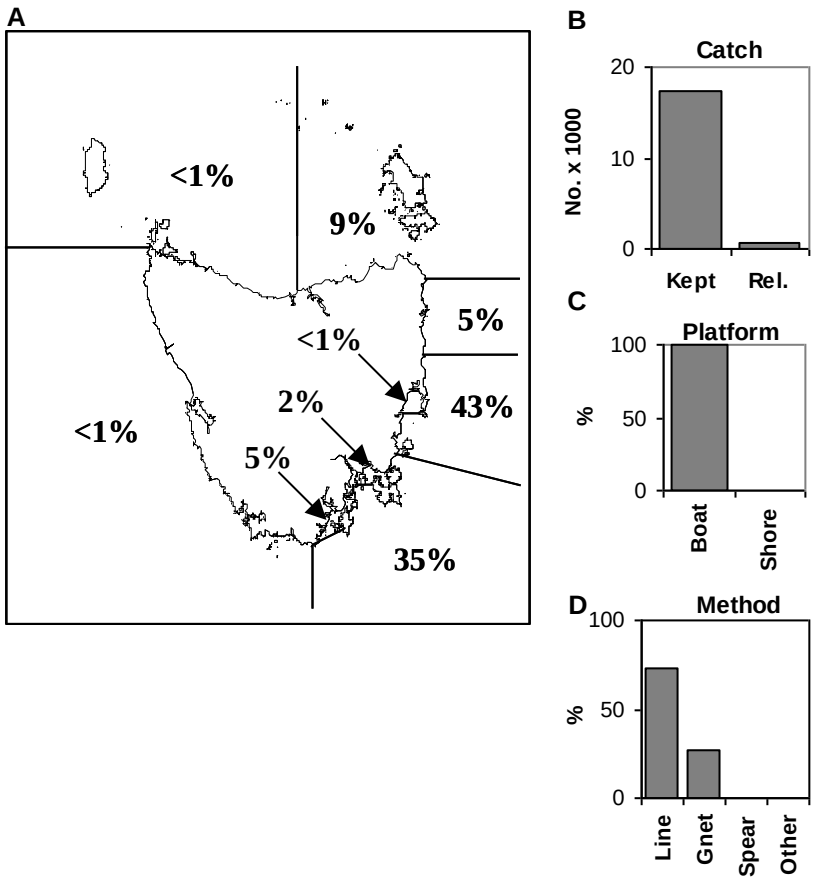

Fig. 16. Key characteristics of the Tasmanian recreational catch of striped trumpeter based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet).

7.7. Stock status

Trumpeters are iconic species in Tasmania, supporting important recreational and commercial fisheries. Sectorial competition occurs for both species. Bastard trumpeter are taken primarily by inshore gillnets by both sectors, whereas striped trumpeter juveniles are captured primarily by inshore gillnets, and adults are captured offshore by both sectors using hook methods.

The stock status of both species is uncertain, and no stock biomass estimates are available, however concern has been raised about depleted levels due to the effects of fishing coupled with apparent poor recruitment recently (Lyle et al., 2004). Of particular concern is the inshore gillnet harvest for striped trumpeter, which has the potential to take large numbers of immature fish, especially when large recruitment pulses are evident.

8. Blue Warehou

8.3. Taxonomy

Blue warehou (*Seriolella brama*) belong to the family Centrolophidae, which includes the spotted warehou (*S. punctata*) and blue eye trevalla (*Hyperoglyphe antartica*).

8.4. Distribution and Habitat

Blue warehou are distributed from southern New South Wales to the middle of the Great Australian Bight in South Australia including Tasmania (Fig. 17), and also occur in New Zealand (Gomon et al., 1994). They are a pelagic species generally found from 50 to 400 m depth, however in Tasmania (the southern-most extent of their distribution) they are found seasonally in shallow inshore waters.

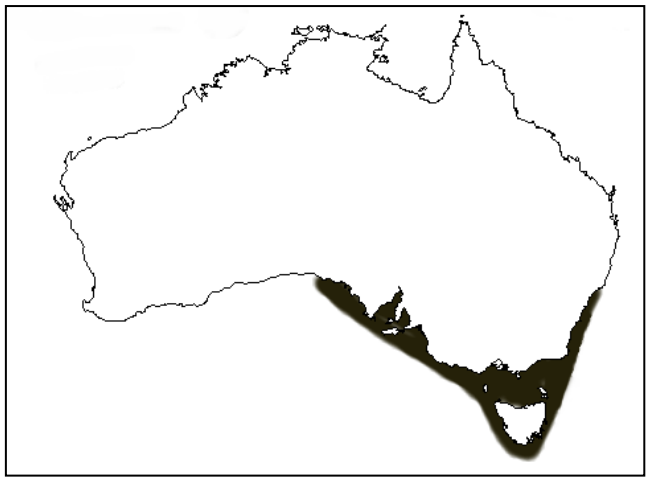

Fig. 17. Distribution of blue warehou in Australia

8.5. Lifecycle

8.5.1. Spawning

Females first mature at 30 cm, with 50% of the population mature at about 36 cm, equivalent to 3-4 years of age (Knuckey and Sivakumaran, 2001). In Tasmania, spawning occurs in early spring (Bruce et al., 2001). The distribution of small larvae (<5.0 mm length) suggests that spawning occurs over a large area, from Kangaroo Island in South Australia to southern Tasmania, with a major spawning ground located on the central-west and north-west coasts of Tasmania (Bruce et al., 2001).

Eggs are pelagic, spherical and 1.4–1.6 mm in diameter (Neira et al., 1998). Annual fecundity increases exponentially with length and ranges from 0.43 million eggs per fish for a 38 cm individual, to 1.35 million eggs for individuals larger than 50 cm (Knuckey and Sivakumaran, 2001).

8.5.2. Early life stages

The early life history of blue warehou is poorly understood (Bruce et al., 2001). Small juveniles are pelagic in offshore waters and appear to associate with scyphozoan jellyfish, specifically with the mauve-stinger jellyfish *Cyanea capillata* (Last et al., 1983). Larger juveniles (approx. 30+ cm) move inshore in schools onto the continental shelf and into bays and inlets, suggesting that such areas are important nurseries for the species (Murphy, 1994; Jordan, 1997).

8.5.3. Diet

In New Zealand, warehou eat zooplankton such as the tunicates *Lasis zonaria* and *Pyrosoma atlantica* (Gavrilov and Markina, 1979). Juveniles also eat small planktonic crustaceans (Kailola et al., 1993).

8.5.4. Age and growth

Blue warehou can reach a maximum of 76 cm length, 7kg weight and may live for 10 years, however most fish are smaller than 50 cm (Last et al., 1983; Smith and Wayte, 2002). Juveniles grow rapidly reaching 23-27 cm at one year (Smith, 1989; Smith and Wayte, 2002).

Recruitment variability appears to be high with strong cohorts reported in Tasmanian waters in 1994 and 1995 (Jordan, 1997).

8.5.5. Movement

The movement of blue warehou is poorly understood, and although a highly mobile species (Gavrilov and Markina, 1979), recent studies have indicated that there are two stocks in Australian waters, one to the west and one to the east of Bass Strait (Smith and Wayte, 2002). They are thought to move into deeper water in winter and spring to spawn, with fish moving into shallow waters during summer and autumn. Anecdotal evidence suggests a relationship between movement, water temperature and prey distribution in Tasmania with high catches in summer (Murphy, 1994) coinciding with a peak in zooplankton biomass on the shelf of eastern Tasmania (Young et al., 1993).

8.6. Fisheries

8.6.1. Overview

Blue warehou is an important species taken by both commercial and recreational fishers. It is an important quota species in the Commonwealth managed South East Fishery, taken by trawlers and gillnet, and is sold predominantly as fresh fish in the Sydney and Melbourne fish markets (Tilzey, 1998; Knuckey and Sivakumaran, 2001). The species is also taken as part of the Tasmanian scalefish fishery, although availability in coastal waters appears to be influenced by prevailing oceanographic conditions and prey availability as well as stock biomass (Lyle and Hodgson, 2001).

8.6.2. Commercial Fishery

Blue warehou are caught by trawl and gillnets, the latter method being preferred by Tasmanian-based fishers, who generally operate in depths of less than 40 metres, and often set nets hard up against the shoreline (Murphy, 1994). Most of the catch in south-eastern Australia is taken in late winter and early spring, whereas the Tasmanian gillnet catch is predominantly taken in summer to a peak in late autumn (Smith, 1989; Murphy, 1994).

Prior to the mid 1980s state catches of blue warehou were comparatively low (< 50 t p.a.) but expanded to over 300 t in the early 1990s and have fluctuated widely since that time (Fig. 18). Varying availability in state waters (due to oceanographic conditions) is generally believed to have been a major driving factor affecting catches during the 1990s but the sharp decline in catches that occurred at the end of the early 1990s appears to be linked to the generally depressed state of the stocks. The commercial fishery has traditionally been concentrated off the south-east coast and thus probably targets the eastern stock. Catches are also taken off the north-east and north-west coasts, the latter potentially involving the western stock of blue warehou (Lyle et al., 2004).

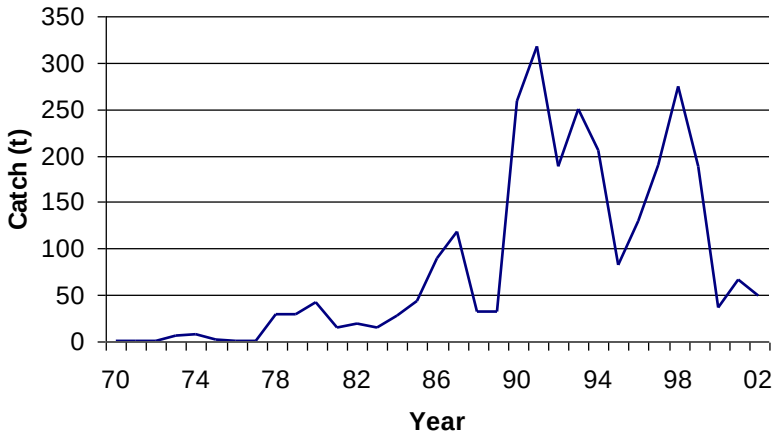

Fig. 18. Tasmanian commercial catches of blue warehou for the period 1970/71 to 2002/03 (based on General Fishing Returns).

8.6.3. Recreational Fishery

Consistent with the commercial fishery, recreational catches are heavily influenced by patterns in the availability of blue warehou. Lyle (2000) estimated that the 1997 recreational gillnet catch of blue warehou was 81,000, substantially higher than the estimate of 19,000 for 2000/01, which was based on line as well as gillnet fishing methods (Fig. 19, Appendix A). Of the total catch, 18,000 (94%) were retained. Catches from the western north coast (especially around Stanley and Wynyard) dominated (43%), followed in importance by the Derwent-Channel (25%) and south-east coast (especially Tasman Peninsula) (17%). Apart from Frederick Henry-Norfolk Bay (8%), catches from other regions were of minor significance. Gillnets accounted for just over half of the catch and line fishing (exclusively with bait) the balance. While boat-based catches dominated (55%), the significance of the shore-based fishery (off wharves and jetties) was also evident.

A minimum size limit of 25 cm TL (equivalent to 22 cm fork length) applies for blue warehou in Tasmania and is below the size at maturity. Blue warehou sampled from gillnet and line catches during 2000/01 included fish between 22 and 48 cm FL, the distribution peaked between 32 and 36 cm, and the average length was 34 cm (900 g) (Fig. 19). The size composition of recreational catches sampled during 1997/98 included larger individuals, with a strong mode at 38-40 cm and most fish between 30-55 cm (Lyle and Campbell, 1999). Graball caught individuals dominated this earlier sample and were substantially larger than line caught fish (averaging 41 cm compared with 34 cm). By contrast, the 2000/01 sample was dominated by line caught fish, and, when method is considered, there was general similarity in size composition between years.

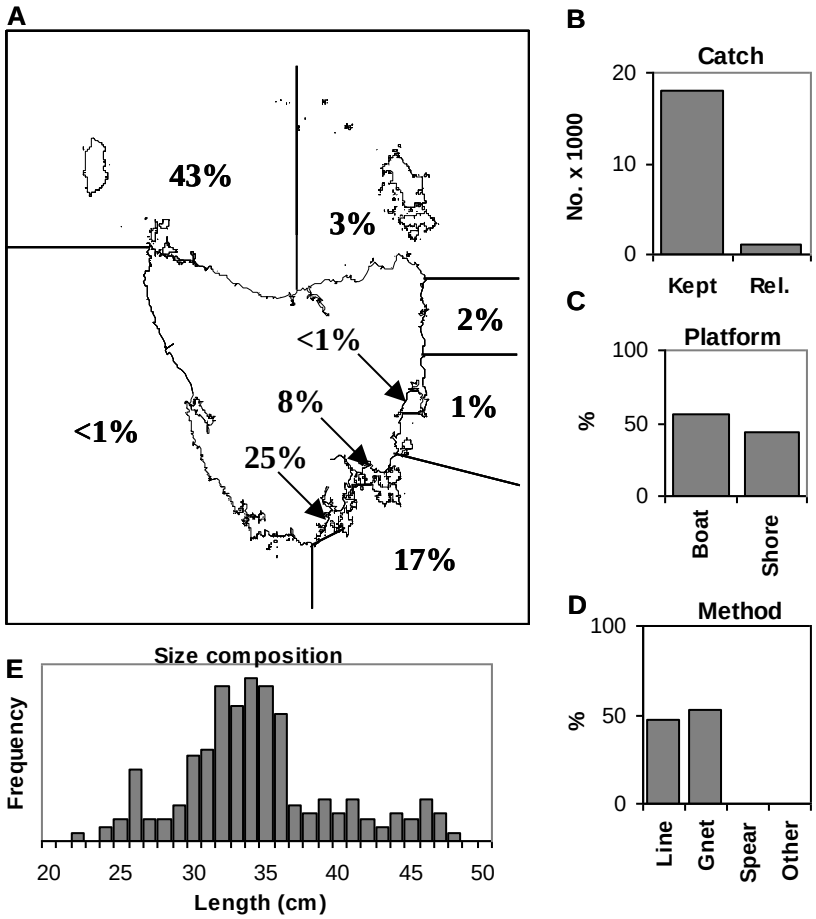

Fig. 19. Key characteristics of the Tasmanian recreational catch of blue warehou based on the 2000/01 National Recreational Fishing Survey: A – regional distribution of retained catch (% of total); B – estimated catch numbers (thousands) kept and released (Rel.); C – proportion (%) of the total retained catch taken by fishing platform; D – proportion (%) of retained catch taken by fishing method (Gnet is gillnet); E – size composition of retained catch based on creel surveys.

8.7. Stock status

Blue warehou support important recreational and commercial fisheries. As both sectors catch blue warehou using gillnets, quite often set hard against the shore, there is the potential for competition.

The species is currently rated as overfished, due primarily to activities in the South East Fishery (Caton, 2003) and catch limits in the Commonwealth fishery have been substantially reduced in recent years. Blue warehou are a pelagic species with highly variable recruitment, and availability to the Tasmanian scalefish fishery is highly variable between years. A substantial proportion of the Tasmanian catch is likely to be immature. No stock biomass estimate is available.

9. Summary

9.3. Key biological parameters

Current knowledge of important biological parameters for the key recreational finfish species is summarised in Table 1. Across the species, most prior research attention has been directed at age and growth, with limited information for spawning season and diet. Little is known about other biological parameters. Estimates of biomass are only available for sand and tiger flathead, and only for a limited area of the state, which, in the case of sand flathead, did not provide coverage of shallow inshore waters where the species is common. Resource status of the key species are unknown, with the exception of blue warehou stocks, which are currently assessed as overfished, due mainly to the impacts of the Commonwealth fishery.

Table 1. Summary of knowledge for important biological parameters for the key recreational finfish species. The key is shown below.

Species	Size at maturity	Spawning season	Fecund.	Diet	Age & Growth	Movement	Stock Status
Black bream	*	*	*	*	*	*	-
Flathead - tiger	**	**	**	**	***	*	-
Flathead - sand	**	**	-	**	***	*	-
Flounder - greenback	*	*	*	**	*	-	-
Flounder - long-snouted	-	*	*	**	*	-	-
Australian salmon	**	**	-	**	**	*	-
Trumpeter - bastard	*	*	-	*	*	*	-
Trumpeter - striped	*	*	*	*	**	*	-
Blue Warehou	**	**	**	*	**	*	**

- Unknown
* Little knowledge (limited information available, includes anecdotal or information from other States)
** Some knowledge (limited information reported)
*** Considerable knowledge (extensive information reported)

9.4. Key species

9.4.1. Black bream

Most research effort targeted at bream has been conducted in Victoria and Western Australia, with little research conducted in Tasmania. As bream are highly variable throughout the species range, the characteristics of Tasmanian populations cannot be assumed to be similar to well researched stocks in other States, such as Victoria. In Tasmania, it is likely that bream move upstream in spring and summer to spawn. They are opportunistic feeders, and elsewhere in Australia have been found to live for over 20 years.

9.4.2. Flathead

There is considerable knowledge about the biology of sand and tiger flathead. All sand flathead are mature by 30 cm, whereas tiger flathead reach maturity at approximately 30 cm for females and 25 cm for males. Spawning occurs in shallow inshore and coastal waters in spring and summer for sand flathead, and summer for tiger flathead.

Both species are active foragers as well as ambush predators. Sand flathead are capable of reaching 53 cm, 3.1 kg weight and may live for as long as 17 years for males and 16 years for females. Length at age is highly variable. Tiger flathead can reach 57 cm and 14 years for males or 65 cm and 17 years for females, although in Tasmanian coastal waters fish above 50 cm are rare.

Mature sand flathead move from inshore spawning grounds in late spring and summer to deep outer-shelf waters in autumn and winter. Tiger flathead in Tasmania move inshore to spawn, however little else is known about movement. In Tasmania, sand flathead dominate the recreational catch, and tiger flathead the commercial flathead catch.

9.4.3. Flounder

Greenback and long-snouted flounder are found on soft substrates in estuaries and inshore coastal waters, and, with the exception of diet, knowledge on their biology and ecology is rudimentary. Size at maturity is unknown for long-snouted flounder, greenback flounder mature between 19 and 30 cm. Both species apparently move into deeper coastal waters in winter and spring to spawn.

Both species consume benthic invertebrates such as polychaetes and molluscs. The greenback flounder is the largest flounder found in Tasmanian waters, reaching 45 cm length and 600 g weight, however they are mostly less than 30 cm. Long-snouted flounder reach 34 cm. Length and weight for age is not available for the flounder species.

9.4.4. Australian salmon

Both eastern and western Australian salmon are found in Tasmania. Much is known about their biology, however very little research has been done recently. Juveniles are found over soft substrates in shallow coastal waters while larger fish move into exposed, coastal waters. Western Australian salmon mature at 4-6 years of age and 50 cm length, whereas eastern Australian salmon mature at around 4 years and 39 cm. Spawning apparently does not occur in waters adjacent to Tasmania, with both species migrating to spawning grounds off the mainland coast.

Western Australian salmon feed predominantly on prey such as pelagic clupeoid fishes, whereas eastern Australian salmon consume mostly small invertebrates found in the

plankton. Western Australian salmon reach 96 cm length, 10.5 kg weight and 9 years of age. Eastern Australian salmon live for around 10 years and can reach 89 cm length and 7 kg weight.

As a fast swimming pelagic fish, long distance movements by salmon are commonplace. Other than migrations associated with spawning, however, knowledge of other movements is limited.

9.4.5. Trumpeters

Understanding of the biology of the striped and bastard trumpeter is limited. Both species live on shallow reefs as juveniles, with adults moving offshore to deeper reefs. Bastard trumpeter are possibly sexually mature at about 45 cm, apparently spawning in late winter, however few mature fish have been observed. Sexual maturity in striped trumpeter occurs at a similar size for females, with spawning occurring between winter to spring.

Bastard trumpeter are only known to consume small invertebrates, whereas striped trumpeter also feed on fish and cephalopods. Bastard trumpeter grow to at least 65 cm length and 4.3 kg weight. Striped trumpeter grow to 1.2 m length, 25 kg weight and can live in excess of 40 years.

Juvenile striped trumpeter tend to remain around shallow reefs with only limited movements, whereas larger fish move offshore and are capable of travelling extremely long distances. There is evidence of marked recruitment variability in the trumpeters with particularly strong cohorts for both species spawned in 1993.

9.4.6. Blue warehou

Blue warehou are generally an offshore pelagic species, however in Tasmania they are found seasonally in shallow inshore waters. A relatively large amount of research has been conducted into their biology, however diet and movement remain poorly studied. Females mature at about 36 cm, and in southern Tasmania spawning occurs in offshore waters in early spring. They can reach 76 cm length, 7 kg weight and can live up to 10 years.

Blue warehou appear to be a highly mobile with variable recruitment.

9.5. Research needs

Understanding the affects of fishing, the status of the fish stocks, and their role in the broader ecosystem requires at least a basic understanding of the fisheries and the population dynamics and life history of the species. Research focus on the recreational fishery has tended to be directed at catch and effort data. As indicated in this review

relatively little is known about the life history and resource status of many of the key recreational species, in part due to research focus on species of commercial significance at the expense of key recreational species.

For each of the key species size and possession limits apply to recreational fishers. Possession limits may play a role in limiting overall catch and assist in sharing the catch between fishers more equitably. Size limits are generally imposed for some biological imperative, typically to allow fish to reach maturity prior to entering the fishery. For several of the key species, size at maturity is either not known or poorly defined. There is a priority to undertake some basic biological sampling to ensure that size limits do in fact achieve the objectives of management. A consequence of size and possession limits is that, by regulation, recreational fishers may have to release some of their catch. In addition, there is a growing trend for recreational fishers to practice catch-and-release. The question of the fate of these released fish arises, that is to say it is important to at least have an understanding of post release survival and factors that might enhance survival rate.

Issues of access and resource allocation between the recreational and commercial sectors are arising within some Australian fisheries. Fisheries are dynamic and changes within one sector, for example to the catch, gear used and area fished, may adversely impact the other. There is, however, little information available on the comparative selectivity of the commercial and recreational fisheries and the competitive interactions that occur between sectors. Knowledge about selectivity has relevance in understanding the relative impacts on fish populations, and an increased understanding of interactions between sectors will allow a better understanding of the relative impacts of each sector upon fish stocks. It will also allow us to predict the likely affect upon one sector caused by changes within the other.

Recently there has been a movement towards ecosystem based fisheries management where an understanding of the system itself, as well as the species, is important. Whilst fishing is an important factor, there are also a number of other human impacts that can indirectly effect fish populations. Most recreational fishing effort is targeted in inshore waters, however these areas are also likely to suffer from human impacts, for example increased runoff due to land clearance. This can change the water quality and sediment characteristics, which in turn can alter key habitats for fish species.

As well as the localised effects of human impacts are the effects of long-term climate change and global warming. This has the potential to impact fish stocks by altering environmental conditions and may affect the distributions and behaviour of some species. It is important that we begin to understand the potential effects that long term human impacts may have on fish populations.

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Appendix A. The total catch, and percentage catch by region, method and platform for the key recreational finfish species.

Species	Bream	Flathead	Flounder	Australian salmon	Bastard trumpeter	Striped trumpeter	Blue warehou
Kept	45396	1377350	71160	314221	34097	17277	18069
Release	30886	758684	4166	108384	4579	679	1175
Total	76282	2136033	75326	422605	38677	17956	19244
% retained	59.5	64.5	94.5	74.4	88.2	96.2	93.9
% total kept by region							
NW	9.2	4.1	2.0	26.7	2.1	0.0	43.2
NE	12.7	8.3	16.5	16.7	4.1	9.4	3.3
E	12.2	4.0	0.1	11.3	2.0	5.2	2.0
CE	1.5	12.4	0.4	4.2	11.7	43.1	0.8
GOB	38.4	24.8	0.9	2.7	0.4	0.0	0.0
SE	1.1	12.3	9.9	4.9	36.2	35.2	17.3
FHN	0.0	14.9	23.8	1.0	5.3	1.9	8.4
DC	24.9	19.2	34.9	6.2	13.2	5.3	25.1
W	0.0	0.1	11.3	26.3	24.9	0.0	0.0
% kept by method							
Line-bait	92.1	86.0	0.4	44.0	2.4	59.3	47.7
Line-lure	0.3	2.8	0.0	34.3	0.0	0.6	0.0
Line-both	4.0	10.4	0.0	16.3	0.0	4.4	0.0
Line-set	0.0	0.2	0.0	0.1	0.0	8.4	0.0
Gillnet	3.2	0.3	15.2	2.8	94.9	27.3	52.3
Spear	0.2	0.3	83.0	0.0	2.3	0.0	0.0
Other	0.2	0.0	1.5	2.5	0.4	0.0	0.0
% kept by platform							
Boat	27.8	93.7	37.1	59.2	98.6	100.0	55.6
Shore	72.2	6.3	62.9	40.8	1.4	0.0	44.4