GOVERNMENT OF WESTERN AUSTRALIA
Department of Primary Industries and Regional Development

RESEARCH ANGLER PROGRAM

Newsletter No. 36
October 2017

Welcome to the RAP Newsletter, providing feedback on the data you are collecting and keeping you informed about what is happening at the Fisheries Division of the Department of Primary Industries and Regional Development.

Status of southern garfish in the Perth region

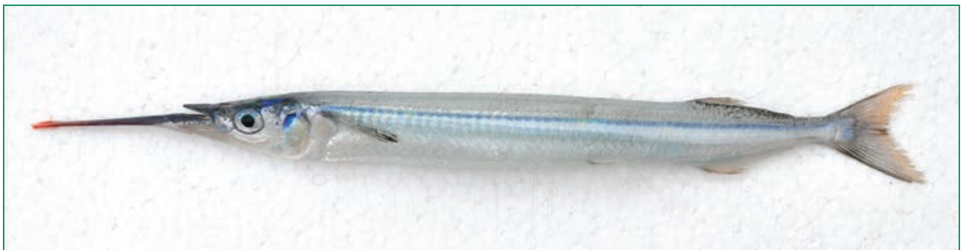

Photo 1: Southern garfish.

In June 2017, the Perth metropolitan area was closed to both recreational and commercial fishing for southern garfish (Hyporhamphus melanochir) to help the local population recover. We would like to thank those of you who have been assisting us to monitor garfish by donating fish or recording logbook data. Your data is essential to our assessments.

Fisheries Research Report 271 contains the results of our first garfish stock assessment, completed in 2014 (http://www.fish.wa.gov.au/Documents/research_reports/frr271.pdf). Our assessments have been updated annually since 2014 and the latest findings are published in the State of the Fisheries Report each year. Here is a quick summary of our latest assessment.

Slow decline since the late 1990s

Cockburn Sound has traditionally been the main fishery for southern garfish in the West Coast Bioregion (WCB). About 80% of commercial landings and 50% of recreational landings of this species in the WCB have been taken in Cockburn Sound.

A previous study in 1998-1999 suggested the garfish population in Cockburn Sound was in relatively good condition. But, soon after this study was completed, the abundance of garfish began a steady decline. In response to this decline we began a major assessment of the stock in mid-2009. Most of our biological sampling to determine age/length/sex composition of fishery landings was done in 2010-2011. We then spent many hours in the lab trying to age the fish using the otoliths we had collected. This was a challenge because garfish otoliths are quite difficult to interpret, although we eventually got the hang of it!

Photo 2: Garfish egg found in Cockburn Sound. Filaments used to attach the egg to marine vegetation are clearly visible. Garfish eggs are relatively large (3 mm diameter). Photo: Jan Richards

We found the typical (most common) age of garfish had declined, from two years in 1998-1999 to one year in 2010-2011 (Figure 1) and the proportion of fish aged more than two years fell from 30 % to less than 5%. The average length also declined. Considering the maximum reported age of 10 years for this species, the age structure of the Cockburn Sound stock in 2010-2011 was heavily 'truncated' (i.e. older fish were absent from the population).

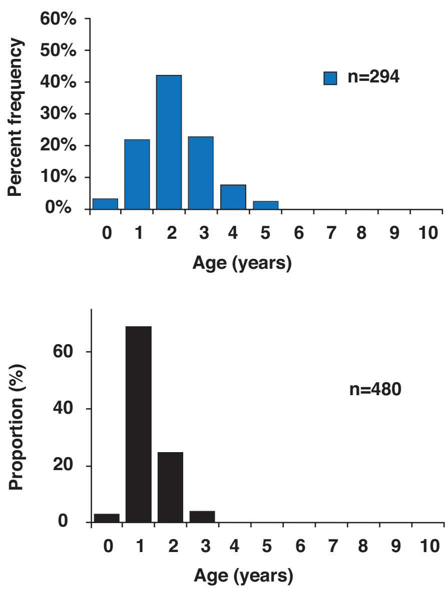

Figure 1. The age structure of southern garfish in Cockburn Sound in 1998 (previous study) (top) compared to 2009-2011 (bottom), showing the disappearance of older fish and a decline in the average age. Note: the maximum age recorded for southern garfish is 10 years.

The age data was used to estimate the 'instantaneous rate of total mortality' (Z) acting on the stock in 1998-1999 and 2010-2011. Z is equal to the sum of fishing mortality (F) plus natural mortality (M), i.e. $Z = F + M$.

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Z was estimated to be 0.90 per year in 1998-1999 and 1.57 per year in 2010-2011 which, in non-technical terms, means there was an annual survivorship (S) of 41% and 21%, respectively. Compared to the rate of survivorship experienced by garfish 'naturally' (i.e. in an unfished population), which is 64% per year (Z = 0.44), the total mortality in 2010-2011 was extremely high. This suggested that fishing pressure in Cockburn Sound increased substantially between 1998-1999 and 2010-2011, resulting in a 50% decline in survivorship.

In our assessments, we tend to focus on the rate of fishing mortality (F), rather than Z or M, because this is the factor that we actively manage (i.e. we can adjust catch and/or fishing effort which will alter F, but we can't change natural mortality). In 2010-2011, the estimated F substantially exceeded the limit reference point for this stock (Figure 2). This level of fishing pressure is considered unsustainable.

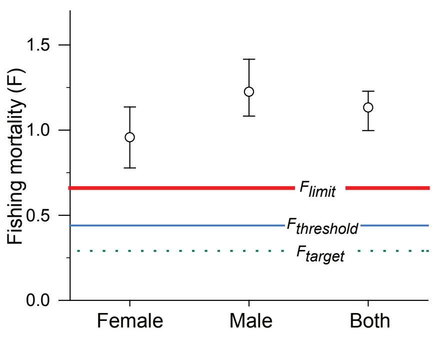

Figure 2: Rate of fishing mortality (F) for southern garfish in Cockburn Sound in 2010-2011, estimated using the age structure of males, females and both sexes combined. Note: each F estimate, including 95 per cent confidence interval, is well above the limit reference level for this species, indicating an unacceptable level of fishing pressure. Differences in F suggest male garfish experience a slightly higher rate of mortality than females.

These findings were consistent with another part of the assessment which estimated that the spawning stock biomass of garfish had been greatly reduced, to around 20% of the 'virgin' (unfished) level in 2010-2011.

And then the heatwave struck....

After our biological sampling in 2010-2011, we continued to monitor catches and catch rates of garfish in Cockburn Sound and the broader Perth area. Commercial and recreational catch rates fell sharply in 2012, and have remained at historically low levels since (Figure 3). Overall trends suggest a very substantial (perhaps 70-90%) reduction in garfish abundance in this area since the late 1990s. Recruitment failure during the 'heatwave' event in summer 2010/11 appeared to have caused the dramatic decline in catches between 2011 and 2012.

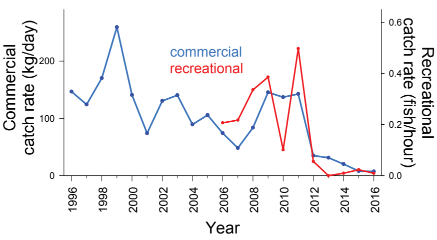

Figure 3: Annual commercial catch rate (standardised) and recreational catch rate of southern garfish in Perth area from 1996 to 2016, indicating a large decline in abundance since the late 1990s, and very low abundance since 2011. The recreational catch rate is calculated from RAP logbook data, only available from 2006 onwards (Note: the commercial fishery voluntarily ceased targeting garfish in 2016).

In summary, our assessment indicates that the garfish stock in Cockburn Sound had been declining since the late 1990s, mainly due to an unsustainable level of fishing pressure (both commercial and recreational). The very depleted state of the stock made it vulnerable to collapse after poor recruitment during the 'marine heatwave'. Five years later garfish abundance remained extremely low in the Perth area, and there was no sign of stock recovery. This indicated that management intervention was required to help this stock recover. With a fishing ban now in place, we will continue to monitor garfish over the next few years to detect signs of recovery.

Garfish biology

Southern garfish occurs across southern Australia, including WA (Kalbarri southwards), SA, Victoria and Tasmania. It reaches a maximum length of 49 cm and can live 10 years. Although this species grows rapidly and attains maturity at a relatively young age (about a year), it has some biological traits that make it relatively vulnerable to overfishing:

Low fecundity: A female may spawn multiple batches of eggs during spring and early summer. Batch fecundity increases with size, ranging from about 100 eggs per batch for a small (22 cm) female to about 4,000 eggs per batch for a large (40 cm) female. This is a low level of egg production compared to many other fish species, which can produce tens of thousands or millions of eggs. Low fecundity limits how fast a garfish population can recover from depletion.

Small populations: In each region, southern garfish occur as multiple, small, sub-populations. For example, Cockburn Sound is believed to host its own sub-population. In SA, researchers have found discrete (non-mixing) garfish populations less than 60 km apart. This situation arises because garfish have limited dispersal. Small populations are more vulnerable to depletion (by fishing or natural factors) than larger populations.

Limited dispersal: Garfish eggs attach to seagrass or other aquatic vegetation via filaments on the egg (see Photo 2). The larval stage is completed inside the egg, and they hatch as tiny juveniles (~7 mm). Due to the attached eggs, and absence of a planktonic larval stage, there is no dispersal during these early stages. Juveniles and adults tend to remain associated with seagrass habitat too, and so an individual fish might spend its entire lifetime within the same seagrass bed. Limited dispersal means little mixing between populations. If a local garfish population is depleted, it may take a long time to recover because it will not be replenished by fish arriving from other stocks.

Dependency on seagrass habitat: Southern garfish are considered 'seagrass-dependent' because seagrass forms a significant part of their diet and their eggs must attach to seagrass (or similar vegetation) to survive. Garfish generally live near seagrass or other marine vegetation all their lives. Seagrass habitat is threatened by human activities (such as dredging, water pollution) in many areas including Cockburn Sound.

Blue groper attitude

Jeff Norriss

The recreational fishing community on WA's south coast has a protective attitude toward the western blue groper that live along the coastline. Some southerners reckon there is something different about blue groper that makes them inherently vulnerable and, as a result, fishing for blue groper is not encouraged.

So what is different about blue groper, compared to the average fish?

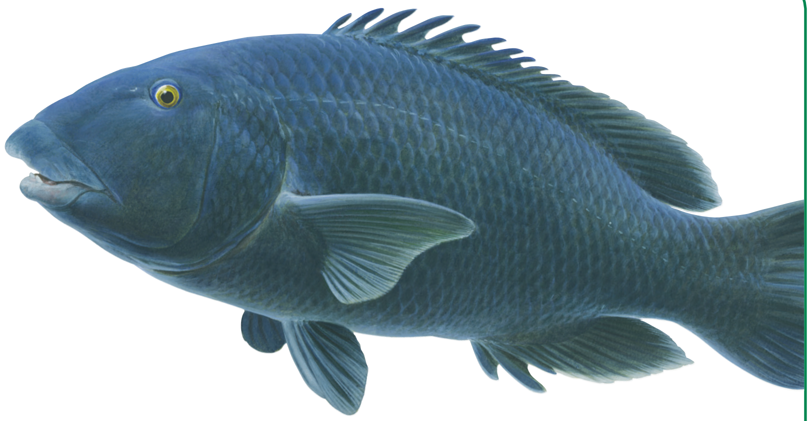

Photo 3: The official Australian record for the largest western blue groper is this 39.48 kg specimen taken September 1969 near Hopetoun by David Hopkins.

Growing to 40 kg, blue groper is southern Australia's largest resident reef fish (Photo 3).

They are very long lived, known to reach 71 years based on counts of annual growth rings on their otoliths (ear bones). They are inclined to take up residence close to shore and often remain within a small home range for years. This has been demonstrated in South Australia through the attachment of acoustic tags (the same kind used in WA and elsewhere to detect white sharks) that alert a listening station if the tagged fish swims within a few hundred metres of it. Living close to shore makes them accessible to divers, to whom large blue groper are either indifferent or inquisitive. Thus, large old fish are consistently vulnerable to spear or line fishers, and the south coast fishing community recognises this.

This protective attitude is very apparent at the major annual fishing tournaments in Esperance and Albany – both of which exclude blue groper. It is not surprising therefore that the recreational catch is quite low. Only 104 fish were taken from the south coast in 2013-14, based on a Department of Fisheries survey of boat-based recreational fishing.

Bag and size limits - Western blue groper		
Minimum legal size	Individual species daily bag limit	
	West Coast	Other bioregions
500 mm	1	1

There are other extraordinary aspects of blue groper biology. All start life as green coloured females, reaching sexual maturity at about 17 years old. Later in life, some change sex and colour to become blue males, but not until their mid-thirties! Males grow larger. Colour is a reliable guide to sex, so if the fish is blue it's male and probably over 30 years of age.

Sex change is likely to be brought on socially, although this is not confirmed. It is thought that if a male dies, perhaps due to fishing, one of the local females responds by changing sex to replace him. Blue groper are thought to have this flexibility because they are members of the wrasse family and socially-induced sex change has been demonstrated in other wrasse species. If this is true, the mid-thirties sex change is not hard-wired and strong fishing pressure would result in a younger sex change.

The blue groper's diet is dominated by bottom-living invertebrates. Preference has been tested experimentally by divers offering three food choices: crabs were the preferred choice over greenlip abalone and spiny sea urchins. When feeding, blue groper sometimes make an audible crack as they carry out aggressive ram-and-bite manoeuvres to dislodge abalone, limpets and chitons clinging tightly to the reef. Their teeth are not the fine, needle-sharp teeth of fish predators like tailor. Rather, they are like small pointed bolts, good for wrenching shellfish off rocks or punching holes in them (Photo 4). Finally, strong crushing plates in their throat grind the food, including the shell, before it enters the stomach (Photo 5). The shells of certain whelks are incredibly strong, but a blue groper has the ability to pulverise them and expel the larger shell fragments through their gills before swallowing the meat.

Photo 4: The lips on this blue groper have been removed to reveal strong bolt-like teeth for wrenching abalone and limpets from the reef.

Photo 5: Robust grinding plates in the throat can crush the toughest shellfish.

When their preferred food sources are scarce, blue groper visit meadows of green macro algae named *Caulerpa*, where they take regular suction-bites out of the bottom, filtering out tiny (1-2 mm) crustaceans from the detritus-rich habitat. Although nowhere near as nutritious as crabs, abalone and such, this 'meadow grazing' may be crucial when other food sources are scarce.

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The south coast fishing community is indeed right in recognising that blue groper is a remarkable species, inherently vulnerable to over-fishing due to their longevity, late maturity and sedentary behaviour. The good news, however, is that a recent assessment of south coast blue groper by Fisheries revealed stocks to be healthy. No doubt the protective attitude of the local fishing community has contributed.

So, will this protective attitude on the south coast continue? That will require the fishing culture to be passed on to the younger generation. At the Albany Senior High School, the English curriculum currently includes a book by famous WA author Tim Winton, entitled *Blueback*. It's about a boy growing up on the south coast who loves to dive with a large blue groper that takes up residence in the bay in front of his home. He names him Blueback, but soon has his work cut out protecting the fish from various threats. Winton himself moved to Albany the year he started high school, and his book passes on the protective community attitude.

In Blueback, the boy ponders deeply about what the fish knows and what it has experienced in its life time. Perhaps we can fill in some gaps? Blue groper know how to roll boulders to reach hidden prey underneath. They interact with seals that chase them, more in play than with predatory intent, as well as with humans. They follow feeding white sharks to pick up food scraps. And some of them change sex along the way. With all they have experienced, blue groper have probably cultivated some attitude of their own.

Redmap – citizen scientists monitoring changes in our marine environment

Fisheries staff recently attended a seminar by the Deputy Associate Dean of Research at the Institute for Marine and Antarctic Studies, University of Tasmania, Greta Pecl. Associate Professor Pecl heads a project called Redmap (Range Extension Database and Mapping project, www.redmap.org.au), a citizen science project that invites recreational fishers, divers and beachcombers from around Australia to submit photographs and data about unusual observations of marine species. This helps Associate Professor Pecl and her team to determine what is happening to our ocean species as the water warms.

We are a partner on this project that has now been operating at a national level for four years.

Redmap has two main objectives. The first is ecological monitoring for the early detection of species that may be extending their geographic distribution due to environmental change ('range shifts'). The second is engaging the public on the ecological impacts of climate change, using the public's own data.

Our staff learnt about the development of this project, its progress in relation to its key objectives of monitoring and engagement and future possibilities for Redmap Australia.

Associate Professor Pecl and her team were recently nominated for the Department of Industry, Innovation and Science Eureka Prize for Innovation in Citizen Science for their Redmap Australia project, highlighting the project's significant contributions by citizen scientists towards better understanding our ocean species and climate change.

Thank you for your ongoing support and happy fishing!

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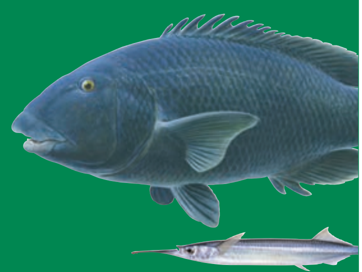

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