Marine fish communities and land use in the Gisborne District

Prepared for Gisborne District Council

September 2010

Authors/Contributors:
Darren Parsons

For any information regarding this report please contact:
Darren Parsons

Fisheries and Marine Ecology, Auckland
+64-9-375 4531
d.parsons@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
41 Market Place
Auckland Central 1010
Private Bag 99940
Newmarket
Auckland 1149

Phone +64-9-375-2050
Fax +64-9-375-2051

NIWA Client Report No:	AKL-2010-035
Report date:	September 2010
NIWA Project:	ELF10205

Cover Photo: Suspended sediment along the Mahia Peninsula coastline. [Anna Madarasz-Smith, Hawke's Bay Regional Council]ELF10205

Contents

Tables

Figures

Reviewed by	Approved for release by
………………………………………	………………………………
Emma Jones	Michael Bruce (Acting Regional Manager)

Executive summary

Gisborne District Council (GDC) has expressed interest in significant and valuable marine fish populations within their jurisdiction. This information will be used in a review of their Regional Coastal Management Plan and when assessing applications for coastal permits to ensure these marine fish populations are not adversely affected.

Hundreds of marine fish species are present within the GDC region. The most relevant information sources specific to this region are: commercial catch information held by the Ministry of Fisheries, telephone diary surveys of recreational fishing in the region and a number of fishery-independent surveys. These include a series of demersal trawl surveys that were conducted in the area, a beach seine survey of Maungawhio Estuary and a diver-study which monitored reef fish in the Te Tapuwae o Rongokako Marine Reserve.

These information sources identified a range of marine fish species that may be considered valuable or important for various reasons (i.e. economic, recreational, cultural and ecological significance). Biological information for many species is incomplete, but some detail is provided on the life history and exploitation (where applicable) of a select list of important species from the region. Of particular note, known spawning grounds for tarakihi and blue moki have been identified within the GDC region. It must be emphasised that this list of species and their key habitats is by no means comprehensive.

The biggest threat to marine fish species from land based activities is likely to be increased sedimentation. This is a particularly relevant issue for the GDC region, which has high sediment loads. Specific details of how sedimentation affects New Zealand's marine fish species, and which species are most vulnerable does not exist. Effects are likely to include reduced feeding and growth rates, increased emigration, gill clogging and associated physiological impacts and increased parasite loads. One of the biggest impacts on marine fish, however, is likely to be an indirect effect; the destruction of habitats that marine fish are dependent on, in particular, nursery habitats for juvenile life stages. The vulnerability of different marine species is likely to vary and be dependent on specific life history aspects and physiological tolerances. To ensure land use practises in the GDC region are sustainable, further investigation of the likely direct and indirect impacts on marine fish communities may be warranted. A suggested process may involve identifying fish-habitat associations and connectivity of fish between different habitats, quantifying the effect of river plumes as well as the specific direct and indirect effects of land based stressors on marine fish and finally to integrate this information with other marine stressors within a spatial mapping context.

1. Introduction

The Gisborne District Council (GDC) is currently reviewing their Regional Coastal Environment Plan. As part of this process, the GDC requested that NIWA undertake a review of the marine fish species within their coastal waters and identify significant and/or valuable fish species.

GDC intend to use this review to assess applications for land use and coastal permits. This will help ensure that future decisions about coastal use within GDC jurisdiction do not have an adverse effect on marine fish communities.

In terms of the marine area within the GDC region, East Cape forms a major biogeographic boundary. Different fish faunas are observed on either side: few subtropical species are present south of the Cape, while few cool temperate species are present north of the Cape (Francis 1996). The reason for this separation is not clear. While the majority of the warm East Auckland Current flows offshore in the vicinity of East Cape, a significant amount flows southward of East Cape and the effect of the cool Southland current on Sea Surface Temperature (SST) is not observed until south of Hawke Bay (Francis 1996). Regardless, the area between East Cape and Hawke Bay acts as a transition zone in terms of marine fish communities (Francis 1996).

Information on marine fish species found throughout New Zealand has accumulated from more than a hundred years of fishery research and natural history observation. Most of these studies have not included the GDC region, but those that have reveal that hundreds of marine fish species occur within this area. Compiling a comprehensive review about these fish and inferring how they may be affected by land use practises is a considerable undertaking. This is largely due to the sizeable number of different species present, the logistical difficulty in determining their distribution patterns and natural history due to the small number of surveys conducted specifically within the GDC region and the lack of specific information about the effect of land based activity on these species. With these points in mind, I first present information about the fish caught and/or observed within the region, and secondly provide a more detailed description of the life history patterns for a list of key fish species. These were selected on the basis of their abundance, value for commercial, recreational, or customary fishers or ecological significance. Where a species was recognised as important, but no studies had been conducted on that species within the GDC jurisdiction I made generalisations from natural history studies conducted in other areas. Finally, I provide generic information on the likely effects of land based sedimentation on marine fish species.

2. Fish species present in GDC region

2.1 Commercial fish species

An indication of the fish species important to commercial fishers within the GDC region can be established from commercial catches reported to the Ministry of Fisheries. The GDC region is encompassed by fisheries statistical areas 11, 12 and 13. Total annual catches (by species) were extracted for the 2009 fishing year from the Ministry of Fisheries database and are presented in Appendix 1. The fishing year runs from October 2009 to October 2010 and therefore the totals presented represent the year to date. There are a number of double entries, where there are both generic (e.g. flats, flounder, sole) and specific entries (e.g. New Zealand sole, yellow-belly flounder, sand and flounder) which may actually refer to the same species). An additional consideration is that the fishery management areas used for this data extract extend into Hawke Bay and to 150 km from the shore at some locations (while GDC jurisdiction only extends to 12 nautical miles (22.2 km) from shore). This means that many deepwater and open water species (e.g. orange roughy and tunas) are included, even though they are not caught within GDC waters. Aside from these issues, the table indicates that well over a hundred fish species are commercially caught in the GDC region. The top 5 inshore species in terms of catch were tarakihi (*Nemadactylus macropterus*), red gurnard (*Chelidonichthys kumu*), kahawai (*Arripis trutta*), snapper (*Pagrus auratus*) and barracouta (*Thyrsites atun*).

In addition to commercial catch information, a series of fishery-independent research trawl surveys were conducted within the GDC region between 1993 and 1996 (Stevenson and Hanchet 2000) (note that these trawl surveys encompassed an area that stretched as far south as the Wairarapa Coast and beyond 12 nm from shore). At least 95 fish species were caught during those trawl surveys, with the most important commercial species listed as; gemfish (*Rexea solandri*), snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), and trevally (*Pseudocaranx dentex*), while some of the other fish that dominated catches were barracouta (*Thyrsites atun*), frostfish (*Lepidopus caudatus*), giant stargazer (*Kathetostoma giganteum*), hoki (*Macruronus novaezelandiae*), jack mackerel (*Trachurus novaezelandiae*), John dory (*Zeus faber*), red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), rig (*Mustelus lenticulatus*), school shark (*Galeorhinus galeus*), silver warehou (*Serioella punctata*), and spiny dogfish (*Squalus acanthias*) (Stevenson and Hanchet 2000).

2.2 Recreational and customary fish species

Fish species caught by recreational and customary fishers within the GDC region have been periodically surveyed using the telephone/diary survey method (Teirney et al. 1997, Bradford 1998 and Boyd et al. in press). While the tonnages estimated by these surveys are widely regarded to be overinflated (B. Hartill, NIWA Fisheries Scientist, pers. com.), they do provide a good indication of the relative importance of each species to recreational fishers. In addition, the survey areas are not always the same for each species and encompass an area much larger than the GDC region. Given these limitations a table of the species caught by recreational and customary fishers in the GDC region is presented, with species ordered by relative importance (Table 1).

Table 1 Species caught by recreational fishers listed in decreasing relative importance in and around the GDC region (Teirney et al. 1997, Bradford 1998 and Boyd et al. in press).

1991–1994 survey	1996 survey	2000 survey	2001 survey
Kahawai	Kahawai	Kahawai	Kahawai
Barracouta	Barracouta	Snapper	Groper
Red cod	Groper	Groper	Snapper
Jack mackerels	Blue moki	Paua	Tarakihi
Red gurnard	Red cod	Barracouta	Blue cod

Groper	Blue cod	Rock Lobster	Paua
Blue cod	Tarakihi	Tarakihi	Rock Lobster
Blue moki	Butterfish	Blue cod	Blue moki
Paua	Paua	Flatfish	Red gurnard
Snapper	Snapper	Trevally	Kingfish
Kingfish	Flatfish	Kingfish	Jack mackerels
School shark	Jack mackerels	Blue moki	Barracouta
Tarakihi	Red gurnard	Red gurnard	Flatfish
Flatfish	Trevally	Jack mackerels	Trevally
Trevally		Grey mullet	Butterfish
Rig		Butterfish	Rig
Blue warehou		Rig	School shark
Rock Lobster		Yellow-eyed mullet	Red cod
John Dory		School shark	Sea perch
Grey mullet		John Dory	Spiny dogfish
		Red cod	Yellow-eyed mullet
		Spiny dogfish	John Dory
		Sea perch	Grey mullet
		Ling	Blue mackerel
		Blue mackerel	Ling

2.3 Non-exploited fish species (fishery independent surveys)

Aside from the fish species commonly caught by recreational or commercial fishers, other species may be abundant in particular coastal habitats, but not vulnerable or desirable to capture. Fishery independent surveys in estuaries and areas of rocky reef have documented some of these species, along with those that are exploited by fishers. A nationwide estuarine fish survey programme included the Maungawhio Estuary, which is close to the GDC region. In this estuary seven fish species were captured using fine mesh beach seines; yellow-eyed mullet (*Aldrichetta forsteri*), estuarine triplefin (*Grahamina nigripenne*), yellow-belly flounder (*Rhombosolea leporine*), sand flounder (*Rhombosolea plebeia*), estuarine stargazer (*Leptoscopus macropygus*), speckled sole (*Peltorhamphus latus*) and seahorse (*Hippocampus abdominalis*) (Morrison 2010, Francis et al, in prep.). Of these, yellow-eyed mullet were by far the most abundant species caught. The Department of Conservation has carried out a survey of the rocky reefs of Te Tapuwae o Rongokako Marine Reserve (Freeman, 2005). This involved divers conducting fish census transects inside and outside the marine reserve. A total of 37 fish species were observed (Table 2), with all reef sites dominated by moderate densities of spotties (*Notolabrus celidotus*), scarlet wrasse (*Pseudolabrus miles*) and reef associated planktivores such as blue maomao (*Scorpis violaceus*), sweep (*Scorpis lineolatus*) and butterfly perch (*Caesioperca lepidoptera*). Exploited species which were observed included snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), blue cod (*Parapercis colias*) and blue moki (*Latridopsis ciliaris*).

Table 2 Fish species observed on diver transects in and around the Te Tapuwae o Rongokako Marine Reserve (Freeman 2005).

Common name	Scientific name
Banded wrasse	*Pseudolabrus fucicola*
Blue cod	*Parapercis colias*
Blue maomao	*Scorpis violaceus*
Blue moki	*Latridopsis ciliaris*
Butterfish	*Odax pullus*
Butterfly perch	*Caesioperca lepidoptera*
Common roughy	*Paratrachichthys trailli*
Common warehou	*Seriolella brama*
Conger eel	*Conger verreauxi*
Copper moki	*Latridopsis forsteri*
Demoiselle	*Chromis dispilus*
Dwarf scorpionfish	*Scorpaena papillosus*
Eagle ray	*Myliobatis tenuicaudatus*
Goatfish	*Upeneichthys lineatus*
Hiwihiwi	*Chironemus marmoratus*
Jack mackerel	*Trachurus novaezelandiae*
John dory	*Zeus faber*
Kahawai	*Arripis trutta*
Kingfish	*Seriola lalandi*
Leatherjacket	*Parika scaber*
Marblefish	*Aplodactylus arctidens*
Opalfish	*Hemerocoetes monopterygius*
Parore	*Girella tricuspidata*
Porae	*Nemadactylus douglasii*
Red-banded perch	*Hypoplectrodes huntii*
Red cod	*Pseudiphycis bachus*
Red moki	*Cheilodactylus spectabilis*
Scarlet wrasse	*Pseudolabrus miles*
Short tailed stingray	*Dasyatis brevicaudata*
Slender roughy	*Optivus elongatus*
Snapper	*Pagrus auratus*
Spotty	*Notolabrus celidotus*
Sweep	*Scorpis lineolatus*
Tarakihi	*Nemadactylus macropterus*
Trevally	*Psuedocaranx dentex*
Yellow-eyed mullet	*Aldrichetta forsteri*
Yellow moray	*Gymnothorax prasinus*

3. Selected fish species – life history information

Fish species described below were chosen as being significant or important within the GDC region because of their abundance, value to fishers or ecological importance. This is by no means a comprehensive list of all the important fish species within the region. As mentioned in Section 1, where no studies had been conducted on a species within the GDC jurisdiction, generalisations from natural history studies conducted in other areas were made. For each species, the New Zealand-wide distribution of different size classes, taken from Hurst et al (2000) is presented. These distributions are based on the collation of fishery-independent surveys (mainly trawl but including other methods) and data from Fisheries Observers. Whilst this study represents the most comprehensive description of New Zealand coastal fish distributions, there are gaps in sampling effort, such as very shallow coastal waters and non-trawlable habitats.

3.1 Snapper

Snapper are distributed throughout the northern half of the North Island and in the northern most parts of the South Island (Fig. 1). On the North Island's east coast their range extends as far south as the Wairarapa, with abundances decreasing south of East Cape (Paul and Tarring 1980). Within their range, snapper occupy nearly all habitat types (e.g., estuarine, soft sediment and rocky reef habitat types) within inshore waters (i.e., to about 200 m depth). Snapper are opportunistic demersal carnivores, eating a range of invertebrates and fishes including crustaceans, worms, echinoderms and molluscs (Colman 1972). Due to their opportunistic nature and abundance, they are important components of the ecosystem in northern waters.

Snapper are serial spawners, meaning that they release many batches of eggs over an extended season during spring and summer (MFish 2010). Their larvae have a relatively short planktonic phase which results in the spawning grounds corresponding fairly closely with the nursery grounds of young snapper (generally shallow sheltered environments) (MFish 2010). They first reach maturity from 20 to 28 cm fork length at 3–4 years of age and may live to 60 years of age (MFish 2010). While some snapper remain resident in an area, moving on a scale of hundreds of metres, other snapper move over many kilometres (Parsons et al. 2003). Some of these more mobile snapper congregate in large schools to spawn in November-December. Water temperature appears to play an important part in the success of recruitment. Generally strong year classes in the population correspond to warm years, while weak year classes correspond to cold years (MFish 2010).

As shown in Figure 1, the presence of juvenile snapper in the GDC region is rare (Paul and Tarring 1980), suggesting that successful spawning may only occur at low levels here, or not every year. If spawning does not take place within the GDC region, snapper within this area may have moved in from successful spawning/nursery grounds further north.

Snapper form a small but important commercial and recreational fishery within the GDC region. It is caught as a bycatch species in the commercial trawl fishery for red gurnard and tarakihi (MFish 2010). Snapper populations in all areas were heavily exploited until the early 1980's and recent catch levels within the SNA2 management area (which encompasses the GDC region) have been less than commercial catch limits (catch ~376 t, Maximum Sustainable Yield ~450 t) (MFish 2010). As a result the snapper population within the East Cape area is likely to be rebuilding (MFish 2010).

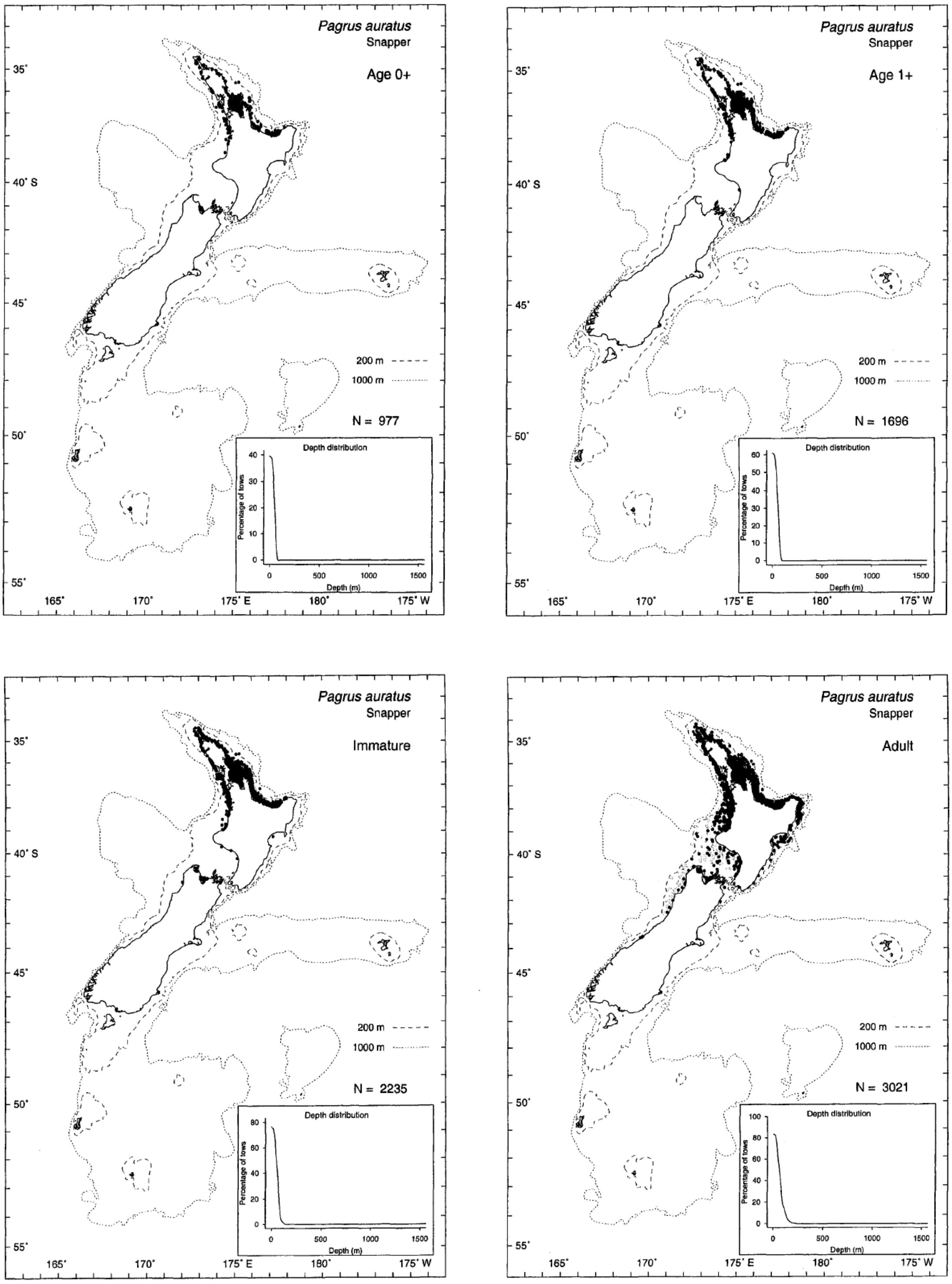


Figure 1: Spatial distribution of snapper age classes as observed by trawl surveys (from Hurst et al. 2000). Black circles indicate locations where the relevant age class was captured during research trawl surveys.

3.2 Blue moki

Blue moki occur around New Zealand but are most abundant between East Cape and Kaikoura. They are a large demersal fish, growing up to 1 m in length, and 10 kg in weight.

Feeding is largely in sandy areas and is non-selective with a diet including invertebrates such as crabs, crustaceans, urchins, worms and shellfish (Ayling and Cox 1987). Juveniles inhabit inshore areas while adults often school offshore over areas of open bottom, although some remain resident on reefs (Ayling and Cox 1987). Blue moki grow rapidly at first, attaining sexual maturity at 40 cm fork length (FL) and 5–6 years of age. Growth then slows, and fish of 60 cm FL are 10–20 years old. Fish over 80 cm FL and 43 years old have been recorded (Manning et al. in press).

The only known spawning ground for blue moki occurs off the East Cape region. The migration to these spawning grounds is indicated by the progression of catches up the coast starting from Kaikoura in May to June, and reaching Gisborne by August to September (Francis 1981), when gonads are fully ripe. From this point catches move south again, reaching Kaikoura by October, when gonads will be in a spent state (Francis 1981).

All blue moki stocks were severely depleted prior to 1975. The current commercial fishery is dominated by set nets used between East Cape and Kaikoura, and catches for MOK1 (the area that incorporates the GDC region) have been stable at around 400 t for many years. The current prognosis is that fishing mortality is low (MFish 2010). Aside from commercial fisheries blue moki are popular with recreational fishers and are taken by beach angling, set netting and spear fishing. Therefore, while overall catches are small, they are a very important fish to the GDC region and Iwi in this area regard blue moki as having a special significance.

3.3 Tarakihi

Tarakihi are distributed throughout New Zealand in water to 300 m depth (Fig. 3). Tarakihi feed by non-selective ingestion of bottom sediments and their diet includes a wide range of invertebrates such as polychaetes, crustaceans, echinoderms, and molluscs (Godfriaux 1974, Ayling and Cox 1987). Tarakihi reach maturity at 25–35 cm or 4–6 years and are serial spawners. They gather in large numbers on the outer shelf. Spawning has been observed to occur between Hicks Bay and Lottin Point between February and April, with the East Cape area one of the few main spawning areas (Robertson 1978). Aggregations of breeding tarakihi rest by day near the bottom in 100–150 m and move in groups into mid water (55–65 m) at night for spawning (Robertson 1978). After spawning, tarakihi move into shallower water over winter (50-100 m). Larvae drift for 7–12 months post spawning before metamorphosing into juveniles. Nursery areas have been identified in the northern and eastern coasts of the South island, around 10–30 km offshore, in water depths of 20–100 m (Fig. 2), and are often characterised by dense and varied sessile invertebrate faunas such as sponges and coral (Vooren 1975). None have been identified in the GDC region but the long larval period may imply that juveniles spawned here drift to and occupy nurseries in southern parts of the country (Vooren 1975). Juveniles stay on the nursery grounds until age 3, then move deeper during years 4 and 5 and leave for spawning grounds in year 6. Tagging suggests that adult tarakihi are capable of moving hundreds of kilometres.

Tarakihi form an important recreational and inshore commercial fishery. Commercial tarakihi landings for TAR2 are about 1700 t annually, mainly from bottom trawl catches between 100–200 m depth (MFish 2010). Commercial landings have been stable at about this level since the 1970’s, suggesting the stock is probably close to its Biomass at Maximum Sustainable Yield (MSY) (MFish 2010).

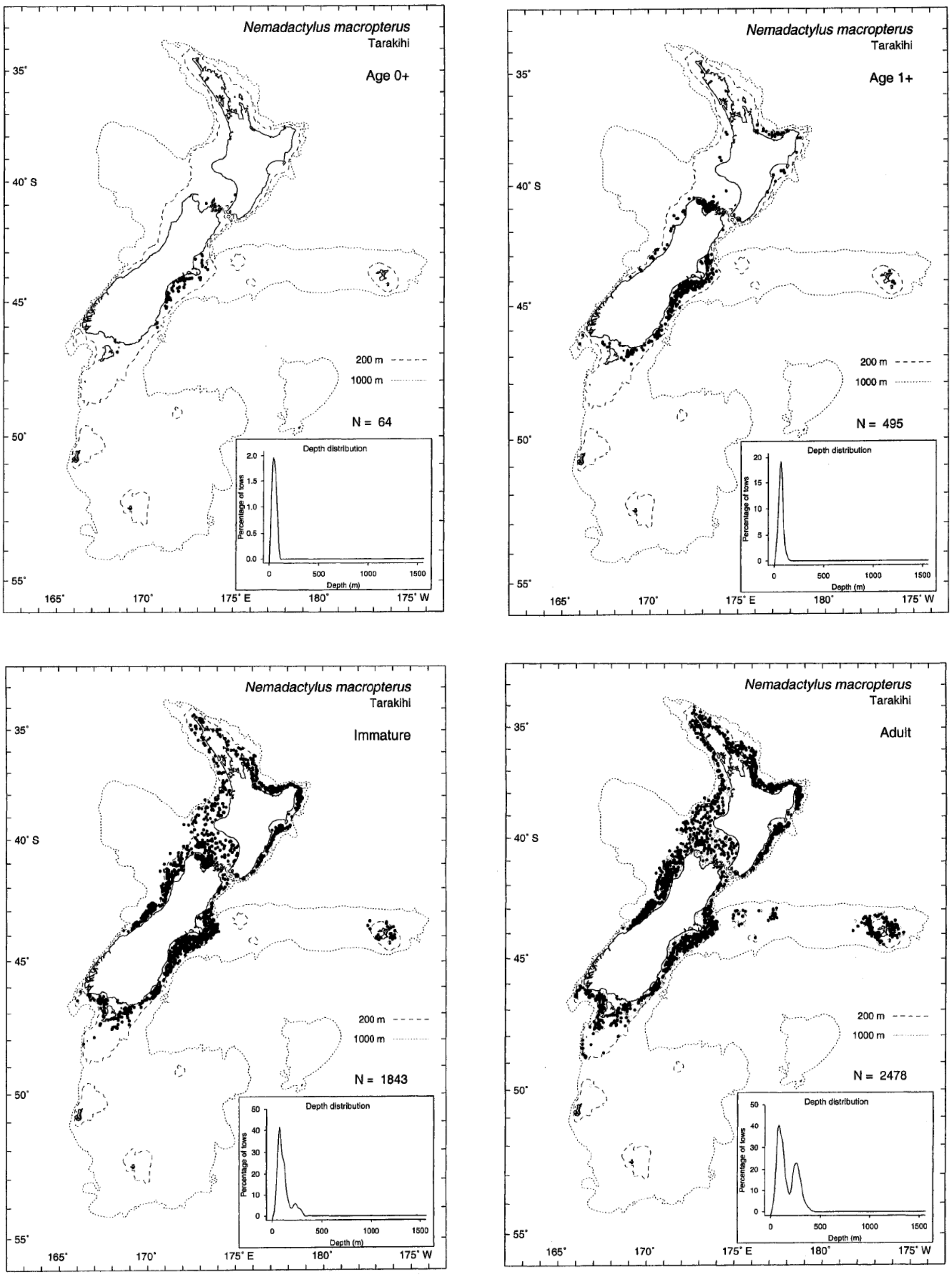


Figure 2: Spatial distribution of tarakihi age classes as observed by trawl surveys (from Hurst et al. 2000). Black circles indicate locations where the relevant age class was captured during research trawl surveys.

3.4 Kahawai

Kahawai are found throughout New Zealand waters, but are more common around the North Island. Kahawai are pelagic (i.e., they live in the water column and not in close relation to the seabed), forming schools of similar sized fish. In inshore areas such as estuaries, river mouths and shallow coastal areas adults usually form moderate sized schools, whereas in offshore areas they often form very large (10 to 200 t) surface schools (Hartill and Walsh 2005). Juvenile kahawai are most abundant in shallow coastal waters in large schools and trawl surveys suggest that juveniles are rarely found beyond 30 m depth (Fig. 3). In inshore areas kahawai feed mostly on pelagic fish (although some demersal fish are consumed), whereas in offshore schools, they feed mostly on krill (Ayling and Cox 1987). Juvenile kahawai feed on planktonic crustaceans.

Tagging studies suggest that kahawai are relatively mobile, with 50 % of tag returns coming from within 40 nautical miles (nm) of release, 95 % of tag returns coming from within 265 nm of release and the furthest distance between tag and release being 743 nm (Wood et al. 1990). Kahawai reach maturity at about 40 cm length (J. McKenzie, NIWA, unpublished data). The spawning habitat is not known, but is thought to be associated with the seabed in open water. Females with running ripe ovaries have been caught off East Cape and Hawke Bay between January and April (Jones et al. 1992)

The total allowable catch (TAC) for KAH2 (the fishery management area that includes the GDC region) is about 1500 t (MFish 2010). Most of the commercial catch comes from purse seine vessels that target surface schools offshore. Set net, trawl and longline make up the remainder of the commercial take. Kahawai is probably the most important recreational fish species by tonnage in the GDC region and is caught by a range of shore and boat based recreational fishing methods. Despite this importance, estimates for recreational kahawai catch in the KAH2 area are deemed unreliable. While stocks from the northern North Island (KAH1) are at sustainable levels and stock biomass is probably increasing, the status of the KAH2 stock remains unknown (MFish 2010).

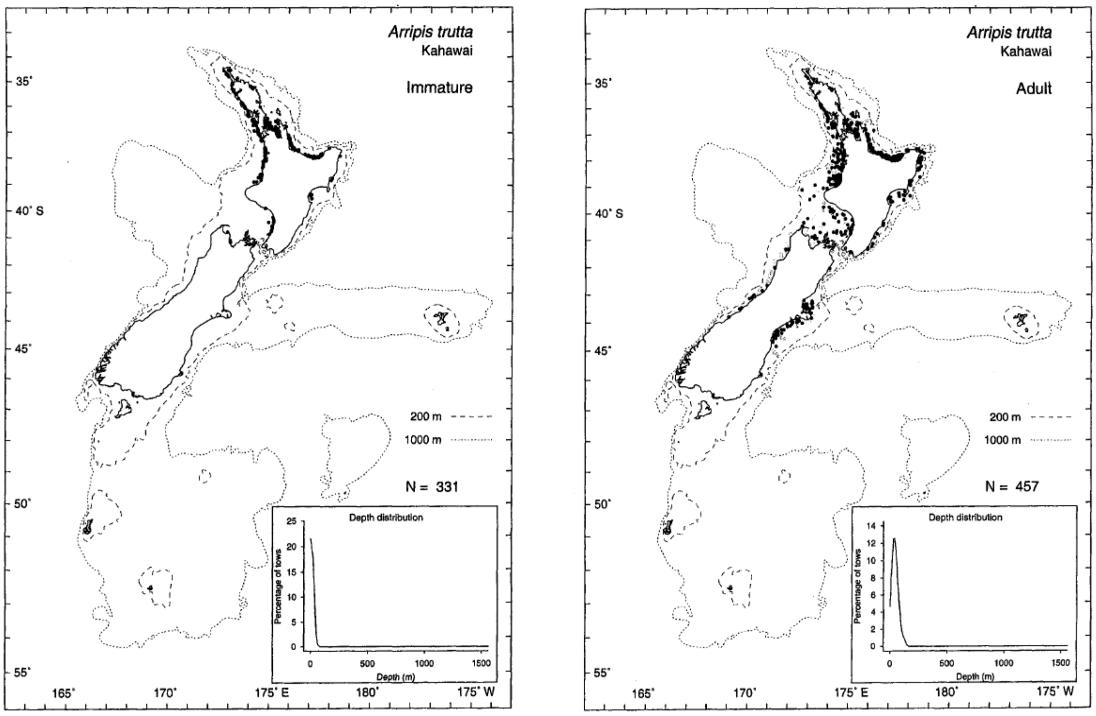


Figure 3: Spatial distribution of kahawai age classes as observed by trawl surveys (from Hurst et al. 2000). Black circles indicate locations where the relevant age class was captured during research trawl surveys.

3.5 Red gurnard

Red gurnard are found around New Zealand to 150 m depth (Fig. 4). A demersal species associated with soft sediment bottoms, they use feeler like rays on the front of their pectoral fins and their bony snout to locate and expose the shellfish, crustaceans and worms on which they feed (Ayling and Cox 1987). Spawning occurs over a widespread area in shallow waters and the mid-shelf and extends from spring to summer, peaking in early summer (Blackwell 1988). Red gurnard larvae spend about 8 days drifting in the plankton before settling (Robertson 1980). The distribution of young of the year (0+) red gurnard presented in Figure 4 suggests that the GDC region may not be an important nursery area for red gurnard. Red gurnard are fast growing, maturing after about 2–3 years or at ~ 23 cm (Blackwell 1988).

Red gurnard form an important target and bycatch species for inshore trawlers in the GDC region. Commercial catches in the GUR2 management area have been between 400 and 700 t since the early 1990's and are probably sustainable (MFish 2010). This species is also important to recreational fishers because they occupy shallow waters and are vulnerable to recreational methods (usually anglers targeting tarakihi or snapper). There are no reliable estimates of the recreational red gurnard catch in the GDC region (MFish 2010).

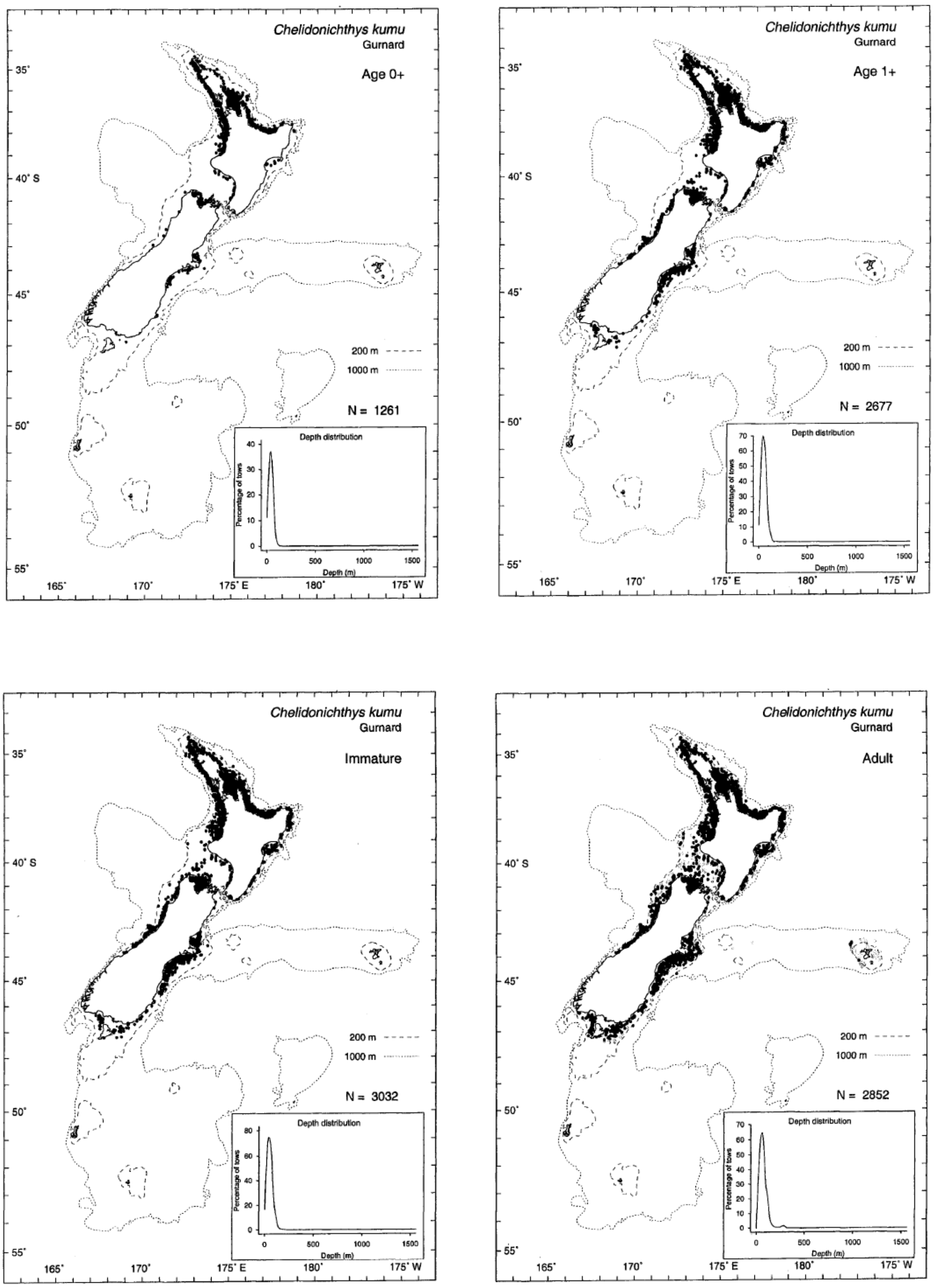
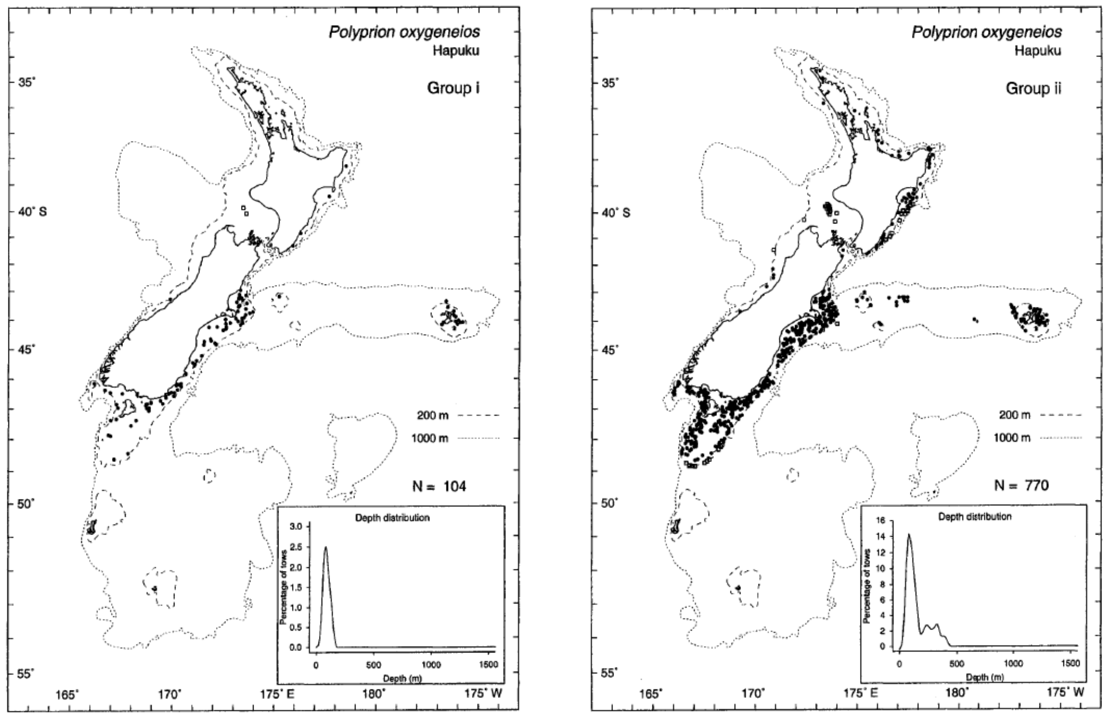


Figure 4: Spatial distribution of red gurnard age classes as observed by trawl surveys (from Hurst et al. 2000). Black circles indicate locations where the relevant age class was captured during research trawl surveys.

3.6 Hapuku and Bass

Hapuku (*Polyprion oxygeneios*) and bass (*Polyprion moeone*) are different but closely related species, identified by a few morphological differences. They occur in shelf (100 m) and slope waters (to about 500 m) around New Zealand (Fig. 5), generally preferring rocky terrain. Hapuku mature between 10 and 13 years (~85 cm) and may live in excess of 60 years (Francis et al. 1999). Spawning occurs in winter, but running ripe fish are seldom caught and spawning grounds are unknown. Juveniles are rarely encountered, but are pelagic, potentially schooling in association with drifting weed. Migration patterns are also not well known, but are probably related to spawning. Tagging has demonstrated a high level of site fidelity; only 5 % of tagged fish moved more than 150 km from the site of release (Beentjes and Francis 1999). Furthermore, fishing grounds can be quickly fished out, suggesting a high level of residency. Trawlers sometimes catch hapuku/bass over flat sandy bottoms, but it is not known whether these fish normally occupy these areas or are passing through. Prey consists of a wide variety of fish and invertebrates including red cod, tarakihi, blue cod, hoki and squid.

The commercial fishery for these species in the GDC region developed during the 1960's and 70's. Most of catch is by longline, with the remainder by set net and trawl. Currently the catch for HPB2 is about 250 t and it is not known whether this level is sustainable or not (MFish 2010). Hapuku and bass are also important recreational species in the GDC region, caught mostly by angling. No reliable recreational catch information exists for the HPB2 management area (which includes the GDC region) (MFish 2010).



Groups i and ii are arbitrary and each may represent several year classes.

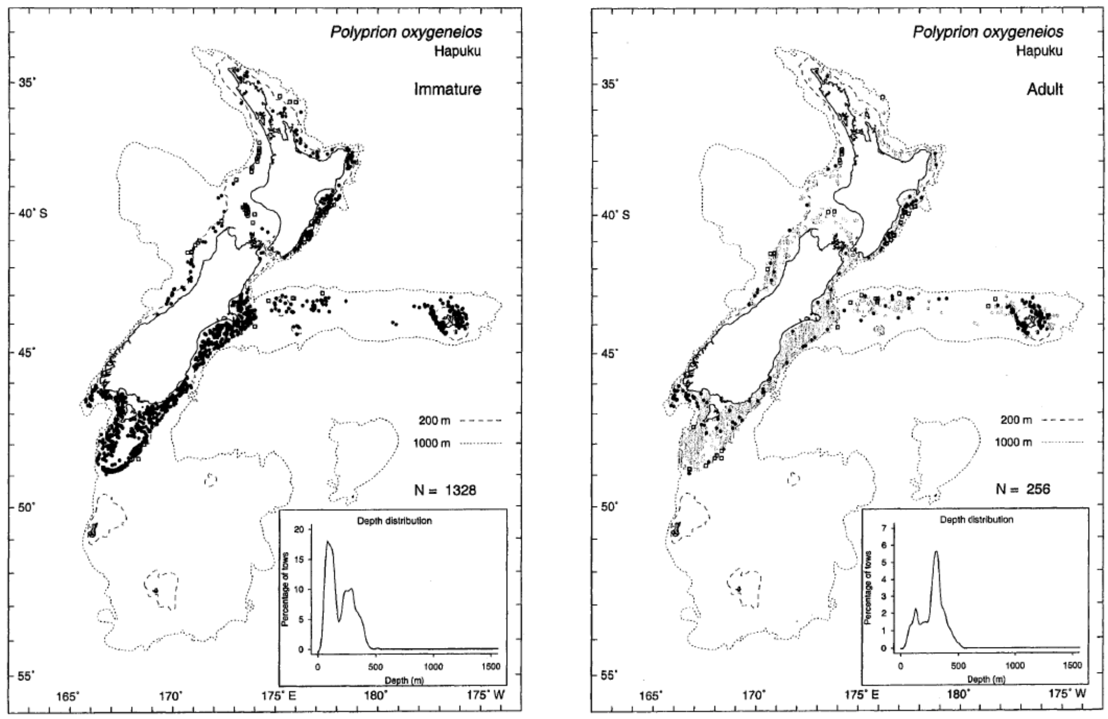


Figure 5: Spatial distribution of hapuku age/stage classes as observed by trawl surveys (black circles) and fishery observers (open squares) (from Hurst et al. 2000). Grey hatching in adult figure indicates locations where species is known to occur.

3.7 Trevally

Trevally are found throughout the North Island and the north of the South Island (Fig. 6). Juveniles to age 2 are found in shallow inshore areas including estuaries and harbours, usually as individuals feeding on small planktonic animals (Gilbert 1988). Fish then enter a demersal phase until sexual maturity. Adults move between demersal and pelagic phases. Schools of trevally occur at the surface, in mid water and on the bottom (Gilbert 1988). Surface schools seem to occur after periods of settled weather and feed mostly on euphausids (krill). When on the bottom they feed on a wide range of benthic invertebrates.

Trevally can live to more than 40 years of age. They grow to ~35 cm and reach sexual maturity after a few years (Walsh et al. 2010), before their growth rate slows. Trevally are partial spawners, releasing small batches of eggs over periods during summer (peaking between January and February).

The commercial catch of trevally in TRE2 is mostly taken by trawl, the remainder coming from purse seine and set net. Catches in TRE2 are about 250 to 400 t, which in recent years has exceeded the allowable catch (MFish 2010). It is not known whether these catches are sustainable (MFish 2010). Trevally are an important recreational species but little information exists on recreational catch within the GDC region.

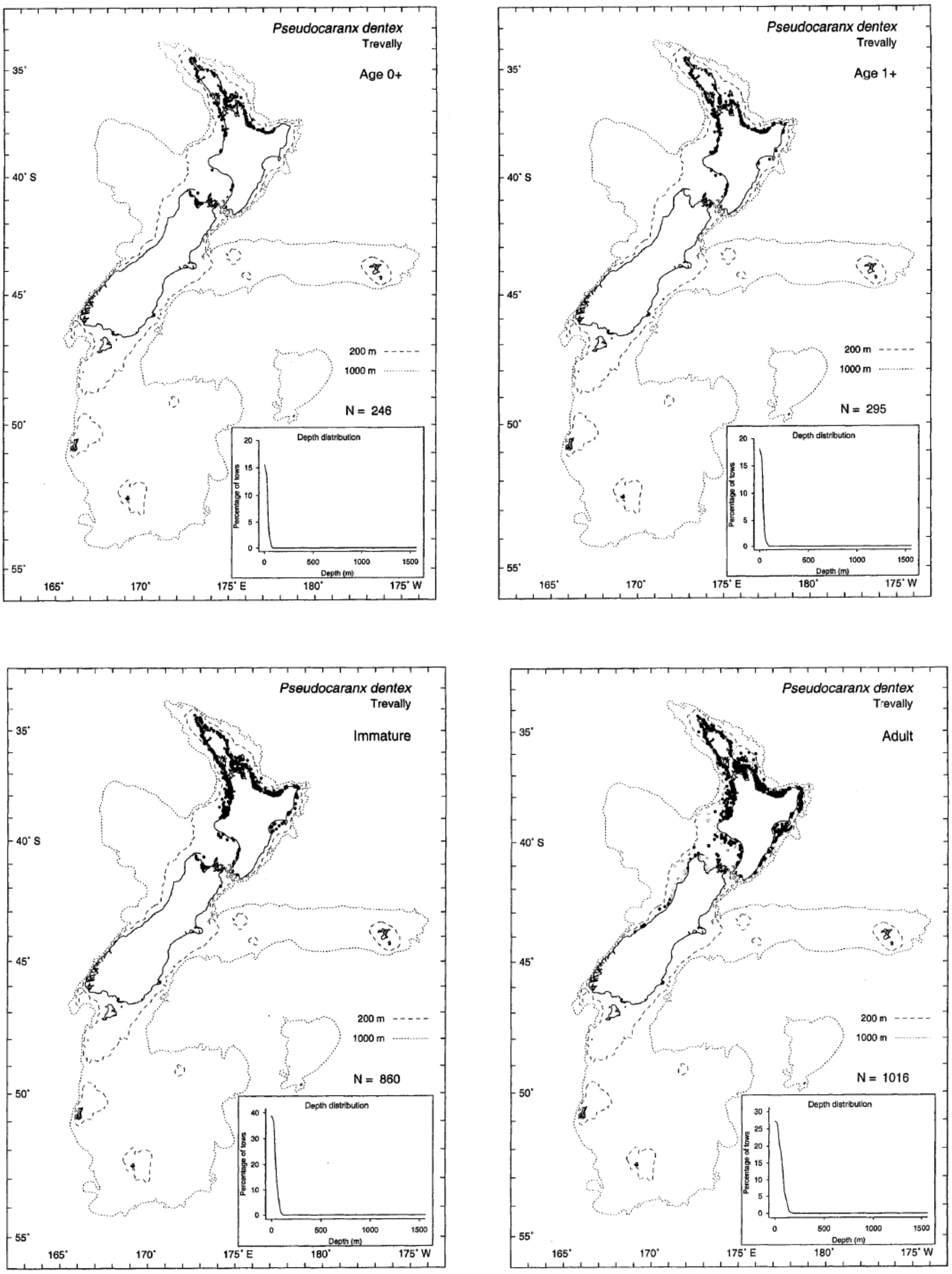
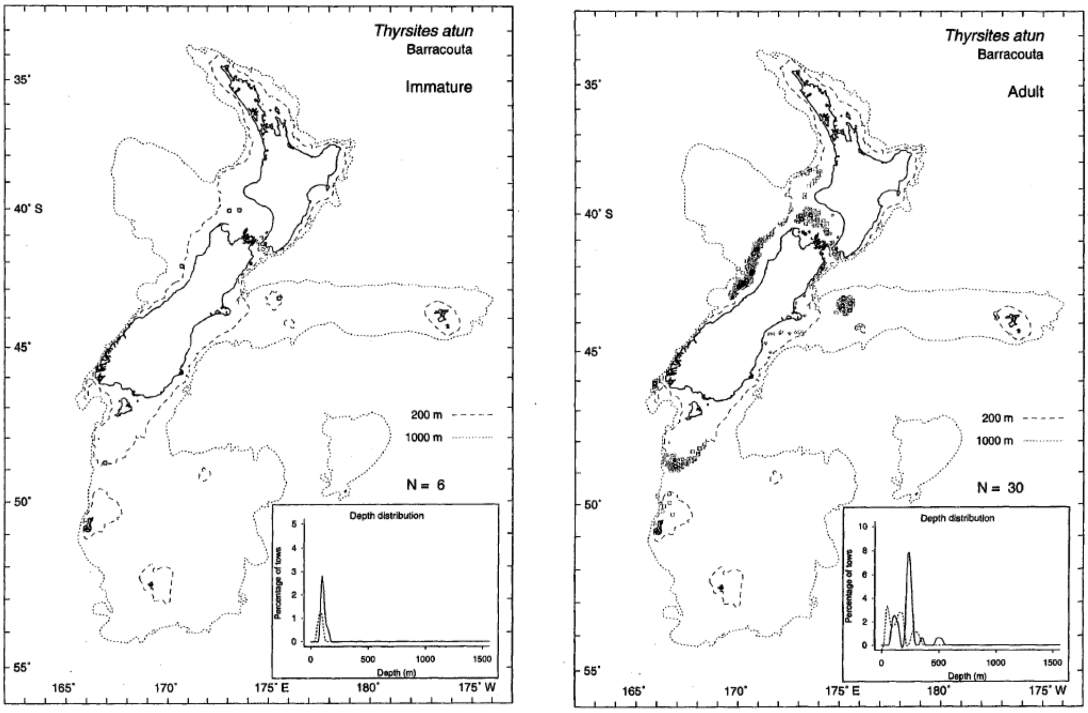


Figure 6: Spatial distribution of trevally age classes as observed by trawl surveys (from Hurst et al. 2000). Black circles indicate locations where the relevant age class was captured during research trawl surveys.

3.8 Barracouta

Barracouta are a pelagic schooling fish found throughout New Zealand waters to 200 m (Ayling and Cox 1987). The east coast of both the North and South Islands (from Kaikoura to the Bay of Plenty) is a spawning area for barracouta from August to September (Hurst 1988). Tagging results suggest that east coast fish from the South Island migrate to the east coast of the North Island during winter to spawn (Hurst and Bagley 1989). Barracouta are thought to feed sparingly before spawning but heavily after (Mehl 1969). Euphasids are common in the diet over winter while fish (especially hoki) are common in summer.

Barracouta are an important commercial species, with nearly all commercial catches taken by trawl. In the last 8 years catches in BAR1 (management area that encompasses GDC region) have fluctuated between 5000 and 9000 t, well below the TACC of 11000 t (MFish 2010). It is not known whether catches are sustainable (MFish 2010).



Juvenile plots are not presented for this species.

Figure 7: Spatial distribution of barracouta age/stage classes as observed by trawl surveys (black circles) and fishery observers (open squares) (from Hurst et al. 2000). Grey hatching in adult figure indicates locations where species is known to occur.

3.9 Albacore tuna

Albacore tuna are large pelagic predators on squid and other fish. They grow to ~50 cm in their first year and can reach 1.4 m (~35 kg) (Ayling and Cox 1987). Research from New Caledonian and Tongan waters suggests that albacore spawn from November to February and are likely to be mature at 70–80 cm (MFish 2010).

This species can move over vast distances and the south Pacific is considered to be one fishery stock for management purposes (MFish 2010). A proportion of this albacore stock is known to visit New Zealand waters, usually over the summer months, and predominantly on the west coasts of the North and South Islands (MFish 2010). A reasonable amount of albacore is also caught in the fishery management areas including the GDC region each year. Indeed, Gisborne is one of the main ports for targeting tuna (including albacore) within New Zealand, although much of this catch comes from outside of the GDC jurisdiction. Albacore are commercially exploited by a summer troll fishery and surface longlining and are also caught by recreational fishers, mostly trolling. It is not possible to conduct a stock assessment for albacore in New Zealand as the proportion of the greater stock within New Zealand waters varies from year to year. Estimates for the south Pacific stock suggest that it is not in an overfished state (MFish 2010).

3.10 Yellow eyed mullet

Much of the information outlined below was taken from Manikiam (1963) *in sensu* MFish (2010). Yellow eyed mullet are found throughout New Zealand, acting as a schooling species that occurs along coasts and in estuaries. They are omnivorous, feeding on algae, crustaceans, diatoms, molluscs, insect larvae fish, polychaetes, coelenterates, fish eggs and detritus. Yellow eyed mullet live to about seven years of Age. Yellow eyed mullet appear to leave their estuarine habitat to spawn in coastal waters during late summer, with eggs and larvae found in the surface waters up to 33 km from shore. Individuals tend to separate by age, with older fish preferring more saline and deeper waters. This species is exploited by commercial and recreational fishers but catch information is limited and the status of stocks is unknown (MFish 2010). Yellow eyed mullet were identified as an important species to the GDC region due to their high abundance in estuarine monitoring in the area (Morrison 2010).

3.11 Spotty

Much of the following information was taken from Jones (1980). Spotties are one of the most abundant fish in coastal New Zealand waters found along open coasts, in harbours and estuaries, mostly in water to 10 m deep, but are found down to 30 m deep. Spotties feed on a wide variety of invertebrates including crabs, hermit crabs, amphipods, shrimps, barnacles, various shellfish and worms. They are protogynous hermaphrodites, so every individual begins life as a female and may at a later stage change into a male. Tagging studies show that males often control a territory that excludes other males, especially during the winter/spring spawning season. These territories are not permanent, however, and males may move up to 800 m away or the borders of the territory may change. Sometimes these wandering fish return and re-establish a new territory, other times they do not return. Males do not control a harem of females, but rather control an area and court and spawn with the females that are present. Not all males can hold an ideal territory, but those that do spawn more often. Ideally a territory will have structure for shelter and an open area for courting a female. The male will chase a ripe female into this area and swim circles around her. If she is receptive, she will settle on the bottom, the male will approach closer before both fish rush upward for ~ 3m, releasing gametes. The larvae will drift in the plankton for about two months before settling as juveniles, often in the fronds of the kelp, *Ecklonia radiata*. These fish reach maturity in their first year and spend one or two years as mature females before turning into males. Recreational fishing for spotties does occur, but catches are likely to be low. Spotties were included as an important species to the GDC region because of their high abundance on rocky reefs in the area (Freeman 2005).

3.12 Blue maomao

Blue maomao occur around the North Island, but are most abundant on the east coast. They are an open water plankton feeder which usually swim in large schools resident to one area (MacDiarmid 1981). They often school around rocky headlands or archways where currents bring them an abundance of their planktonic crustacean food (MacDiarmid 1981). These schools are usually in the surface layers to 20 m depth. They probably spawn between October and December (Ayling and Cox 1987). Juveniles recruit from November to January in shallow (<10 m) water (MacDiarmid 1981). Juveniles initially associate closely with the seabed, but move up into the water and school with adult fish as they grow (MacDiarmid 1981). Blue maomao are not a common fishery target and catches are likely to be very low. This species was highlighted as important to the GDC region because of its high abundance on rocky reefs in the area (Freeman 2005).

3.13 Non-fin fish species

In addition to finfish, several marine invertebrates are important to the GDC region. Three of the most significant are the rock lobster or crayfish (*Jasus edwardsii*), paua (*Haliotis iris*) and sea urchin or kina (*Evechinus chloroticus*). Within the GDC region, extremely important commercial, recreational and customary fisheries exist for all three species which are also valuable components of rocky reef ecosystems.

All three species occupy shallow rocky reefs. While paua and kina are grazing herbivores, rock lobster are carnivorous, eating invertebrates from reef and soft sediment areas. Rock lobsters also have a complicated life history (following information sourced from MFish 2010). They mate in autumn after moulting their carapace. Eggs are then retained by the female until they hatch in spring. Larvae drift tens to hundreds of kilometres from shore and remain in the plankton for at least 12 months. Larvae then settle in water < 20 m deep, but settlement varies widely between areas and years. As adults rock lobster are capable of migrating over large distances.

Rock lobster and paua stocks in the GDC area are heavily fished by commercial and recreational fishers and the commercial rock lobster quota has been reduced many times in recent years. The status of paua and kina stocks in the area are unknown (MFish 2010).

4. Potential effects of land use activities

Urban, industrial and agricultural land use practises impose a range of impacts on marine environments. As well as direct human activities, such as coastal engineering (e.g construction of harbours, marinas, dredging etc), coastal run-off from the land introduces organic (e.g. organohalides) and inorganic (e.g. heavy metals) pollution, sediment and nutrients. The effects of these inputs include eutrophication and sedimentation. The most damaging land based stressor in New Zealand's marine environment is most likely increased sedimentation loads arising from large scale forest clearance for farmland, exotic forestry and urban areas (Morrison et al. 2009). Sedimentation is extremely relevant for the GDC region due to the highly erodable soils in this area and is about five times higher than before

European deforestation (Battershill 1993). For example, the Waipaoa River has one of the highest sediment loads in the country (Griffiths and Glasby 1985). While the impact of high sediment loads on New Zealand marine species is poorly understood, studies from overseas suggest that sedimentation usually leads to deleterious effects. These effects include reduced effectiveness of visual feeding which can reduce feeding activity overall leading to lower growth rates and emigration, and the clogging of gills which can reduce oxygen transfer and lead to sub-lethal effects such as decreased tolerance to disease (for references see Morrison et al. 2009). Examples specific to New Zealand include the reduced survival of kina and paua juveniles and larvae where sediment levels are elevated (Phillips and Shima 2006, and Walker 2007). Juvenile snapper are also known to experience a range of impacts from sedimentation including gill deformation, higher parasite loads and reduced feeding success (M. Lowe, NIWA, unpublished data).

Vulnerability is likely to vary from species to species and be dependent on specific life history aspects and physiological tolerances. In general, species which occupy deeper water will be largely removed from land based effects and are less likely to be impacted. It is important to consider all life stages, however. A deep water species may have juvenile life stages that inhabit shallow water where they could be vulnerable to land based influences. Other species may be more tolerant to land based effects. For example, species that occupy estuarine waters (e.g. yellow-eyed mullet) may have a higher tolerance than species which occupy exposed rocky reefs where sediment struggles to accumulate (e.g. kina). How an animal feeds may also influence its vulnerability to sedimentation. For example, filter feeders (e.g. scallops, mussels and tuatua) may be particularly vulnerable to having their gills clogged by elevated sediment loads.

Sedimentation can also indirectly affect fish by destroying important biogenic habitats through smothering or reducing light levels, especially for plants/algae such as sea grass. Many species are likely to be dependent on such vulnerable habitat types, which often act as juvenile nursery habitats, e.g. seagrass, horse mussels, sponges, and other biogenic reefs. As such, these species may be particularly at threat.

5. Future research on land based impacts and marine fish

The current understanding of land based impacts on coastal fish species in New Zealand is very limited. Specific topics that may warrant further investigation and that NIWA can assist with are defined below.

Fish-habitat associations: Fundamental and systematic inventorying of the habitats fish species are associated with across different life stages. Special attention should also be paid to the possibility of habitat ‘bottle-necks”, which may limit the overall number of fish able to be produced by a given system. Currently there is little understanding of these relationships making the basic assessment of fisheries habitat values, and potential threats to these values, problematic for many species.

Habitat connectivity: A better understanding of the spatial linkages via movement between different habitats and areas as fished species pass through different life stages. Without accounting for such connectivity, we will always be limited in our ability to identify the important factors driving variation in fish abundance in a given area, and where management efforts might best be directed.

River plumes: A better understanding of how river plumes influence coastal fish species, both positively and negatively. This should incorporate the different types of marine settings rivers empty into (estuarine, sheltered coast, or exposed coast). Changes in river flows and associated debris and nutrient loads could also be incorporated into this work, to assess how changes in water extraction might interact with coastal fisheries.

Land based stressor impacts: The actual effect of sedimentation and eutrophication on selected fish species and fish habitats. These include both direct impacts, such as adverse physiological and behavioural effects on fish species, and indirect impacts such as loss of critical habitats, and reductions in prey assemblages. The potential effects of eutrophication on coastal fish species have also been unexplored in New Zealand, and deserve attention

Integration with marine stressors: Stressors do not operate in isolation. Marine based stressors (e.g., fishing, mining, and dredging) and land-based stressors will interact with each other, with their relative importance at a given location depending on the distance to the source of the different stressors, and what natural systems and processes are operating at that location. For instance, more ocean-influenced systems that have seldom experienced land-based influences may have stronger responses to such influences when they do occur, than more land influenced systems that have evolved under continual inputs (e.g., sediment inputs from the Southern Alps).

Spatial mapping and synthesis: Such thinking also ultimately lends itself, in a management sense, towards the spatial zoning of marine ecosystems (based on functions and stressors), and how then to regulate human activities and impacts relative to these different zones. GIS and other technologies are available that make such synthesis possible. All field surveys, and associated experimental work, should be spatially explicit so that outcomes can be incorporated into GIS frameworks, both as decision support management systems and as research tools that can help direct and interpret new research initiatives.

6. Summary

- A wide variety of marine fish species occur in the GDC region which encompasses a significant biogeographic boundary in East Cape. Available fishery-dependant and independent data sources were used to identify species of economic, recreational, cultural and / or ecological significance.

- These include commercially & recreationally exploited species such as tarakihi, red gurnard, kahawai and blue moki, species abundant in estuarine areas such as yellow-eyed mullet and around rocky reef areas such as blue maomao and spotty.

- Important spawning grounds have been identified within the GDC for tarakihi and blue moki.

- Limited sampling has been carried out in this region, particularly in inshore coastal habitats such as estuaries, rocky reefs and biogenic habitats, and for some species, limited biological information exists either locally and / or nationally. As such, the list of key species and key habitats, such as juvenile nursery grounds, spawning and feeding areas, is not exhaustive.
- The biggest threat to marine fish from land based activities is likely to be increased sedimentation. This is a particularly relevant issue for the GDC region, which has high sediment loads.
- Specific details of how sedimentation affects New Zealand's marine fish, and which species are most vulnerable does not exist. Direct effects are likely to include reduced feeding and growth rates, increased emigration, gill clogging and associated physiological impacts and increased parasite loads. Indirect effects include degradation of essential fish habitats such as biogenic habitats that form juvenile nursery grounds.

Acknowledgments

I am grateful to the Ministry of Fisheries, who supplied commercial catch data as well as Emma Jones and Mark Morrison who reviewed this report.

Glossary of abbreviations and terms

GDC	Gisborne District Council
MSY	Maximum Sustainable Yield
nm	Nautical Mile
SST	Sea Surface Temperature
TAC	Total Allowable Catch

References

Ayling, T., and Cox, G.J., 1987. Collins guide to the sea fishes of New Zealand. Collins, Auckland. 343 p.

Battershill, C., 1993. What we do to the land we do to the sea: Effects of sediments on coastal marine systems. New Zealand Conservation Society, *Marine Conservation and Wildlife Protection Conference* 1992. p 65.

Beentjes, M.P., and Francis, M.P., 1999. Movements of hapuku, *Polyprion oxygeneios* determined from tagging studies. *New Zealand Journal of Marine and Freshwater Research* 33: 1-12.

Blackwell, R., 1988. Red gurnard. *New Zealand Fisheries Assessment Research Document* No. 23. 19 p.

Boyd, R.O., Reilly, J.L., in press. National marine recreational fishing survey: harvest estimates. *New Zealand Fisheries Assessment Report*.

Bradford, E., 1998. Harvest estimates from the 1996 national marine fishing surveys. New Zealand Fisheries Assessment Research Document, No.16. 27 p.

Colman, J.A., 1972. Food of snapper, *Chrysophrys auratus* (Forster), in the Hauraki Gulf, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 6: 221–239.

Francis, M. P., 1981. Spawning migration of moki (*Latridopsis ciliaris*) off eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research* 15: 267–273.

Francis, M.P., 1996. Geographic distribution of marine reef fishes in the New Zealand region. *New Zealand Journal of Marine and Freshwater Research* 30: 35–55.

Francis, M.P., Mulligan, K.P., Davies, N.M., and Beentjes, M.P., 1999. Age and growth estimates for New Zealand hapuku, *Polyprion oxygeneios*. *Fishery Bulletin* 97: 227–242.

Francis, M.P., Morrison, M.A., Leathwick, J., and Walsh, C. (in prep). Predicting patterns of fish richness, occurrence, and abundance in New Zealand estuaries.

Freeman, D., 2005. Reef fish monitoring Te Tapuwae o Rongokako Marine Reserve. *Department of Conservation Technical Report*. 26 p.

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

Gilbert, D.J., 1988. Trevally. *New Zealand Fisheries Assessment Research Document* No. 29. 29 p.

Griffiths, G.A., and Glasby, G.P., 1985. Input of river-derived sediment to the New Zealand continental shelf: I. Mass. *Estuarine, Coastal and Shelf Science* 21: 773-787.

Hartill, B., and Walsh, C., 2005. Characterisation of the kahawai fisheries of New Zealand and review of biological knowledge. Research report for the Ministry of Fisheries. 160 p.

Hurst, R.J., 1988. Barracouta. *New Zealand Fisheries Assessment Research Document* No. 8. 30 p.

Hurst, R.J., and Bagley, N.W., 1989. Movements and possible stock relationships of the New Zealand barracouta, *Thrysites atun*, from tag returns. *New Zealand Journal of Marine and Freshwater Research* 23: 105–111.

Hurst, R.J., Bagley, N.W., Anderson, O.F., Francis, M.P., Griggs, L.H., Clark, M.R., Paul, L.J., and Taylor, P.R., 2000. Atlas of juvenile and adult fish and squid distributions from bottom and midwater trawls and tuna longlines in New Zealand waters. NIWA Technical Report No. 84. 167 p.

Jones, G.P., 1980. Interrelationships between ecology, behaviour and life history in the protogynous hermaphrodite *Pseudolabrus celidotus* (Pisces: Labridae). Unpublished thesis, University of Auckland, Auckland.

Jones, J.B., Cresswell, P., McKenzie, J., Drummond, K., 1992. Kahawai fishery assessment for the 1992–93 fishing year. *New Zealand Fisheries Assessment Research Document* No. 2. 27 p.

MacDiarmid, A.B., 1981. Factors influencing the distribution and abundance of two temperate planktivorous reef fish, *Pempheris adspersa* and *Scorpis violacenus*. Unpublished thesis, University of Auckland, Auckland.

Manikiam, J.S., 1963. Studies on the yellow-eye mullet. Unpublished thesis, Victora University, Wellington.

Manning, M.J.; Stevenson, M.L.; Dick, C.M., in press. The length and age composition of the commercial catch of blue moki (*Latridopsis ciliaris*) in MOK 1 during the 2004/05 and 2005/06 fishing years including total and fishing mortality estimates. *New Zealand Fisheries Assessment Report*.

Mehl, J.A.P., 1969. Food of barracouta (Teleosti: Gempylidaw) in eastern Cook Strait. *New Zealand Journal of Marine and Freshwater Research* 3: 389–394.

MFish, 2010. Ministry of Fisheries plenary report. 1040 p.

Morrison, M.A., Lowe, M.L., Parsons, D.M., Usmar, N.R., McLeod, I.M., 2009. A review of land-based effects on coastal fisheries and supporting biodiversity in New Zealand. *New Zealand Aquatic Environment and Biodiversity Report* No. 37. 100 p.

Morrison, M., 2010. Monitoring of fish in estuaries – application to Hawke Bay estuaries. *NIWA Client Report* prepared for Hawkes Bay Regional Council. 45 p.

Parsons D.M., Babcock R.C., Hankin R.K.S., Willis T.J., Aitken J.P., O'Dor R.K., Jackson G.D., 2003. Snapper *Pagrus auratus* (Sparidae) home range dynamics: acoustic tagging studies in a marine reserve. *Marine Ecology Progress Series* 262: 253–265.

Paul, L.J., Tarring, S.C., 1980. Growth rate and population structure of snapper, *Chrysophrys auratus*, in the East Cape region, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 14: 237–247.

Phillips, N.E., and Shima, J.S., 2006. Differential effects of suspended sediments on larval survival and settlement of New Zealand urchins *Evechinus chloroticus* and abalone *Haliotis iris*. *Marine Ecology Progress Series* 314: 149–158.

Robertson, D.A., 1978. Spawning of tarakihi (Pisces: Cheilodactylidae) in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research* 12: 277–286.

Robertson, D.A., 1980. Hydrology and quantitative distribution of planktonic eggs of some marine fishes off the Otago coast, south-eastern New Zealand. *Fisheries Research Bulletin*, No. 21, Ministry of Fisheries.

Stevenson, M., and Hanchet, S., 2000. Review of the inshore trawl survey series of the east coast of the North Island, 1993-96. *NIWA Technical Report* 85. 58 p.

Teirney, L.D., Kilner, A.R., Millar, R.B., Bradford, E., Bell, J.D., 1997. Estimation of recreational harvests from 1991–92 to 1993–94. *New Zealand Fisheries Assessment Research Document* No. 15. 43 p.

Vooren, C.M., 1975. Nursery grounds of tarakihi (Teleostei: Cheilodactylidae) around New Zealand. *New Zealand Journal of Marine and Freshwater Research* 9: 121–158.

Walker, J.W., 2007. Effects of fine sediments on settlement and survival of the sea urchin *Evechinus chloroticus* in northeastern New Zealand. *Marine Ecology Progress Series* 331: 109–118

Walsh, C., McKenzie, J.M., O Maolagain, C., Buckthought, D., Blackwell, R., James, G.D., Rush, N., 2010. Length and age composition of commercial trevally landings in TRE1 and TRE7, 2006–07. *New Zealand Fisheries Assessment Report* 20010/9.

Wood, B.A., Bradstock, M.A., and James, G.D. 1990. Tagging of kahawai, *Arripis trutta*, in New Zealand, 1981–84. *New Zealand Fisheries Technical Report* 19. 16 p.

Appendix 1. Fish species caught by commercial fishers in fishery statistical areas 11, 12 and 13 for the 2009 fishing year with catch weights for each species.

Common name	Scientific name	Catch (tons)
TARAKIHI	*Nemadactylus macropterus*	1370.6
ORANGE ROUGHY	*Hoplostethus atlanticus*	455.6
CARDINALFISH	*Apogonidae spp.*	453.4
RED GURNARD	*Chelidonichthys kumu*	421.0
KAHAWAI	*Arripis trutta*	375.9
RUBY FISH	*Plagiogeneion rubiginosum*	350.9
LING	*Genypterus blacodes*	307.2
BLUENOSE	*Hyperoglyphe antarctica*	262.2
SNAPPER	*Pagrus auratus*	245.1
BARRACOUTA	*Thyrsites atun*	189.8
ALFONSINO	*Beryx splendens & B. decadactylus*	149.8
BLUE MOKI	*Latridopsis ciliaris*	143.4
TREVALLY	*Pseudocaranx dentex*	141.2
HAPUKU & BASS	*Polyprion oxygeneios & P americanus*	104.4
ALBACORE TUNA	*Thunnus alalunga*	102.0
HOKI	*Macruronus novaezelandiae*	93.8
SILVER WAREHOU	*Seriolella punctata*	86.2
SCHOOL SHARK	*Galeorhinus galeus*	84.9
BROADBILL SWORDFISH	*Xiphias gladius*	78.8
RED COD	*Pseudophycis bachus*	73.0
GEMFISH	*Rexea solandri*	57.4
BLUE SHARK	*Prionace glauca*	54.2
RIBALDO	*Mora moro*	41.7
RIG	*Mustelus lenticulatus*	37.9
JOHN DORY	*Zeus faber*	36.1
COMMON WAREHOU	*Seriolella brama*	35.9
BIGEYE TUNA	*Thunnus obesus*	35.8
JACK MACKEREL	*Trachurus spp.*	27.5
SUNFISH	*Mola mola*	26.5
FLATS		26.2
SOUTHERN BLUEFIN TUNA	*Thunnus maccoyii*	26.0
KINGFISH	*Seriola lalandi*	24.7
MAKO SHARK	*Isurus oxyrinchus*	21.4
PORCUPINE FISH	*Allomycterus jaculiferus*	17.4

HAGFISH	*Eptatretus cirrhatus*	17.3
SOWFISH	*Paristiopterus labiosus*	17.0
BASS GROPER	*Polyprion americanus*	16.2
SPINY DOGFISH	*Squalus acanthias*	16.1
HAPUKU	*Polyprion oxygeneios*	13.6
N.Z. SOLE	*Peltorhamphus novaezeelandiae*	12.5
SEAL SHARK	*Dalatias licha*	12.4
ROUGH SKATE	*Dipturus nasutus*	11.6
FROSTFISH	*Lepidopus caudatus*	9.6
SAND FLOUNDER	*Rhombosolea plebeia*	8.4
SEA PERCH	*Helicolenus spp.*	8.3
MOONFISH	*Lampris guttatus*	8.1
CARPET SHARK	*Cephaloscyllium isabellum*	7.7
SMOOTH SKATE	*Dipturus innominatus*	7.4
CONGER EEL	*Conger spp.*	6.7
THRESHER SHARK	*Alopias vulpinus*	5.6
OTHER SHARKS, DOGFISH	*Selachii spp.*	5.6
SMOOTH OREO	*Pseudocyttus maculatus*	5.4
ELECTRIC RAY	*Torpedo fairchildi*	4.8
PORBEAGLE SHARK	*Lamna nasus*	4.8
SHOVELNOSE SPINY DOGFISH	*Deania calcea*	4.0
BLUE MACKEREL	*Scomber australasicus*	3.9
SOUTHERN BOARFISH	*Pseudopentaceros richardsoni*	3.5
LEATHERJACKET	*Parika scaber*	3.5
OILFISH	*Ruvettus pretiosus*	3.5
RATTAILS	*Macrouridae spp.*	3.4
ELEPHANT FISH	*Callorhinchus milii*	3.4
PACIFIC BLUEFIN TUNA	*Thunnus orientalis*	3.3
SPIKY OREO	*Neocyttus rhomboidalis*	3.2
EAGLE RAY	*Myliobatis tenuicaudatus*	3.1
TRUMPETER	*Latris lineata*	3.1
PORAE	*Nemadactylus douglasi*	3.0
STRIPED MARLIN	*Tetrapturus audax*	2.8
GIANT STARGAZER	*Kathetostoma giganteum*	2.7
YELLOW-BELLY FLOUNDER	*Rhombosolea leporina*	2.7
BUTTERFLY TUNA	*Gasterochisma melampus*	2.6
SPOTTED GURNARD	*Pterygotrigla picta*	2.4
REDBAIT	*Emmelichthys nitidus*	2.4
FLOUNDER		2.3
SOLE		2.3
RAYS BREAM	*Brama brama*	2.0

HAIRY CONGER	*Bassanago hirsutus*	1.8
TURBOT	*Colistium nudipinnis*	1.6
MIRROR DORY	*Zenopsis nebulosus*	1.6
BROWN STARGAZER	*Xenocephalus armatus*	1.2
ESCOLAR	*Lepidocybium flavobrunneum*	1.2
BUTTERFISH	*Odax pullus*	1.1
JOHNSON'S COD	*Halargyreus johnsonii*	1.0
SLICKHEAD	*Alepocephalidae*	1.0
PACIFIC SLEEPER SHARK	*Somniosus pacificus*	1.0
PELAGIC STINGRAY	*Dasyatis guileri*	0.8
RAYS	*Various families*	0.8
GHOST SHARK	*Hydrolagus novaezealandiae*	0.7
LONGTAILED STINGRAY	*Dasyatis thetidis*	0.7
WHITE WAREHOU	*Seriolella caerulea*	0.6
RUDDERFISH	*Centrolophus niger*	0.5
YELLOWFIN TUNA	*Thunnus albacares*	0.5
SPOTTED STARGAZER	*Genyagnus monopterygius*	0.5
BLACK MARLIN	*Makaira indica*	0.4
LOOKDOWN DORY	*Cyttus traversi*	0.4
NORTHERN BLUEFIN TUNA	*Thunnus thynnus*	0.4
SILVER DORY	*Cyttus novaezealandiae*	0.4
LEMON SOLE	*Pelotretis flavilatus*	0.3
RED SNAPPER	*Centroberyx affinis*	0.3
PIGFISH	*Congiopodus leucopaecilus*	0.3
BLUE MARLIN	*Makaira mazara*	0.2
JAVELIN FISH	*Lepidorhynchus denticulatus*	0.2
UNICORN RATTAIL	*Trachyrincus longirostris*	0.2
COMMON ROUGHY	*Paratrachichthys trailli*	0.2
BLACK OREO	*Allocyttus niger*	0.2
SKIPJACK TUNA	*Katsuwonus pelamis*	0.2
GREY MULLET	*Mugil cephalus*	0.1
PARORE	*Girella tricuspidata*	0.1
PEARLEYE	*Benthalbella elongata*	0.1
RED MOKI	*Cheilodactylus spectabilis*	0.1
DOLPHINFISH	*Coryphaena hippurus*	0.1
SMALL-HEADED COD	*Lepidion microcephalus*	0.1
DEEPWATER DOGFISH		0.1
LONG-NOSED CHIMAERA	*Harriotta raleighana*	0.1
PALE GHOST SHARK	*Hydrolagus bemisi*	0.1
BLUE COD	*Parapercis colias*	0.1
BIG-EYE THRESHER SHARK	*Alopias superciliosus*	0.1

SHORTBILL SPEARFISH	*Tetrapturus angustirostris*	0.1
CATFISH (FRESHWATER)	*Ictalurus nebulosus*	0.0
SLENDER TUNA	*Allothunnus fallai*	0.0
SHORT-TAILED BLACK RAY	*Dasyatis brevicaudata*	0.0
BASKETWORK EEL	*Diastobranchus capensis*	0.0
WITCH	*Arnoglossus scapha*	0.0
NORTHERN BASTARD COD	*Pseudophycis breviuscula*	0.0
BIG-SCALE POMFRET	*Taratichthys longipinnis*	0.0
SPLENDID PERCH	*Callanthias spp.*	0.0
WHITEBAIT	*Family galaxiidae (juvenile)*	0.0
BASKING SHARK	*Cetorhinus maximus*	0.0
SCALY GURNARD	*Lepidotrigla brachyoptera*	0.0
SOUTHERN BASTARD COD	*Pseudophycis barbata*	0.0
SAURY	*Scomberesox saurus*	0.0
HAKE	*Merluccius australis*	0.0
NORTHERN SPINY DOGFISH	*Squalus griffini*	0.0

Note: catch is rounded to one decimal place so catches < 0.1 ton appear as 0.0 ton.