IX-19 New Zealand Shelf: LME #46

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The New Zealand Shelf LME stretches across from the subtropics to the sub-Antarctic. It covers a surface area of nearly one million km^2, of which 0.03% is protected, and contains 0.08% of the world's sea mounts (Sea Around Us 2007). The shelf surrounding New Zealand's North Island and South Island vary in width from a few tens to several hundred kilometres. This LME is characterised by its temperate climate, influenced by the warm Tasman and North Cape currents in the north and by the cooler Southland Current in the South. The marine environment is diverse and includes estuaries, mudflats, mangroves, seagrass and kelp beds, reefs, sea mount communities and deep sea trenches. Morgan (1989) and UNEP (2003) pertain to this LME.

I. Productivity

The New Zealand Shelf LME is a Class III, low productivity (<150g$Cm^{-2}yr^{-1}$) ecosystem. See also Bradford-Grieve et al. (2003, 2006). While the southern Plateau region subantarctic water, limited by iron availability, is a low production system, the Chatham Rise, eastern Cook Strait, and the NE shelf are considerably more productive. For a study of ocean fronts and their contribution to marine productivity in this LME, see the National Institute of Water and Atmospheric Research website, www.niwa.co.nz. View a SeaWiFS image of ocean chlorophyll in New Zealand coastal waters at www.niwa.cri.nz. In the southern part of this LME, there is higher productivity in the fiord ecosystems. The current definitive data on marine species in the New Zealand flora and fauna from the National Institute of Water and Atmospheric Research of New Zealand (NIWA) are a maximum of 16,214 species in total, including known, undescribed species.

Oceanic fronts: This LME features several well-defined fronts (Figure IX-19.1) that together determine the ecological regime of the New Zealand shelf (Belkin and Gordon 1996; Belkin and Cornillon 2003; Belkin et al. 2009). In the north, the Tasman Front and its extension associated with the North Cape Current bring warm and salty tropical waters to the east coast of North Island. This influx, together with vigorous tidal mixing thanks to rough bathymetry, is largely responsible for the exceptionally high productivity off the Bay of Islands, where big game fish like marlins and kingfish come unusually close to the mainland coast, forming fishing grounds just a few miles offshore, for example, off Cape Brett. West of North Island, the southern branch of the Tasman Front heads toward Cook Strait. In the south, the Southland Current Front runs northward along the east coast of South Island toward Banks Peninsula. East of New Zealand, the double Subtropical Frontal Zone that consists of the North and South STF extends eastward along the north and south flanks of the Chatham Rise up to Chatham Island and beyond. This double Subtropical Frontal Zone is similar to the double frontal zones found in other subtropical oceans (Belkin, 1988, 1993, 1995, Belkin et al. 2009; Belkin and Gordon, 1996). See also Bradford-Grieve et al. (2006).

New Zealand Shelf SST (Belkin 2009)
Linear SST trend since 1957: 0.11°C.
Linear SST trend since 1982: 0.32°C.

The New Zealand Shelf features strong interannual variability, with a magnitude exceeding 1°C, superimposed over a slow-warming trend (Figure IX-19.2). Any correlation between this LME and the upstream LMEs off Australia can only be rather tenuous since different parts of the New Zealand Shelf are advectively affected by different Australian LMEs. For example, the North Island is oceanographically linked to

the Northeast Australian Shelf LME, whereas the South Island is linked to the Southeast Australian Shelf LME. The all-time maximum of 1971 in New Zealand occurred two years prior to the near-all-time maximum of 1973 in the East Central Australian Shelf LME, therefore these events could not have been advectively connected.

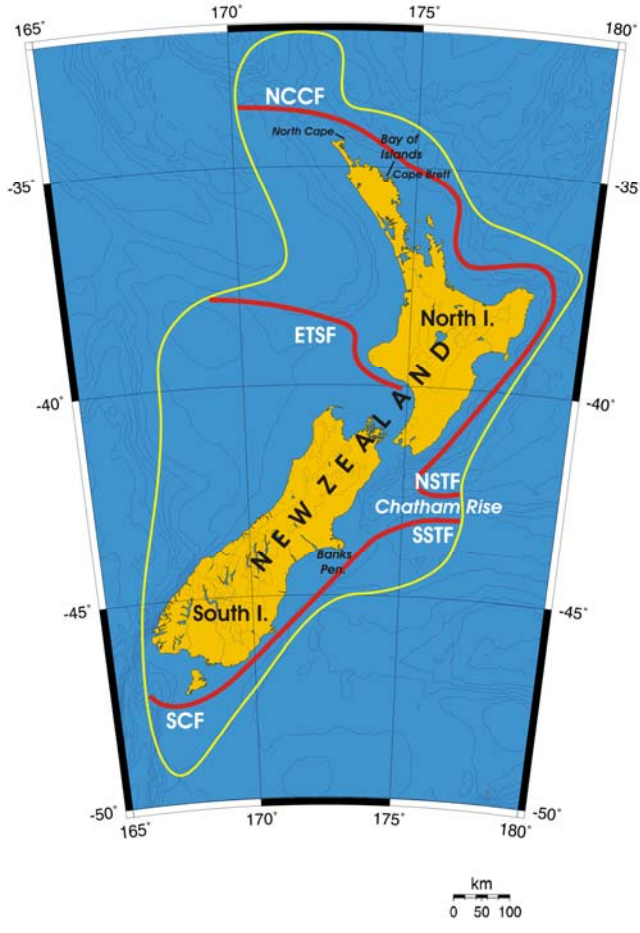

Figure IX-19.1. Fronts of the New Zealand Shelf LME. ETSF, East Tasman Front; NCCF, North Cape Current Front; NSTF, North Subtropical Front; SCF, Southland Current Front; SSTF, South Subtropical Front. Yellow line, LME boundary. After Belkin et al. (2009), Belkin and Cornillon (2003), and Belkin and Gordon (1996).

Another warm peak, of 1974, occurred off New Zealand a year after the 1973 warm peak in the East-Central Australia LME; these events may have been advectively connected. The warm events of 1971-1974 were confined to these two LMEs connected by the East Australian Current and its eastward extensions, namely Tasman Front (TF), North Cape Current Front (NCCF), and East Tasman Sea Front (ETSF) (Figure IX-19.1).

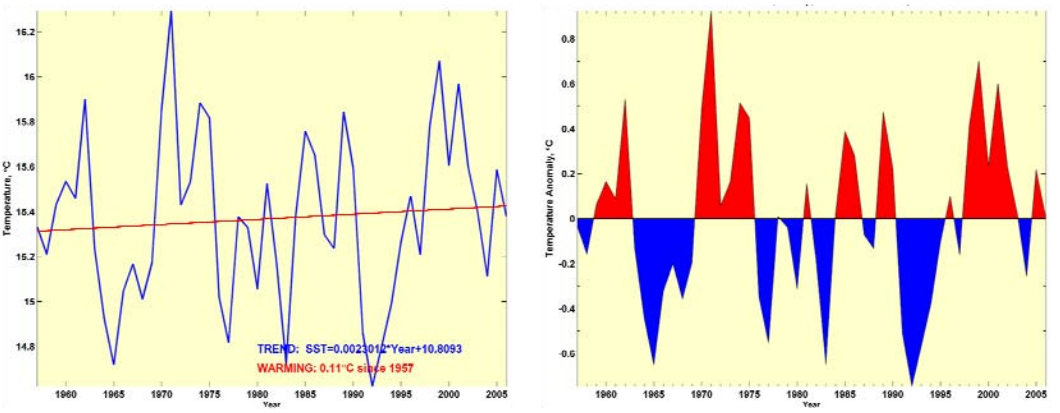

Figure IX-19.2. New Zealand Shelf LME annual mean SST (left) and SST anomalies (right), 1957-2006, based on Hadley climatology. After Belkin (2009).

New Zealand Shelf LME Chlorophyll and Primary Productivity: The New Zealand Shelf LME is a Class III, low productivity (<150gCm^{-2}yr^{-1}) ecosystem. See also Bradford-Grieve et al. (2003, 2006).

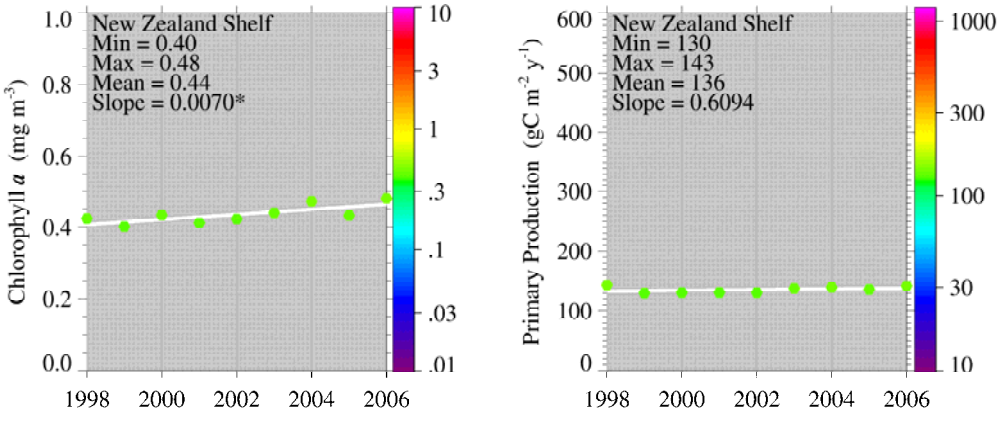

Figure IX 19.3. New Zealand Shelf LME annual trends in chlorophyll *a* (left) and primary productivity (right), 1998-2006. Values are colour coded to the right hand ordinate. Figure courtesy of J. O'Reilly and K. Hyde. Sources discussed p. 15 this volume.

I. Fish and Fisheries

The New Zealand Ministry of Fisheries estimates about 750,000 tonnes of seafood is harvested annually from New Zealand's fisheries—70% from deepwater and midwater fisheries, 11% pelagic, 10% farmed species, and 9% from their inshore fisheries. Note that the Chatham Rise and the Southern Plateau, 2 major fishing regions, are not entirely included in the LME. The Ministry also estimates that 20% of the population engages in marine recreational fishing annually and that the expenditure made by recreational fishers to catch five key recreational species is nearly NZ$1 billion per year (www.govt.nz/en-nz). Among the important fisheries in this LME are those for migratory apex predators such as tuna, billfish, and shark, squid, hoki, orange roughy, rock lobster, mussels (cultured) and snapper are key export species. According to the Ministry, the value of fish exports in 2004 grew more than the volume and generated NZ$1.2 billion, NZ$1.0 billion from capture fisheries and NZ$200 million from aquaculture.

Fisheries policies in New Zealand hope to secure a long-term future for the industry by setting sustainable catch limits and providing harvesting rights to benefit all New Zealanders, including the indigenous Maori. Fiords in the southern part of this LME support commercial and recreational fisheries as well as traditional Maori fisheries. Information on the fisheries in this LME is available on the FAO website (www.fao.org/). For information on areas closed to fishing, see the New Zealand Department of Conservation (www.doc.govt.nz/).

Total reported landings show a sharp spike in 1977 of 220,000 tonnes, likely associated with the declaration of the 200 nautical mile Exclusive Economic Zone around this LME by New Zealand, followed by a continuous increase through the 1980s and 1990s and a decline in the 2000s (Figure IX-19.4). The value of the reported landings reached US$583 million (in 2000 US dollars) in 1984, followed by a decline to between US$260 million and US$450 million in recent years (Figure IX-19.5).

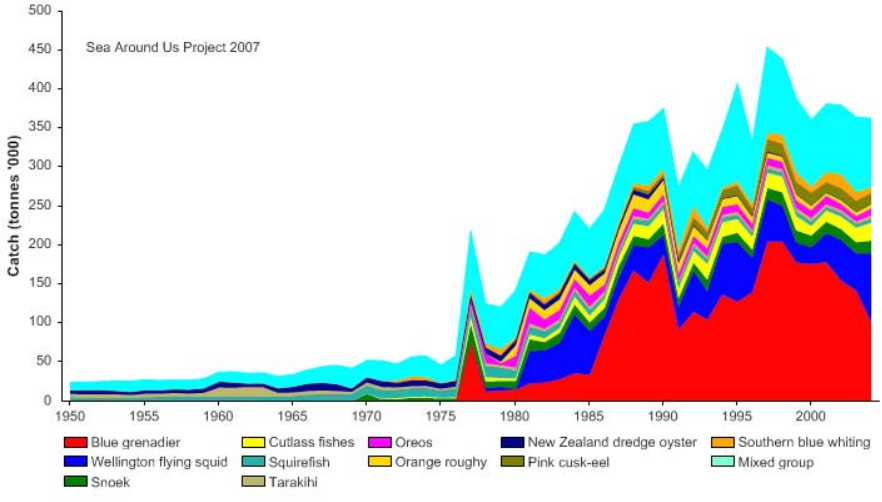

Figure IX-19.4. Total reported landings in the New Zealand Shelf LME by species (Sea Around Us 2007).

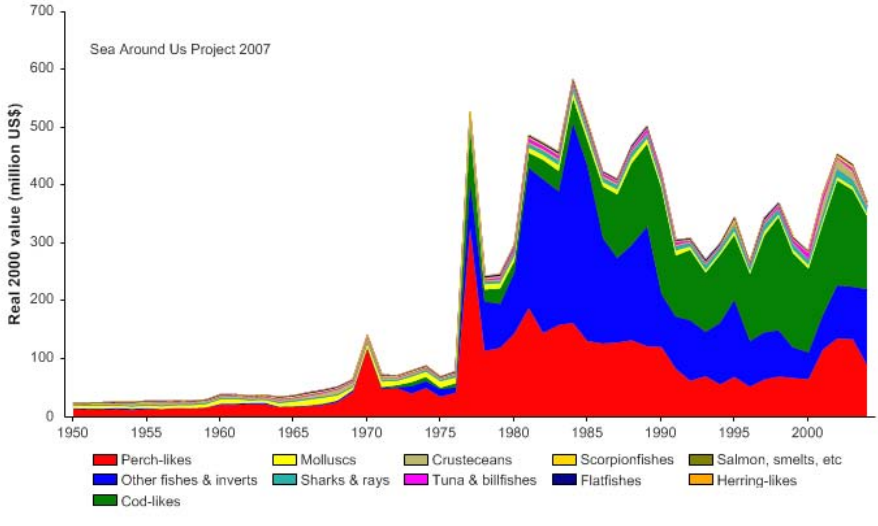

Figure IX-19.5. Value of reported landings in the New Zealand Shelf LME by commercial groups (Sea Around Us 2007).

The primary production required (PPR; Pauly & Christensen 1995) to sustain the reported landings is currently below 4% with New Zealand accounting for the great majority of the ecological footprint in the LME (Figure IX-19.6).

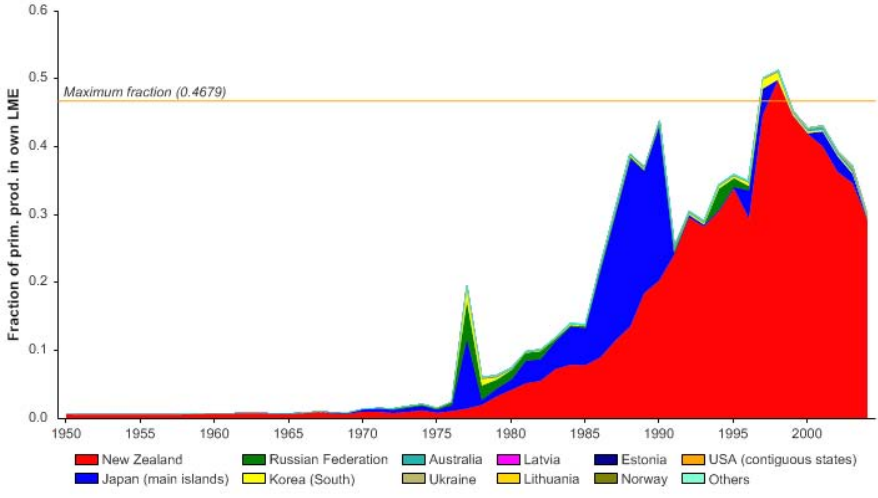

Figure IX-19.6. Primary production required to support reported landings (i.e., ecological footprint) as fraction of the observed primary production in the New Zealand Shelf LME (Sea Around Us 2007). The 'Maximum fraction' denotes the mean of the 5 highest values.

The mean trophic level of the reported landings (i.e., the MTI; Pauly & Watson 2005) has been on a rise since the mid-1970 (Figure IX-19.7, top) as has the FiB index (Figure IX-19.7, bottom). Together with the data presented in Figure IX-19.6, such trends suggest the development of previously under-utilized, high trophic fisheries resources by local as well as foreign fleets.

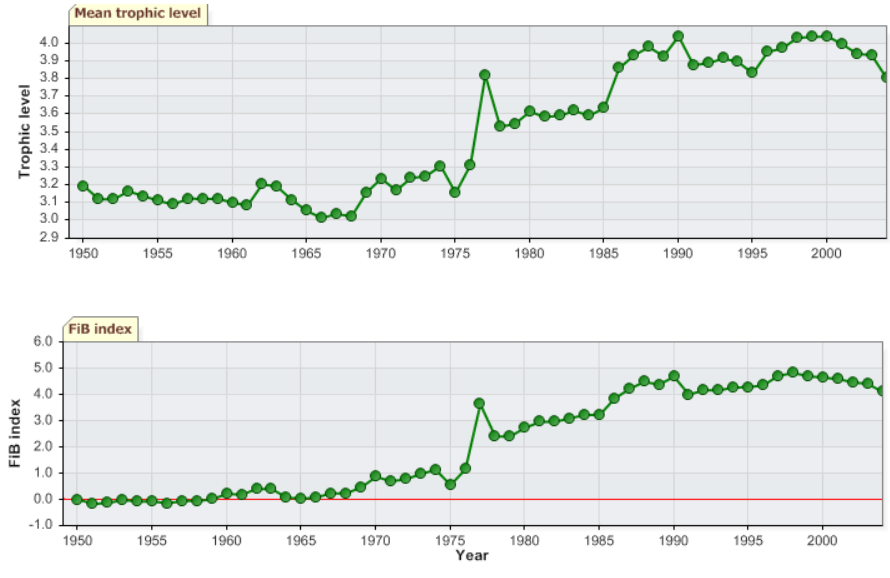

Figure IX-19.7. Mean trophic level (i.e., Marine Trophic Index) (top) and Fishing-in-Balance Index (bottom) in the New Zealand Shelf LME (Sea Around Us 2007).

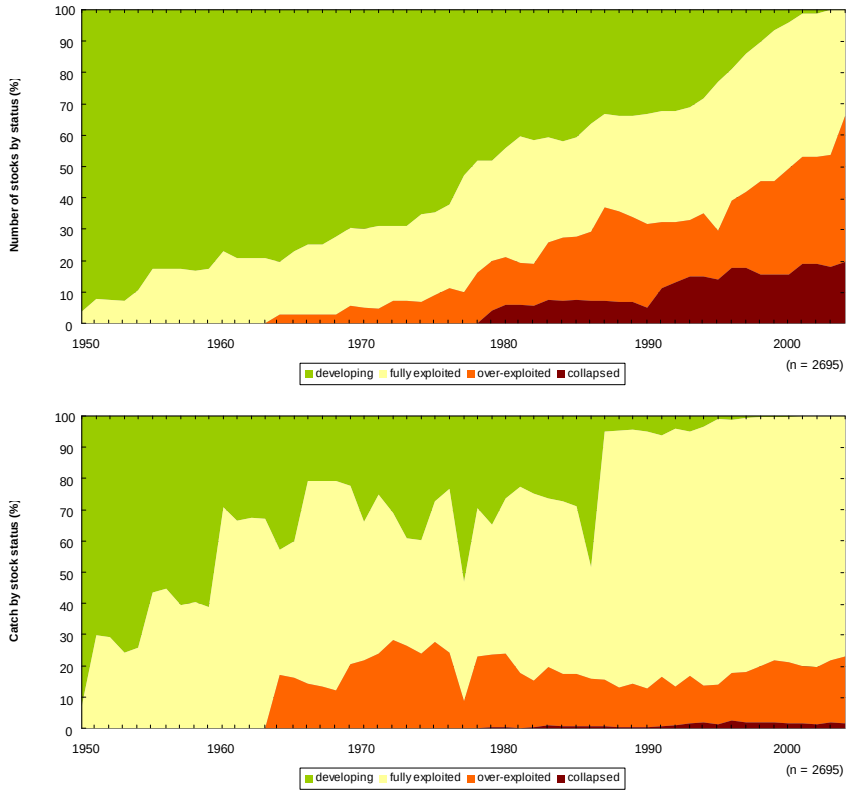

Figure IX-19.8. Stock-Catch Status Plots for the New Zealand Shelf LME, showing the proportion of developing (green), fully exploited (yellow), overexploited (orange) and collapsed (purple) fisheries by number of stocks (top) and by catch biomass (bottom) from 1950 to 2004. Note that (n), the number of 'stocks', i.e., individual landings time series, only include taxonomic entities at species, genus or family level, i.e., higher and pooled groups have been excluded (see Pauly *et al*, this vol. for definitions).

The Stock-Catch Status Plots for the LME illustrate that more than half of the stocks in the region are currently either overexploited or have collapsed (Figure IX-19.8, top). However, the majority of the reported landings are supplied by stocks classified as 'fully exploited' (Figure IX-19.8, bottom).

III. Pollution and Ecosystem Health

Fisheries impacts on the environment are not completely understood and the data is incomplete. Gill nets pose a risk to marine birds, particularly if set near feeding or breeding areas. Yellow-eyed penguins appear most at risk from nets set by commercial fishermen for bottom dwelling species such as rig and dogfish. The nets are set well within the feeding range of these penguins. Fiord ecosystems in the southern part of this LME are in need of protection. In that region, the crested penguin, *Eudyptes pachyrhynchus*, is at risk. Native flora and fauna are affected by invasions of the Asian kelp, *Undaria*, and toxic micro-algae. Additional information on marine invasions, ballast water, marine toxins, harmful algal blooms and diarrheic shellfish poisoning, is given www.cawthron.org.nz. Studies are underway to assess trawling damage to benthic species and to deepwater seamount habitat.

It has been suggested that changes in sea surface conditions have contributed to the spread of toxic algae and invasive seaweeds in New Zealand waters. Toxic algal blooms occurring in the 1990s have killed marine life and caused illness in humans. Other issues

affecting the marine environment are waste and hazardous substances. New Zealand produces a higher rate of municipal waste (two thirds of a tonne per person each year) than most other developed countries. Industrial waste is estimated at 300,000 tonnes a year. Another ecosystem health issue is climate change. Gases released into the atmosphere are enhancing the natural greenhouse effect at a rate that could extensively damage the LME's biophysical systems. Atmospheric levels of carbon dioxide and methane - two of New Zealand's major greenhouse gases – are rising. Studies are underway to assess the impact of terrestrial runoff on coastal ecologies and marine communities.

IV. Socioeconomic Conditions

The population of New Zealand exceeds 4 million and impacts the marine environment through commerce, recreation (including whale watching), indigenous fishing (Maori and Pacific Islanders), commercial fisheries, marine aquaculture, trade, defence and security. The ocean floor is explored and mined for minerals, natural gas and oil. Ports and harbours in this LME are Auckland, Christchurch, Dunedin, Tauranga and Wellington. Statistics New Zealand has developed socioeconomic indicators for the environment that complement the Ministry for the Environment's Environmental Performance Indicators programme (www.stats.govt.nz/). The Ministry of Fisheries estimates direct full-time employment in commercial fisheries and aquaculture at 10,500, and direct and indirect full-time employment in those jobs at 26,000 (www.fish.govt.nz/). Commercially important species are managed under the quota management system (the QMS). The Ministry lists 2,200 persons as holding a quota and a total quota value of $3.5 billion. The Māori now own 40% of quota and have additional involvement in 20% of quota (www.fish.govt.nz/). Recommended TACs for various species for 2006/2007are listed at www.fish.govt.nz/ and in 2006 it was thought that some TAC levels were still too high to be sustainable. Of the 93 stocks on which New Zealand has information for current stock size, 76 (82%) are at or near target levels.

V. Governance

This LME is governed by New Zealand, and is included within the UNEP Pacific Regional Seas Programme. Managing the marine environment is a complex process involving overlapping and conflicting interests, agencies and legislation. Issues arising between commercial fisheries and conservation interests are addressed under different regulations administered by the Department of Conservation and the Ministry of Fisheries. The latter, since the 1930s, has been responsible for the sustainable use of fisheries for the social, economic and cultural well-being of the people. All stakeholders of the marine environment are included in the advancement of sustainable management. There are currently 97 species groupings in the QMS, divided into 629 fishstocks or geographic Quota Management Areas (QMAs). Of the 629 fishstocks, 280 have TACCs (Total Allowable Commercial Catches) of 10 tonnes or less, leaving approximately 349 significant fishstocks that need to be closely monitored (www.fish.govt.nz).

New Zealand is in the process of developing a comprehensive National Oceans Policy which aims to address a range of marine issues including fisheries, maritime transport and protection of the marine environment. New Zealand's Department of Conservation is responsible for marine reserves and for marine mammals such as dolphins, whales, sea lions and fur seals. New Zealand has a number of coastal national parks (Bay of Islands Maritime and Historic Park, Hauraki Gulf Maritime Park).. The New Zealand Biodiversity Strategy (2000) goal includes having 10% of the marine environment in a network of Marine Protected Areas by 2010. For more information on marine reserves see the Department of Conservation website at (www.doc.govt.nz/). The Ministry of Foreign Affairs and Trade is responsible for New Zealand's international effort to address

environmental pressures arising from climate change, conservation of species, protection of ocean biodiversity, hazardous substances, and international agreements on environmental goods and services. The Environment Division leads this work and all multilateral environmental agreements, such as the United Nations Framework Convention on Climate Change (ministry web site at www.mfat.govt.nz/).

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www.fish.govt.nz/en-nz/Press/September+2006/Sustainability (for 2006-2007 TAC statistics)
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