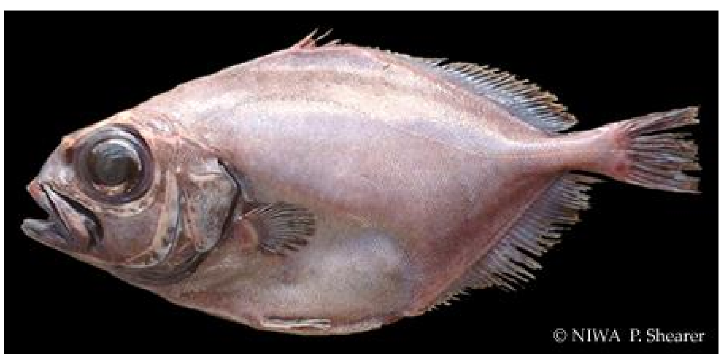
SPRFMO-IV-SWG-11

Information describing Oreosomatidae (*Allocyttus niger, Neocyttus rhomboidalis and Pseudocyttus maculates)* fisheries relating to the South Pacific Regional Fisheries Management Organisation

Black oreo

Spiky oreo



Smooth oreo

WORKING DRAFT
02 September 2007

1 Overview

In the South Pacific Ocean, the oreo species complex of three commercial species occurs primarily along the deeper continental shelves and slopes of southern Australia and New Zealand. The smooth oreo also occurs off central and southern Chile. Oreos inhabit deep, cold waters, and often form large aggregations over rough ground near pinnacles and canyons. Many aspects of the basic biology of these species are reasonably well known, although the biology of the juveniles is poorly understood.

Target trawl fisheries for oreos have occurred in the South Pacific since the early 1980s. Oreos are a major bycatch of the orange roughy fishery. No fishing methods other than trawl have been used successfully to catch oreos.

There is no information on stock structure of oreo stocks beyond EEZs. However, on the basis of our knowledge within EEZs, it is likely that stocks are distinct at a broad feature level (e.g. the Louisville Ridge) and possibly even at scales within features.

Oreos are a deepwater species complex with limited habitat in the high seas area of the South Pacific. All the oreo species examined are characterised by very slow growth, great longevity, late age at maturity, and low fecundity relative to other teleosts. Their aggregating behaviour around prominent submarine features allows large catches to be taken easily. There are numerous assumed distinct stocks within and between EEZs. Hence, they are quite vulnerable to rapid overfishing and serial depletion.

The main method used to catch this species is a high-opening trawl generally fished hard down on the bottom. Trawling for this species on seamounts, knolls and pinnacles has substantial impacts on habitat and benthic invertebrate species, but the reciprocal impact of this on the oreo populations or other species is unknown.

There are currently no known management measures in place for oreos.

This is a living document. It is a draft report and requires additional information to complete.

2 Taxonomy

2.1 Phylum

Vertebrata

2.2 Class

Actinopterygii

2.3 Order

Zeiformes

2.4 Family

Oreosomatidae

2.5 Genus and species

Allocyttus niger James, Inada & Nakamura, 1988

Neocyttus rhomboidalis, Gilchrist, 1906

Pseudocyttus maculatus, Gilchrist, 1906

2.6 Scientific synonyms

None known

2.7 Common names

Allocyttus niger – black oreo; *Neocyttus rhomboidalis* – spiky oreo; and, *Pseudocyttus maculatus* – smooth oreo

2.8 Molecular (DNA or biochemical) bar coding

No information

3 Species Characteristics

3.1 Global distribution and depth range

The black oreo inhabits New Zealand and Australian waters, the southern Tasman Sea and the Louisville Ridge only, between latitudes of about 38º and 53º S (James et. al. 1988). Black oreos are prevalent on the southern Chatham Rise. Black oreo occurs in depths from 450–1450 m, but is most abundant between 600 m and 1000 m (Anderson et al. 1998) (Figure 1).

The spiky oreo has been reported off southern Africa, Argentina, the southeast Indian Ocean, along southern Australia, throughout the New Zealand shelf area, in the Tasman Sea and on the Louisville Ridge. It has been recorded from depths of 200 m to 1500 m, but is most abundant between 600 m and 1000 m (Anderson et al. 1998) (Figure 2).

The smooth oreo inhabits the continental slopes of southern continents (Australia, New Zealand and Chile) (Karrer 1990). On the high seas it is known from the central Tasman Sea and the Louisville Ridge. It has been recorded from depths of 400 m to at least 1500 m, but is most abundant between 700 m and 1400 m in the Pacific region (Anderson et al. 1998) (Figure 3).

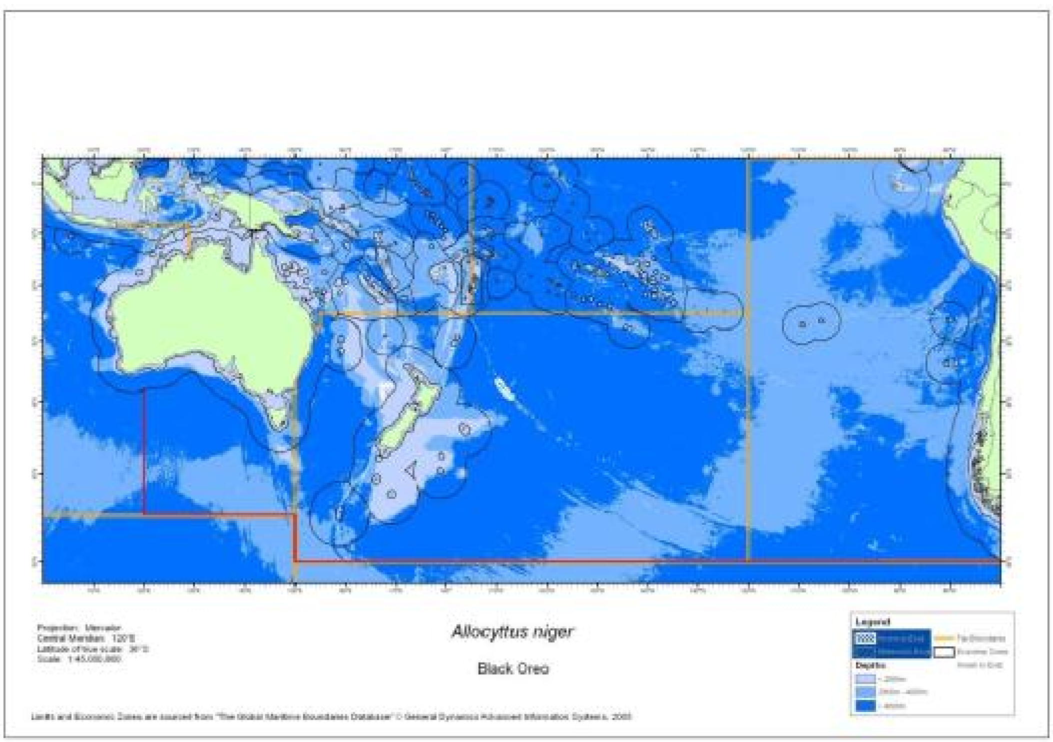


Figure 1: Distribution of black oreo fishing grounds in the South Pacific.

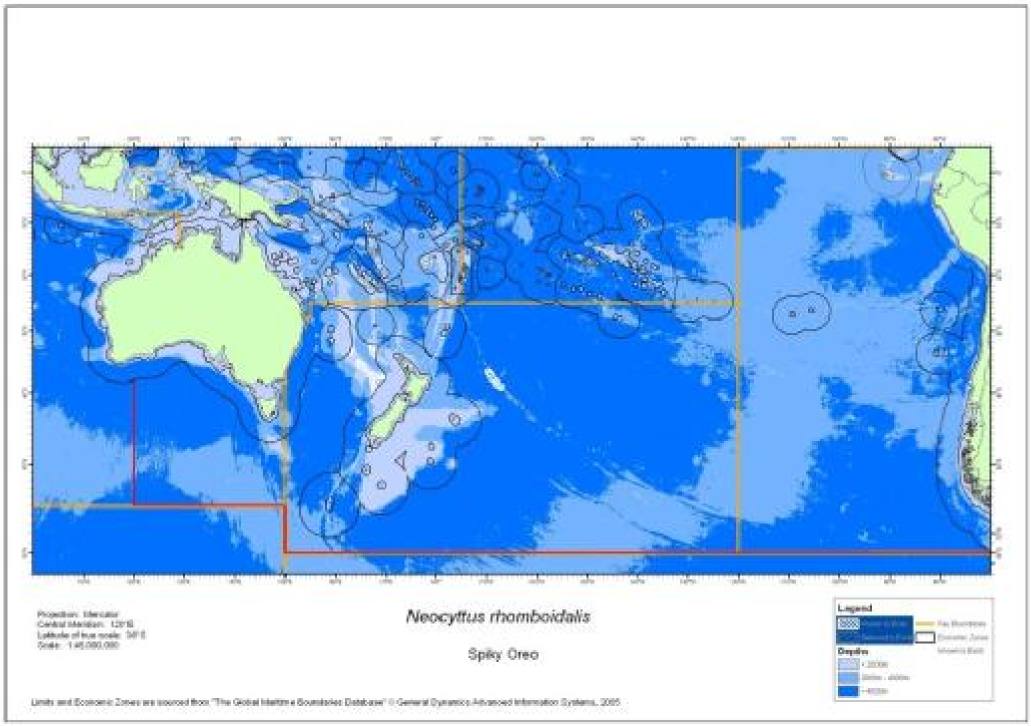


Figure 2: Distribution of spiky oreo fishing grounds in the South Pacific.

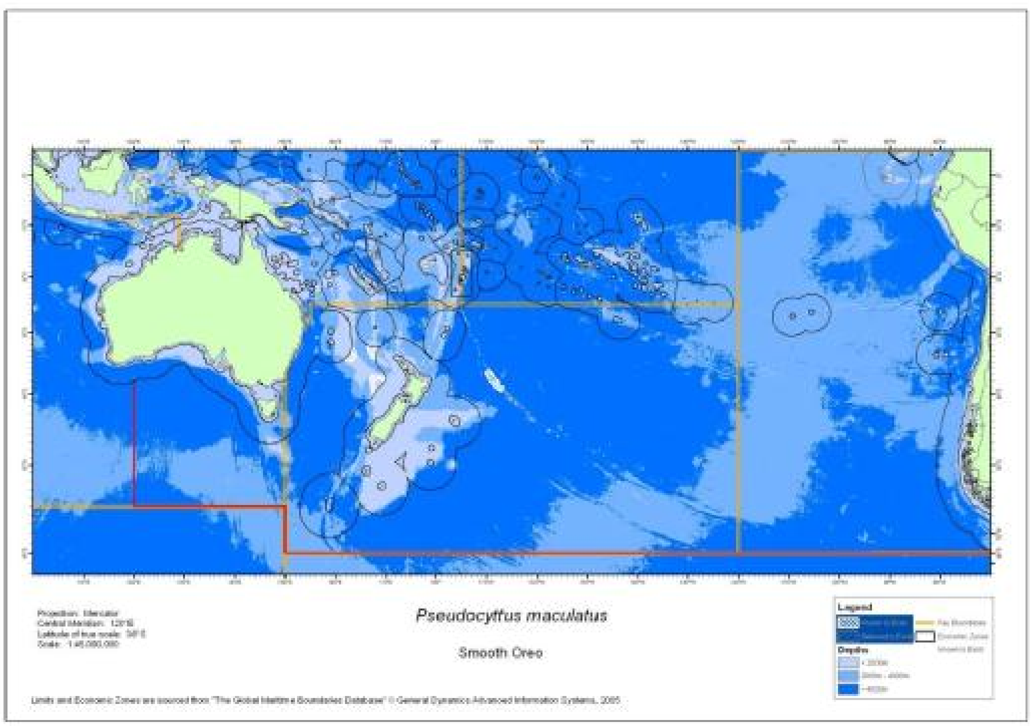


Figure 3: Distribution of smooth oreo fishing grounds in the South Pacific.

3.2 Distribution within South Pacific area

The areas of known distributions outside EEZs for each species of oreo are given in Figures 1-3 above. Based on catch effort data reported to New Zealand and Australia (Clark 2006), scientific observer data and habitat assumptions the area assumed to be occupied by each species is: black oreo, 64,000 km^2; spiky oreo, 205,000 km^2; and, smooth oreo 172,000 km^2.

3.2.1 Inter-annual and/or seasonal variations in distribution

There is a movement to the spawning grounds although the extent and distance covered are unknown.

3.2.2 Other potential areas where the species may be found

It is believed that additional oreo fishing grounds could be found on the southern Louisville Ridge.

3.3 General habitat

Black oreos and spiky oreos are found close to the seabed in deep water. The adults form large shoals over rough ground near pinnacles and canyons. Juveniles are pelagic and inhabit oceanic waters where they tend to be dispersed over smooth grounds (Kailola et al. 1993). Smooth oreos inhabit deep continental slopes, with adults occurring near the bottom, often in large schools near pinnacles and canyons. Juveniles occur near the surface, often in association with krill (Heemstra 1990). There is no evidence of marked vertical migration by any of these species during day or night (Clark et al. 1989).

3.4 Biological characteristics

For all oreo species sexes co-occur but schools often appear to be segregated by sex based on sampling data.

The juveniles of all species are quite different in shape from the adults (Paulin et al. 1989). Most juveniles have an expanded belly with large warty protuberances.

Black oreo

Morphology: Five to eight dorsal spines, 28–33 soft dorsal rays, 2–3 anal spines, and 26–31 soft anal rays. The body is black to grey, with fins dark.

Black oreo can reach a total length of about 55 cm; females reach a larger size than males. Age estimates in excess of 150 years have been derived from counts of zones in otolith thin sections, an un-validated method (Smith & Stewart 1994; Doonan et al. 1995), indicating a very slow growth rate for this species. Current productivity parameters used in assessments of New Zealand's black oreo stocks are: von Bertalanffy L_∞ and k, 40 cm and 0.043 yr–1 for females, 37 cm and 0.056 yr–1 for males; M = 0.044 yr–1 (Ministry of Fisheries 2007) length and age at maturity for females are 34 cm and 27 years.

Black oreo are synchronous spawners, spawning in Australasian waters in late spring to early summer (Pankhurst et al. 1987; Lyle et al. 1992). Fecundity is about 17 500 eggs per kg of body weight. Eggs float near the surface and larvae probably also inhabit surface waters (Kailola et al. 1993). Black oreo appear to have a pelagic juvenile phase, but little is known about this phase because few small fish have been caught. The pelagic phase may last for 4–5 years until the fish reach lengths of 21–26 cm (McMillan et al. 1997). The adults feed mainly on salps and benthic crustaceans (Clark et al. 1989).

Spiky oreo

Morphology: Seven dorsal spines, 33–35 soft dorsal rays, 3–4 anal spines, and 30–33 soft anal rays. The body is grey with the fins dark.

Spiky oreo can reach a total length of about 44 cm; females reach a larger size than males. A maximum age in excess of 120 years has been derived from counts of zones in otolith thin sections, an un-validated method (Smith & Stewart 1994), indicating a very slow growth rate for this species. Available productivity parameters for spiky oreo stocks are: $L\infty$ = 36 cm, k = 0.051 yr–1, for combined sexes (Smith & Stewart 1994). Length at maturity is estimated to be 22 cm and 34 cm for males and females, respectively.

Spiky oreo are synchronous spawners, spawning in Australian waters from late winter to spring (Lyle et al. 1992; Stewart 1992). Eggs float near the surface and larvae probably also inhabit surface waters (Kailola et al. 1993). Spiky oreo are also presumed to have a pelagic juvenile phase. The adults feed mainly on salps, but also eat fish, crustaceans, and squid (Lyle & Smith 1997).

Smooth oreo

Morphology: Five to seven dorsal spines, 33–36 soft dorsal rays, 2–3 anal spines, and 31–34 soft anal rays. Adults are chocolate brown with darker fins.

Smooth oreo can reach a total length of about 60 cm; females reach a larger size than males. Maximum age estimates of about 100 years have been derived from counts of zones in otolith thin sections, an unvalidated method (Smith & Stewart 1994; Doonan et al. 1995), indicating a very slow growth rate for this species. Current productivity parameters used in assessments of New Zealand's smooth oreo stocks are: von Bertalanffy $L\infty$ and k, 51 cm and 0.047 yr–1 for females, 44 cm and 0.067 yr–1 for males; M = 0.063 yr–1 (Ministry of Fisheries 2007). Length and age at maturity for females are 40 cm and 31 years.

Smooth oreo are synchronous spawners, spawning in Australasian waters in late spring to early summer (Pankhurst et al. 1987; Lyle et al. 1992). Fecundity is about 10 800 eggs per kg of body weight. Eggs float near the surface and larvae probably also inhabit surface waters (Kailola et al. 1993). Smooth oreo appear to have a pelagic juvenile phase, but little is known about this phase because few small fish have been caught. The pelagic phase may last for 5–6 years until the fish reach lengths of 16–19 cm (Doonan et al. 1997). The adults feed mainly on salps (Clark et al. 1989).

3.5 Population structure

Stock structure in the black oreo and smooth oreo in Australian and New Zealand waters was examined using genetic (allozyme and mitochondrial DNA) and morphological counts (Ward et al. 1996). It was concluded that the New Zealand black oreos constituted a stock distinct from the Australian sample based primarily on a small but significant difference in mtDNA haplotype frequencies. No significant differences were found between the smooth oreo samples (Ward et al. 1996), but a broad scale stock as suggested by these results seems unlikely given the large distances between New Zealand and Australia (Ministry of Fisheries 2007).

A further study examined stock relationships of black and smooth oreos in various management areas of the New Zealand EEZ. Techniques used included genetic (nuclear and mitochondrial DNA), lateral line scale counts, settlement zone counts, parasites, otolith microchemistry, and otolith shape (Smith et al. 1999, 2000). There were indications of multiple stocks of both species within the New Zealand EEZ.

There is no information on stock structure of oreos beyond EEZs. However, on the basis of our knowledge within EEZs, it is likely that stocks are distinct at a broad feature level (e.g. the Louisville Ridge), and possibly even at scales within features.

3.6 Biological productivity

The biology of the oreo species is moderately well known. Biological productivity is believed to be very low. This is due to a combination of late onset of maturity, low fecundity, low annual growth rate in relation to size and high longevity. The proportion of biomass that can be harvested sustainably is very small.

3.7 Role of species in the ecosystem

Oreos appear to be bentho-pelagic grazers, feeding mainly on salps. However, the presence of fish, squid, and benthic invertebrates in their diets indicates that they are also opportunistic predators. Dietary composition appears to change with fish size in smooth and black oreos (Clark et al. 1989).

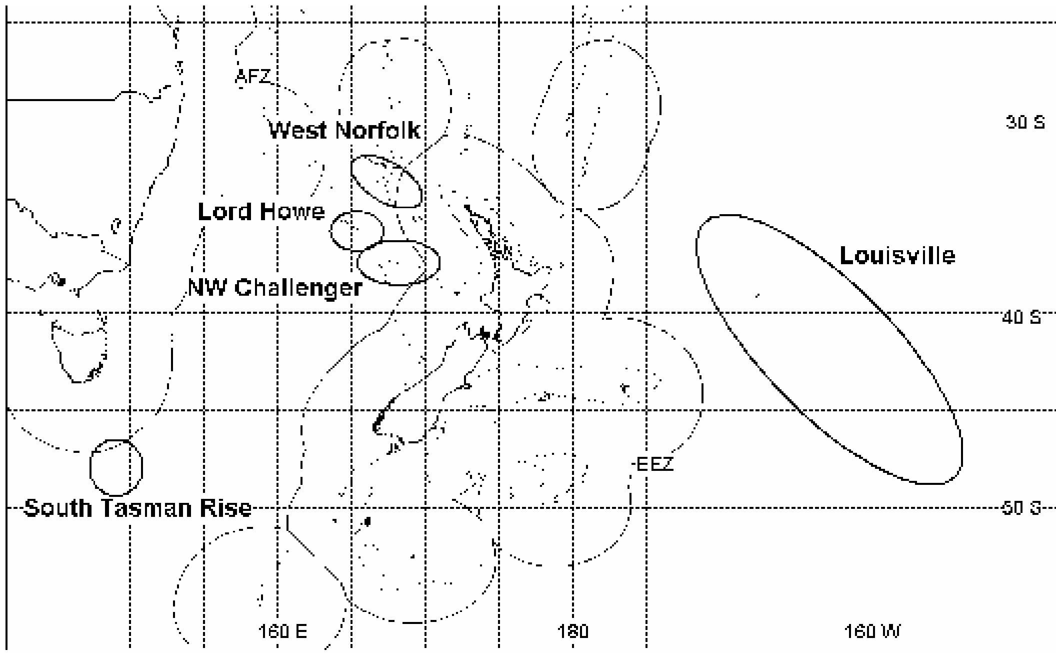
4 Fisheries Characterisation

4.1 Distribution of fishing activity

Oreos have been target fished by trawl off New Zealand since 1979, as well as being a major bycatch of the orange roughy fishery (see the orange roughy species profile at http://www.southpacificrfmo.org/science-working-group/swg-profiles/species-profiles/ for more information). They have been a significant bycatch of the trawl fishery for orange roughy off Australia since the mid 1980s, and a minor bycatch within the Chilean EEZ since 1999. Known high seas fishing grounds in the southwest Pacific are detailed in Figure 4.

Landings data by oreo species are available for some areas (e.g., see Ministry of Fisheries 2007 for New Zealand data). Also, some landings may include species other than the three examined above (e.g., the warty oreo, *Allocyttus verrucosus*).

Figure 4: The New Zealand/Australia region, showing location of major fisheries for oreos roughy outside the New Zealand and Australian EEZs (1000 m depth contour shown around New Zealand) (from Clark 2006).



Fishing also occurs within the New Zealand, Chilean and Australian EEZs. The main fishing grounds within the New Zealand EEZ are to the south of the Chatham Rise off the east coast of New Zealand. In Australia the main fishing grounds are the Cascade Plateau and south of Tasmania. Fishing in the South east Pacific occurs only within the Chilean EEZ around 33°S to 34°S on the Bajo O'Higgins and Juan Fernandez seamounts.

*****Note that this section could be updated further based on various New Zealand and Australian documents (e.g. SPRFMO-IV-SWG-05), or simply cross referenced to the orange roughy profile (which is typically the target species where oreos are caught on the high seas).***

4.2 Fishing technology

The characteristics of vessels fishing oreos differ between areas. They range from relatively small (20–30 m length) trawlers that return their catch to shore whole on ice, however the majority of catch is taken by factory trawlers (up to 70–80 m) that process the catch onboard to head-and-gut or fillet form. Trawl gear has developed over the duration of the fishery, and is designed to cope with rough seafloor (use of bobbin and rockhopper ground gear) and large catches. Electronics have also developed extensively in the last 2 decades, with, for example, echosounders, GPS, and net-monitoring equipment making deep fishing much more efficient and effective.

*****Note that this section could be updated further based on various New Zealand and Australian documents (e.g. SPRFMO-IV-SWG-05), or simply cross referenced to the orange roughy profile (which is typically the target species where oreos are caught on the high seas).***

4.3 Catch history

Target trawl fisheries, as well as being a major bycatch of the orange roughy fishery, for oreos have occurred in the South Pacific since the early 1980s to the present day.

*****Note that this section needs to be updated further based on various documents (e.g. SPRFMO-IV-SWG-05 which reports oreo specific data available from Australia, Cook Islands, Korea, New Zealand and the Ukraine.***

4.4 Stock status

Australia

The Australian stock(s) status within zone is not known or uncertain – insufficient information is available to make a judgment.

New Zealand

The New Zealand stocks within zone range from moderately to fully exploited. For full details on a stock-by-stock basis see Ministry of Fisheries (2007).

High Seas Stocks

The status of most high seas stocks is uncertain, but likely range from underexploited to overexploited.

4.5 Threats

No threat status known.

4.6 Fishery value

New Zealand

In 2005 the export values for black oreo were NZ$ 3 128 434. The mean unit value ranged between 0.5 and 7.9 depending on the landed state, with chilled fillets being of the highest value (New Zealand Seafood Exports Report 5A, 2005).

In 2005 the export values for smooth oreo were NZ$ 14 130 106. The mean unit value ranged between 6.4 and 9.8 depending on the landed state, with chilled fillets being of the highest value (New Zealand Seafood Exports Report 5A, 2005).

5 <u>Current Fishery Status and Trends</u>

5.1 Stock size

There are estimates of population size for various stocks of oreo within the New Zealand EEZ (Ministry of Fisheries 20067). Methods used to provide estimates of absolute or relative abundance include bottom trawl surveys, analyses of commercial catch and effort data, and acoustic surveys.

There are currently no estimates available for the high seas.

5.2 Estimates of relevant biological reference points

There are no current estimates for the high seas, however, for estimates inside the New Zealand EEZ see Ministry of Fisheries (2007).

5.2.1 Fishing mortality

There are no current estimates.

5.2.2 Biomass

There are no current estimates.

5.2.3 Other relevant biological reference points

There are no current estimates.

6 Impacts of Fishing

6.1 Incidental catch of associated and dependent species

No estimates available.

6.2 Unobserved mortality of associated and dependent species

It is likely that deep-sea corals, other benthic fauna, fish and unobserved seabird mortalities go unrecorded.

6.3 Bycatch of commercial species

On the basis of New Zealand catch effort data for the high seas only, the main commercial bycatch species taken when targeting oreos during the period 1994 - 2005 included other oreos, orange roughy and alfonsino.

On the basis of New Zealand catch effort data for the high seas only, other bycatch species taken when targeting oreos during the period 1994 - 2005 included cardinalfish, hake, hoki, rattails, ribaldo, other deepwater sharks and dogfishes.

6.4 Habitat damage

The main method used to catch this species is a high-opening trawl generally fished close to or on the bottom. Trawling for this species on seamounts impacts habitat (Clark and O'Driscoll 2003; Koslow et al. 2001), but the precise impact of this on the oreo populations or other species on the seamounts is unknown.

Studies have shown that repeated trawl disturbances alter the benthic community by damaging or removing macro-fauna and encouraging anaerobic bacterial growth (see review by Cryer et al. (in prep). Severe damage of coral cover from bottom trawl fishing inside the Australian EEZ has been documented (Koslow et al. 2001). Video images reveal bare rock and pulverized coral rubble where bottom trawling has occurred.

Bottom trawling also tends to homogenise the sediment, which damages the habitat for certain fauna. Benthic processes, such as the transfer of nutrients, remineralisation, oxygenation and productivity, which occur in undisturbed, healthy sediments, are also impaired (Cryer et al. in prep).

As fishing gear disturbs soft sediment they produce sediment plumes and re-mobilise previously buried organic and inorganic matter. This increase in the rates of nutrients into the water column has important consequences for the rates of biogeochemical cycling (Kaiser et al. 2002).

The actual extent of bottom trawling on different sediment types, how widespread the issue may be, and rates of recovery are all unknown.

6.5 Trophic relationships

*****Note that this section is yet to be completed***

7 <u>Management</u>

7.1 Existing management measures inside EEZs

Landings of oreos from the New Zealand and Australian EEZs are regulated by TAC's.

7.2 Existing management measures in areas beyond national jurisdiction

There are no regulations regarding limits on catch in international waters with the exception of the South Tasman Rise region. This area has been subject to catch restrictions for Australian and New Zealand vessels under a Memorandum of Understanding between the two countries (Arrangement between the Government of New Zealand and the Government of Australia for the Conservation and Management of Orange Roughy on the South Tasman Rise).

7.3 Fishery management implications

All the oreo species examined above are characterised by very low biological productivity relative to other teleosts. Their aggregating behaviour around prominent submarine features allows large catches to be taken easily. There are assumed to be numerous distinct stocks within and between EEZs. Hence, they are probably quite vulnerable to rapid overfishing and serial depletion.

No methods other than trawl have been used successfully to catch oreos. Controls on this method will directly impact the ability to harvest oreos.

7.4 Ecosystem Considerations

Two main issues exist in terms of ecosystem impacts: The first is changes in predator-prey relationships leading to shifts in food-web structure and other impacts associated with the extraction of large numbers of target and bycatch species. The second is the physical impact of fishing on the ocean bottom, in particular on rare or fragile corals and benthic organisms that drive the ecosystem (“ecosystem engineers”).

Little is known about the effects of removing large amounts of higher predators in deep sea ecosystems (Butler et al. 2001). However, fundamental shifts on fish assemblage have been documented along the continental shelf in the North Pacific. Average fish size, across a diversity of species, has declined 45% in 21 years due to fishing exploitation (Levin et al. 2006). In certain stocks orange roughy have been fished down to 30% of biomass, because this species is the dominant biomass in the community the impacts of over extraction could potentially be large. In particular, changes in predator-prey relationships that lead to shifts in food-web structure may not necessarily be reversed by the reduction of fishing pressure.

The physical impact of bottom trawling damages long lived species (such as deepwater sessile epi-fauna), which reduces habitat complexity. Structurally complex and stable habitats, such as deep water associated with seamounts, have the longest recovery trajectories in terms of the recolonisation of habitat by the associated fauna (Kaiser et al. 2002). At the beginning of the orange roughy fishery in the late 90’s on the South Tasman Rise observers estimated a bycatch of ~ 1.6 tonnes of coral for each hour or towing a trawl net (Clarke & Anderson, 2003). Extrapolated figures from this fishery demonstrate that over 10 000 tonnes of coral in the first year of the fishery was taken; this does not include coral damaged on the bottom. Clarke & O’Driscoll (2003) carried out photographic surveys on the Northwest Chatham Rise and found a strong contrast in coral cover between fished and unfished seamounts with 2-3% and 10% respectively.

The removal of topographic complexity may allow higher predation rates due to a reduction in available refuge, and therefore may adversely affect recruitment. This failure of recruitment, in addition to overexploitation, can lead to changes in community structure and decreases in biodiversity. Cryer et al (2002) found that invertebrate species richness and diversity was negatively correlated with fishing activity. Community structure can also be affected by sediment stirred up by bottom trawl gear that smothers bottom dwelling communities, which in turn can adversely affect feeding and or respiration of many benthic organisms. Geochemical cycles can also be altered.

Other potential ecosystem effects of fishing include: effects on abundance and body size distributions that can result in a fauna dominated by small sized individuals; genetic selection for different physical characteristics and reproductive traits; and effects on populations of non-target species as a result of by-catch or ghost fishing (Kaiser et al. 2002).

Overall, there is little scientific information on the long term impacts of bottom trawling, the overall productivity of deepwater systems and their resilience.

Currently no methods other than trawl have been used successfully to catch oreo, and no practices are employed to reduce the environmental impact of this fishery.

8 Research

8.1 Current and ongoing research

High seas

The only current research on high seas fisheries is examination of catch totals each year for New Zealand and Australian vessels. New Zealand has undertaken at sea observer coverage (including catch characterisation, effort data collection, non-target catch monitoring and sampling for biological data) of its high seas fishing fleet.

8.2 Research needs

There are currently no fishery independent surveys of high seas fisheries. Data are needed on biomass or trends in relative abundance in order to assess status of the stocks.

A research gap for oreos in general is a lack of understanding of recruitment. This knowledge gap is a critical uncertainty but it is largely intractable at this time.

9 Additional Remarks

At least one other oreo species, the warty oreo (*Allocyttus verrucosus*) is also taken in commercial oreo landings. It occurs on the southern Australian, northern New Zealand, and Chilean shelves, most commonly at depths greater than 1000 m (Anderson et al. 1998). It has similar biology and behaviour to the three oreo species described above (Clark et al. 1989, Kailola et al. 1993, Lyle & Smith 1997). It is smaller, and has limited commercial value.

Black oreo and smooth oreo are often found in association with other oreos, orange roughy (*Hoplostethus atlanticus*), and Baxter's dogfish (*Etmopterus baxteri*). Spiky oreo are often found in association with other oreos, orange roughy (*Hoplostethus atlanticus*), hoki (*Macruronus novaezelandiae*), javelinfish (*Lepidorhynchus denticulatus*), lookdown dory (*Cyttus traversi*), and ling (*Genypterus blacodes*).

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