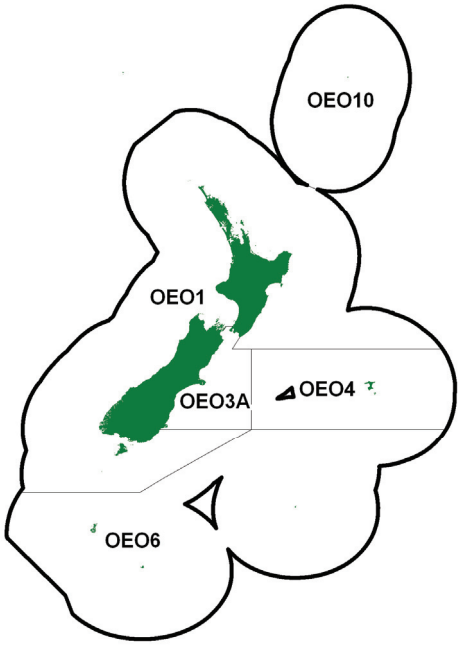
OREOS (OEO)

(*Allocyttus niger*, *Neocyttus rhomboidalis* and *Pseudocyttus maculatus*)



1. INTRODUCTION

The main black oreo and smooth oreo fisheries have been assessed separately and individual reports produced for each as follows:

1. OEO 3A black oreo and smooth oreo
2. OEO 4 black oreo and smooth oreo
3. OEO 1 and OEO 6 black oreo and smooth oreo

2. BIOLOGY

2.1 Black oreo

Occur from 600 to 1300 m depth. The geographical distribution south of about 45° S is not well known. It is a southern species and is abundant on the south Chatham Rise, along the east coast of the South Island, the north and east slope of Pukaki Rise, the Bounty Platform, the Snares slope, Puysegur Bank and the northern end of the Macquarie Ridge. They probably occur right round the slope of the Campbell Plateau.

Spawning occurs from late October to at least December and is widespread on the south Chatham Rise. Mean length at maturity for females, estimated from Chatham Rise trawl surveys (1986–87, 1990, 1991–93) using macroscopic gonad staging, is 34 cm TL.

They appear to have a pelagic juvenile phase, but little is known about this phase because only about 12 fish less than 21 cm TL have been caught. The pelagic phase may last for 4–5 years to lengths of 21–26 cm TL.

Unvalidated age estimates were obtained for Chatham Rise and Puysegur-Snares fish in 1995 and 1997 respectively using counts of the zones (assumed to be annual) observed in thin sections of otoliths. These estimates indicate that black oreo is slow growing and long lived. Maximum estimated age was 153 years (45.5 cm TL fish). Australian workers used the same methods, i.e., sections of otoliths, and reported similar results.
A von Bertalanffy growth curve was fitted to the Puysegur samples only (Table 1). Estimated age at maturity for females was 27 years.

A first estimate of natural mortality (*M*), 0.044 (yr^{-1}), was made in 1997 using the Puysegur growth data only. This estimate is uncertain because it appeared that the otolith samples were taken from a well fished part of the Puysegur area.

Black oreo appear to settle over a wide range of depths on the south Chatham Rise, but appear to prefer to live in the depth interval 600–800 m that is often dominated by individuals with a modal size of 28 cm TL.

2.2 Smooth oreo

Occur from 650 to about 1500 m depth. The geographical distribution south of about 45° S is not well known. It is a southern species and is abundant on the south Chatham Rise, along the east coast of the South Island, the north and east slope of Pukaki Rise, the Bounty Platform, the Snares slope, Puysegur Bank and the northern end of the Macquarie Ridge. They probably occur right round the slope of the Campbell Plateau.

Spawning occurs from late October to at least December and is widespread on the south Chatham Rise in small aggregations. Mean length at maturity for females, estimated from Chatham Rise trawl surveys (1986–87, 1990, 1991–93) using macroscopic gonad staging, is 40 cm TL.

They appear to have a pelagic juvenile phase, but little is known about this phase because only about six fish less than 16 cm TL have been caught. The pelagic phase may last for 5–6 years to lengths of 16–19 cm TL.

Unvalidated age estimates were obtained for Chatham Rise and Puysegur-Snares fish in 1995 and 1997 respectively using counts of the zones (assumed to be annual) observed in thin sections of otoliths. These estimates indicate that smooth oreo is slow growing and long lived. Maximum estimated age was 86 years (51.3 cm TL fish). Australian workers used the same methods, i.e., sections of otoliths, and reported similar results.

A von Bertalanffy growth curve was fitted to the age estimates from Chatham Rise and Puysegur-Snares fish combined and the parameters estimated for the growth curve are in Table 1. Estimated age at maturity for females was 31 years.

An estimate of natural mortality, 0.063 (yr^{-1}), was made in 1997. The estimate was from a moderately exploited population of fish from the Puysegur region. The Puysegur fishery started in 1989–90 and by August-September 1992 (when the otoliths were sampled) about 24% of the smooth oreo catch from 1989–90 to 1995–96 had been taken. Future estimates of *M* should, if possible, be made from an unexploited population.

There are concentrations of recently settled smooth oreo south and south west of Chatham Island, although small individuals (16–19 cm TL) occur widely over the south Chatham Rise at depths of 650–800 m.

Table 1: Biological parameters used for black oreo and smooth oreo stock assessments. –, not estimated.

Fishstock									Estimate
1. Natural Mortality – *M* (yr^{-1})									
	Females			Males			Unsexed		
Black oreo	0.044			0.044			0.044		
Smooth oreo	0.063			0.063					
2. Age at recruitment – A_r (yr)									
Black oreo	–			–			–		
Smooth oreo	21			21					
3. Age at maturity A_M (yr)									
Black oreo	27			–			–		
Smooth oreo	31			–					
4. von Bertalanffy parameters									
	Females			Males			Unsexed		
	$L_{¥(cm, TL)}$	$k(yr^{-1})$	t_0 (yr)	$L_{¥(cm, TL)}$	$k(yr^{-1})$	t_0 (yr)	$L_{¥(cm, TL)}$	$k(yr^{-1})$	t_0 (yr)
Black oreo	39.9	0.043	-17.6	37.2	0.056	-16.4	38.2	0.05	-17.0
Smooth oreo	50.8	0.047	-2.9	43.6	0.067	-1.6			
5. Length-weight parameters (Weight = $a(length)^b$ (Weight in g, length in cm fork length).)									
	Females			Males			Unsexed		
	a		b	a		b	a		b
Black oreo	0.008		3.28	0.016		3.06	0.0078		3.27
Smooth oreo	0.029		2.90	0.032		2.87			
6. Length at recruitment (cm, TL)									
	Females			Males			Unsexed		
Black oreo	-			-			-		
Smooth oreo	34			-					
7. Length at maturity (cm, TL)									
Black oreo	34			-			-		
Smooth oreo	40			-			-		
8. Recruitment variability (σ_R)									
Black oreo	0.65			0.65			0.65		
Smooth oreo	0.65			0.65					
9. Recruitment seeepness									
Black oreo	0.75			0.75			0.75		
Smooth oreo	0.75			0.75					
10. Fishing mortality (F_{max} (yr^{-1}))									
Black oreo	0.9			0.9			–		
Smooth oreo	0.9			0.9					
11. Max exploitation (E_{max} (yr^{-1}))									
Black oreo	-			-			0.67		

3. STOCKS AND AREAS

3.1 Black oreo

Stock structure of Australian and New Zealand samples was examined using genetic (allozyme and mitochondrial DNA) and morphological counts (fin rays, etc.). It was concluded that the New Zealand samples constituted a stock distinct from the Australian sample based on "small but significant difference in mtDNA haplotype frequencies (with no detected allozyme differences), supported by differences in pyloric caeca and lateral line counts". The genetic methods used may not be suitable tools for stock discrimination around New Zealand.

A New Zealand pilot study examined stock relationships using samples from four management areas (OEO 1, OEO 3A, OEO 4 & OEO 6) 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. Lateral line scale and pyloric caeca counts were different between samples from OEO 6 and the other three areas. The relative abundance of three parasites differed significantly between all areas. Otolith shape from OEO 3A samples was different to that from OEO 1

and OEO 4, but OEO 1, OEO 4 and OEO 6 otolith samples were not morphologically different. Genetic, otolith microchemistry, and settlement zone analyses showed no regional differences.

3.2 Smooth oreo

Stock structure of Australian and New Zealand samples was examined using genetic (allozyme and mitochondrial DNA) and morphological counts (fin rays, etc.). No differences between New Zealand and Australian samples were found using the above techniques. A broad scale stock is suggested by these results but this seems unlikely given the large distances between New Zealand and Australia. The genetic methods used may not be suitable tools for stock discrimination around New Zealand.

A New Zealand pilot study examined stock relationships using samples from four management areas (OEO 1, OEO 3A, OEO 4 & OEO 6) 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. Otolith shape from OEO 1 and OEO 6 was different to that from OEO 3A and OEO 4 samples. Weak evidence from parasite data, one gene locus and otolith microchemistry suggested that northern OEO 3A samples were different from other areas. Lateral line scale and otolith settlement zone counts showed no differences between areas.

These data suggest that the stock boundaries given in previous assessment documents should be retained until more definitive evidence for stock relationships is obtained, i.e., retain the areas OEO 1, OEO 3A, OEO 4, and OEO 6 (see the figure on the first page of the Oreos assessment report above).

The three species of oreos (black oreo, smooth oreo and spiky oreo) are managed as if they were one stock. Each species could be managed separately. They have different depth and geographical distributions, different stock sizes, rates of growth, and productivity.

4. FISHERY SUMMARY

4.1 Commercial fisheries

Commercial fisheries occur for black oreo (BOE) and smooth oreo (SSO). Oreos are managed as a species group, which includes spiky oreo (SOR). The Chatham Rise (OEO 3A and OEO 4) is the main fishing area, but other fisheries occur off Southland on the east coast of the South Island (OEO 1/OEO 3A), and on the Pukaki Rise, Macquarie Ridge, and Bounty Plateau (OEO 6).

Total reported landings of oreos and TACs are shown in Table 2, while Figure 1 depicts the historical landings and TACC values for the main OEO stocks. Total oreo catch from OEO 4 exceeded the TAC from 1991–92 to 1994–95 and was close to the TAC from 1995–96 to 2000–01 (Table 2). Catch remained high in OEO 4 while the orange roughy fishery has declined. The OEO 4 TAC was reduced from 7000 to 5460 in 2001–02 but was restored to 7000 t in 2003–04. The oreo catch from OEO 3A was less than the TAC from 1992–93 to 1995–96, substantially so in 1994–95 and 1995–96. The OEO 3A TAC was reduced from 10,106 to 6600 t in 1996–97. A voluntary agreement between the fishing industry and the Minister of Fisheries to limit catch of smooth oreo from OEO 3A to 1400 t of the total oreo TAC of 6600 t was implemented in 1998–99. Subsequently the total OEO 3A TAC was reduced to 5900 t in 1999–00, 4400 in 2000–01, 4095 in 2001–02 and 3100 t in 2002–03. Catch from the Sub-Antarctic area (OEO 6) increased substantially in 1994–95 and exceeded the TAC in 1995–96. The OEO 6 TAC was increased from 3000 to 6000 t in 1996–97. There was also a voluntary agreement not to fish for oreos in the Puysegur area which started in 1998–99. OEO 1 was fished under the adaptive management programme up to the end of 1997–98. The OEO 1 TAC reverted back to pre-adaptive management levels from 1998–99.Catches have declined since then, and from 1 October 2007 the TACC was reduced to 2500 t.

Reported estimated catches by species from tow by tow data recorded in catch and effort logbooks (Deepwater, TCEPR, and CELR) and the ratio of estimated to landed catch reported are given in Table 3.

Table 2: Total reported landings (t) for all oreo species combined by Fishstock from 1978–79 to 2008–09 and TACs (t) from 1982–83 to 2008–09.

Fishing	OEO 1		OEO 3A		OEO 4		OEO 6	
year	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1978–79*	2 808	–	1 366	–	8 041	–	17	–
1979–80*	143	–	10 958	–	680	–	18	–
1980–81*	467	–	14 832	–	10 269	–	283	–
1981–82*	21	–	12 750	–	9 296	–	4 380	–
1982–83*	162	–	8 576	10 000	3 927	6 750	765	–
1983–83#	39	–	4 409	#	3 209	#	354	–
1983–84†	3 241	–	9 190	10 000	6 104	6 750	3 568	–
1984–85†	1480	–	8 284	10 000	6 390	6 750	2 044	–
1985–86†	5 390	–	5 331	10 000	5 883	6 750	126	–
1986–87†	532	4 000	7 222	10 000	6 830	6 750	0	3 000
1987–88†	1 193	4 000	9 049	10 000	8 674	7 000	197	3 000
1988–89†	432	4 233	10 191	10 000	8 447	7 000	7	3 000
1989–90†	2 069	5 033	9 286	10 106	7 348	7 000	0	3 000
1990–91†	4 563	5 033	9 827	10 106	6 936	7 000	288	3 000
1991–92†	4 156	5 033	10 072	10 106	7 457	7 000	33	3 000
1992–93†	5 739	6 044	9 290	10 106	7 976	7 000	815	3 000
1993–94†	4 910	6 044	9 106	10 106	8 319	7 000	983	3 000
1994–95†	1 483	6 044	6 600	10 106	7 680	7 000	2 528	3 000
1995–96†	4 783	6 044	7 786	10 106	6 806	7 000	4 435	3 000
1996–97†	5 181	6 044	6 991	6 600	6 962	7 000	5 645	6 000
1997–98†	2 681	6 044	6 336	6 600	7 010	7 000	5 222	6 000
1998–99†	4 102	5 033	5 763	6 600	6 931	7 000	5 287	6 000
1999–00†	3 711	5 033	5 859	5 900	7 034	7 000	5 914	6 000
2000–01†	4 852	5 033	4 577	4 400	7 358	7 000	5 932	6 000
2001–02†	4 197	5 033	3 923	4 095	4 864	5 460	5 737	6 000
2002–03†	3 034	5 033	3 070	3 100	5 402	5 460	6 115	6 000
2003–04†	1 703	5 033	2 856	3 100	6 735	7 000	5 811	6 000
2004–05†	1 025	5 033	3 061	3 100	7 390	7 000	5 744	6 000
2005–06†	850	5 033	3 333	3 100	6 829	7 000	6 463	6 000
2006–07†	903	5 033	3 073	3 100	7 211	7 000	5 926	6 000
2007–08†	947	2 500	3 092	3 100	7 038	7 000	5 902	6 000
2008–09†	582	2 500	2 848	3 100	6 907	7 000	5 540	6 000

Fishing	Totals	
year	Landings	TAC
1978–79*	12 231	–
1979–80*	11 791	–
1980–81*	25 851	–
1981–82*	26 514	–
1982–83*	13 680	17 000
1983–83#	8 015	#
1983–84†	22 111	17 000
1984–85†	18 204	17 000
1985–86†	16 820	17 000
1986–87†	15 093	24 000
1987–88†	19 159	24 000
1988–89†	19 077	24 233
1989–90†	18 703	25 139
1990–91†	21 614	25 139
1991–92†	21 718	25 139
1992–93†	23 820	26 160
1993–94†	23 318	26 160
1994–95†	18 291	26 160
1995–96†	23 810	26 160
1996–97†	24 779	25 644
1997–98†	21 249	25 644
1998–99†	22 083	24 633
1999–00†	22 518	23 933
2000–01†	22 719	22 433
2001–02†	18 721	20 588
2002–03†	17 621	19 593
2003–04†	17 105	21 133
2004–05†	17 220	21 133
2005–06†	17 475	21 133
2006–07†	17 113	21 133
2007–08†	16 979	18 600
2008–09†	15 877	18 600

Source: FSU from 1978–79 to 1987–88; QMS/MFish from 1988–89 to 2005–06. *, 1 April to 31 March. #, 1 April to 30 September. Interim TACs applied. †, 1 October to 30 September. Data prior to 1983 were adjusted up due to a conversion factor change.

Table 3: Reported estimated catch (t) by species (smooth oreo (SSO), black oreo (BOE) by Fishstock from 1978–79 to 2007–08 and the ratio (percentage) of the total estimated SSO plus BOE, to the total reported landings (from Table 1). –, less than 1. No catch split available for 2008-09.

	SSO				BOE			
Year	OEO 1	OEO 3A	OEO 4	OEO 6	OEO 1	OEO 3A	OEO 4	OEO 6
1978–79*	0	0	0	0	9	0	0	0
1979–80*	16	5 075	114	0	118	5 588	566	18
1980–81*	1	1 522	849	2	66	8 758	5 224	215
1981–82*	21	1 283	3 352	2	0	11 419	5 641	4 378
1982–83*	28	2 138	2 796	60	6	6 438	1 088	705
1983–83#	9	713	1 861	0	1	3 693	1 340	354
1983–84†	1 246	3 594	4 871	1 315	1 751	5 524	1 214	2 254
1984–85†	828	4 311	4 729	472	544	3 897	1 651	1 572
1985–86†	4 257	3 135	4 921	72	1 060	2 184	961	54
1986–87†	326	3 186	5 670	0	163	4 026	1 160	0
1987–88†	1 050	5 897	7 771	197	114	3 140	903	0
1988–89†	261	5 864	6 427	–	86	2 719	1 087	0
1989–90†	1 141	5 355	5 320	–	872	2 344	439	–
1990–91†	1 437	4 422	5 262	81	2 314	4 177	793	222
1991–92†	1 008	6 096	4 797	2	2 384	3 176	1 702	15
1992–93†	1 716	3 461	3 814	529	3 768	3 957	1 326	69
1993–94†	2 000	4 767	4 805	808	2 615	4 016	1 553	35
1994–95†	835	3 589	5 272	1 811	385	2 052	545	230
1995–96†	2 517	3 591	5 236	2 562	1 296	3 361	364	1 166
1996–97†	2 203	3 063	5 390	2 492	2 578	3 549	530	1 950
1997–98†	1 510	4 790	5 868	2 531	1 027	1 623	811	1 982
1998–99†	2 958	2367	5 613	3 462	820	3 147	844	1 231
1999–00†	2 533	1 733	5 985	4 306	970	3 943	628	1 043
2000–01†	4 012	1 648	5 924	4 183	332	3 005	799	1 128
2001–02†	2 973	1 769	3 806	4 470	697	2 378	515	983
2002–03†	2 521	1 395	4 105	3 941	481	1 636	868	1 640
2003–04†	1 046	1 244	5 082	3 767	458	1 590	973	1 496
2004–05†	665	1 447	5 848	3 840	234	1 594	851	1 580
2005–06†	529	1 354	5 145	3 289	265	1 770	763	2 616
2006–07†	530	1 220	5 863	2 214	263	1 651	795	3 071
2007–08†	407	1 482	6 150	2 182	429	1 521	592	3 022

Year	Total estimated	Estimated landings (%)
1978–79*	9	–
1979–80*	11 495	98
1980–81*	16 637	64
1981–82*	26 096	98
1982–83*	13 259	97
1983–83#	7 971	100
1983–84†	21 769	99
1984–85†	18 004	99
1985–86†	16 644	99
1986–87†	14 531	96
1987–88†	19 072	100
1988–89†	16 444	86
1989–90†	15 471	83
1990–91†	18 708	87
1991–92†	19 180	88
1992–93†	18 640	78
1993–94†	20 599	88
1994–95†	14 719	81
1995–96†	20 093	84
1996–97†	21 755	88
1997–98†	20 142	95
1998–99†	20 442	93
1999–00†	21 142	94
2000–01†	21 031	93
2001–02†	17 591	94
2002–03†	16 587	94
2003–04†	15 656	92
2004–05†	16 059	93
2005–06†	15 731	90
2006–07†	15 607	91
2007–08†	15 785	93

Source: FSU from 1978–79 to 1987–88 and MFish from 1988–89 to 2006–07

* 1 April to 31 March. #, 1 April to 30 September. †, 1 October to 30 September.

Descriptive analyses of the main New Zealand oreo fisheries were updated with data from 2006–07 in 2008. Standardised CPUE analyses of black and smooth oreo have been updated as follows:

- smooth oreo in OEO 3A in 2009
- black oreo in OEO 4 in 2009
- black oreo in OEO 6 (Pukaki) in 2009
- smooth oreo OEO 6 (Bounty) in 2008
- black oreo in OEO 3A in 2008
- smooth oreo in OEO 4 in 2007
- smooth oreo in Southland (OEO 1 and OEO 3A)in 2007
- smooth oreo OEO 6 (Pukaki) in 2006

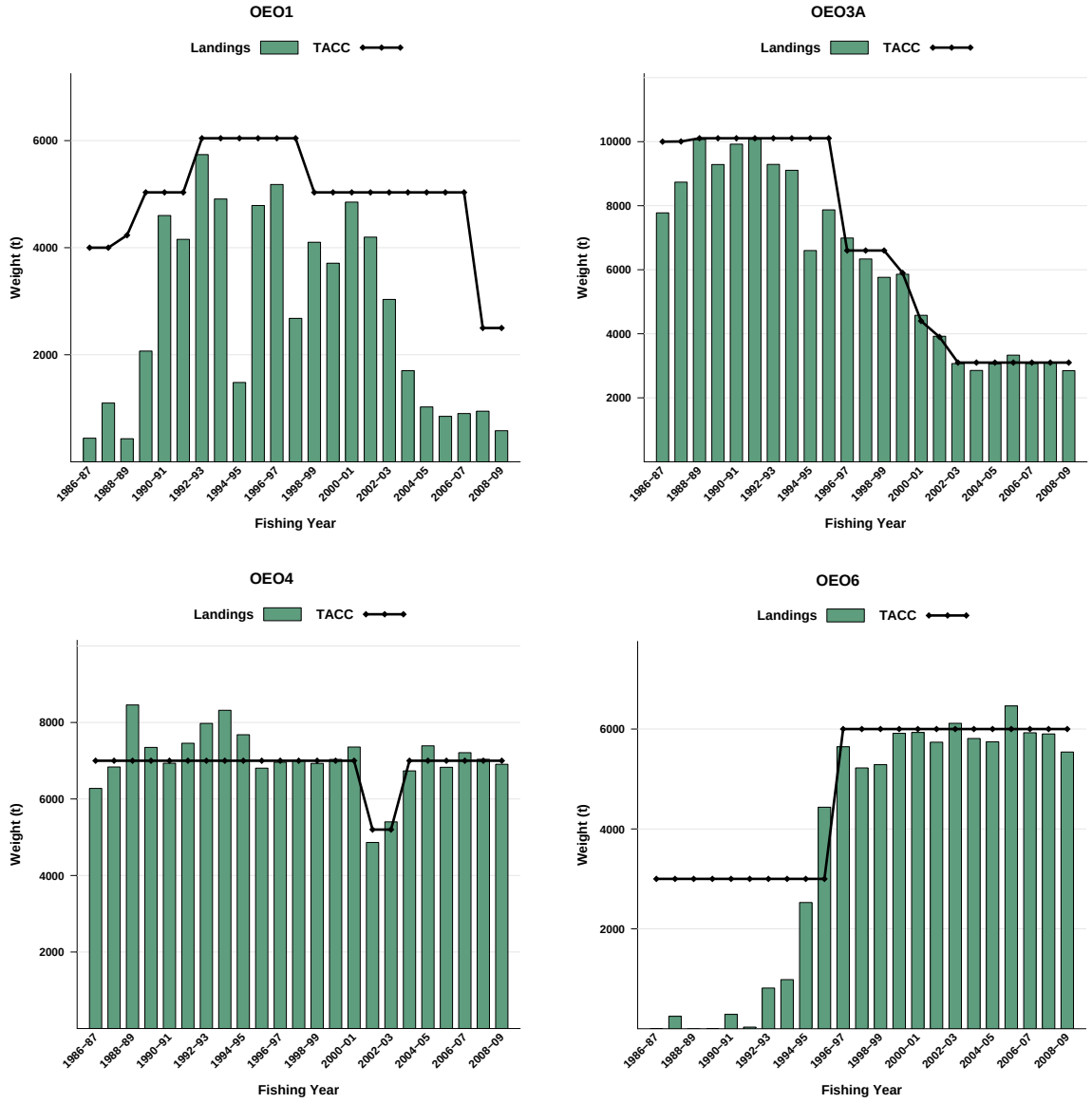


Figure 1: Historical landings and TACC for the four main OEO stocks. From top left to bottom right: OEO1 (Central East - Wairarapa, Auckland, Central Egmont, Challenger, Southland, South East Catlin Coast), OEO3A (South East Cook Strait/Kaikoura/Strathallan), OEO4 (South East Chatham Rise), and OEO6 (Sub-Antarctic). Note that these figures do not show data prior to entry into the QMS.

4.2 Recreational fisheries

There are no known recreational fisheries for black oreo and smooth oreo.

4.3 Customary non-commercial fisheries

There is no known customary non-commercial fishing for black oreo and smooth oreo.

4.4 Illegal catch
Estimates of illegal catch are not available.

4.5 Other sources of mortality
Dumping of unwanted or small fish and accidental loss of fish (lost codends, ripped codends, etc.) were features of oreo fisheries in the early years. These sources of mortality were probably substantial in those early years but are now thought to be relatively small. No estimate of mortality from these sources has been made because of lack of hard data and because they now appear to be small. Estimates of discards of oreos were made for 1994–95 and 1995–96 from MFish observer data. This involved calculating the ratio of discarded oreo catch to retained oreo catch and then multiplying the annual total oreo catch from the New Zealand EEZ by this ratio. Estimates were 207 and 270 t for 1994–95 and 1995–96 respectively.

5. ENVIRONMENTAL EFFECTS OF FISHING

This section is new for the May 2010 Plenary and has been considered by the Aquatic Environment Working Group (AEWG). It includes only a summary of the incidental bycatch of marine mammals and seabirds in this fishery and does not consider other potential environmental effects. A more detailed assessment of environmental effects across all fisheries will be available in the Ministry's Aquatic Environment Plenary that is under development.

5.1 Role in the ecosystem
Not discussed by the AEWG.

5.2 Incidental catch (fish and invertebrates)
Not discussed by the AEWG.

5.3 Incidental catch (seabirds and mammals)
This section provides an overview of the incidental captures of seabirds and marine mammals in deepwater fisheries; this grouping of fisheries covers orange roughy, oreo species and cardinal fish. Capture estimates include only those animals landed (alive, injured or dead) on fishing vessels but may not include all sources of cryptic mortality e.g. seabirds struck by the warp but not landed onboard the vessel. Various projects have estimated the total incidental captures in this fishery. This section refers to ratio estimates of incidental captures for all years and model based estimates where available (for methods see MacKenzie and Fletcher 2006, Abraham et al. 2010, Thompson et al. in press).

Annual observed seabird capture rates ranged from 0.07 to 3.47 per hundred tows in deepwater fisheries during the period from 1998-99 to 2007-08. Estimated means of total annual captures ranged from 10 to 74 seabirds (ratio estimated) and 38 to 91 (model estimated) (Table 4). Note that the confidence intervals have reduced as observer coverage rates have increased throughout the period.

Seabird species that were observed caught in the hoki fishery from 1998-99 to 2007-08 are (with total numbers of each species observed caught during this period); white-chinned petrel (24), cape petrels (16), black-browed albatross (unidentified) (12), albatrosses (unidentified) (5), grey petrel (3), Salvin's albatross (3), white-capped albatross (3), seabird – large (2), common diving petrel (2), Chatham Island albatross (2), Buller's albatross (2), Gibson's albatross (1), petrel (unidentified) (1), giant petrels (unidentified) (1), Pacific albatross (1), white-faced storm petrel (1), seabird – small (1), sooty shearwater (1), storm petrels (1), shy albatross (1), and other species (2) (Abraham et al. 2010). Note that identification to species or group level is done by observers onboard and some birds are not readily identifiable.

Annual observed fur seal capture rates ranged from 0.00 to 0.30 per hundred tows in deepwater fisheries during the period from 1998-99 to 2007-08. Estimates of total annual captures ranged from 0 to 13 fur seals (Table 5).

5.4 Benthic interactions

These deepwater fishes are taken almost entirely using bottom trawls but a summary has not been discussed by the AEWG

5.5 Other considerations

Not discussed by the AEWG.

Table 4: Summary of all bird captures in the deepwater trawl fishery, for 10 fishing years, with the number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per hundred tows, total estimated captures with 95% confidence intervals, percentage of tows included in the estimate (from Abraham et al. 2010) and model based estimates of captures with 95% confidence intervals for ORH target trawling by vessels over 28 m (from MacKenzie & Fletcher 2006).

	Observed					Ratio estimated			Model based estimate	
	Tows	No. obs	% obs	Captures	Rate	Captures (95% c.i.)		% effort in est.	Captures (95% c.i.)	
1998–99	13 714	1 010	7.4	35	3.47	74	(44 - 124)	99.4	91	(66 - 130)
1999–00	12 505	1 934	15.5	5	0.26	53	(20 - 102)	99.3	38	(22 - 61)
2000–01	8 925	1 187	13.3	4	0.34	30	(13 - 52)	99.2	71	(44 - 112)
2001–02	8 220	1 377	16.8	6	0.44	34	(17 - 54)	99.2	50	(29 - 86)
2002–03	8 867	1 380	15.6	1	0.07	13	(6 - 21)	99.6	47	(27 - 81)
2003–04	8 006	1 261	15.8	3	0.24	29	(12 - 52)	99.8	60	(37 - 94)
2004–05	8 406	1 618	19.2	19	1.17	86	(39 - 157)	99.7		
2005–06	8 291	1 292	15.6	5	0.39	33	(13 - 57)	99.2		
2006–07	7 477	2 320	31	1	0.04	10	(2 - 23)	99.7		
2007–08	6 743	2 810	41.7	6	0.21	16	(11 - 23)	99.4		

Table 5: Summary of New Zealand fur seal captures in the deepwater trawl fishery, for 10 fishing years, with the number of tows, number of tows observed, percentage of tows observed, number of observed captures, capture rate per hundred tows, total estimated captures with 95% confidence intervals, percentage of tows included in the estimate (from Abraham et al. 2010) and model based estimates of captures with 95% confidence intervals (from Thompson et al. in press).

	Observed					Ratio estimated			Model based estimate	
	Tows	No. obs	% obs	Captures	Rate	Captures (95% c.i.)		% effort in est.	Captures (95% c.i.)	
1998–99	13 714	1 010	7.4	3	0.3	4	(3 - 5)	92.9		
1999–00	12 505	1 934	15.5	0	0	0	(0 - 1)	99.3		
2000–01	8 925	1 187	13.3	1	0.08	1	(1 - 2)	89		
2001–02	8 220	1 377	16.8	0	0	0	(0 - 1)	91.1		
2002–03	8 867	1 380	15.6	0	0	0	(0 - 1)	99.6	5	(0 -16)
2003–04	8 006	1 261	15.8	2	0.16	11	(2 - 25)	99.8	10	(3 - 28)
2004–05	8 406	1 618	19.2	4	0.25	13	(6 - 23)	99.7	17	(6 - 41)
2005–06	8 291	1 292	15.6	2	0.15	11	(2 - 23)	99.2	11	(3 - 29)
2006–07	7 477	2 320	31	2	0.09	3	(2 - 5)	99.7	4	(2 - 8)
2007–08	6 743	2 810	41.7	4	0.14	7	(4 - 11)	99.4	7	(4 - 15)

6. FOR FURTHER INFORMATION

Clark MR., Anderson OF., Gilbert DJ. 2000. Discards in trawl fisheries for southern blue whiting, orange roughy, hoki, and oreos in waters around New Zealand. NIWA Technical Report 71. 73p.

Coburn RP., McMillan PJ. 2006. Descriptions of the black oreo and smooth oreo fisheries in OEO 1, OEO 3A, OEO 4, and OEO 6 from 1977–78 to the 2004–05 fishing years. New Zealand Fisheries Assessment Report 2006/60. 70p.

Coburn RP., McMillian PJ., Gilbert DJ. 2007. Inputs for a stock assessment of smooth oreo, Pukaki Rise (part of OEO 6). New Zealand Fisheries Assessment Report 2007/23. 32p

Doonan IJ., McMillan PJ., Hart AC. 1997. Revision of smooth oreo life history parameters. New Zealand Fisheries Assessment Research Document 1997/9. 11p.

Doonan IJ., McMillian PJ., Hart AC. 2008. Aeging of smooth oreo otoliths for stock assessment. New Zealand Fisheries Assessment Report 2008/08. 29p.

Doonan IJ., McMillan PJ., Kalish JM., Hart AC. 1995. Age estimates for black oreo and smooth oreo. New Zealand Fisheries Assessment Research Document. 1995/14. 26p.

Hart AC., McMillan PJ. 2006. A summary of observer biological information on the New Zealand black oreo and smooth oreo fisheries from 1979–80 to 2004–05. New Zealand Fisheries Assessment Report 2006/55. 39p.

McKenzie A. 2007. Stock assessment for east Pukaki Rise smooth oreo (part of OEO 6). New Zealand Fisheries Assessment Report 2007/34. 27p.

McMillan PJ., Doonan IJ., Hart AC. 1997. Revision of black oreo life history parameters. New Zealand Fisheries Assessment Research Document 1997/8. 13p.

Smith P., Proctor C., Robertson S., McMillan P., Bull B., Diggles B. 2000. Stock relationships of black oreo in New Zealand waters. Final Research Report for Ministry of Fisheries Research Project DEE9801. Objective 1 (Part two). 79p.

Smith P., McMillan P., Proctor C., Robertson S., Knuckey I., Diggles B., Bull B. 1999. Stock relationships of smooth oreo in New Zealand waters. Final Research Report for Ministry of Fisheries Research Project DEE9801. 76p.

Stewart BD., Smith DC. 1994. Development of methods to age commercially important dories and oreos. Final Report to the Fisheries Research and Development Corporation.

Ward RD., Elliot NG., Yearsley GK., Last PR. 1996. Species and stock delineation in Australasian oreos (Oreosomatidae). Final Report to Fisheries Research and Development Corporation. 144p.