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Oreo stock assessment

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7. Executive Summary

MFish catch and effort data for the black oreo and smooth oreo fisheries carried out in OEO 1, OEO 3A, OEO 4 and OEO 6 were analysed and a report describing the fisheries was completed for the years 1977–78 to 1996–97.

Observer length frequency data for black oreo and smooth oreo from OEO 3A and OEO 4 were obtained from the MFish Observer length database and analysed for trends in mean length over time. Few trends were evident largely because of a lack of past data. No new research data were available to continue the series of mean lengths collected on past random trawl surveys. Most recent research data have been collected from target trawls and are therefore not comparable with past random trawl data.

A stock assessment for OEO 3A smooth oreo was conducted using an updated standardised CPUE analysis and updated catch. This assessment was expected to incorporate absolute abundance estimates derived from the 1997 acoustic survey (Project OEO9701). But the Deepwater Stock Assessment Working Group decided in March 1998 that the smooth oreo OEO 3A absolute abundance estimates were not ready to be used in an assessment. A stock assessment for OEO 4 smooth oreo was unchanged from that presented in 1997 because absolute abundance estimates from the 1997 acoustic survey (Project OEO9701) were not available.

Results of these assessments and the other oreo assessments were summarised in the "Oreos" section in Annala *et al.* (1998)

8. Objectives

PROGRAMME OBJECTIVES:

1. To carry out a stock assessment of black oreo and smooth oreo, including estimating biomass and sustainable yields.

OBJECTIVES FOR 1997–98:

1. To update the descriptive analysis of the commercial catch and effort data for black and smooth oreos from selected fisheries with the inclusion of data up to the end of the 1996–97 fishing year. These fisheries include OEO 1, OEO 3A, OEO 4 and OEO 6.

2. To analyse length frequency, sex ratio, and reproductive condition data for black oreo and smooth oreo collected by the Scientific Observer Programme and from other sources during the 1996–97 fishing year for input into stock assessment models.

3. To update the stock assessment of smooth oreo in OEO 3A and OEO 4, including estimating biomass and sustainable yields.

9. Methods

Objective 1
This objective involved two key activities. The first was to obtain summarised catch by species by area from MFish and to use the data to update existing tables in the Working Group Report. The second was to obtain oreo catch and effort data for OEO 1, OEO 3A, OEO 4 and OEO 6 from MFish, to analyse the data, and to prepare a description of the oreo fisheries in those areas. This descriptive work is covered in a separate report.

Objective 2
This objective involved two key activities. The first was to obtain, analyse and present black oreo and smooth oreo length, sex (and associated position, depth, etc) data collected from commercial catches by the MFish Scientific Observer programme. This involved a new analysis for black oreo from OEO 3A and OEO 4 with data requested from 1986–87 to 1996–97 and an updated analysis for smooth oreo from OEO 3A and OEO 4 with new data obtained from 1995–97. Data were obtained from the MFish Observer length database and were checked for errors before being analysed for mean annual length using the statistical package S. The following analyses were performed:

OEO 3A, smooth oreo and black oreo
Length and sex data were scaled by catch size, and were separated into male and female and that collected on Soviet and New Zealand vessels. These data were further subdivided by depth into deeper than and shallower than 900 m. The sets of data were stratified in this way to attempt to make them homogeneous and comparable. Mean length and 95% confidence intervals were calculated for each of the (up to eight) sets of data. Samples available for analysis for smooth oreo are in Table 1 and the number

of tows from which the samples were drawn are in Table 2. Corresponding sample information for black oreo are in Tables 3 and 4.

Table 1: Smooth oreo sample sizes (total numbers of male and female fish) collected by observers from New Zealand and Soviet vessels by depth by calendar year from OEO 3A . –, no data

Year	New Zealand		Soviet	
	<900 m	>900 m	<900 m	>900 m
1979	–	–	–	658
1986	–	–	–	134
1987	–	544	171	713
1988	–	1 132	276	132
1989	–	–	–	–
1990	268	2 656	–	–
1991	633	286	–	–
1992	–	–	–	–
1993	–	–	–	–
1994	100	261	–	–
1995	–	519	–	–
1996	–	107	–	–

Table 2: Smooth oreo sample sizes (numbers of tows) collected by observers from New Zealand and Soviet vessels by depth by calendar year from OEO 3A . –, no data

Year	New Zealand		Soviet	
	<900 m	>900 m	<900 m	>900 m
1979	–	–	–	25
1986	–	–	–	1
1987	–	6	1	4
1988	–	11	3	1
1989	–	–	–	–
1990	4	23	–	–
1991	6	3	–	–
1992	–	–	–	–
1993	–	–	–	–
1994	1	3	–	–
1995	–	5	–	–
1996	–	1	–	–

Table 3: Black oreo sample sizes (total numbers of male and female fish) collected by observers from New Zealand and Soviet vessels by depth by calendar year from OEO 3A . –, no data

Year	New Zealand		Soviet	
	<900 m	>900 m	<900 m	>900 m
1979	–	–	–	3 750
1986	–	–	707	271
1987	–	–	214	858
1988	100	694	4 178	312
1989	–	–	–	–
1990	512	950	–	–
1991	904	251	–	–
1992	–	–	–	–
1993	–	–	–	–
1994	–	175	–	–
1995	442	233	–	–
1996	114	–	–	–

Table 4: Black oreo sample sizes (numbers of tows) collected by observers from New Zealand and Soviet vessels by depth by calendar year from OEO 3A . –, no data

Year	New Zealand		Soviet	
	<900 m	>900 m	<900 m	>900 m
1979	–	–	–	34
1986	–	–	6	2
1987	–	–	1	5
1988	1	7	32	3
1989	–	–	–	–
1990	5	9	–	–
1991	8	3	–	–
1992	–	–	–	–
1993	–	–	–	–
1994	–	2	–	–
1995	4	3	–	–
1996	1	–	–	–

OEO 4 smooth oreo

Length and sex data were scaled by catch size, and were separated into male and female and were further subdivided into five areas chosen to group data from catches on either predominantly flat ground or seamounts as follows:

Area 1, flat ground and drop-offs from 178° E to 177° 08' W, excluding seamounts.

Area 2, mostly seamounts (Hegerville/Paranoia, etc) from 177° 08' W to 176° 16' W.

Area 3, mostly seamounts (Condom/Big chief, etc) from 176° 16' W to 175° W.

Area 4, mostly seamounts (Andes) from 175° W to 174° W.

Area 5, the seamounts present in Area 1 (Trev's/Kiso, etc) from 178° E to 177° 08' W.

The sets of data were stratified in this way to attempt to make them homogeneous and comparable. Mean length and 95% confidence intervals were calculated for each of the (up to ten) sets of data. Samples available for analysis are summarised in Table 5 and the number of tows from which the samples were drawn are in Table 6.

Table 5: Smooth oreo sample sizes (total numbers of male and female fish) collected by observers from five areas in OEO 4 by calendar year. –, no data

Area Year	1	2	3	4	5
1986	307	–	–	–	–
1987	–	–	–	–	–
1988	1 507	–	–	–	–
1989	1 024	–	–	–	–
1990	1 524	210	2 070	–	779
1991	1 651	495	105	4 030	531
1992	–	–	–	456	–
1993	36	308	1 743	2 775	–
1994	616	2 105	526	2 973	–
1995	1 231	934	751	528	330
1996	3 140	2 027	205	196	353

Table 6: Smooth oreo sample sizes (numbers of tows) collected by observers from five areas in OEO 4 by calendar year. –, no data

Area Year	1	2	3	4	5
1986	2	–	–	–	–
1987	–	–	–	–	–
1988	14	–	–	–	–
1989	5	–	–	–	–
1990	8	2	14	–	5
1991	6	4	1	28	3
1992	–	–	–	2	–
1993	1	3	14	24	–
1994	6	9	6	21	–
1995	8	5	5	5	4
1996	14	15	2	1	4

OEO 4 black oreo

There were insufficient Scientific Observer data for meaningful analysis.

The second key activity was to analyse length and sex data collected during research surveys. There has been a limited amount of oreo length/sex data collected on the Chatham Rise in the last 2 years. Trips that sampled oreos from the south and east Chatham Rise are listed in Table 7.

Table 7: Research surveys which trawled and measured samples of black oreo (BOE) and smooth oreo (SSO) on the Chatham Rise in 1996 and 1997. n is the number of fish measured

Voyage	Depth range (m)	Main species	SSO (n)	BOE (n)
TAN9601	210–786	HOK,LIN,SWA,HAK	321	1 039
TAN9602	89–754	HOK,LIN,SWA,HAK	0	76
TAN9701	209–793	HOK,LIN,SWA,HAK	206	568
TAN9705	168–1 100	ORH	101	579
TAN9713	620–1 250	BOE,SSO	5 250	6 266

Only two of these surveys (TAN9705 & TAN9713) aimed at catching deepwater species as the other three surveys were random trawl surveys of middle depth species and therefore only fished part of the depth range of black oreo and smooth oreo. TAN9705 had few samples of oreos as it was aimed at orange roughy. A substantial number of oreos were measured on TAN9713 during the acoustic survey of OEO 3A and part of OEO 4. The oreo catches taken during this survey were made during target trawling for species composition and mark identification and these data are not considered comparable with those collected during the previous series of south Chatham Rise random stratified trawl surveys. They can be considered the start of a new time series of length data.

Analyses of OEO 3A smooth oreo length/sex data from the 1986, 1987, 1990, 1991–93 and 1995 south Chatham Rise trawl surveys were presented in Doonan *et al.* (1995), Figure 8 and OEO 4 data in Doonan *et al.* (1997), Figure 4. Black oreo stocks on the Chatham Rise have not previously been assessed and consequently the research mean length data have not been presented to the Working Group.

<u>Objective 3</u>
There were two key activities planned for this objective. The first was to carry out a stock assessment of OEO 3A smooth oreo. This was expected to incorporate absolute abundance estimates from the acoustic survey of oreo stocks in OEO 3A carried out from 10 November to 19 December 1997. But the Deepwater Working Group agreed that because of the preliminary nature of the acoustic results, the 1997 acoustic abundance estimate would not be used in the 1998 assessment. An assessment was therefore presented to the Working Group based on a revised standardised CPUE analysis incorporating updated catch data.

The second key activity was to carry out a stock assessment of OEO 4 smooth oreo. This was also initially expected to incorporate absolute abundance estimates from the acoustic survey of oreo stocks carried out from 10 November to 19 December 1997. But OEO 4 was not fully surveyed and no absolute abundance estimate is available. The 1998 stock assessment presented in the 1998 Plenary Report (Annala *et al.* 1998) was therefore unchanged from that presented in 1997.

10. Results

<u>Objective 1</u>

Activity 1. Summarised oreo catch data were obtained from MFish and were compiled and then compared for consistency with previous years data before being added to Tables 1 & 2 in the Oreo Working Group Report (Annala *et al.* 1998).

Activity 2. The descriptive CPUE analysis of OEO 1, OEO 3A, OEO 4 and OEO 6 is reported separately.

<u>Objective 2</u>

Activity 1. The mean lengths and 95% confidence intervals for smooth oreo and black oreo data collected by observers are plotted in Figures 1–3.

<u>OEO 3A, smooth oreo (Figure 1)</u>
There is an apparent decline in mean length in the New Zealand and Soviet data from depths greater than 900 m but there are too few data in the other two groups to determine any trend.

<u>OEO 3A, black oreo (Figure 2)</u>
New Zealand mean lengths from greater than 900 m declined from 1988 to 1994 then increased in 1995. Means from Soviet data appeared to decline from 1979 to 1988 but there are too few data to determine convincing trends.

<u>OEO 4, smooth oreo (Figure 3)</u>
Mean lengths from Areas 2 and 5 fluctuated while those from Areas 1 and 4 declined and those from Area 3 increased. Results are inconclusive.
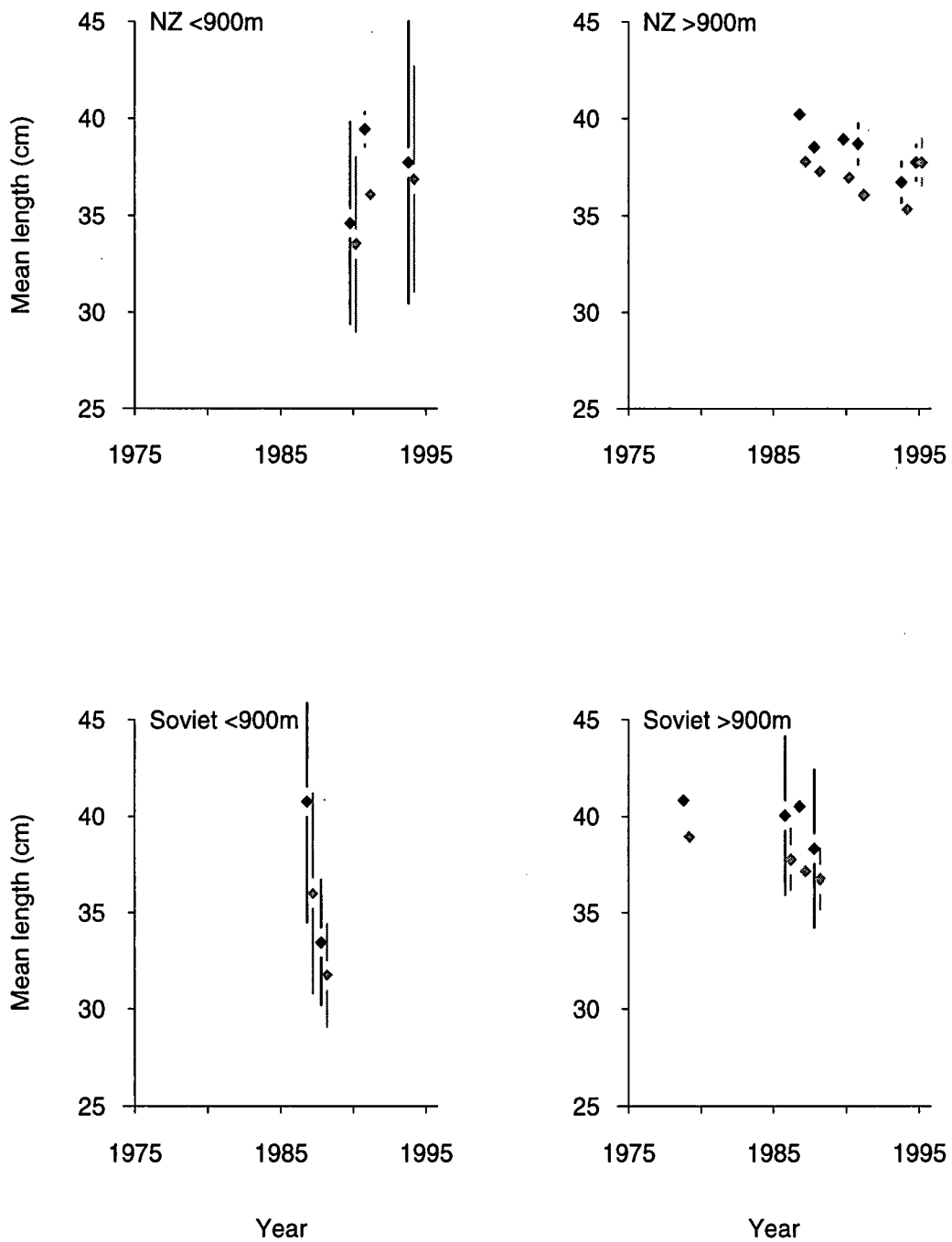
Figure 1: OEO 3A smooth oreo mean lengths (♦), and 95% confidence interval (vertical lines), cm TL, from samples collected by the MFish Scientific Observer Programme. Data are plotted for New Zealand or Soviet vessels and from < 900 m or > 900 m. Black is female and grey is male.
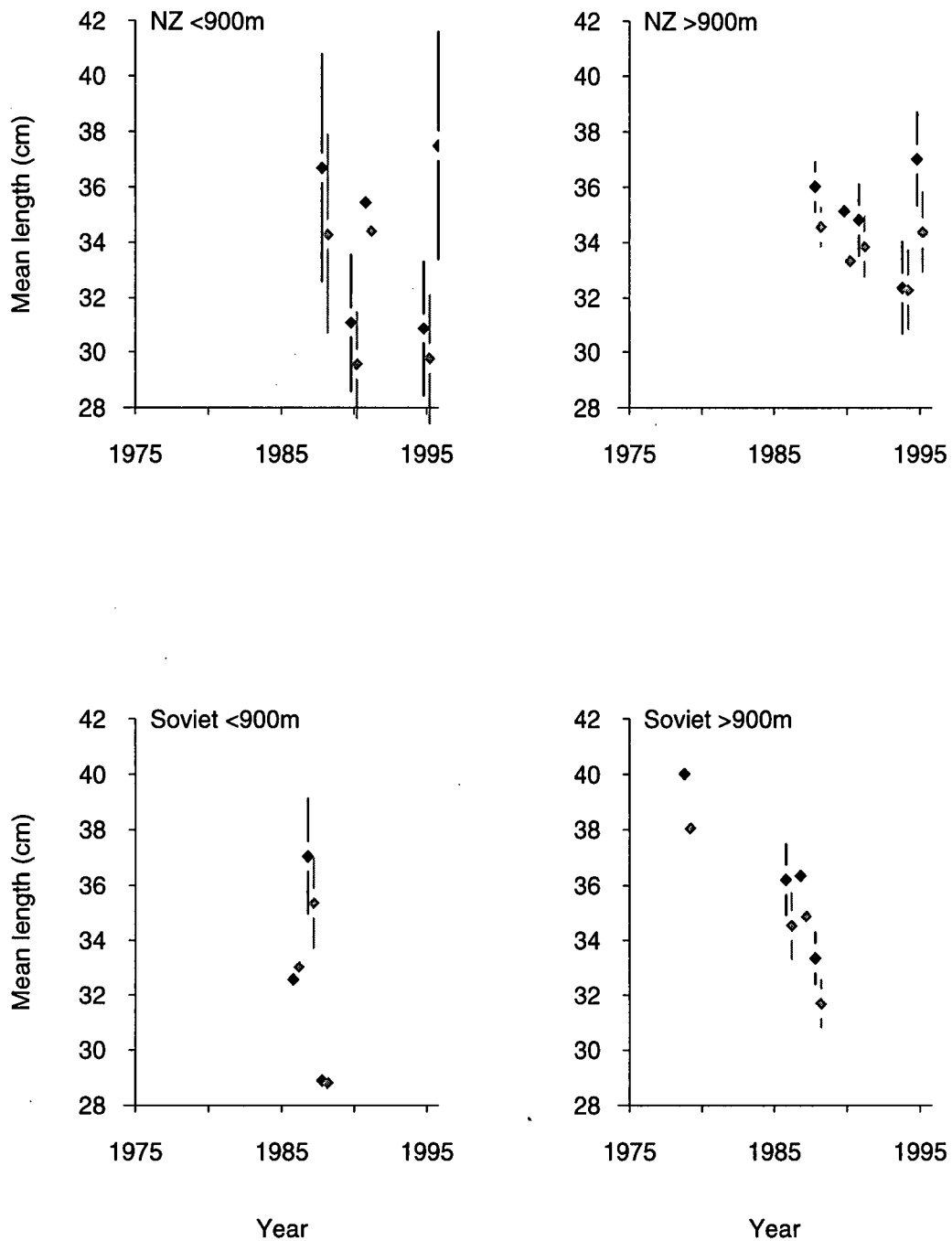
Figure 2: OEO 3A black oreo mean lengths (◆), and 95% confidence interval (vertical lines), cm TL, from samples collected by the MFish Scientific Observer Programme. Data plotted for New Zealand or Soviet vessels and from < 900 m or > 900 m. Black is female and grey is male.
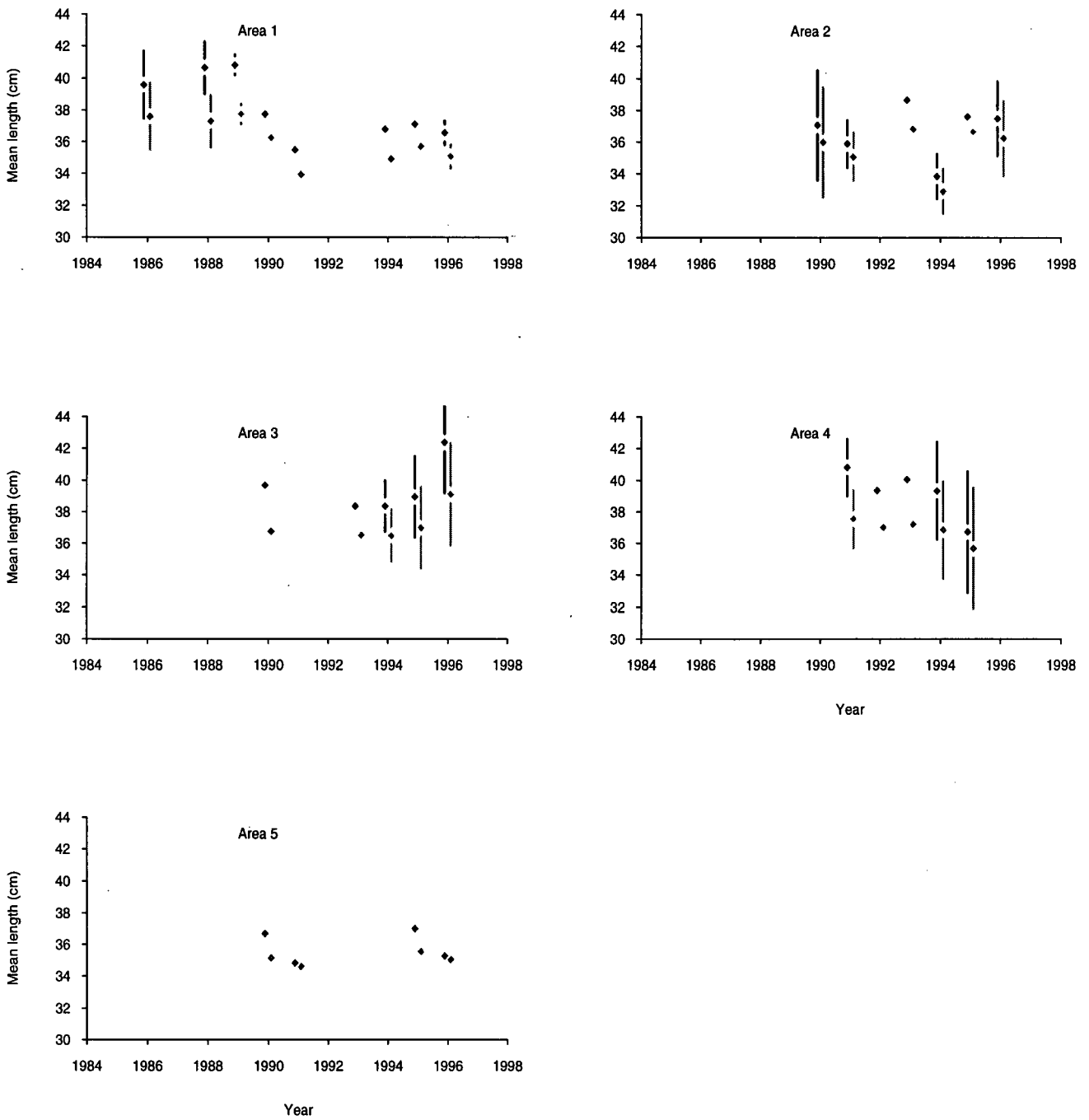
Figure 3: OEO 4 smooth oreo mean lengths (◆), and 95% confidence interval (vertical lines), cm TL, from samples collected by the MFish Scientific Observer Programme. Data are plotted for 5 separate areas (see text for explanation). Black is female and grey is male.

Activity 2. Research data. See comments under Methods above. There are no recent research data that can be compared with data collected from the random bottom trawl surveys of the south Chatham Rise carried out between 1986 and 1995.

Objective 3

The first key activity was to carry out a stock assessment of OEO 3A smooth oreo and the second was to carry out a stock assessment of OEO 4 smooth oreo. These assessments are documented in the "Report from the Fishery Assessment Plenary" (Annala *et al.* 1998) but are repeated below for completeness.

STOCK ASSESSMENT

Smooth oreo, OEO 3A

Biomass and yield estimates were revised from 1997 based on a deterministic stock reduction analysis incorporating relative abundance indices from a revised standardised CPUE analysis and revised catches, and life history parameters (1997). The analyses excluded trawl survey relative abundance data.

Smooth oreo, OEO 4

Biomass and yield estimates were not changed from 1997 and were estimated with a deterministic stock reduction analysis incorporating the south Chatham Rise *Tangaroa* trawl survey data as an abundance index (1991–93 and 1995), life history parameters (1997) and constrained q values (0.27–1.8).

(a)   **Estimates of fishery parameters and abundance**

Estimates of fishery parameters are shown in Table 8. Ranges of 0.5–3.5 were considered for F_{max} (fishing mortality) in the 1996 assessment but these only altered B_0 for smooth oreo in OEO 3A by about 6% so an assumed value of 0.9 was used in all the analyses below. Recruitment was assumed to be deterministic.

Table 8:   Estimates of fishery parameters for smooth oreo

Parameter	Symbol (unit)	1998 assumptions	
		Female	Male
Recruitment variability		0.65	0.65
Recruitment steepness		0.75	0.75
Fishing mortality	F_{max} (yr^{-1})	0.9	0.9

Relative abundance estimates

Four trawl surveys of the south Chatham Rise have been carried out from 1991 to 1995 using *Tangaroa* (Table 9).

Table 9:   Revised research survey recruited abundance estimates (t) for smooth oreo from the south Chatham Rise. N is the number of stations

OEO 3A

	Mean biomass	Lower bound	Upper bound	*c.v.*(%)	N
1991	1 849	0	4 549	73	44
1992	3 476	0	8 535	73	24
1993	4 162	0	11 867	93	24
1995	316	124	507	30	23

OEO 4

	Mean biomass	Lower bound	Upper bound	c.v.(%)	N
1991	133 492	52 951	214 034	30	110
1992	83 550	27 619	139 481	33	122
1993	71 982	38 673	105 290	23	124
1995	27 187	7 029	47 346	37	149

Abundance estimates for OEO 3A smooth oreo from standardised CPUE analysis

A standardised CPUE analysis for smooth oreo first carried out in 1995 was revised and also updated with the 1996–97 catch data. CPUE data from the part of OEO 3A which contained the main fishery (the CPUE study area, with the approximate boundaries of 43° 40' S to 45° 30' S and 172° E to 176° E) were used. Data from Waitaki and Kaikoura were excluded. Any year's data were discarded where only one vessel fished or where there were less than 50 tows in that year. Soviet and New Zealand data were treated separately and individual vessel parameters were used in the regressions. Each data series (Soviet and New Zealand) was analysed to produce a zero catch and positive catch index series and these were then combined to give a time series of combined abundance indices. The Soviet and the New Zealand time series of combined abundance indices both showed a declining trend although the New Zealand series increased slightly in 1996–97, Table 10.

Table 10: Smooth oreo, OEO 3A. Soviet and New Zealand time series of combined abundance indices from a standardised CPUE analysis

Year	Soviet	New Zealand
1982–83	6.92	–
1983–84	1.75	–
1984–85	3.41	–
1985–86	2.55	–
1986–87	1.00	2.25
1987–88	0.61	1.98
1988–89	–	1.25
1989–90	–	1.24
1990–91	–	1.00
1991–92	–	1.79
1992–93	–	1.20
1993–94	–	1.23
1994–95	–	1.06
1995–96	–	0.68
1996–97	–	0.74

Abundance estimates for OEO 3A smooth oreo from acoustic survey

An acoustic survey of smooth oreo and black oreo in OEO 3A was carried out from 10 November to 19 December 1997 (TAN9713). The survey covered the "flat" with a series of random north-south transects over 6 strata at depths of 600–1200 m. Hills were also sampled using parallel and "starburst" transects. Targeted and some random (background) trawling was carried out to identify targets and to determine species composition. In situ target strength measurements were carried out on 10 marks including 2 smooth oreo, 2 black oreo and 6 mixed oreo marks. Estimates of smooth oreo biomass and variance and in situ smooth oreo and black oreo target strength were presented to the Deepwater Working Group. Potential sources of bias for the biomass estimates include (ranked from large to small): the value used to estimate the absorption of sound in seawater, the black oreo target strength, the ratio of smooth oreo to black oreo in the "OREO" acoustic mark category, the target strength estimates for species other than oreos, the height that oreos occur above the bottom, the target strength of smooth oreos, changing "intermediate" to "background" acoustic mark categories.

The Deepwater Working Group agreed that because of the preliminary nature of the acoustic results, the 1997 acoustic biomass estimate would not be used in the 1998 assessment.

Abundance estimates for OEO 4 smooth oreo from trawl surveys

The estimates, and their c.v.s, from the four standard *Tangaroa* south Chatham Rise trawl surveys were treated as relative abundance indices. The trawl survey abundance estimates showed a declining trend (Table 9).

(b)   Biomass estimates

Smooth oreo, OEO 3A

The two time series of combined CPUE abundance indices and their c.v.s, the revised catch history, and the life history parameters for smooth oreo were used in a deterministic stock reduction analysis to produce biomass estimates (the "base case"). Estimates were also made using just the New Zealand CPUE index of abundance (Table 10).

In previous assessments only catch from the study area was used in the stock reduction analysis and the biomass estimate were later scaled up by the ratio of the catch from the whole area to that from the study area. The 1998 analysis used a new catch history based on reported landings from for the whole of OEO 3A from 1983–84 onward multiplied by the ratio of estimated catch of smooth oreo to black oreo reported in Tables 1 and 2 of the Oreos section of the 1998 Plenary document. Reported catch prior to 1983–84 was not changed from the previous analysis. In addition new c.v.s for each year were used for both the Soviet and New Zealand series including a c.v. for the reference year. Previously the index for the reference year had a zero c.v.

Biomass estimates, including the 95% confidence intervals and the maximum likelihood value are in Table 11. The 95% confidence interval estimates of B_0 for the base case from this analysis were 74 000–128 000 t, based on bootstrap simulations that used the c.v. from the CPUE indices and assumed deterministic recruitment. Biomass estimates are uncertain because the variability of the CPUE data resulted in a 43% (61% in 1997) c.v. for the Soviet index series and a 40% (57% in 1997) c.v. for the New Zealand index. The reduced c.v. values are due to the new c.v. for the reference year.

The preliminary estimates of absolute biomass from the 1997 acoustic survey are consistent with the results of the stock assessment using the two CPUE time series.

Table 11: Biomass estimates (t) for smooth oreo from the stock reduction model for OEO 3A. The 95% confidence limits are in parentheses

	B_0	Mid-year $B_{1996-97}$	
		(t)	($\%B_0$)
Base case	84 000 (74 000–128 000)	19 000 (8 500–64 000)	23 (11–50)
New Zealand CPUE only	87 000 (75 000–144 000)	22 000 (9 000–80 000)	25 (12–55)

Smooth oreo, OEO 4

Estimates of biomass were not changed from 1997 and were made with a deterministic stock reduction analysis which used the trawl survey abundance estimates as a relative abundance index, the catch history, and the life history parameters.

The smooth oreo catch history used in the analysis was from the trawl survey area (176° E to 44° S, 174° W) only. These data include catch from the hills as well as from the flat so it was assumed that the trawl survey is an index of the fish abundance on both hills and flat. The estimated catch from catch effort returns were scaled to the QMR reported catch of oreo from the survey area. "OEO" (unspecified oreo) reported catch was apportioned to species by the ratio of estimated smooth oreo to black oreo catch from the catch effort data. Catches from 1977–78 to 1982–83 were adjusted to the 1 October-30 September fishing year.

Biomass estimates (and yield estimates below) for the trawl survey area were adjusted up to the total OEO 4 area using the ratio of the catches from the rest of area OEO 4 not indexed by the trawl survey (4098 t) to the catch from the survey area (60 403 t) from the fishing years 1986–87 to 1995–96, i.e., a ratio of 1.07. The 1986–87 season was chosen as the start of the adjusted catch data series because the Quota Management System was introduced in that year.

The method of Cordue (1996) was used to set bounds on q by assigning lower and upper ranges for values of the elements contributing to q. These are vertical availability (u_v, the proportion of fish herded down below the headline of the net), areal availability (u_a, the proportion of fish that is in the survey area at the time of the survey), and vulnerability (v, the average proportion of fish that is available to the net that is caught). Estimates of the individual elements were:

	Low	High
u_v	0.8	1.0
u_a	0.5	0.9
v	0.67	2.0

The upper bound on q (1.8) was formed from the product of the upper values of the three elements of catchability and the lower bound (0.27) from the product of the lower values. These values are similar to those estimated from stock reduction analysis for orange roughy from deepwater surveys on the north Chatham Rise, Puysegur Bank and Challenger Plateau (0.6–1.7). The q value estimated from the stock reduction analysis for OEO 4 (run with no bounds on q and $F_{max} = 0.9$) was very high, 3.4, (note that it was 4.2 for the 1996 assessment which used different life history parameters and other inputs).

Biomass estimates using stock reduction analysis were therefore made with q values bounded by 0.27 and 1.8 (Table 12). No confidence limits were estimated but the q bounds gave plausible lower and upper limits (B_{min} and B_{max} in Table 12), i.e., B_0 will be within the range 100 000 to 386 000 t. The decline in the trawl survey abundance index can not be modelled adequately within these bounds which implies that the true value of B_0 is at the lower end of the range.

Table 12: Biomass estimates (t) for smooth oreo from the stock reduction models for OEO 4. Estimates were made using q values of 0.27 and 1.8

	B_0	Mid-year $B_{1995-96}$	
		(t)	(%B_0)
B_{min} (q = 1.8)	100 000	33 000	33
B_{max} (q = 0.27)	386 000	321 000	83

(c)   Estimation of Maximum Constant Yield (MCY)

Smooth oreo, OEO 3A and OEO 4

Using the method of Francis (1992), the maximum constant catch that can be taken indefinitely (without reducing the population below 20% B_0 more than 10% of the time) from a population with life history parameters as in Table 13 was 1.6% B_0. Under continued fishing at this level the mean biomass was 44% B_0.

Table 13: Life history parameters for smooth oreo. –, not estimated

Smooth oreo

Parameter	Symbol (unit)	Female	Male
Natural mortality	M (yr^{-1})	0.063	0.063
Age at recruitment	A$_r$ (yr)	21	21
Age at maturity	A$_m$ (yr)	31	–
von Bertalanffy parameters	L$_\infty$ (cm, TL)	50.8	43.6
	k (yr^{-1})	0.047	0.067
	t$_0$ (yr)	-2.9	-1.6
Length–weight parameters	a	0.029	0.032
	b	2.90	2.87
Length at recruitment	(cm, TL)	34	–
Length at maturity	(cm, TL)	40	–

Yield estimates for smooth oreo from OEO 3A (Table 14) and OEO 4 (Table 15) were calculated from the results of the stock reduction analyses reported above, using the "Depressed stocks" methods from Francis (1992). Where stocks are depressed (below 20% B$_0$), the MCY for 1998–99 was scaled down. For OEO 4 values are not changed from the 1997 assessment and it was not possible to give a confidence interval for each estimate because the q bounds uniquely define the range of estimates.

The level of risk to the stocks by harvesting the populations at the estimated MCY values cannot be determined.

Table 14: Yield estimates (t) for smooth oreo OEO 3A. The 95% confidence limits are in parentheses

	MCY$_{1998-99}$	MCY$_{long-term}$	CAY$_{1998-99}$
Base case	1 300 (670–2 000)	1 300 (1 200–2 000)	940 (430–3 100)
New Zealand cpue only	1 400 (700–2 300)	1 400 (1 200–2 300)	1 100 (460–3 900)

Table 15: Yield estimates (t) for smooth oreo for OEO 4. Estimates were made using q values of 0.27 and 1.8

	MCY$_{1997-98}$	MCY$_{long-term}$	CAY$_{1997-98}$
B$_{min}$ (q = 1.8)	1 600	1 600	1 400
B$_{max}$ (q = 0.27)	6 200	6 200	15 000

(d)   Estimation of Current Annual Yield (CAY)

Smooth oreo, OEO 3A and OEO 4

CAY was estimated using the methods listed in Francis (1992). F$_{CAY}$, the maximum constant fishing mortality (F) that can be applied (without reducing the population below 20% B$_0$ more than 10% of the time) to a population with the life history parameters as in Table 13 is 0.0497. The mean catch when fishing at F = 0.0497 is 1.93% B$_0$, and the mean biomass (B$_{MAY}$) is 25% B$_0$. Yield estimates are in Tables 14 and 15.

(e)   Other factors

Yields may be under-estimated if there was a change over time in the proportion of oreo catch that was not reported. It was assumed that the exploitation rates for smooth oreo in OEO 4 were the same in the trawl survey area and in the rest of OEO 4.

Because of differences in biological parameters between the species, it would be appropriate to split the current TACCs for black oreo and smooth oreo. Separate species catch limits are considered important to reduce the risk of over- or under-fishing that might be caused by the application of a single TACC to separate species.

STATUS OF THE STOCKS

OEO 3A, smooth oreo,

Estimates of current and virgin biomass were made for smooth oreo for area OEO 3A. Biomass estimates are uncertain because of high $c.v.s$ for the CPUE abundance index series and because the value of F_{max} was assumed.

For the base case analysis, the 95% confidence interval for B_0 lies between 74 000 and 128 000 t. Yields from this stock will be low because the productivity of smooth oreo is low, based on unvalidated age estimates. The long-term MCY estimates from the base case analysis were 1200–2000 t, substantially less than the mean catch of smooth oreo in OEO 3A (about 3700 t per year). The degree of uncertainty is likely to be greater than the ranges presented. However it is highly likely that current biomass is less than B_{MAY}. It seems likely that the recent catch levels of smooth oreo from OEO 3A are higher than the long term sustainable yield and will not allow the stock to move towards B_{MAY}.

Removal of the Soviet CPUE index gave similar estimates of B_0 and long-term yield to the base case. The analysis improved the current status of the stock but it is still likely that $B_{1996-97}$ is below B_{MAY}.

OEO 4, smooth oreo

The estimates of biomass and yields are highly uncertain. The estimates of current and virgin biomass were made based on plausible catchability bounds of 0.27–1.8. At the lower bound, current biomass is greater than B_{MAY} but long term yield is less than the current catch. At the upper bound long term yield is greater than or about equal to the current catch. The steep decline in the trawl survey indices implies that B_0 lies at the lower end of the range presented.

11. Conclusions

Objective 1
Results of descriptive analysis of commercial catch and effort data for black oreo and smooth oreo are provided as a separate MFish Final Report.

Objective 2
Observer length frequency data for black oreo and smooth oreo from OEO 3A and OEO 4 were obtained from the MFish Observer length database and analysed for trends in mean length over time. Few trends were evident largely because of a lack of past data.

The changes that have taken place in the catches of deepwater species including decreased catch of orange roughy on the Chatham Rise and the apparent decline of the OEO 3A fishery, have had an effect on the pattern of fishing and consequently obtaining consistent oreo samples from the Chatham Rise fishery is likely to remain problematical.

The goal of this work includes monitoring mean length as an index of changes in the age structure of the population; possible use of mean length changes as an index of recruitment to the fishery; and for comparison with randomly sampled research mean length data to determine if research samples are representative of the population. The

data gathered to date have been too few to allow for any of these potential applications.

No new research data were available to continue the series of mean lengths collected on past random trawl surveys. Most recent research data have been collected from target trawls and are therefore not comparable with past random trawl data.

Objective 3
The stock assessment of OEO 3A smooth oreo was a revised and updated version of the 1997 assessment and was based on the standardised CPUE analysis developed in 1995 (Doonan et al. 1995). The Working Group decided that the OEO 3A smooth oreo absolute abundance estimate was not ready to use in the 1998 assessment. Consequently planned work under this objective was reduced and a full assessment and presentation to the 1998 plenary meeting and production of a FARD were not required.

The stock assessment of OEO 4 smooth oreo was unchanged from 1997 because there were no new estimates of abundance available. Absolute abundance estimates were expected at the time this work was contracted but were not available and consequently a full assessment and presentation to the 1998 plenary meeting and production of a FARD were not required.

12. Publications

Part of this work has been incorporated into the section on Oreos in the "Report from the Fishery Assessment Plenary"(Annala et al. 1998).

13. Data Storage

CPUE data are on the "Deepwater" database maintained by NIWA, Greta Point. This document and the attached report on Objective 1 are held in electronic form at NIWA, Greta Point.

References

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