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THE 1987-88 DEMERSAL FISH SURVEYS OFF CENTRAL CALIFORNIA (34°30'N TO 36° 30'N)

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center

NOAA Technical Memorandum NMFS

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John L. Butler
Carol A. Kimbrell
William C. Flerx

Southwest Region
National Marine Fisheries Service, NOAA
P.O. Box 271
La Jolla, California 92038

Richard D. Methot

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest and Alaska Fisheries Center
Seattle, Washington 98105

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U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary
National Oceanic and Atmospheric Administration
William E. Evans, Under Secretary for Oceans and Atmosphere
National Marine Fisheries Service
James W. Brennan, Assistant Administrator for Fisheries

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THE 1987-88 DEMERSAL FISH SURVEYS OFF CENTRAL CALIFORNIA (34° 30'N TO 36° 30'N)

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ABSTRACT

The biomass of demersal fish species near Morro Bay, California was estimated from their catch rates in bottom trawls. The 1987 survey used a systematic sampling design over a 100 - 700 fathom depth range, and the 1988 survey used a stratified random sampling design over a 30 - 700 fathom depth range. Both surveys encompassed the depth range of target species and yielded similar estimates for the abundance of important demersal species.

The biomass of Dover sole, Microstomus pacificus, was estimated in 1987 to be 15,900 metric tons over the 100 to 700 fathom depth range, and 17,300 m.t. in 1988 over the 30 to 700 fathom depth range. The biomass of sablefish, Anoplopoma fimbria, was estimated to be 7,200 and 12,000 m.t. in 1987 and 1988, respectively. The biomass of shortspine thornyhead, Sebastolobus alascanus, was estimated at 6,400 and 5,900 m.t. in the two surveys. The biomass of longspine thornyhead, Sebastolobus altivelis, was estimated at 7,500 and 13,000 m.t. The biomass of rex sole, Glyptocephalus zachirus, was 5,300 and 3,800 m.t., but the nearshore limit of this species was not surveyed. The biomass of Pacific grenadier, Coryphaenoides acrolepis, was 2,400 and 2,200 m.t. and that of giant grenadier, Coryphaenoides pectoralis was 1,800 and 1,300 m.t., but the offshore limits of these species were not surveyed.

INTRODUCTION

The continental slope off California supports an important fishery for demersal species, primarily Dover sole, sablefish and shortspine thornyhead. The northern California port of Eureka has been the location of a large and stable Dover sole fishery with 1969 - 1987 landings averaging 5,037 metric tons (mt) per year. The central California port of Morro Bay has been the site of a recent increase in bottom trawl fishing. Landings of Dover sole at this port ranged from 10 - 100 mt prior to 1983, then averaged 1,888 mt during 1984 - 1987. Catches of thornyheads and grenadiers have increased in the last two years in California. Little is known of stock size or productivity of the exploited species in the Morro Bay area. To contribute information for management of these stocks, the Southwest Fisheries Center initiated survey cruises to estimate the biomass, productivity and distribution of the bottom fish community of the continental slope off Central California.

This report documents the 1987 and 1988 biomass estimates for continental slope fishes found off Central California in the region of Morro Bay. These estimates are based on bottom trawl samples taken during cruises of the NOAA Fisheries Research Vessel, David Starr Jordan, in January and February of 1987 and March and April of 1988 and cover the geographic area from 34° 30'N, 120° 30'W to 36° 30'N, 122° 30'W. The 1987 cruise was a pilot survey and the 1988 survey was performed later in the year than that for 1987 in order to calibrate estimates of Dover sole biomass using both swept area and egg production techniques. Comparisons between the egg production method and swept trawl for Dover sole biomass are the subject of a manuscript in preparation (C. H. Lo, pers. comm., NOAA, National Marine Fisheries Service, Southwest Fisheries Center, P.O. Box 271, La Jolla, CA, 92038-0271, 619/546-7106).

DESCRIPTION OF THE SURVEYS

The 1987 survey area (Fig.1) extended from Purisima Point to Half Moon Bay, California, during the period 11 January to 15 February 1987. The station pattern was based on four lines with stations from shallow to deep water off Purisima Pt., Pt. Estero, Pt. Año Nuevo and Half Moon Bay. Stations were systematically centered at 100 fathom intervals from 100 to 700 fathoms. Additional samples were taken at 500 fathoms because the abundance of spawning Dover sole was expected to be high at this depth. 55 trawls were made, with 42 usable trawls inside the 1988 study area, ten outside the 1988 study area and three not usable.

The 1988 survey area (Fig. 2) was confined to the area 34° 30'N, 120° 30'W and 36° 30'N, 122° 30'W which contained the southern two lines occupied in 1987. A stratified random design was chosen for the 1988 survey after examination of the 1987 results. Three depth strata were chosen to pool samples with

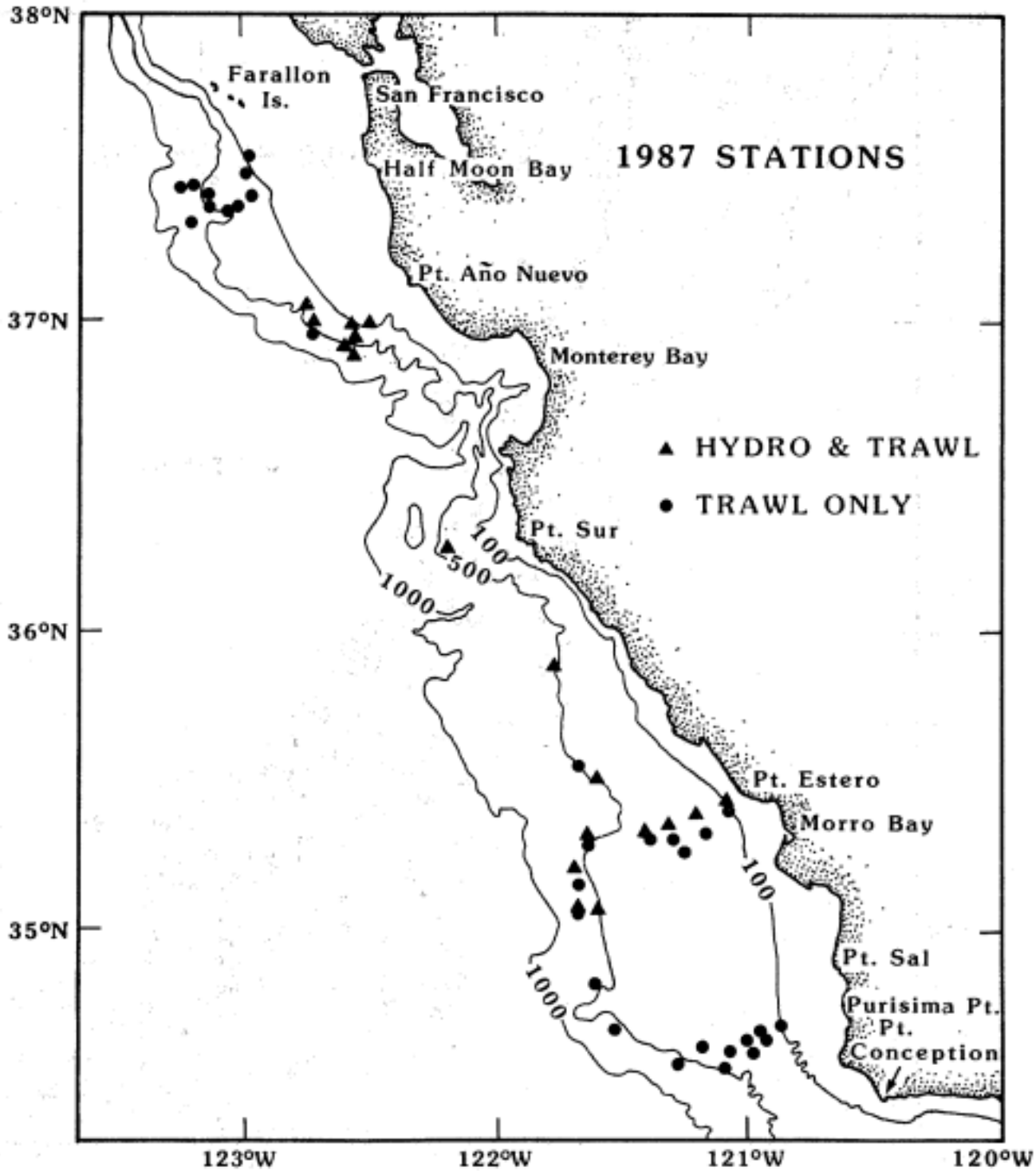

Figure 1. Trawl stations occupied on the January-February 1987 groundfish cruise of the David Starr Jordan.

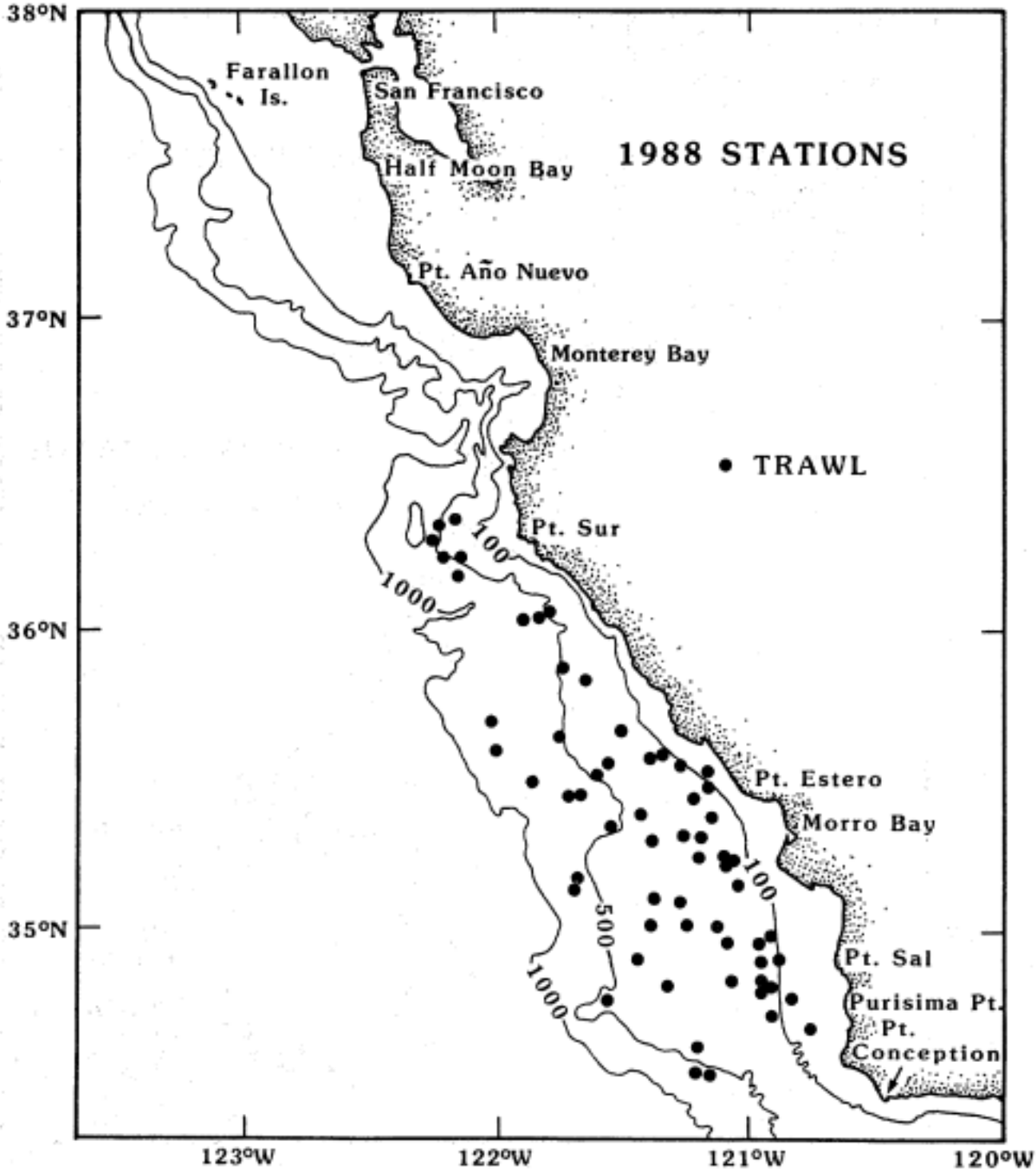

Figure 2. Trawl stations occupied on the February-April 1988 groundfish cruise of the David Starr Jordan.

similar catch rates and biological characteristics for Dover sole: 30 to 250 fathoms, 250 to 550 fathoms, and 550 to 700 fathoms. Random stations were chosen in each depth stratum with the number of stations being approximately proportional to the biomass of Dover sole in each stratum: ratios of 5/16 in the shallowest stratum, 7/16 in the middle stratum, and 4/16 in the deepest stratum. Each station was previewed using existing bathymetric charts to eliminate stations where no suitable trawling site existed. The start of a trawl was limited to a 2 nmi radius from the selected position during Leg I (22 February - 8 March 1988, 29 usable trawls) and 10 nmi during Legs II and III (8 March - 9 April 1988, 29 usable trawls). If a suitable trawling site was not present, the station was abandoned.

During the 1987 and 1988 surveys samples were taken with both the 400-Eastern and the modified Nor'Eastern trawls. The modified Nor'Eastern was used for the first three of 55 trawls in 1987, but its use was discontinued because of difficulty in keeping the trawl on bottom with the small (5' x 7') trawl doors used in 1987; the catch data were not used. Because of the handling characteristics and the loss of one trawl, only the first seven of 64 trawls of the 1988 survey were made with the modified Nor'Eastern. Catch processing and subsampling procedures generally followed standard procedures employed by the NWAFC (Smith and Bakkala, 1982). The total catch of each species was weighed and a subsample of up to 100 individuals was weighed and measured. Area sampled by the 400-Eastern was estimated from the trawl mouth width[1] and distance towed. Distance towed was estimated from the beginning and ending position, or from the regression of distance traveled as a function of the duration in hours of the tow ($Nmi = -0.02 + 3.86\ Hr$, $n = 33$, $r^2 = 0.88$). We do not know actual distance towed on the bottom.

Biomass of demersal fish was estimated from the average density in each depth stratum and the total area within the stratum in the survey area. The total area of each depth stratum in the study area was calculated from original hydrographic data obtained from the U. S. Hydrographic Office. Two estimates of biomass were obtained from the 1987 survey, one using 100 fathom strata centered on the depth sampled and the other using the 1988 depth strata. Density estimates were obtained from the pooled densities of trawls in each stratum.

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[1] Four measurements of trawl width were made at a depth of 100 fathoms with 300 fathoms of trawl cable. The mean was 14.6 m with a range of 13.9 to 15.3 m. Craig Rose (NWAFC, Seattle, WA) unpublished data.

RESULTS

Data associated with the Jan-Feb 1987 and Mar-Apr 1988 bottom trawls are given in Table 1. Catch data for Dover, sablefish, shortspine thornyhead, longspine thornyhead, rex sole, Pacific grenadier, and giant grenadier are given in Table 2. Catch data from trawls made outside the 1988 study area (north of ~36.5°N) were not used for the 1987 biomass estimates. Length-frequency data for the above species of bottom fish taken by trawls during the 1987 and 1988 cruises within the 1988 study area are given in Table 3. The length-frequencies have been weighted by the ratio of number caught/number measured in each trawl. Table 4 gives summary statistics for the species in Table 3.

Dover sole

Catches of Dover sole varied with the depth of the trawl (Fig. 3) and three depth strata are identifiable. Trawls taken in shallow water (<250 fathoms) catch many small fish but the biomass is low (Figs. 3 and 4). The middle depth range (250 - 550 fathoms) has higher but more variable catch rates than either deeper or shallower strata. In the deepest stratum catch rates and variance are low. Based on the results in 1987, a stratified random sampling design was employed in 1988 to reduce the overall variance in the estimate of total biomass.

Abundance estimates of Dover sole for each year and stratum are presented in Tables 5 and 6. The 1987 estimates are presented using the original systematic sampling design and the 1988 stratified sampling design. The 1987 sampling design was centered on 100 fathom intervals from 100 to 700 fathoms and is assumed to have sampled the depths from 50 to 750 fathoms. The 1988 stratified design sampled from 30 to 700 fathoms. Because the 1988 stratified design includes more shallow area where densities are higher and less deeper area where densities are lower, biomass estimates for 1987 differ with the method used to pool the samples. 1987 biomass estimates for Dover sole in the sampling area were 13,513 ± 1,747 (±2SE, standard error) using the 1987 systematic design and 15,858 ± 2,077 mt using the 1988 stratified design. The 1988 biomass estimate was 17,297 ± 2,013 mt.

Female Dover sole averaged about 45 mm longer than males. Mean size of both sexes increased with depth (Table 4).

Sablefish

Density estimates for each stratum and each year are presented in Tables 7 and 8. The estimated biomass of sablefish in 1987 was 6,552 ± 835 mt using the systematic design and 7,223 ± 1050 mt

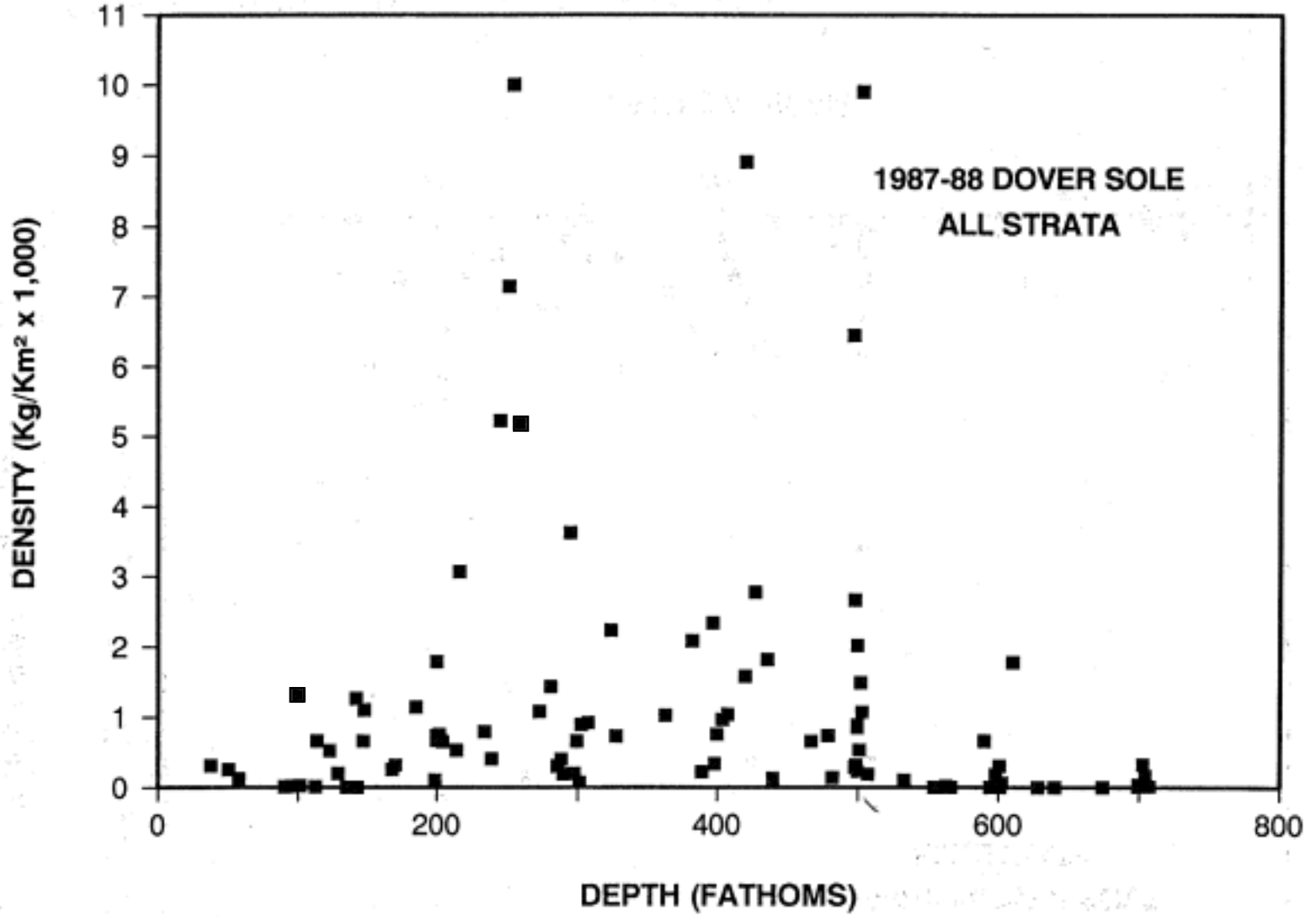

Figure 3. Density of Dover sole vs depth of capture.

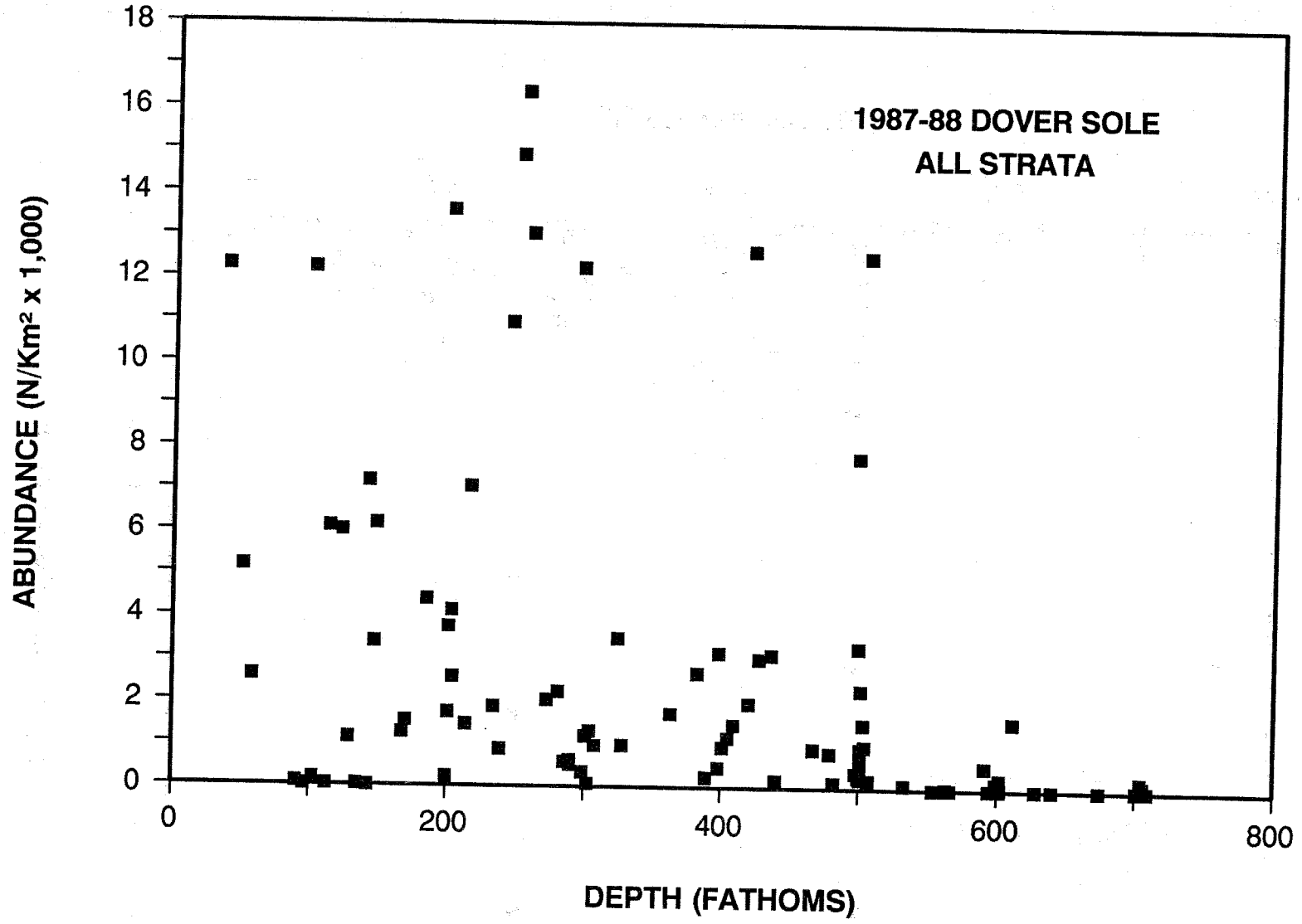

Figure 4. Abundance of Dover sole vs depth of capture.

using the stratified design. The 1988 estimate was 11,991 ± 814 mt.

Female sablefish averaged 42 mm longer than males in 1987 and 19 mm longer in 1988. Mean size of both sexes increased greatly with depth. The shallow stratum contained a high percentage of small (31-35 cm) sablefish that probably are one-year-old recruits.

Shortspine thornyhead.

Density estimates for each stratum and each year are presented in Tables 9 and 10. The estimated biomass of shortspine thornyhead in 1987 was 6,042 ± 367 mt using the systematic design and 6,438 ± 397 mt using the stratified design. The 1988 estimate was 5,534 ± 374 mt.

Male and female shortspine thornyhead are of similar size (Table 4). In 1988 the mean size increased with increasing depth, but no increase occurred in the deepest stratum in 1987. Note, however, the high standard deviation (SD) in the deep stratum in 1987. It is possible that misidentification of longspine thornyhead contributed to the high SD and to lack of increase in mean size.

Longspine thornyhead.

Density estimates for each depth stratum and each year are presented in Tables 11 and 12. The estimated biomass of longspine thornyhead in 1987 was 6,533 ± 282 mt using the systematic design and 7,510 ± 619 mt using the stratified design. The 1988 estimate was 12,962 ± 1108 mt.

Rex sole.

Density estimates for each depth stratum and each year are presented in Tables 13 and 14. The estimated biomass of rex sole in 1987 was 3,514 ± 685 mt using the systematic design and 5,259 ± 911 mt using the stratified design. The 1988 estimate was 3,806 ± 591 mt. The density of rex sole was high at the shallowest stations (at least in 1987) so these biomass estimates must be considered as lower bounds to the true population abundance.

Pacific grenadier.

Density estimates for each depth stratum and each year are presented in Tables 15 and 16. The estimated biomass of Pacific grenadier in 1987 was 2,488 ± 456 mt using the systematic design and 2,393 ± 487 mt using the stratified design. The 1988 estimate

was 2,230 ± 279 mt. The distribution of Pacific grenadier extends well beyond the deepest depth sampled, so that this biomass estimate must be considered an underestimate.

Giant grenadier.

Density estimates for each depth stratum and each year are presented in Tables 17 and 18. The estimated biomass of giant grenadier in 1987 was 1,764 ± 198 mt using the systematic design and 1,760 ± 205 mt using the stratified design. The 1988 estimate was 1,338 ± 170 mt. The distribution of giant grenadier extends well beyond the deepest depth sampled, so that this biomass estimate also must be considered an underestimate.

DISCUSSION

The estimated biomass of Dover sole was remarkably similar between cruises. Densities of Dover sole collected by the Northwest and Alaska Fisheries Center's slope survey in trawl samples off Oregon (Table 19) are similar to the densities reported here. The trawl used by the NWAFC was a modified nor'eastern which has a higher mouth opening and a chain/disk footrope but is not expected to be a biased sampler of flatfish. The estimate of about 15,000 mt off Morro Bay is a good indicator of the biomass of this species in the survey area.

The estimated biomass of sablefish is about 10,000 mt in the survey area. This estimate may be biased because sablefish are not restricted to the bottom and, because of their large size and mobility, may also avoid the net. Higher densities of sablefish were observed in the NWAFC slope survey off Oregon. These higher densities may be due to greater vulnerability to a net with a higher mouth opening or to higher population levels in that region.

We caution that the accuracy of these reported biomass estimates depends on the accuracy of the estimate of area sampled and the catchability of individual species. Measurement of the mouth opening is necessary on each cruise, if not each trawl. Distance trawled or time on the bottom should also be measured.

ACKNOWLEDGEMENTS

We gratefully acknowledge the contribution of personnel and equipment from groups at the SWFC-La Jolla Laboratory, SWFC-Tiburon Laboratory, and the NWAFC-RACE Division. L. Eber of the SWFC provided valuable assistance in the calculation of stratum areas.

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Smith, G. B. and R. G. Bakkala. 1982. Demersal fish resources of the eastern Bering Sea: spring 1976. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-754, 129 p.

Table 1. Data associated with bottom trawls taken in Jan-Feb 1987 and Mar-Apr 1988. Tows made with the modified Nor'Eastern and tows with unacceptable performance have been deleted.

1987 trawls made within 1988 study area

Trawl	Date			Position				Depth		Duration	Distance		Area[a]
	Yr	Mo	Da	W Lat.		N Long.		Fath	M	Hr	NMi	Km	Km^2
4	87	1	12	34°	37'	121°	03'	408	746	1.00	3.84[b]	7.12	0.104
5	87	1	14	35	24	121	03	96	176	0.50	1.91[b]	3.54	0.052
6	87	1	15	35	20	121	09	199	364	0.50	1.91[b]	3.54	0.052
7	87	1	15	35	16	121	14	302	552	1.00	3.84[b]	7.12	0.104
8	87	1	15	35	18	121	23	397	726	1.00	3.84[b]	7.12	0.104
10	87	1	16	35	05	121	39	702	1284	1.00	3.84[b]	7.12	0.104
11	87	1	16	35	09	121	39	601	1099	1.00	3.84[b]	7.12	0.104
12	87	1	17	35	18	121	37	503	920	1.00	3.89	7.21	0.105
13	87	1	17	35	33	121	40	500	914	1.00	3.84[b]	7.12	0.104
14	87	1	18	35	52	121	45	503	920	1.00	3.72	6.89	0.101
15	87	1	18	36	15	122	11	500	914	1.00	3.84[b]	7.12	0.104
16	87	1	19	36	59	122	30	100	183	0.50	1.85	3.43	0.050
17	87	1	19	36	59	122	34	200	366	0.50	1.91[b]	3.54	0.052
18	87	1	20	36	57	122	34	303	554	1.00	3.89	7.21	0.105
21	87	1	21	36	55	122	35	610	1116	1.00	3.84[b]	7.12	0.104
22	87	1	21	36	53	122	34	703	1286	1.00	4.07	7.54	0.110
28	87	1	24	37	26	123	13	598	1094	1.00	4.44	8.23	0.120
29	87	1	24	37	26	123	15	700	1280	1.00	3.44	6.37	0.093
31	87	2	5	34	40	120	56	200	366	0.52	1.72	3.19	0.047
32	87	2	5	34	36	120	57	300	549	1.00	4.06	7.52	0.110
33	87	2	5	34	38	121	10	400	732	1.00	4.19	7.76	0.113
34	87	2	6	34	33	121	04	497	909	1.00	3.39	6.28	0.092
35	87	2	6	34	33	121	16	601	1099	1.00	3.57	6.62	0.097
36	87	2	7	34	41	121	30	700	1280	1.00	3.87	7.17	0.105
37	87	2	7	34	50	121	35	502	918	1.00	3.74	6.93	0.101
38	87	2	8	35	05	121	39	708	1295	1.00	4.22	7.82	0.114
39	87	2	8	35	10	121	39	600	1097	1.00	4.02	7.45	0.109
40	87	2	9	35	18	121	36	500	914	1.00	3.98	7.37	0.108
41	87	2	9	35	18	121	23	404	739	1.00	3.89	7.21	0.105
42	87	2	9	35	18	121	16	289	529	1.00	3.07	5.69	0.083
43	87	2	9	35	20	121	09	200	366	0.50	2.31	4.28	0.062
44	87	2	10	35	24	121	03	102	187	0.50	1.96	3.63	0.053
45	87	2	10	35	18	121	16	298	545	0.52	1.72	3.19	0.047
46	87	2	10	35	33	121	39	499	913	1.00	3.80	7.04	0.103
47	87	2	11	35	53	121	45	500	914	1.00	3.59	6.65	0.097
48	87	2	11	36	15	122	11	498	911	1.00	3.87	7.17	0.105
49	87	2	12	36	58	122	43	705	1289	1.00	3.44	6.37	0.093
50	87	2	13	36	57	122	34	295	539	0.88	3.00	5.56	0.081
51	87	2	13	37	19	123	13	590	1079	1.00	4.19	7.76	0.113
55	87	2	15	36	59	122	35	202	369	0.50	1.91	3.54	0.052

[a] 14.6 m trawl width.

[b] Distance traveled estimated from the regression of nautical miles as a function of trawl duration in *hours*. NMi = -0.019 + 3.86 Hr, n = 33, r^2 = .875.

Table 1. Cont'd.

1987 trawls made outside 1988 study area (north of 36.5°N)

Trawl	Date			Position				Depth		Duration	Distance		Area[a]
	Yr	Mo	Da	W Lat.		N Long.		Fath	M	Hr	NMi	Km	Km^2
19	87	1	20	37°	02'	122°	47'	305	722	0.83	3.18	5.90	0.086
20	87	1	20	37	02	122	46	500	896	1.00	3.84	7.12	0.104
23	87	1	22	37	32	122	59	490	183	0.75	2.88	5.33	0.078
24	87	1	22	37	29	122	59	100	373	0.50	1.91	3.54	0.052
25	87	1	23	37	24	122	58	204	558	1.00	3.94	7.30	0.107
26	87	1	23	37	22	123	02	510	759	1.00	3.84	7.12	0.104
27	87	1	23	37	19	123	08	99	933	1.00	3.84	7.12	0.104
52	87	2	14	37	22	123	09	410	914	0.83	2.82	5.23	0.076
53	87	2	14	37	21	123	04	415	750	1.00	4.24	7.86	0.115
54	87	2	14	37	32	122	60	395	181	0.50	2.09	3.87	0.057

1988 trawls

Trawl	Date			Position				Depth		Duration	Distance		Area[a]
	Yr	Mo	Da	W Lat.		N Long.		Fath	M	Hr	NMi	Km	Km^2
1	88	2	23	34°	55'	120°	51'	91	166	0.50	1.32	2.45	0.036
3	88	2	24	35	13	121	03	214	391	0.50	1.35	2.50	0.037
4	88	2	24	35	20	121	16	281	514	0.50	0.98	1.82	0.027
5	88	2	24	35	20	121	12	239	437	0.50	1.26	2.33	0.034
6	88	2	24	35	34	121	17	135	247	0.50	1.33	2.47	0.036
10	88	3	4	35	20	121	32	507	927	0.50	1.30	2.41	0.035
11	88	3	6	36	20	122	13	498	911	0.50	1.31	2.43	0.035
12	88	3	7	34	49	120	56	148	271	0.50	1.32	2.45	0.036
13	88	3	11	35	02	121	14	324	593	0.50	1.25	2.32	0.034
14	88	3	11	35	05	121	14	328	600	0.50	1.55	2.87	0.042
15	88	3	12	35	06	121	15	168	307	0.50	1.36	2.52	0.037
17	88	3	12	35	30	121	08	51	93	0.33	0.80	1.48	0.022
18	88	3	13	36	01	121	52	594	1086	0.95	2.66	4.93	0.072
19	88	3	13	35	42	122	00	628	1148	0.70	1.79	3.32	0.048
20	88	3	14	35	39	121	44	501	916	0.50	1.20	2.22	0.032
21	88	3	14	35	31	121	35	482	881	0.50	1.30	2.41	0.035
22	88	3	14	35	23	121	25	420	768	1.00	2.30	4.26	0.062
23	88	3	15	35	27	121	43	599	1095	1.00	2.43	4.50	0.066
24	88	3	15	35	08	121	40	674	1233	1.00	2.10	3.89	0.057
25	88	3	16	34	53	121	25	251	459	0.50	1.25	2.32	0.034
26	88	3	16	35	08	121	22	363	664	0.50	1.35	2.50	0.037
27	88	3	17	35	15	121	11	286	523	0.50	1.38	2.56	0.037
28	88	3	17	35	09	121	01	204	373	0.50	1.21	2.24	0.033
29	88	3	17	34	59	120	53	113	207	0.50	1.30	2.41	0.035

Table 1. Cont'd.

1988 Trawls cont'd.

Trawl	Date			Position				Depth		Duration	Distance		Area[a]
	Yr	Mo	Da	W Lat.		N Long.		Fath	M	Hr	NMi	Km	Km^2
30	88	3	18	34°	48'	120°	54'	123	225	0.50	1.32	2.45	0.036
31	88	3	18	34	48	120	47	58	106	0.50	1.56	2.89	0.042
32	88	3	18	34	44	120	53	114	208	0.50	1.52	2.82	0.041
33	88	3	18	34	39	120	44	38	69	0.50	1.50	2.78	0.041
34	88	3	19	34	37	121	11	436	797	0.50	1.34	2.48	0.036
35	88	3	19	34	31	121	08	562	1028	1.00	2.40	4.45	0.065
36	88	3	20	35	01	121	22	259	474	0.50	1.10	2.04	0.030
37	88	3	21	35	34	121	22	234	428	0.50	1.13	2.09	0.031
38	88	3	21	35	35	121	19	142	260	0.50	1.31	2.43	0.035
39	88	3	21	35	24	121	10	185	338	0.50	1.29	2.39	0.035
40	88	3	22	35	22	121	08	170	311	0.50	1.39	2.58	0.038
41	88	3	22	35	13	121	04	216	395	0.50	1.28	2.37	0.035
42	88	3	25	34	53	120	55	147	269	0.50	1.38	2.56	0.037
43	88	3	26	34	57	121	03	273	499	0.50	1.63	3.02	0.044
44	88	3	26	35	00	121	00	290	530	0.50	1.55	2.87	0.042
45	88	3	26	34	50	121	02	245	448	0.50	1.49	2.76	0.040
46	88	3	28	35	20	121	22	382	699	0.50	1.20	2.22	0.032
47	88	3	29	35	12	121	40	601	1099	1.00	2.29	4.24	0.062
48	88	3	31	35	34	121	35	440	805	0.50	1.43	2.65	0.039
49	88	3	31	35	27	121	39	597	1092	1.00	2.55	4.73	0.069
50	88	4	1	35	29	121	48	597	1092	1.00	2.82	5.23	0.076
51	88	4	1	35	36	121	59	602	1101	0.75	1.93	3.58	0.052
52	88	4	2	35	53	121	42	467	854	0.50	1.49	2.76	0.040
53	88	4	2	36	02	121	49	554	1013	1.00	2.65	4.91	0.072
54	88	4	3	36	03	121	47	479	876	0.50	1.42	2.63	0.038
55	88	4	3	36	13	122	11	566	1035	1.00	2.58	4.78	0.070
56	88	4	4	36	20	122	10	420	768	0.50	1.28	2.37	0.035
57	88	4	4	36	16	122	09	427	781	0.50	1.23	2.28	0.033
58	88	4	5	36	17	122	15	533	975	0.50	1.08	2.00	0.029
59	88	4	6	36	09	122	06	640	1170	1.00	2.44	4.52	0.066
60	88	4	6	35	48	121	37	389	711	0.50	1.51	2.80	0.041
61	88	4	6	35	39	121	29	308	563	0.50	1.25	2.32	0.034
62	88	4	7	35	28	121	09	129	236	0.53	1.42	2.63	0.038
63	88	4	8	34	48	120	55	143	262	0.20	0.51	0.95	0.014
64	88	4	8	34	49	121	18	254	465	0.50	1.05	1.95	0.028
65	88	4	9	34	46	121	32	398	728	0.50	1.49	2.76	0.040
66	88	4	9	34	31	121	08	563	1030	1.00	2.80	5.19	0.076

Table 2. Catch data for Dover sole, sablefish, shortspine thornyhead, longspine thornyhead, rex sole, Pacific grenadier, and giant grenadier taken by bottom trawls in Jan-Feb 1987 and Mar-Apr 1988.

1987 trawls made within 1988 study area

Trawl	Depth (fath)	Density (Kg/km^2)							Abundance (N/Km^2)						
		Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant	Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant
5	96	1	11	0	0	44	0	0	19	39	0	0	426	0	0
16	100	1,296	1,505	0	0	1,282	0	0	12,230	3,460	0	0	8,975	0	0
44	102	13	0	0	0	184	0	0	170	0	0	0	2,508	0	0
6	199	86	0	39	0	53	0	0	213	0	135	0	252	0	0
17	200	1,776	291	52	0	1,017	0	0	13,597	445	387	0	7,033	0	0
31	200	721	44	122	0	4,582	0	0	3,750	64	924	0	26,049	0	0
43	200	652	59	50	0	2,035	0	0	1,744	80	80	0	9,885	0	0
55	202	744	262	23	0	1,670	0	0	4,139	252	174	0	11,222	0	0
42	289	385	520	1,240	100	2	0	0	626	361	4,189	1,035	24	0	0
50	295	3,610	497	156	17	701	6	0	12,245	517	653	382	1,863	12	0
45	298	180	187	473	128	0	0	0	344	150	1934	903	0	0	0
32	300	644	130	1,049	167	72	0	19	1,193	118	3,366	1,371	282	0	18
7	302	55	162	596	163	0	0	0	77	135	2,376	1,296	0	0	0
18	303	879	387	293	17	103	0	0	1,302	361	447	266	276	0	0
8	397	2,323	9	1,260	1,196	0	0	36	3,161	39	1,288	6,348	0	0	19
33	400	739	208	533	1,357	0	0	2	953	176	1,072	11,137	0	0	9
41	404	946	24	332	1,390	0	4	0	1,163	19	485	10,752	0	19	0
4	408	1,017	138	371	891	0	0	39	1,466	125	818	7,446	0	0	29
34	497	6,435	168	992	1,474	0	13	15	7,794	120	1,003	10,939	0	55	22
48	498	2,654	366	1,475	2,213	0	65	54	3,292	262	793	14,709	0	143	76
46	499	302	586	955	1,961	0	15	285	272	297	875	16,122	0	88	360
13	500	838	0	790	1,345	0	0	397	712	0	715	10,072	0	0	0
15	500	2,004	1,048	1,983	824	0	0	279	2,308	424	1,238	4,789	0	0	366
40	500	217	748	923	1,825	0	37	8	232	419	864	22,327	0	121	9
47	500	874	505	908	1,532	0	16	132	927	352	772	13,455	0	72	134
37	502	1,470	2,047	986	1,484	0	2,038	52	1,502	1,059	642	11,823	0	2,349	69
12	503	9,892	5,323	826	1,189	0	88	34	12,533	3,536	877	10,020	0	95	38
14	503	1,050	604	410	736	0	20	0	994	755	556	4,250	0	20	0
51	590	640	1,096	490	60	0	508	660	538	572	273	388	0	732	591
28	598	169	185	38	22	0	804	325	150	92	8	117	0	866	216
39	600	0	1,083	221	463	0	417	123	0	0	0	0	0	680	147
11	601	0	668	155	133	0	131	33	0	0	0	0	0	154	10
35	601	291	798	387	528	0	1,872	115	248	414	466	5,403	0	3,275	155
21	610	1,769	611	212	790	0	275	585	1,579	298	96	4,549	0	327	655
29	700	27	72	15	38	0	139	736	21	32	11	204	0	97	569
36	700	0	465	0	54	0	884	162	0	0	0	0	0	1,299	162
10	702	26	228	122	67	0	299	563	19	96	116	212	0	231	597
22	703	311	125	95	165	0	0	599	227	36	64	916	0	0	663
49	705	155	589	122	201	0	911	1,126	129	301	75	1,605	0	1,902	860
38	708	0	121	48	43	0	189	203	0	0	0	0	0	245	210

Table 2. Cont'd.

1987 trawls made outside 1988 study area (north of 36.5°N)

Trawl	Depth (fath)	Density (Kg/km^2)							Abundance (N/Km^2)						
		Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant	Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant
54	99	209	99	0	0	2,483	0	0	884	725	0	0	16,578	0	0
23	100	802	669	0	0	735	0	0	4618	900	0	0	5,278	0	0
24	204	1,721	589	505	0	163	0	0	11,590	484	4,635	0	1,993	0	0
25	305	362	87	74	6	49	0	0	544	75	225	66	206	0	0
19	395	821	265	455	1,577	0	0	287	1,303	128	441	15608	0	0	302
53	410	1,087	132	214	1,335	0	34	16	3,805	105	227	5737	0	323	26
26	415	1,410	96	370	784	0	0	17	3,087	77	375	4647	0	0	19
20	490	559	164	2,354	2,764	0	96	485	635	125	1,278	15714	0	144	501
52	500	2,865	317	372	2,036	0	107	80	4,441	245	301	15265	0	419	79
27	510	14,167	211	1,739	678	0	114	277	18,181	154	948	3332	0	154	327

1988

Trawl	Depth (fath)	Density (Kg/km^2)							Abundance (N/Km^2)						
		Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant	Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant
33	38	312	0	0	0	0	0	0	12,275	0	0	0	0	0	0
17	51	258	0	0	0	0	0	0	5,175	0	0	0	0	0	0
31	58	121	0	0	0	89	0	0	2,575	0	0	0	830	0	0
1	91	5	634	0	0	139	0	0	84	783	0	0	2,963	0	0
29	113	4	0	0	0	495	0	0	28	0	0	0	7,367	0	0
32	114	662	18	0	0	936	0	0	6,108	49	0	0	12,435	0	0
30	123	516	29	0	0	2368	0	0	6,020	84	0	0	28,236	0	0
62	129	195	27	0	0	196	0	0	1,120	78	0	0	1,537	0	0
6	135	3	0	0	0	43	0	0	28	0	0	0	471	0	0
38	142	1,263	97	8	0	586	0	0	7,177	141	85	0	4,946	0	0
63	143	0	147	0	72	746	0	0	0	0	0	0	0	0	0
42	147	655	7	22	0	897	0	0	3,384	27	54	0	9,986	0	0
12	148	1,101	56	19	0	465	0	0	6,190	84	224	0	8,740	0	0
15	168	260	125	0	0	43	0	0	1,250	163	0	0	462	0	0
40	170	318	18	0	0	3,147	0	0	1,540	53	0	0	17,651	0	0
39	185	1,140	146	181	0	749	0	0	4,394	143	315	0	4783	0	0
28	204	646	300	62	0	735	0	0	2,568	367	214	0	3,486	0	0
3	214	528	43	29	0	304	0	0	1,452	82	110	0	1,616	0	0
41	216	3,071	425	282	0	328	0	0	7,068	260	116	0	1,416	0	0
37	234	792	1,377	175	0	71	0	0	1,868	1,508	852	0	393	0	0
5	239	403	471	428	0	916	0	0	882	382	941	0	3,806	0	0
45	245	5,221	299	883	0	0	0	0	10,951	223	1,390	0	0	0	0

Table 2. Cont'd.

1988 cont'd.		Density (Kg/km^2)							Abundance (N/Km^2)						
Trawl	Depth (fath)	Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant	Dover	Sabl	SsTh	LsTh	Rex	Pacif	Giant
25	251	7,135	1,103	341	1,770	2,795	0	0	14,896	1,092	266	21,591	9,657	0	0
64	254	10,006	2,117	210	1,136	1,463	0	0	16,376	1,616	246	14,476	5,841	0	0
36	259	5,186	--	519	1,535	676	0	0	13,051	537	1,544	17,630	2,552	0	0
43	273	1,074	124	1,116	508	0	0	0	2,041	113	2,306	3,243	0	0	0
4	281	1,436	640	1,495	17	0	0	0	2,220	414	4,338	489	0	0	0
27	286	306	756	1,573	382	0	0	0	589	508	5,278	2,702	0	0	0
44	290	187	621	1,326	884	0	0	0	525	477	2,148	8,380	0	0	0
61	308	921	1999	608	350	0	0	35	974	1,299	1,889	2,568	0	0	30
13	324	2,236	446	450	1,208	0	0	0	3,484	295	797	14,240	0	0	0
14	328	729	155	205	83	0	0	0	978	95	239	1,718	0	0	0
26	363	1,022	679	391	1,255	0	0	0	1,726	521	411	15,389	0	0	0
46	382	2,085	694	550	2,071	0	0	0	2,684	494	524	4,816	0	0	0
60	389	216	270	41	446	0	0	32	245	171	49	4,683	0	0	24
65	398	335	1,780	364	892	0	0	0	472	1,117	397	12,801	0	0	0
22	420	1,575	1,252	847	3,910	0	0	10	1,968	884	868	28,639	0	0	16
56	420	8,909	147	106	168	0	7	0	12,663	87	58	1,358	0	29	0
57	427	2,777	1,876	552	1,639	0	14	538	3,019	1,472	601	15,466	0	120	631
34	436	1,819	2,993	1,205	3,688	0	0	34	3,128	2,237	1,685	38,952	0	0	28
48	440	127	693	502	1,007	0	20	28	181	465	586	6,635	0	78	26
52	467	656	1,300	377	2,296	0	7	453	918	893	372	22,929	0	50	546
54	479	734	1,505	497	1,423	0	33	123	833	938	391	10,356	0	52	104
21	482	144	62	66	511	0	27	0	142	57	57	4,019	0	142	0
11	498	286	3,480	1,024	5,926	0	147	401	366	2,311	789	45,344	0	395	451
20	501	529	1,714	912	2,915	0	350	70	524	1,142	771	27,347	0	123	154
10	507	187	3,380	1,923	5,381	0	214	19	199	2,188	1,449	37,812	0	654	28
58	533	103	3,517	1,137	3,164	0	1,227	637	103	1,575	822	28,576	0	1,610	788
53	554	0	407	423	227	0	97	54	0	0	0	0	0	139	70
35	562	0	1,372	175	370	0	290	136	0	0	0	0	0	539	169
66	563	17	165	44	37	0	35	35	26	106	53	356	0	66	40
55	566	0	197	149	187	0	409	107	0	0	0	0	0	502	129
18	594	0	25	35	49	0	189	0	0	0	0	0	0	278	0
49	597	0	94	71	94	0	761	899	0	0	0	0	0	1,260	999
50	597	0	785	152	554	0	170	34	0	0	0	0	0	196	39
23	599	41	1,011	392	54	0	461	238	30	594	350	274	0	563	289
47	601	0	1,068	195	558	0	1,306	465	0	0	0	0	0	1721	549
51	602	59	1,373	281	165	0	1,782	230	38	746	115	1,186	0	2,158	210
19	628	0	278	55	150	0	505	67	0	0	0	0	0	640	103
59	640	0	286	57	144	0	799	395	0	0	0	0	0	1,076	364
24	674	0	144	57	81	0	607	363	0	0	0	0	0	775	423

Table 3. Length-frequency data[1] by depth stratum and sex for Dover sole, sablefish, shortspine thornyhead, longspine thornyhead, rex sole, Pacific grenadier and giant grenadier for Jan-Feb 1987 (within 1988 study area) and Mar-Apr 1988.

1987 Dover sole Stratum (fathoms):	50-249			250-549			550-750		
TL[2] (mm)	Male (n)	Female (n)	Unkn.[3] (n)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)
120	--	1	--	--	--	--	--	--	--
170	--	--	1	--	--	--	--	--	--
180	--	1	10	--	--	--	--	--	--
190	1	3	27	--	--	--	--	--	--
200	--	2	41	--	--	--	--	--	--
210	5	3	72	--	1	--	--	--	--
220	17	3	159	1	--	--	--	--	--
230	23	21	109	--	2	--	--	--	--
240	54	39	100	10	--	--	--	--	--
250	98	32	--	--	1	--	--	--	--
260	75	56	2	31	21	--	--	--	--
270	215	81	2	44	40	--	--	--	--
280	143	76	--	32	41	--	--	--	--
290	66	38	1	35	73	--	--	--	--
300	38	26	--	24	50	--	--	--	--
310	16	20	--	10	122	--	--	--	--
320	11	29	--	18	129	--	--	--	--
330	10	21	--	25	93	--	--	--	--
340	1	27	--	103	139	--	--	--	--
350	6	25	--	68	115	--	--	3	--
360	4	16	--	125	95	--	--	--	--
370	1	5	--	107	56	--	--	--	--
380	2	8	--	125	108	--	2	--	--
390	1	10	--	289	116	--	3	1	--
400	--	8	--	247	190	1	--	8	--
410	--	2	--	215	162	--	2	9	--
420	--	2	--	119	164	--	--	16	--
430	--	5	--	153	306	1	1	25	--
440	--	1	--	87	230	--	3	35	--
450	--	--	--	41	217	--	2	46	--
460	--	--	--	33	184	--	2	53	--
470	--	--	--	24	158	--	--	48	--
480	--	--	--	3	119	--	--	21	--
490	--	--	--	--	91	--	--	14	--
500	--	--	--	--	24	--	--	10	--
510	--	--	--	--	28	--	--	3	--
520	--	--	--	--	18	--	--	--	--
530	--	--	--	--	1	--	--	1	--
550	--	--	--	--	--	--	--	1	--

[1]Weighted by the ratio of number caught/number measured.

[2]TL = total length.

[3]Sex unknown.

Table 3. Cont'd.

1988 Dover sole Stratum (fathoms):	30-249			250-549			550-699		
TL (mm)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)
70	5	--	--	--	--	--	--	--	--
100	10	5	--	--	--	--	--	--	--
110	41	52	--	--	--	--	--	--	--
120	74	88	1	--	--	--	--	--	--
130	28	53	1	--	--	--	--	--	--
140	17	17	--	--	--	--	--	--	--
150	2	7	--	--	--	--	--	--	--
160	19	34	--	--	--	--	--	--	--
170	42	48	--	--	--	--	--	--	--
180	70	67	--	--	--	--	--	--	--
190	50	49	--	--	--	--	--	--	--
200	35	52	--	--	--	--	--	--	--
210	29	55	--	--	--	--	--	--	--
220	54	75	--	--	1	--	--	--	--
230	42	77	--	--	--	--	--	--	--
240	48	89	--	--	9	--	--	--	--
250	31	101	--	1	1	--	--	--	--
260	28	78	--	5	2	--	--	--	--
270	49	80	--	17	4	--	--	--	--
280	35	81	--	14	16	--	--	--	--
290	38	77	--	28	11	--	--	--	--
300	45	79	--	21	18	--	--	--	--
310	44	81	--	65	60	--	--	--	--
320	49	75	--	82	66	--	--	--	--
330	53	51	--	130	58	--	--	--	--
340	32	76	--	115	74	--	--	--	--
350	39	70	--	107	101	--	--	--	--
360	27	72	--	89	63	--	--	--	--
370	27	63	--	108	128	--	--	--	--
380	13	42	--	74	125	--	--	--	--
390	5	59	--	89	139	--	--	--	--
400	--	32	--	65	127	--	--	1	--
410	--	24	--	62	87	--	--	--	--
420	2	19	--	47	99	--	--	1	--
430	--	16	--	37	86	--	--	1	--
440	--	9	--	15	87	--	--	--	--
450	2	6	--	2	83	--	--	--	--
460	--	--	--	--	60	--	--	1	--
470	--	5	--	1	60	--	--	--	--
480	--	--	--	4	39	--	--	1	--
490	--	--	--	--	24	--	--	--	--
500	--	5	--	--	17	--	--	1	--
510	--	--	--	--	4	--	--	--	--
520	--	--	--	--	1	--	--	--	--
540	--	--	--	--	2	--	--	--	--

Table 3. Cont'd.

1987 sablefish Stratum (fathoms):	50-249			250-549			550-750		
FL[4] (mm)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)
300	1	1	--	--	--	--	--	--	--
310	6	5	5	--	--	--	--	--	--
320	8	10	2	--	--	--	--	--	--
330	13	12	5	--	--	--	--	--	--
340	16	10	7	--	--	--	--	--	--
350	7	8	11	1	--	--	--	--	--
360	1	4	--	--	--	--	--	--	--
370	2	1	--	1	--	--	--	--	--
380	--	--	1	--	--	--	--	--	--
390	3	2	1	2	--	--	--	--	--
400	7	6	6	--	1	--	--	--	--
410	5	4	6	--	1	3	--	--	--
420	3	5	5	1	1	--	1	--	--
430	--	1	--	1	2	1	--	--	--
440	2	2	4	4	2	3	--	--	--
450	9	3	--	8	2	2	--	--	--
460	--	3	--	9	1	7	--	--	--
470	--	1	1	30	5	4	9	--	--
480	--	4	--	28	3	7	4	--	--
490	--	--	--	36	9	8	10	--	--
500	--	1	--	46	6	14	10	1	--
510	--	--	--	62	12	8	29	1	--
520	--	--	--	50	34	5	29	5	--
530	--	--	--	42	33	11	30	--	--
540	--	--	1	42	57	5	25	4	--
550	--	--	--	15	56	7	23	5	--
560	--	--	--	12	37	21	24	5	--
570	--	--	--	9	30	16	20	4	--
580	--	--	--	8	35	6	14	9	--
590	--	--	--	10	35	14	6	3	--
600	--	--	--	2	21	3	9	7	--
610	--	--	--	--	13	--	5	9	--
620	--	--	--	--	25	--	3	5	--
630	--	--	--	--	12	6	1	3	--
640	--	--	--	--	33	--	1	3	--
650	--	--	--	--	4	--	--	5	--
660	--	--	--	--	10	--	--	9	--
670	--	--	--	--	6	--	--	5	--
680	--	--	--	--	4	6	--	3	--
690	--	--	--	--	6	--	--	2	--
700	--	--	--	--	4	--	1	5	--
710	--	--	--	--	--	--	--	1	--
740	--	--	--	--	--	--	--	1	--
760	--	--	--	--	--	--	--	1	--
770	--	--	--	--	--	--	--	1	--
780	--	--	--	--	--	--	--	1	--
810	--	--	--	--	3	--	--	1	--

[4]FL = fork length.

Table 3. Cont'd.

1988 sablefish Stratum (fathoms):	30-249		250-549		550-699	
FL (mm)	Male (n)	Female (n)	Male (n)	Female (n)	Male (n)	Female (n)
270	1	--	--	--	--	--
290	4	--	--	--	--	--
300	8	5	--	--	--	--
310	3	5	--	--	--	--
320	1	4	--	--	--	--
330	3	5	--	--	--	--
340	--	2	--	--	--	--
350	--	2	--	--	--	--
370	1	1	--	--	--	--
380	2	2	--	--	--	--
390	1	--	--	--	--	--
400	4	--	1	1	--	--
410	4	--	2	--	--	--
420	4	2	4	--	--	--
430	4	6	12	4	1	--
440	9	4	12	4	1	--
450	7	9	24	2	1	--
460	8	8	13	14	--	--
470	3	10	67	6	1	--
480	--	6	66	20	5	--
490	--	3	88	10	10	2
500	1	--	94	16	19	2
510	--	1	72	28	17	3
520	--	--	68	23	21	5
530	--	--	78	14	22	4
540	--	1	35	17	18	6
550	--	--	32	19	9	5
560	--	3	30	17	19	5
570	--	--	18	22	11	3
580	--	--	9	9	10	8
590	--	--	5	9	5	7
600	--	--	1	9	4	9
610	--	1	2	16	4	4
620	--	--	1	3	2	4
630	--	--	--	7	--	--
640	--	--	--	1	2	2
650	--	--	--	1	--	--
660	--	--	--	--	--	3
670	--	--	--	2	--	1
680	--	1	--	--	--	--
700	--	--	--	1	--	1
710	--	--	--	--	--	1
740	--	1	--	--	--	--
760	--	--	--	--	--	1

Table 3. Cont'd.

1987 shortspine thornyhead

TL (mm)	Stratum (fathoms): 50-249 Unkn. (n)	250-549 Unkn. (n)	550-750 Unkn. (n)
80	--	--	1
90	--	--	3
100	--	--	7
110	2	--	6
120	1	6	10
130	--	--	5
140	1	--	3
150	--	3	1
160	--	5	--
170	2	4	1
180	5	3	3
190	7	24	3
200	6	25	1
210	16	42	1
220	14	77	5
230	13	95	2
240	16	115	8
250	5	128	11
260	5	126	1
270	2	110	2
280	1	70	--
290	--	62	1
300	1	66	2
310	--	77	1
320	--	50	--
330	--	73	1
340	2	65	2
350	1	64	1
360	1	55	5
370	--	69	7
380	--	125	5
390	--	76	3
400	1	67	7
410	2	76	8
420	--	67	4
430	--	96	9
440	1	51	6
450	1	44	6
460	--	47	6
470	--	34	6
480	1	64	8

TL (mm)	50-249 Unkn. (n)	250-549 Unkn. (n)	550-750 Unkn. (n)
490	--	44	7
500	--	31	9
510	--	18	3
520	--	28	7
530	1	16	7
540	--	36	4
550	--	40	3
560	--	14	5
570	--	6	--
580	--	12	2
590	--	7	5
600	--	22	1
610	--	3	2
620	--	6	1
630	--	2	--
640	--	--	2
650	--	2	--
660	--	--	1
670	--	2	1
680	--	3	1
690	--	2	--

Table 3. Cont'd.

1988 shortspine thornyhead Stratum (fathoms):	30-249			250-549			550-699		
TL (mm)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)	Male (n)	Female (n)	Unkn. (n)
110	1	--	3	--	--	--	--	--	--
120	--	1	--	--	--	--	--	--	--
130	--	--	2	--	--	--	--	--	--
140	1	1	1	--	--	--	--	--	--
150	3	4	2	--	--	1	--	--	--
160	1	1	1	--	--	1	--	--	--
170	--	2	3	--	--	--	--	--	--
180	--	--	2	1	2	6	--	--	--
190	--	2	--	--	4	1	--	--	--
200	--	4	1	1	4	8	--	--	--
210	1	7	1	2	6	6	--	--	--
220	4	6	3	7	9	18	--	--	--
230	2	5	--	5	10	13	--	1	--
240	2	4	1	8	26	11	--	--	--
250	1	6	4	15	28	18	--	--	--
260	2	1	--	6	25	18	--	--	--
270	1	6	--	9	23	15	--	--	--
280	2	5	1	10	22	15	--	--	--
290	--	--	--	5	29	5	--	--	--
300	--	--	1	7	16	2	--	--	--
310	--	1	--	18	18	6	1	--	--
320	--	3	--	14	22	3	--	--	--
330	--	3	--	11	13	2	1	--	--
340	1	4	--	11	31	1	2	2	--
350	--	1	--	11	18	3	1	1	--
360	1	1	--	17	23	--	5	1	--
370	1	1	--	8	14	--	4	1	--
380	--	1	--	12	12	--	1	--	--
390	1	3	--	11	24	--	5	--	--
400	--	--	--	15	11	--	6	3	--
410	1	3	--	15	11	--	1	4	--
420	1	2	--	16	17	--	3	2	--
430	--	1	--	19	15	--	4	2	--
440	--	1	--	12	10	--	--	5	--
450	--	3	--	6	13	1	2	2	--
460	--	2	--	6	10	--	5	2	--
470	--	3	--	9	10	--	2	2	--
480	--	2	--	9	15	--	2	4	--
490	--	3	--	4	10	--	3	2	--
500	--	--	--	6	10	--	2	2	--
510	--	--	--	4	9	--	--	1	--
520	--	--	--	6	5	--	--	--	--
530	--	2	--	3	5	--	1	3	--
540	--	2	--	1	6	--	3	3	--
550	--	--	--	1	7	--	1	1	--
560	--	1	--	1	5	--	--	2	--
570	--	1	--	1	3	--	--	--	--
580	--	--	--	--	1	--	--	1	--
590	--	1	--	--	2	--	1	--	--
600	--	--	--	1	2	--	--	--	--
610	--	--	--	--	--	--	--	1	--
620	--	--	--	--	--	--	1	--	--
630	--	--	--	--	--	--	--	2	--
640	--	--	--	--	1	--	--	--	--
650	--	--	--	--	1	--	--	--	--

Table 3. Cont'd.

1987 longspine thornyhead Stratum (fathoms):	50-249	250-549	550-750
TL (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
50	--	--	1
60	--	--	3
70	--	32	7
80	--	33	2
90	--	141	30
100	--	47	34
110	--	196	34
120	--	520	53
130	--	687	87
140	--	660	82
150	--	525	77
160	--	335	37
170	--	526	36
180	--	705	37
190	--	619	76
200	--	882	71
210	--	1,011	80
220	--	1,224	100
230	--	1,817	111
240	--	1,812	115
250	--	1,472	107
260	--	1,397	123
270	--	774	133
280	--	545	61
290	--	291	70
300	--	101	44
310	--	72	39
320	--	28	7
330	--	13	1
340	--	10	2

1988 longspine thornyhead Stratum (fathoms):	30-249	250-549	550-699
TL (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
60	--	21	7
70	--	36	67
80	--	76	69
90	--	83	165
100	--	169	254
110	--	202	195
120	--	430	174
130	--	617	154
140	--	637	157
150	--	521	123
160	--	503	101
170	--	767	91
180	--	758	108
190	--	704	81
200	--	1,032	81
210	--	948	74
220	--	1,377	88
230	--	1,046	98
240	--	1,125	96
250	--	1,136	102
260	--	939	88
270	--	538	55
280	--	277	27
290	--	131	16
300	--	58	7
310	--	3	13
320	--	8	
330	--	2	1
340	--	1	
360	--	1	
370	--	1	

Table 3. Cont'd.

1987 rex sole Stratum (fathoms):	50-249	250-549	550-750
TL (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
80	1	--	--
120	1	--	--
150	1	--	--
160	3	--	--
170	9	--	--
180	14	--	--
190	21	--	--
200	23	--	--
210	62	--	--
220	29	--	--
230	33	--	--
240	35	2	--
250	56	1	--
260	117	--	--
270	391	2	--
280	350	3	--
290	354	5	--
300	400	16	--
310	419	21	--
320	475	43	--
330	320	56	--
340	202	36	--
350	97	19	--
360	59	7	--
370	7	4	--
380	12	1	--
390	1	--	--

1988 rex sole Stratum (fathoms):	30-249	250-549	550-699
TL (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
70	1	--	--
90	5	--	--
100	5	--	--
110	29	--	--
120	2	1	--
130	9	1	--
140	1	1	--
150	1	2	--
170	12	--	--
180	33	--	--
190	234	--	--
200	270	1	--
210	469	2	--
220	424	2	--
230	389	5	--
240	313	5	--
250	157	2	--
260	143	2	--
270	113	2	--
280	252	3	--
290	225	11	--
300	269	8	--
310	219	30	--
320	170	44	--
330	144	57	--
340	112	86	--
350	50	88	--
360	18	73	--
370	10	81	--
380	1	47	--
390	--	11	--
400	--	6	--
410	--	1	--

Table 3. Cont'd.

1987 Pacific grenadier Stratum (fathoms):			
	50-249	250-549	550-750
SV[5] (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
40	--	1	1
50	--	--	3
60	--	--	4
70	--	1	5
80	--	2	9
90	--	2	18
100	--	2	29
110	--	8	54
120	--	11	44
130	--	4	43
140	--	6	45
150	--	6	16
160	--	3	39
170	--	10	38
180	--	24	47
190	--	15	64
200	--	41	115
210	--	57	134
220	--	54	101
230	--	36	87
240	--	16	53
250	--	2	18
260	--	1	15
270	--	--	14
280	--	--	2
290	--	--	1
300	--	--	1

1988 Pacific grenadier Stratum (fathoms):			
	30-249	250-549	550-699
SV (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
30	--	1	3
40	--	1	5
50	--	--	19
60	--	1	12
70	--	--	5
80	--	--	4
90	--	1	10
100	--	4	13
110	--	8	18
120	--	12	18
130	--	7	9
140	--	4	19
150	--	3	14
160	--	4	25
170	--	--	33
180	--	6	33
190	--	14	65
200	--	9	84
210	--	15	81
220	--	7	54
230	--	1	39
240	--	1	17
250	--	--	18
260	--	1	5
270	--	--	4
290	--	--	1

[5]SV = snout to vent length.

Table 3. Cont'd.

1987 giant grenadier Stratum (fathoms):	50-249	250-549	550-750
SV (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
50	--	3	--
110	--	1	--
150	--	2	--
160	--	4	9
170	--	11	35
180	--	19	41
190	--	8	48
200	--	11	31
210	--	1	17
220	--	2	10
230	--	1	6
240	--	1	--
250	--	1	--
260	--	--	1
270	--	1	--
280	--	--	2
300	--	--	1
330	--	--	1
400	--	--	1
410	--	--	1
460	--	--	1

1988 giant grenadier Stratum (fathoms):	30-249	250-549	550-699
SV (mm)	Unkn. (n)	Unkn. (n)	Unkn. (n)
110	--	--	3
130	--	1	--
140	--	1	--
150	--	3	3
160	--	7	15
170	--	17	49
180	--	24	45
190	--	15	46
200	--	11	25
210	--	11	13
220	--	2	6
230	--	4	4
240	--	--	2
250	--	1	--
260	--	--	5
280	--	--	1

Table 4. N, mean length, and standard deviation (SD) by sex and depth stratum for Dover sole, sablefish, and shortspine thornyhead and by depth stratum for longspine thornyhead, rex sole, Pacific grenadier and giant grenadier for Jan-Feb 1987 (within the 1988 study area) and Feb-Apr 1988.

Dover sole[1]

		Stratum[2]: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	Male	212	277	33	489	385	46	10	424	29	711	353	66
	Female	245	310	54	1,083	418	54	233	454	27	1,561	406	67
	Unknown	104	221	17	2	415	21	0	--	--	106	225	31
	All	561	281	53	1,574	408	54	243	453	28	2,378	382	78
1988	Male	513	246	71	403	359	40	0	--	--	916	296	81
	Female	962	272	76	964	405	51	6	448	38	1,932	339	93
	Unknown	2	125	7	0	--	--	0	--	--	2	125	7
	All	1,477	263	75	1,367	392	52	6	448	38	2,850	325	92

Sablefish[3]

		Stratum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	Male	68	359	40	268	510	36	224	540	37	560	503	67
	Female	69	371	52	278	565	54	90	618	65	437	545	96
	Unknown	43	376	51	94	518	55	0	--	--	137	474	85
	All	180	368	48	640	535	54	314	562	59	1,134	516	85
1988	Male	68	396	65	568	509	36	183	536	37	819	505	52
	Female	81	431	86	246	538	52	79	578	51	406	524	77
	Unknown	1	310	--	0	--	--	0	--	--	1	310	--
	All	150	414	79	814	518	43	262	549	46	1,226	512	63

Shortspine thornyhead[1]

		Stratum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	All	84	231	62	1,235	377	106	223	370	158	1,542	368	118
1988	Male	27	251	85	308	372	84	57	431	68	392	372	90
	Female	100	314	118	492	363	98	50	465	79	642	363	106
	Unknown	26	190	55	116	254	40	0	--	--	142	243	50
	All	153	282	114	916	352	96	107	446	75	1,176	352	104

[1] Total length.

[2] 1987 stratum 1: 50-249 fathoms, 2: 250-549 fathoms, 3: 550-750 fathoms, ALL: 50-750 fathoms. 1988 stratum 1: 30-249 fathoms, 2: 250-549 fathoms, 3: 550-699 fathoms, ALL: 30-699 fathoms.

[3] Fork length.

Table 4. Cont'd.

Longspine thornyhead[1]

		Stratum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	All	--	--	--	1,757	216	46	759	210	60	2,516	214	51
1988	All	--	--	--	2,547	202	49	1,210	159	64	3,757	188	58

Rex sole[1]

		Statum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	All	669	280	46	162	326	21	--	--	--	831	289	46
1988	All	1,290	262	56	277	339	44	--	--	--	1,567	276	62

Pacific grenadier[4]

		Stratum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	All	--	--	--	167	222	116	785	322	204	952	304	195
1988	All	--	--	--	105	175	68	569	178	53	674	178	56

Giant grenadier[4]

		Stratum: 1			2			3			ALL		
Year	Sex	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1987	All	--	--	--	167	372	198	502	473	241	669	448	235
1988	All	--	--	--	97	186	21	217	186	23	314	186	22

[4]Snout to vent length.

Table 5. 1987 Dover sole.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-749	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	275	3,631	359	66	209	502	530	2598	305	54
Mean	34	182	30	22	42	84	133	260	51	9
SD	31	238	51	30	28	99	63	304	64	12
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	69	185	30	44	84	95	133	260	51	9
SD	61	239	51	61	56	119	63	304	64	12
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	4,483	2,655	243	4,140	4,689	2,631	1,686	3,057	419	66
SD	5,099	3,645	431	5,721	4,674	4,321	871	3,812	550	84
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	661	1826	282	437	796	959	1,256	2,574	478	87
SD	596	2354	485	608	547	1,217	624	2,982	617	113
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	2,677	13,154	824	735	1,128	3,207	2,381	5,442	1,025	121
SD	1,200	6,317	828	788	651	2,226	859	4,337	902	134
±2SE	907	2,899	499	1,115	651	1,991	992	2,891	807	120
TOTAL BIOMASS	16,655 metric tons			14,038 metric tons						
SD	6,483			5,136						
DF	36			32						
±2SE	2,161			1,816						
CV	6.5 %									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 6. 1988 Dover sole.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($\times 10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	642	1,717	7
Mean	29	66	1
SD	46	85	1
N	22	26	13
CATCH RATE (kg/hr)			
Mean	59	128	1
SD	91	169	1
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	3,734	3,243	7
SD	3,435	4,829	14
N	22	26	13
DENSITY (kg/km^2)			
Mean	794	1,951	9
SD	1,166	2,693	18
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	3,216	14,054	26
SD	2,347	7,228	31
±2SE	1,024	2,891	18
TOTAL BIOMASS	17,297 metric tons		
SD	7,599		
DF	57		
±2SE	2,013		
CV	5.8%		

Table 7. 1987 sablefish.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-749	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	110	1,386	636	76	34	164	41	1,181	474	162
Mean	14	69	53	25	7	24	10	118	79	27
SD	24	122	38	35	6	14	9	157	34	18
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	28	70	53	51	14	30	10	118	79	27
SD	48	122	38	71	12	14	9	157	34	18
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	543	461	154	1,166	168	274	90	722	229	78
SD	1,112	749	186	1,622	161	149	64	981	216	105
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	272	683	504	505	131	314	94	1,140	740	267
SD	479	1,157	351	707	121	160	82	1,494	310	193
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	1,099	4,920	1,470	850	186	980	179	2,409	1,586	375
SD	964	3,106	599	917	144	293	113	2,172	454	229
±2SE	729	1,425	361	1,297	144	262	131	1,448	406	205
TOTAL BIOMASS	7,488 metric tons			6,635 metric tons						
SD	3,307			2,437						
DF	36			32						
±2SE	1,102			862						
CV	7.4 %									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 8. 1988 sablefish.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($\times 10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	140	1,187	458
Mean	6	47	35
SD	10	36	29
N	22	25	13
CATCH RATE (kg/hr)			
Mean	13	92	37
SD	20	72	32
N	22	25	13
ABUNDANCE (N/km^2)			
Mean	201	899	111
SD	337	682	242
N	22	25	13
DENSITY (kg/km^2)			
Mean	192	1,332	554
SD	312	1,067	478
N	22	25	13
BIOMASS (kg/km^2) x km^2			
Metric tons	776	9,598	1,617
SD	628	2,864	817
±2SE	274	1,169	472
TOTAL BIOMASS	11,991 metric tons		
SD	3,044		
DF	56		
±2SE	814		
CV	3.4%		

Table 9. 1987 shortspine thornyhead.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-749	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	15	1,658	201	0	15	346	265	1,047	160	41
Mean	2	83	17	0	3	58	66	105	27	7
SD	2	46	16	0	2	40	39	43	16	5
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	4	84	17	0	6	62	66	105	27	7
SD	4	45	16	0	3	36	39	43	16	5
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	213	1,248	92	0	340	2,161	916	834	141	44
SD	295	968	136	0	310	1,346	299	182	174	44
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	36	828	159	0	57	635	624	1,025	251	67
SD	39	440	144	0	34	390	375	403	149	49
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	145	5,962	463	0	81	2,122	1,182	2,167	537	94
SD	78	1,182	246	0	40	712	516	586	218	58
±2SE	59	542	148	0	40	637	596	391	195	52
TOTAL BIOMASS	6,570 metric tons			6,183 metric tons						
SD	1,210			1,082						
DF	36			32						
±2SE	403			382						
CV	3.1%									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 10. 1988 shortspine thornyhead.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($x10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	76	670	137
Mean	3	26	11
SD	8	19	9
N	22	26	13
CATCH RATE (kg/hr)			
Mean	7	50	11
SD	16	36	9
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	195	1,111	40
SD	365	1,248	95
N	22	26	13
DENSITY (kg/km^2)			
Mean	95	705	160
SD	204	497	127
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	384	5,082	468
SD	410	1,334	216
±2SE	179	533	125
TOTAL BIOMASS	5,934 metric tons		
SD	1,412		
DF	57		
±2SE	374		
CV	3.2%		

Table 11. 1987 longspine thornyhead.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-749	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	0	2,058	265	0	0	53	517	1,488	207	58
Mean	0	103	22	0	0	9	129	149	34	10
SD	0	71	24	0	0	7	24	47	29	6
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	0	103	22	0	0	10	129	149	34	10
SD	0	71	24	0	0	7	24	47	29	6
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	0	7,972	1,116	0	0	876	8,921	11,851	1,743	490
SD	0	6,033	1,794	0	0	421	2,065	5,037	2,303	587
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	0	1,000	214	0	0	99	1,208	1,458	333	95
SD	0	682	236	0	0	62	198	444	282	64
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	0	7,208	624	0	0	330	2,290	3,084	713	133
SD	0	1,830	404	0	0	113	272	646	412	76
±2SE	0	840	243	0	0	101	314	430	369	68
TOTAL BIOMASS	7,831 metric tons			6,550 metric tons						
SD	1,874			824						
DF	36			32						
±2SE	625			291						
CV	4.0%									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 12. 1988 longspine thornyhead.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($x10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	1	1,663	176
Mean	0	64	14
SD	0	63	12
N	22	26	13
CATCH RATE (kg/hr)			
Mean	0	119	14
SD	1	107	12
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	0	15,083	140
SD	0	12,619	323
N	22	26	13
DENSITY (kg/km^2)			
Mean	3	1,714	205
SD	15	1,554	172
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	13	12,349	599
SD	30	4,171	294
±2SE	13	1,668	170
TOTAL BIOMASS	12,962 metric tons		
SD	4,181		
DF	57		
±2SE	1,108		
CV	4.3%		

Table 13. 1987 rex sole.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-699	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	558	76	0	76	482	76	0	0	0	0
Mean	70	4	0	25	96	13	0	0	0	0
SD	68	13	0	28	71	20	0	0	0	0
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	140	4	0	51	193	15	0	0	0	0
SD	136	15	0	55	143	25	0	0	0	0
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	8,294	122	0	3,970	10,888	407	0	0	0	0
SD	7,814	408	0	3,640	8,473	662	0	0	0	0
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	1,358	44	0	503	1,871	147	0	0	0	0
SD	1,409	153	0	554	1,513	251	0	0	0	0
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	5,500	317	0	847	2,653	490	0	0	0	0
SD	2,835	411	0	718	1,802	460	0	0	0	0
±2SE	2,143	189	0	1,016	1,802	411	0	0	0	0
TOTAL BIOMASS	5,817 metric tons			3,990 metric tons						
SD	2,865			1,993						
DF	36			32						
±2SE	955			705						
CV	8.2%									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 14. 1988 rex sole.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($x10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	466	156	0
Mean	21	6	0
SD	28	20	0
N	22	26	13
CATCH RATE (kg/hr)			
Mean	44	12	0
SD	57	40	0
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	5,051	694	0
SD	6,821	2,161	0
N	22	26	13
DENSITY (kg/km^2)			
Mean	602	190	0
SD	762	604	0
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	2,439	1,367	0
SD	1,534	1,620	0
±2SE	669	648	0
TOTAL BIOMASS	3,806 metric tons		
SD	2,231		
DF	57		
±2SE	591		
CV	7.8%		

Table 15. 1987 Pacific grenadier.

STRATUM (fathoms)	1988 STRATA[1] 30–249	250–549	550–699	1987 STRATA 50–150	150–250	250–350	350–450	450–550	550–650	650–750
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	0	234	665	0	0	0	0	233	423	243
Mean	0	12	55	0	0	0	0	23	70	40
SD	0	45	49	0	0	0	0	61	56	35
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	0	12	55	0	0	0	0	23	70	40
SD	0	45	49	0	0	0	0	61	56	35
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	0	149	817	0	0	2	5	294	1,006	629
SD	0	507	913	0	0	5	8	686	1,044	713
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	0	115	536	0	0	1	1	229	668	404
SD	0	442	499	0	0	2	2	603	577	360
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	0	830	1,564	0	0	3	2	485	1,431	567
SD	0	1,185	852	0	0	4	3	877	845	427
±2SE	0	544	514	0	0	3	3	585	756	382
TOTAL BIOMASS	2,393 metric tons			2,488 metric tons						
SD	1,460			1,291						
DF	36			32						
±2SE	487			456						
CV	10.2%									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 16. 1988 Pacific grenadier.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($\times 10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	0	64	452
Mean	0	2	35
SD	0	7	27
N	22	26	13
CATCH RATE (kg/hr)			
Mean	0	5	38
SD	0	14	32
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	0	125	762
SD	0	330	609
N	22	26	13
DENSITY (kg/km^2)			
Mean	0	79	570
SD	0	243	483
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	0	567	1,664
SD	0	653	825
±2SE	0	261	477
TOTAL BIOMASS	2,230 metric tons		
SD	1,052		
DF	57		
±2SE	279		
CV	6.3%		

Table 17. 1987 giant grenadier.

STRATUM (fathoms)	1988 STRATA[1] 50-249	250-549	550-699	1987 STRATA 50-149	150-249	250-349	350-449	450-549	550-649	650-749
AREA IN KM^2	4,049	7,204	2,919	1,683	1,418	3,344	1,895	2,114	2,142	1,404
Fraction swept ($x10^{-4}$)	1.03	2.74	4.33	.91	1.86	1.58	2.24	4.81	3.01	4.40
KM^2 SWEPT (14.6 m trawl mouth)										
Total	0.42	1.97	1.27	0.15	0.26	0.53	0.43	1.02	0.65	0.62
Mean	0.05	0.10	0.11	0.05	0.05	0.09	0.11	0.10	0.11	0.10
SD	0.004	0.014	0.008	0.00	0.01	0.02	0.00	0.00	0.01	0.01
N	8	20	12	3	5	6	4	10	6	6
CATCH TAKEN (kg/trawl)										
Total	0	139	541	0	0	2	8	129	203	338
Mean	0	7	45	0	0	0	2	13	34	56
SD	0	12	30	0	0	1	2	14	27	30
N	8	20	12	3	5	6	4	10	6	6
CATCH RATE (kg/hr)										
Mean	0	7	45	0	0	0	2	13	34	56
SD	0	12	30	0	0	1	2	14	27	30
N	8	20	12	3	5	6	4	10	6	6
ABUNDANCE (N/km^2)										
Mean	0	57	403	0	0	3	14	107	296	510
SD	0	107	266	0	0	7	11	134	240	247
N	8	20	12	3	5	6	4	10	6	6
DENSITY (kg/km^2)										
Mean	0	68	436	0	0	3	19	126	307	565
SD	0	112	314	0	0	7	18	135	241	326
N	8	20	12	3	5	6	4	10	6	6
BIOMASS (kg/km^2) x km^2										
Metric tons	0	488	1272	0	0	10	37	266	657	793
SD	0	302	537	0	0	13	25	197	353	387
±2SE	0	139	324	0	0	11	29	131	315	346
TOTAL BIOMASS	1,760 metric tons			1,764 metric tons						
SD	616			560						
DF	36			32						
±2SE	205			198						
CV	5.8%									

[1]Approximate equivalents to the 1988 strata; depth minima and maxima were 96 and 674 fathoms in 1987 as compared to 38 and 708 fathoms in 1988.

Table 18. 1988 giant grenadier.

STRATUM (fathoms)	30-249	250-549	550-699
AREA IN KM^2	4,049	7,204	2,919
Fraction swept ($\times 10^{-4}$)	1.89	1.32	2.91
KM^2 SWEPT (14.6 m trawl mouth)			
Total	0.767	0.953	0.851
Mean	0.035	0.037	0.065
SD	0.006	0.007	0.008
N	22	26	13
CATCH TAKEN (kg/trawl)			
Total	0	82	194
Mean	0	3	15
SD	0	6	16
N	22	26	13
CATCH RATE (kg/hr)			
Mean	0	6	15
SD	0	12	16
N	22	26	13
ABUNDANCE (N/km^2)			
Mean	0	109	260
SD	0	219	266
N	22	26	13
DENSITY (kg/km^2)			
Mean	0	92	233
SD	0	183	241
N	22	26	13
BIOMASS (kg/km^2) x km^2			
Metric tons	0	660	679
SD	0	490	412
±2SE	0	196	238
TOTAL BIOMASS	1,338 metric tons		
SD	641		
DF	57		
±2SE	170		
CV	6.4%		

Table 19. Comparison of depth-specific density with 400-Eastern off Morro Bay, Califoria to depth-specific density measured with the modified nor-eastern in autumn 1984 off Oregon (Raymore and Weinberg, in prep.). Catch rates are in kg/km. The small difference in trawl width (14.6 m vs 13.4 m) has not been accounted for.

North subarea 44°22.5'-45°40'N	Depth (fathoms)					
	60-100	100-200	200-300	300-400	400-500	All
Sablefish	55.7	38.7	36.2	116.1	60.8	61.5
Dover sole	14.0	16.6	18.8	16.5	10.2	15.2
Shortspine	0	18.4	23.2	19.4	0	13.5
Longspine	0	0	0	21.2	32.7	11.0
Rex sole	6.4	7.1	0	0	0	3.1

South subarea 43°00'-44°22.5'N	Depth (fathoms)					
	60-100	100-200	200-300	300-400	400-500	All
Sablefish	8.8	59.5	37.6	53.3	23.4	36.5
Dover sole	18.6	13.2	11.9	40.3	24.4	21.7
Shortspine	1.2	6.6	5.1	10.7	6.8	6.1
Longspine	0	0	0	17.5	28.9	9.3
Rex sole	7.4	10.4	6.1	0	0	5.1

SWFC 1987 34.5°-36.5°N	Depth (fathoms)					
	90-100	101-200	201-300	301-400	401-500	All
Sablefish	11.1	1.2	4.7	2.8	5.8	4.6
Dover sole	9.5	12.9	16.2	14.6	24.8	17.2
Shortspine	0	.8	8.6	9.8	14.2	8.5
Longspine	0	0	1.2	10.0	21.8	13.5
Rex sole	9.7	23.0	7.1	.4	0	6.8

SWFC 1988 34.5°-36.5°N	Depth (fathoms)						
	30-60	61-100	101-200	201-300	301-400	401-500	All
Sablefish	0	--	.9	10.4	12.6	21.6	9.9
Dover sole	3.4	--	8.1	49.1	15.7	27.6	23.7
Shortspine	0	--	.3	9.5	5.4	8.4	5.3
Longspine	0	--	.1	9.1	13.1	33.4	13.1
Rex sole	.4	--	14.1	8.8	0	0	6.1

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