Preliminary Analysis of Pacific Coast Demersal Fish Assemblages

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ABSTRACT—The purpose of this portion of an on-going study was to describe demersal fish assemblages on the Oregon continental shelf between the mouth of the Columbia River and Yaquina Head, based on species biomass data collected during the 1977 Rockfish Survey, and to compare these assemblages with those described from data collected in 1973 during the Oregon Department of Fish and Wildlife otter trawl survey. Statistical clustering techniques (including the Bray-Curtis index of dissimilarity and group-average clustering strategy) yielded 12 assemblages. Except for one area (Falcon Shalebeds), species dominating each assemblage were consistent between the two surveys.

Introduction

Using statistical clustering techniques we describe the distribution of northeast Pacific rockfishes and other groundfishes in terms of species assemblages over an area of continental shelf and slope ranging from the mouth of the Columbia River to Yaquina Head off Oregon. Cluster analysis facilitates the description of multispecies distributions.

One benefit of this work is that the catch composition of fleets operating in specific areas can be roughly anticipated from assemblage maps derived from the analysis. Station positions forming the basis of an assemblage monitoring program will be proposed in a later report following analysis of the entire data base covering an area from Point Hueneme, Calif., to Kodiak Island, Alaska.

In this paper, we compare assemblage distributions based on two data sources: The 1973 Oregon Department of Fish and Wildlife (ODFW) otter trawl survey, designed to sample flatfishes; and the portion of the West Coast Joint Agency Rockfish Survey covering a similar area of continental shelf. Whether assemblages persist through a time scale of years is an important fisheries resource question. If assemblages are relatively stable, multispecies management strategies could possibly be devised taking asemblage composition into account.

Cluster Analysis Techniques

Two techniques were used to reduce variability and skewness in the biomass frequency distributions arising from the contagious distribution of many rockfish species. First, data from three adjacent sites, each within a 36.6-m (20-fathom) depth interval parallel to the coast, were pooled or clumped (Tyler and Stephenson[1]) into 55 clumps from 115 sites. Second, data were transformed to $\log_{10}$ values. Clump similarities were described using a Bray-Curtis dissimilarity index (Clifford and Stephenson, 1975). The index for each pair of clumps was calculated from species biomass data expressed as a proportion of the total biomass at each site. A group-average fusion strategy (Clifford and Stephenson, 1975) was used to link similar clumps into clusters. The linked clusters were then displayed in a dendrogram (Fig. 1).

Results of Cluster Analysis

Boundaries were drawn among clumps according to the classifications produced by the clustering algorithm. At a dissimilarity level of 0.50, the dendrogram could be divided into two large clusters or assemblages (Fig. 1). Clumps located at depths greater than 145 m (80 fathoms) were classified apart from those located further inshore (Fig. 1).

At a dissimilarity level of 0.45, three large clusters or assemblages were defined. Of these three, the Intermediate assemblages included clusters A, B, C, and E. They were bounded offshore by the 145-m (80-fathom) contour and inshore by the shallowest site clumps of the survey. The Deep clusters or assemblages included clusters F, G, and H. The component clumps of these clusters were located between the 145-m (80-fathom) and 220-m (120-fathom) contours. The Slope assemblages were comprised of clusters J, L, I, and K. The component clumps of these clusters were located at depths greater than 220 m (120 fathoms). The initial tendency for boundaries to form along depth contours is reinforced by the method of clumping stations within depth intervals parallel to the coast.

Further decomposition of these three main clusters at a dissimilarity level of 0.35 yielded assemblages within each

[1]Tyler, A. V., and W. Stephenson. 1978. Application of statistical cluster analysis methods to otter trawl data. Unpubl. manuscr., 29 p. Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331.

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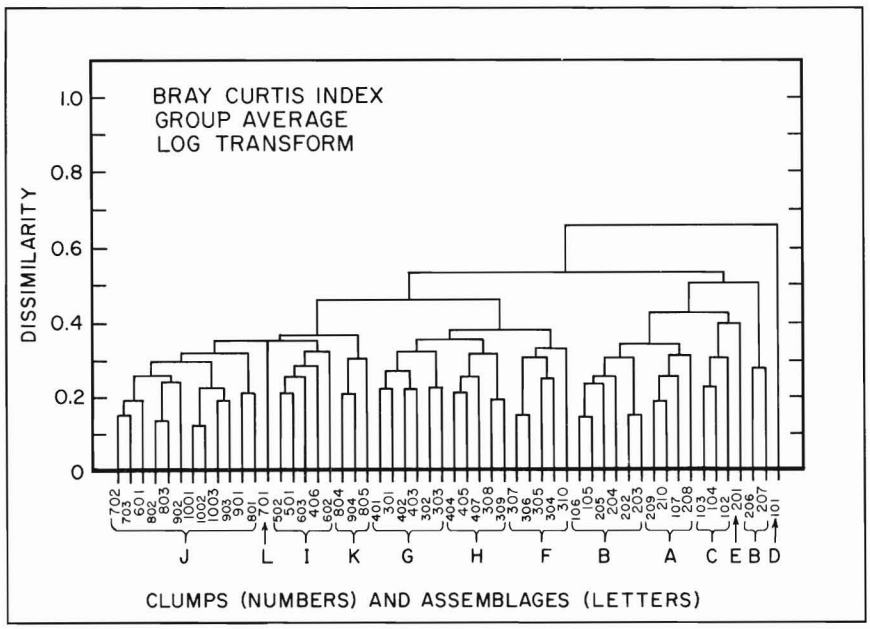

Figure 1.—Classification of site clumps from the Columbia River to Yaquina Head, Oreg., based on 1977 Rockfish Survey data. Numbers refer to site clumps. Letters refer to assemblages: A = Columbia Intermediate, B = Tillamook Intermediate, C = Nestucca Intermediate, F = Falcon Shale, G = Nestucca Deep, H = Tillamook Deep, I = Tillamook Slope, J = Cascade Slope, and K = Columbia Slope. The labels D, E, and L represent only single clumps (3 sites each) not closely linked to any other cluster and are thus not defined as assemblages themselves.

of the depth boundaries. These are shown as lettered clusters in Figure 1 and hatched areas in Figure 2. The use of the 0.35 level of dissimilarity can be justified by the contiguous locations of clumps when cluster divisions are mapped. Assemblage B is labelled in two sections of the dendrogram. The second portion, less closely linked, is comprised of two clumps (206, 207, Fig. 1) in the same geographical region (off Tillamook Head, Fig. 2) as those in the main body of Assemblage B. Species composition within the two clumps was similar to that of the main body. However, catch rates of species other than the dominant species, Pacific whiting, *Merluccius productus,* were so low in this subregion that any higher than average occurrence of a less common species gave the impression of high dissimilarity. Consequently, we decided it would be undue embellishment to classify the clumps as a separate assemblage.

The species composition (by biomass) in each assemblage is listed in Table 1. Infrequently occurring fish taxa which were recorded but not displayed in Table 1 included the Pacific electric ray, *Torpedo californica;* Pacific halibut, *Hippoglossus stenolepis;* slender sole, *Lyopsetta exilis;* northern anchovy, *Engraulis mordax;* American shad, *Alosa sapidissima;* aurora rockfish, *Sebastes aurora;* silvergray rockfish, *S. brevispinis;* rosethorn rockfish, *S. helvomaculatus*; shortbelly rockfish, *S. jordani; Argyropelecus* sp.; *Icelinus* sp.; Agonidae; Chauliodontidae; Myctophidae; Liparidae; and Zoarcidae. We named the assemblages by their correspondent geographical features.

Five species were widely distributed over the Intermediate, Deep, and Slope assemblages: Pacific whiting; sablefish, *Anoplopoma fimbria;* Dover sole, *Microstomus pacificus;* arrowtooth flounder, *Atheresthes stomias;* and rex sole, *Glyptocephalus zachirus*. The Columbia Intermediate, Tillamook Intermediate, and Nestucca Intermediate assemblages (Fig. 2) were all dominated by Pacific whiting, as was the Nestucca Deep assemblage farther offshore. Dover sole dominated the Columbia Slope and Cascade Slope assemblages. These five species were commonly among the six most abundant species ranked by catch weight throughout assemblage strata.

Although Pacific whiting dominated all three Intermediate assemblages, the degree of domination was least in the Columbia Intermediate Assemblage. In that assemblage, Pacific whiting composed 30.1 percent of the biomass caught, at 152.8 pounds/haul, compared with 80.5 percent of the total biomass of both the Tillamook and Nestucca Intermediate assemblages, at 646.4 and 653.3 pounds/haul, respectively. Catch per haul of other species was greater in the Columbia Intermediate Assemblage than in the other two assemblages.

Dover sole, the second most abundant species in the assemblage, composed 20.2 percent of the total biomass with a catch rate of 102.7 pounds/haul. Canary rockfish, *Sebastes pinniger;* arrowtooth flounder; and sablefish were the third to fifth most abundant species, at catch rates of 82.7, 43.8, and 24.2 pounds/haul, respectively. Percentage composition of these species (on a biomass basis) was 16.3, 8.6, and 4.8 percent, respectively. Rex sole were more abundant in this assemblage than any other. These principal species were also important in the Tillamook Intermediate Assemblage as well. There, the second major species (after Pacific whiting) was canary rockfish (9.1 percent of total biomass, 73.4 pounds/haul). However, the third to fifth most abundant species, arrowtooth flounder, Dover sole, and sablefish, respectively, composed less than 3 percent of the total biomass each, and occurred at rates of 14-20 pounds/haul.

The Nestucca Intermediate Assemblage, also heavily dominated by Pacific whiting, was separated from other assemblages by the high occurrences of Pacific herring, *Clupea haren-*

gus pallasi, and eulachon, *Thaleichthys pacificus* (3.9 and 3.5 percent of total biomass, 31.9 and 28.6 pounds/haul, respectively). The assemblage was also characterized by highest relative abundance and catch rate of lingcod, *Ophiodon elongatus,* among all assemblages.

Among Deep assemblages, catch rates were highest in the Falcon Shale Assemblage. Redstripe rockfish, *S. proriger,* was the most abundant species in this assemblage, followed by canary rockfish. These species occurred at higher catch rates (249.5 and 142.5 pounds/haul, respectively) and composed a larger percentage of the catch (28.5 and 16.3 percent, respectively) than in any other assemblage described. Other important species in this assemblage included sablefish, arrowtooth flounder, and Pacific whiting. The first two of these three species occurred at higher catch rates (101.4, 91.8, and 71.0 pounds/haul, respectively) than elsewhere. Yellowtail rockfish, *S. flavidus,* were also relatively important in this assemblage (4.4 percent of biomass, 38.4 pounds/haul).

The Tillamook Deep Assemblage was dominated by two rockfish species as well, sharpchin rockfish, *S. zacentrus,* and Pacific ocean perch, *S. alutus,* both of which occurred there in greater abundance than they did in most of the other assemblages (23.7 and 15.4 percent of total weight caught, 149.3 and 96.9 pounds/haul, respectively). Dover sole, arrowtooth flounder, sablefish, and Pacific whiting were also highly important. Splitnose rockfish, *S. diploproa,* were most common in the Tillamook Deep Assemblage.

The Nestucca Deep Assemblage was the only Deep assemblage not dominated by rockfishes. Pacific whiting and sablefish were most abundant (32.1 and 20.9 percent by biomass, 128.1 and 83.3 pounds/haul, respectively), followed by arrowtooth flounder and Dover sole (12.9 and 6.7 percent, 51.5 and 26.7 pounds/haul, respectively). Pacific ocean perch and darkblotched rockfish, *S. crameri,* were ranked fifth and sixth by weight (6.5 and 3.9 percent, 25.8 and 15.8 pounds/haul, respectively).

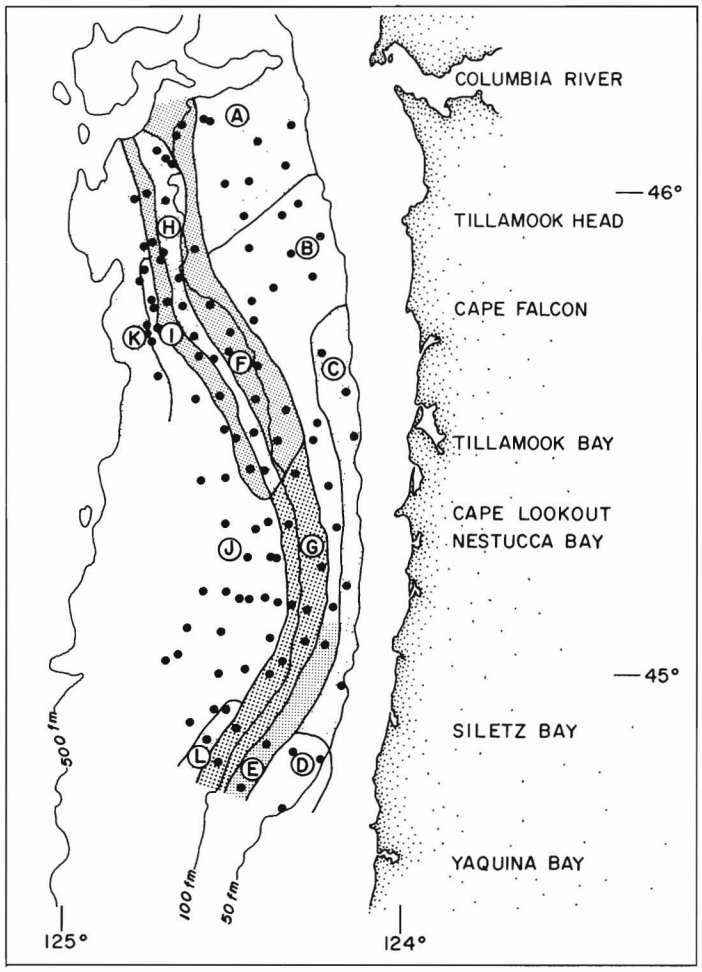

Figure 2.—Map of groundfish assemblages from the Columbia River to Yaquina Head, Oreg., based on component site clumps from 1977 West Coast Joint Agencies Rockfish Survey data. Dots represent trawl sets. Letters refer to assemblages: A = Columbia Intermediate, B = Tillamook Intermediate, C = Nestucca Intermediate, F = Falcon Shale, G = Nestucca Deep, H = Tillamook Deep, I = Tillamook Slope, J = Cascade Slope, and K = Columbia Slope. The labels D, E, and L represent only single clumps (3 sites each) not closely linked to any other cluster and are thus not defined as assemblages themselves.

Compared with other Slope assemblages, the Tillamook Slope was characterized by highest abundances (mean pounds/haul) of Pacific ocean perch and darkblotched rockfish (97.2 and 48.6 pounds/haul, respectively). Percent composition contributed by these species was 33.6 and 16.8 percent, respectively. Dover sole was the third most abundant species in the assemblage (based on percent composition) although the catch rate was lower than in other Slope assemblages. Shortspine thornyhead, *Sebastolobus alascanus,* ranking fourth in the Tillamook Slope Assemblage, occurred at approximately the same relative abundance (percent composition) and catch rate (pounds/haul) as in the Cascade Slope Assemblage. Sablefish and Pacific whiting occurred at levels intermediate to the other two Slope assemblages. Among Slope assemblages, the Tillamook Slope contained highest

Table 1.—Species composition of assemblages, based on 1977 National Marine Fisheries Service rockfish survey. Species listed include those which ranked among the 15 most abundant (by percentage composition, biomass) in an assemblage. An asterisk (*) indicates species is one of six most abundant (by percentage composition, biomass) in an assemblage. Some invertebrates have been omitted.

	A			B			C			F			G			H		
	Columbia Intermediate			Tillamook Intermediate			Nestucca Intermediate			Falcon Shale			Nestucca Deep			Tillamook Deep		
Species	Rank	% (lb)	Mean lb/haul	Rank	% (lb)	Mean lb/haul	Rank	% (lb)	Mean lb/haul	Rank	% (lb)	Mean lb/haul	Rank	% (lb)	Mean lb/haul	Rank	% (lb)	Mean lb/haul
Spiny dogfish	24	0.1	0.6	16	0.2	1.4	9	0.7	5.8	28	0.1	0.9	10	1.4	5.7	28	0.1	0.5
Big skate	13	0.9	4.5		—			—		35	<0.1	0.2	12	1.3	5.2		—	
Black skate		—		28	<0.1	0.2		—			—		31	<0.1	0.1		—	
Longnose skate	17	0.6	2.9		—			—		21	0.3	2.9	32	<0.1	0.1	36	<0.1	0.1
Ratfish	14	0.9	4.3	23	0.1	0.5	15	0.2	1.8	26	0.2	1.5	20	0.3	1.3	25	0.2	1.0
Pacific sanddab		—		27	<0.1	0.2	14	0.3	2.8		—			—			—	
Arrowtooth flounder	4*	8.6	43.8	3*	2.6	20.5	6*	1.4	11.0	4*	10.5	91.8	3*	12.9	51.5	4*	8.6	54.4
Flathead sole	11	1.1	5.5	13	0.3	2.1		—		27	0.4	1.3		—		26	0.1	0.9
Petrale sole	27	<0.1	0.4	19	0.2	1.2	13	0.4	2.8	32	<0.1	0.4	26	0.1	0.4	23	0.2	1.3
English sole	30	<0.1	0.1		—		8	0.9	7.3		—			—		32	<0.1	0.1
Dover sole	2*	20.2	102.7	4*	1.7	13.8	4*	2.6	21.4	8	4.4	38.4	4*	6.7	26.7	3*	10.7	67.3
Rex sole	6*	4.2	21.5	7	0.4	3.4	11	0.6	4.8	9	1.4	12.2	8	2.2	8.6	11	2.2	14.1
Sablefish	5*	4.8	24.2	5*	1.7	13.7	10	0.7	5.4	3*	11.6	101.4	2*	20.9	83.3	5*	7.7	48.5
Pacific herring		—			—		2*	3.9	31.9		—			—			—	
Pacific cod	7	2.6	13.4	14	0.2	1.6	12	0.4	3.2	14	0.8	6.6	15	0.7	2.8	24	0.2	1.0
Lingcod	18	0.5	2.8	8	0.4	3.3	5*	2.0	16.4	17*	0.4	3.4	17	0.4	1.8	21	0.3	2.2
Pacific whiting	1*	30.1	152.8	1*	80.5	646.4	1*	80.5	653.3	5*	8.1	71.0	1*	32.1	128.1	6*	6.4	40.3
Eulachon	10	1.2	6.3	9	0.3	2.7	3*	3.5	28.6	10	1.0	8.6	11	1.4	5.4	33	<0.1	0.1
Shortspine thornyhead	8	1.9	9.6	22	<0.1	0.7	23	<0.1	0.2	13	0.9	7.8	7	3.1	12.4	10	2.8	17.9
Boccaccio		—		11	0.3	2.4		—		16	0.5	4.5	18	0.4	1.5	15	1.0	6.3
Canary rockfish	3*	16.3	82.7	2*	9.1	73.4	20	0.1	0.8	2*	16.3	142.5	28	0.1	0.3	8	4.1	26.0
Darkblotched rockfish	9	1.4	7.1	17	0.2	1.4	17	0.1	0.9	22	0.2	2.1	6*	3.9	15.8	9	3.3	20.9
Flag rockfish	23	0.1	0.6	18	0.1	1.2		—		19	0.4	3.3	32	<0.1	0.1	18	0.5	3.4
Greenstriped rockfish	16	0.8	4.0	15	0.2	1.5	18	0.1	0.9	15	0.6	5.6	13	1.0	3.8	16	0.9	5.6
Pacific ocean perch	28	<0.1	0.4	29	<0.1	0.1		—		24	0.2	2.0	5*	6.5	25.8	2*	15.4	96.9
Redstripe rockfish		—			—			—		1*	28.5	249.5		—		13	1.9	11.9
Rougheye rockfish	19	0.3	1.6		—			—			—		27	0.1	0.4	37	<0.1	0.1
Sharpchin rockfish		—			—			—		6*	5.6	48.8	29	0.1	0.3	1*	23.7	149.3
Splitnose rockfish		—			—			—			—		16	0.6	2.5	7	4.2	26.6
Stripetail rockfish		—			—			—		12	0.9	8.0	14	0.9	3.6	14	1.0	6.4
Yelloweye rockfish		—			—			—		18	0.4	3.4		—		27	0.1	0.8
Yellowmouth rockfish		—			—			—			—			—		12	2.0	12.3
Yellowtail rockfish	5	0.8	4.2	10	0.3	2.5	19	0.1	0.9	7	4.4	38.4	21	0.2	1.0	29	0.1	0.4
Widow rockfish	12	1.0	5.3	23	<0.1	0.2	22	<0.1	0.2	25	0.2	1.9	19	0.3	1.3	20	0.4	2.3
Squid		—			—			—			—			—			—	
Dungeness crab	21	0.3	1.5	6*	0.4	3.5	7	1.2	9.4	36	<0.1	0.2	30	<0.1	0.2		—	

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abundances of splitnose rockfish and the only occurrence of sharpchin rockfish.

The Columbia Slope Assemblage was highly dominated by Dover sole, representing 43.2 percent of the total weight caught, and highest mean catch rate (77.7 pounds/haul) found in any of the Slope assemblages. Of lesser importance were Pacific ocean perch (15.3 percent of total weight, 27.6 pounds/haul); and darkblotched rockfish, sablefish, and Pacific whiting, ranging from 5.6 to 6.8 percent of total catch and from 10.1 to 12.1 pounds/haul. Rex sole and yelloweye rockfish, *Sebastes ruberrimus*, were most abundant in this assemblage, relative to other Slope assemblages.

The three most abundant species in the Cascade Slope Assemblage, Dover sole, Pacific whiting, and sablefish, contributed nearly equal weights to the total catch (18.3, 16.6, and 15.4 percent, respectively) and occurred at nearly equal mean weights/haul (46.9, 42.5, and 39.3 pounds/haul, respectively). Sablefish and Pacific whiting were more abundant here than in the other two Slope assemblages. Rougheye rockfish, *S. aleutianus*, were more abundant in this assemblage than in any other Slope assemblage.

Comparison With 1973 Oregon Survey

Difference in species abundance between the 1973 ODFW survey and the 1977 Rockfish Survey may be due to gear differences. Since the 1973 survey gear was designed to capture flatfishes efficiently, it is not surprising that soles and skates ranked much higher in 1973 than in 1977. The 1977 survey was conducted with a trawl that is more efficient for off-bottom fishes, and so increased catches of the genera *Sebastes, Thaleichthys,* and *Clupea* in 1977 cannot be interpreted as a real abundance shift. Differences in catch per haul may also be partially ascribed to differences in sampling programs. Hauls taken by the ODFW covered 1 nautical mile, while hauls taken during the 1977 Rockfish Survey covered an average of 1.5 nautical miles each. However, decreased catch per haul of rockfishes in 1977 relative to 1973 is not likely to be an artifact of sampling procedure.

Table 1.—Continued.

Species	I Tillamook Slope Rank	% (lb)	Mean lb/haul	J Cascade Slope Rank	% (lb)	Mean lb/haul	K Columbia Slope Rank	% (lb)	Mean lb/haul
Spiny dogfish		—			—			—	
Big skate		—			—			—	
Black skate	18	0.1	0.3	20	0.1	0.3	14	0.5	0.9
Longnose skate		—		13	0.7	1.7	9	2.5	4.4
Ratfish	12	0.6	1.9	17	0.2	0.4	11	1.2	2.2
Pacific sanddab		—			—			—	
Arrowtooth flounder	8	3.9	11.2	7	6.3	16.1	12	1.1	2.0
Flathead sole		—			—			—	
Petrale sole		—		28	0.2	0.4		—	
English sole		—		15	0.3	0.7	16	0.2	0.4
Dover sole	3*	10.0	29.0	1*	18.3	46.9	1*	43.2	77.7
Rex sole	11	1.2	3.6	11	1.3	3.4	6*	5.4	9.8
Sablefish	5*	7.5	21.8	3*	15.4	39.3	4*	6.4	11.6
Pacific herring		—			—			—	
Pacific cod		—			—			—	
Lingcod		—			—			—	
Pacific whiting	6*	6.1	17.5	2*	16.6	42.5	5*	5.6	10.1
Eulachon		—			—			—	
Shortspine thornyhead	4*	8.9	25.7	5*	8.4	21.6	7	4.7	8.5
Boccaccio	16	0.2	0.5		—			—	
Canary rockfish		—		24	0.1	0.2		—	
Darkblotched rockfish	2*	16.8	48.6	12	1.2	3.1	3*	6.8	12.1
Flag rockfish	13	0.6	1.7	10	2.2	5.6	17	0.1	0.2
Greenstriped rockfish		—			—			—	
Pacific ocean perch	1*	33.6	97.2	8	5.0	12.8	2*	15.3	27.6
Redstripe rockfish	15	0.2	0.5		—			—	
Rougheye rockfish		—		6*	7.7	19.8	15	0.2	0.4
Sharpchin rockfish	9	2.2	6.4		—			—	
Splitnose rockfish	7	5.6	16.3	9	2.7	6.9	13	0.9	1.6
Stripetail rockfish	19	0.1	0.1		—			—	
Yelloweye rockfish		—			—		8	3.6	6.4
Yellowmouth rockfish	14	0.4	1.3	22	0.1	0.2		—	
Yellowtail rockfish		—			—			—	
Widow rockfish	17	0.1	0.3	25	0.1	0.1		—	
Squid	10	1.8	5.3	16	0.2	0.6		—	
Dungeness crab		—			—			—	

A complete discussion of the 1973 ODFW survey results is not included here because the assemblages have been described elsewhere (Tyler and Stephenson, footnote 1).

Maps of the assemblages (Fig. 2, 3) show similarities between years. For both surveys, assemblages were strongly associated with depth contours. Intermediate depth assemblages lay between the 90- and 145-m contours (50-80 fathoms) in both years (assemblages A, B, C and D, E in Fig. 2 and 3, respectively). No assemblage corresponding to the Columbia Intermediate was found in 1973 and there was a sharper north-south delineation of the Tillamook and Nestucca Intermediate Assemblages that year. The Nestucca Deep Shelf Assemblage (Fig. 2G, Fig. 3H) is in the same geographic position. The Tillamook Deep and Falcon Shale Assemblage (Fig. 2H,F; Fig. 3F,G) vary somewhat between surveys in that the Falcon Shale Assemblage does not extend as far north in the 1973 survey as it did in 1977. Three shallow assemblages occurring in regions shallower than 90 m (50 fathoms) were described from data collected on the 1973 survey. There is no basis for comparison for the inner shelf, unsampled in 1977; and also the slope regions, unsampled in 1973.

In both surveys, the Intermediate Assemblages as well as the Nestucca Deep Assemblage were dominated by Pacific whiting. Substantial catches of Pacific whiting were also made in the Tillamook Deep Assemblage where the species ranked seventh in 1973 and sixth in 1977. Others that were among the 11 most abundant species in all Intermediate and Deep Shelf assemblages in both surveys were: Dover sole, arrowtooth flounder, and rex sole. The Tillamook Intermediate assemblages were also similar in both years in that yellowtail rockfish and canary rockfish were among the top 10 species. Lingcod ranked 14th with a catch rate of 9.6 pounds/haul in 1973, and ranked 8th with a mean catch rate of 3.3 pounds/haul in 1977. It is likely that the abundance of lingcod was about the same during the two surveys. The rank was lower in 1973 due to higher ranking flatfishes and the longnose skate.

Spiny dogfish, lingcod, and English sole were among the 10 most abundant species in both surveys of the Nestucca Intermediate Assemblage. A difference seemed to be that Pacific cod, yellowtail rockfish, and canary rockfish ranked among the top 10 in 1973 but not in 1977 when the higher opening trawl should have captured them more easily. Also catch rates were lower in 1977: Yellowtail rockfish, 15.3 pounds/haul in 1973, 0.9 in 1977; canary rockfish, 5.2 pounds/haul in 1973, 0.8 in 1977; Pacific cod, 6.0 pounds/haul in 1973, 3.2 in 1977.

The Nestucca Deep Assemblages were similar in both years. Spiny dogfish, shortspine thornyhead, Pacific ocean perch, and darkblotched rockfish were among the top 10 species. Three rockfish appeared to be less abundant in 1977 than in 1973: Greenstriped rockfish, *S. elongatus,* ranked 8th in 1973, 24.9 pounds/haul, and ranked 13th in 1977, 3.8 pounds/haul; yellowtail rockfish ranked 14th in 1973, 3.4 pounds/haul, and ranked 21st in 1977, 1.0 pound/haul; stripetail rockfish, *S. saxicola,* ranked 9th in 1973, 13.5 pounds/haul, and ranked 14th in 1977, 3.6 pounds/haul.

The Tillamook Deep Assemblages were similar in both years. Shortspine thornyhead, Pacific ocean perch, and darkblotched rockfish ranked among the 10 most abundant species each year. Less abundant species also showed similarities. Greenstriped rockfish ranked 11th in 1973, with a catch rate of

1.5 pounds/haul, ranked 16th in 1977, catch rate of 5.6 pounds/haul. Lingcod ranked 13th, catch rate of 4.9 pounds/haul in 1973, and ranked 21st, catch rate of 2.2 pounds/haul in 1977.

The Falcon Shale Assemblage was noticeably different in the two surveys. In 1973 catches were poor in both number of species taken and low mean catch rates but this was not true in 1977. The mean catch rate of the 10 most abundant species in 1973 was 17.2 pounds/haul, but 80.3 pounds/haul in 1977. This is partially ascribable to longer duration of tows in 1977. There were 14 species of fish recorded in 1973, and 30 in 1977. Except for the ubiquitous species and canary rockfish, the species composition of the 10 most abundant species was different.

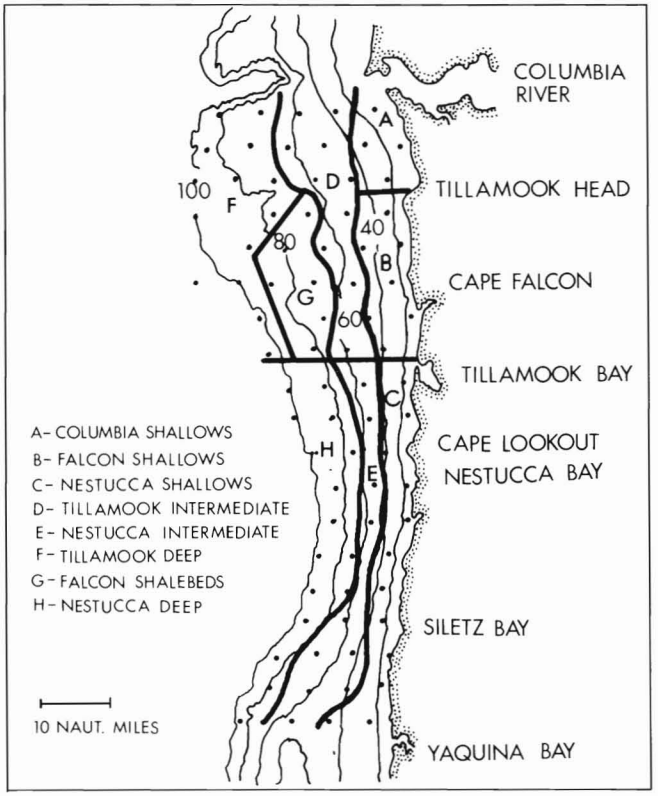

Figure 3.—Map of groundfish assemblages from the Columbia River to Yaquina Bay, Oreg., based on component site clumps from 1977 Oregon Department of Fish and Wildlife otter trawl survey data. Dots represent trawl sets.

Summary and Conclusions

The groundfish fauna on the continental shelf and slope off Oregon, between the Columbia River and Yaquina Head (Newport), consists of four major faunistic zones: The shallow neritic zone, from nearshore to 90 m (50 fathoms); the intermediate shelf zone, 90-145 m (50-80 fathoms); the deep shelf zone, 145-220 m (80-120 fathoms); and the slope zone beginning at 220 m. The analysis of the shallow zones was reported elsewhere (Tyler and Stephenson, footnote 1) from the ODFW survey. Over the four major faunistic zones there were 12 assemblages: The Columbia Shallows, Falcon Shallows, Nestucca Shallows, Columbia Intermediate, Tillamook Intermediate, Nestucca Intermediate, Tillamook Deep, Falcon Shale, Nestucca Deep, Tillamook Slope, Cascade Slope, and Columbia Slope. Since many of the species in these assemblages undergo seasonal movements or migrations, these descriptions are primarily applicable to summer conditions.

The shallow water assemblages are characterized mainly by differences in flatfish presence and abundance. The intermediate shelf assemblages are dominated by Pacific whiting and by species overlapping from the shallow shelf and the deep shelf zones. The deep shelf assemblages are characterized by combinations of rockfish species. Pacific ocean perch, Pacific whiting, arrowtooth flounder, Dover sole, sablefish, and darkblotched rockfish tend to be among the more abundant species throughout the deep shelf and slope zones. The slope assemblages are set apart mainly by combinations of rockfish species. Except for the Falcon Shale Assemblage, species dominance was consistent between 1973 and 1977 surveys.

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