RESOURCE SURVEYS ON THE CONTINENTAL SHELF OFF OREGON

SECTION 1: GROUNDFISH SURVEY
SECTION 2: SHRIMP SURVEY

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RESOURCE SURVEYS ON THE CONTINENTAL SHELF OFF OREGON

SECTION 1: GROUNDFISH SURVEY

Introduction

This report summarizes program progress in FY 1972. Activities were directed almost entirely toward the groundfish survey of the continental shelf off Oregon between the Columbia River and Cape Blanco. Since the area was too large to be surveyed in one cruise, it will be surveyed over a two year period. The first phase covered the area between the Columbia River and Yaquina Head.

Objectives of the survey were to obtain estimates of biomass of fishes occupying the continental shelf with particular emphasis on flatfish and to develop techniques of indexing year class strength of flatfishes important to the commercial fishery prior to their recruitment to the fishery.

Methods

It was decided, during initial planning, that the survey be limited to the continental shelf between 10-fathoms and 110-fathoms (Figure 1). It was also decided to limit the survey period to the month of September. It was intended that the survey be carried as far as Newport, but favorable weather enabled us to occupy an additional 24-stations. For purposes of this report, only the area from the Columbia River to Yaquina Head is discussed.

Trawl stations were located by use of a 5x5-mile grid with a random starting point and were identified for both the northern and southern halves of the survey area. Length of tow was limited to 10-Loran microseconds or 0.75 nautical mile. This corresponds to a tow of about 22 minutes in time.

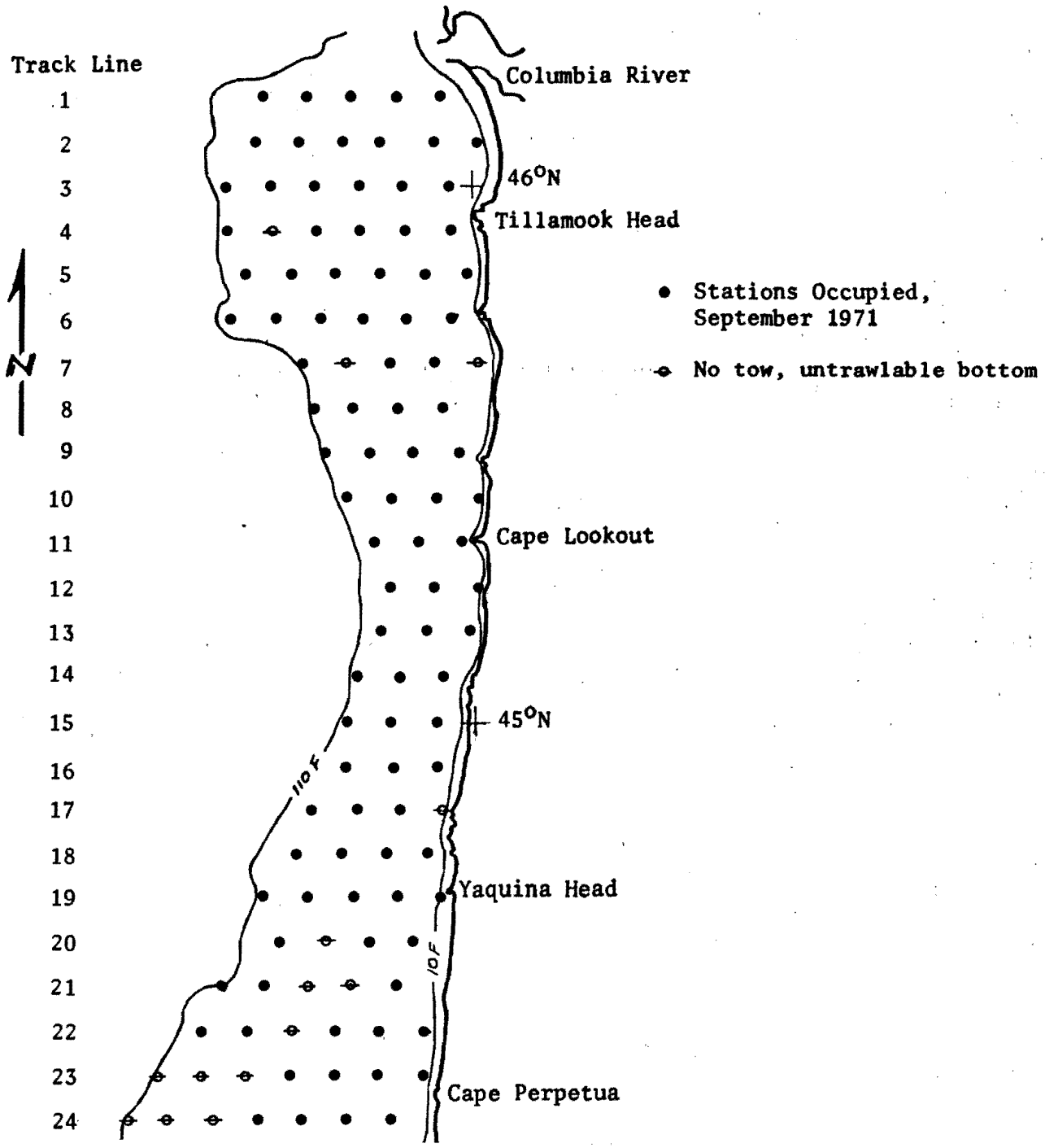
The trawl used was a 400-mesh eastern type constructed entirely of 3½-inch mesh. Foot rope length was 77-feet. Sweep lines consisted of 15-fathom bridles and 10-fathom dandy lines.

The catches were dumped onto a sorting table that measured 6-feet square by 12-inches deep and 42-inches high.[1/] The catch was sorted by species and weights recorded. Species other than flatfish were discarded after being weighed.

Flatfish taken at each station were sampled for age and sex composition. Sampling was systematic with the rate of sampling ranging from 100% to 5% of the catch. Most often the entire catch was sampled.

Heads of all species were removed for otoliths or interopercles except Dover sole in which case a fillet, with skin attached, was taken for scales. Heads and fillets were placed in plastic bags and frozen for later processing in the laboratory ashore. Aging structures were read in accordance with accepted techniques.

1/ The table height will be reduced by 3-inches for the 1972 survey.


Track Line
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
N
Columbia River
46°N
Tillamook Head
Cape Lookout
45°N
Yaquina Head
Cape Perpetua
110 F
10 F
Stations Occupied, September 1971
No tow, untrawlable bottom

Biomass was determined by dividing the area of each grid square[1/] by the swept area (0.0039 nautical mile squared per tow). Non-trawlable area was subtracted from total survey area. The resulting expansion factor was then multiplied by the catch per grid square and the grid biomasses summed. Catchability of the trawl was assumed to be one.

Results

The survey covered 2,470 square miles or about 62% of the continental shelf lying between the Columbia River and Cape Blanco. Stations occupied on 24 track lines are shown in Figure 1. Results are limited to track lines planned for the 1971 survey, viz.,numbers 1-19.

Estimates of Biomass on the Continental Shelf

Pacific hake was the most abundant of all species caught (Table 1). This is a minimum estimate in that the trawl is most efficient in catching flatfish. Dover sole was next in importance in abundance and most abundant of present commercial species followed by arrowtooth flounder and English sole.

Other species of lesser commercial importance, but moderately abundant, were sablefish and lingcod. Abundant, noncommercial species were ratfish and skates.

Estimates of Biomass Outside 12-Miles

Of the total biomass, 44% was outside the 12-mile contiguous zone (Table 1). Important commercial species varied widely as to the amount outside 12-miles. The important rockfish species were found mostly outside the 12-mile zone and as a group, 64% were outside 12-miles. Less than 50% of the flatfish group was outside 12-miles, but Dover sole stocks outside 12-miles were 72%.

Nearly all the English sole and a large portion of the petrale sole were inside the 12-mile zone.

Depth Distribution

Most petrale and all of the English, butter, and sand sole and nearly all sanddab occurred on the shelf (Figure 2). It is obvious from the pattern of distribution for the other species, especially for Dover sole and arrowtooth flounder, that some of the stocks extend beyond the shelf.

Age Composition

Age composition of the 10 species of flatfish sampled is shown in Table 2 along with the percentage of the catch sampled. Year class strength, as measured by these data, show that the 1968 year class may be an important contributor to the fishery in 1972, especially for English sole. The Commercial catch of age 4 English sole females in 1972 will indicate whether this is true.[2/]

1/ A tow represents the mid-point of a 5x5 mile square.

2/ At present, English sole females are the best indicator of year class strength available.

Table 1. Biomass Estimates of Common Species Taken on the 1971 Groundfish Surveys, Columbia River to Yaquina Head.

Species	Biomass: Amount on Continental Shelf Metric Tons	Biomass: Portion Outside 12 Miles Metric Tons	%
Spiny dogfish	748.8	195.4	26
Skates	8,231.3	3,803.1	46
Ratfish	4,964.7	1,303.2	26
American shad	315.5	75.3	24
Pacific cod	623.5	117.4	19
Pacific hake	79,309.1	33,664.4	42
Pacific tomcod	57.1	0.9	2
Rockfishes			
Pacific ocean perch	104.6	86.3	83
Silvergray rockfish	314.3	314.3	100
Blackmouth rockfish	420.9	383.7	91
Splitnose rockfish	22.3	20.5	92
Greenstriped rockfish	1,559.4	1,168.3	75
Widow rockfish	134.6	6.8	5
Rosethorn rockfish	5.9	5.9	100
Black rockfish	226.9	0.0	0
Bocaccio	310.4	49.1	16
Canary rockfish	1,458.6	780.9	54
Flag rockfish	1,153.1	1,129.6	98
Stripetail rockfish	173.1	173.0	100
Sharpchin rockfish	312.0	261.2	84
Yellowtail rockfish	1,447.5	353.0	24
Yellowmouth rockfish	126.7	126.7	100
Shortspine thornyhead	723.3	575.6	80
Sablefish	4,292.2	2,586.0	60
Lingcod	2,696.8	1,027.1	38
Wolfeel	77.8	0.0	0
Flatfishes			
Speckled sanddab	1.1	0.0	0
Pacific sanddab	2,249.8	117.6	5
Dover sole	12,037.7	8,713.5	72
English sole	5,890.7	222.9	4
Petrale sole	3,130.1	526.4	17
Rex sole	5,393.8	2.061.0	38
Arrowtooth flounder	6,251.0	4,398.8	70
Sand sole	190.6	0.0	0
Slender sole	251.6	178.5	71
Butter sole	150.2	0.5	<1
Flathead sole	328.0	270.0	82
Rocksole	20.8	1.6	8
Starry flounder	87.4	0.0	0
Curlfin sole	65.5	0.6	1
Total All Species	145,858.7	64,699.1	44
Group Totals			
Rockfishes	8,493.6	5,434.9	64
Flatfishes	36,048.3	16,491.4	46

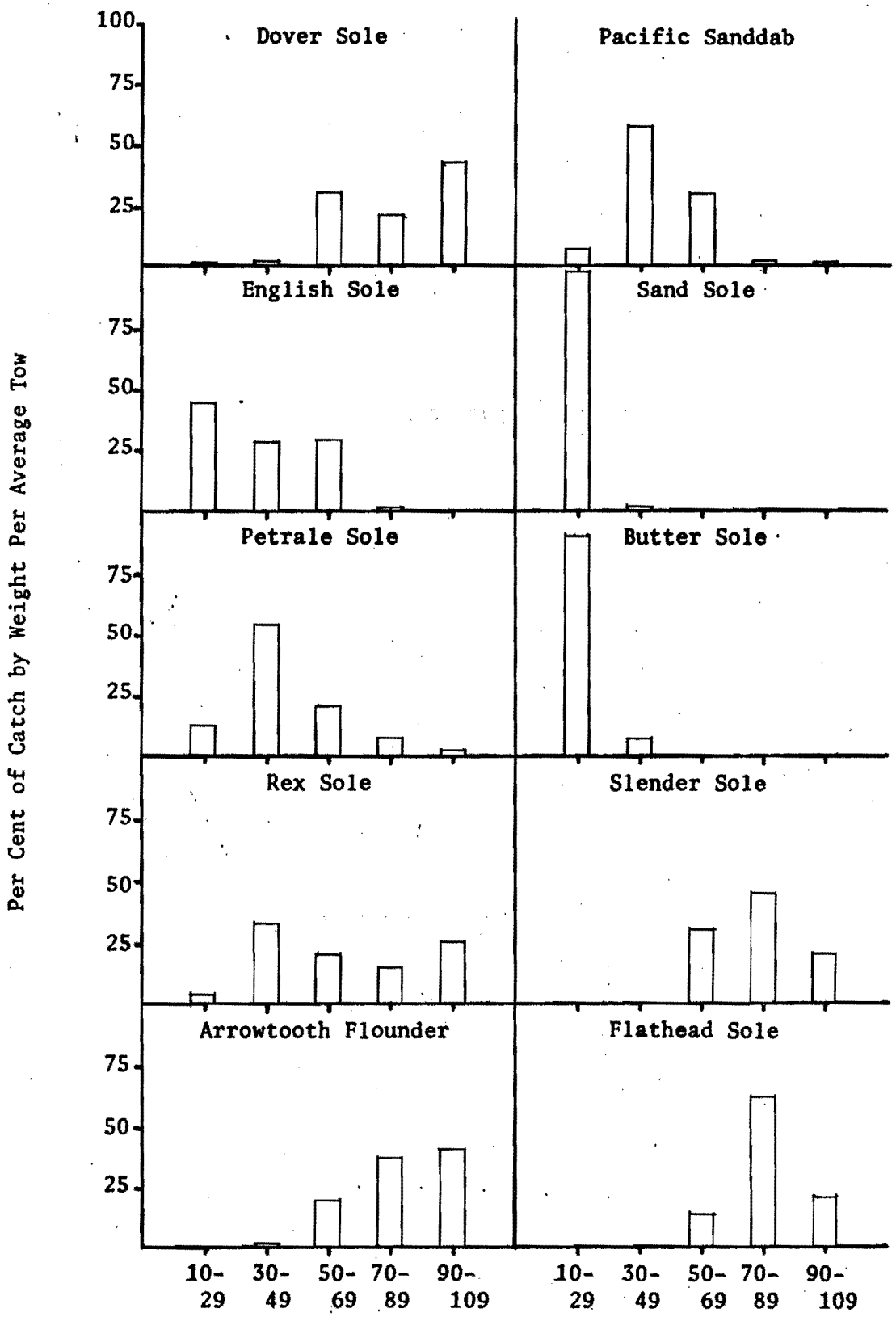


Figure 2. Depth Distribution of Flatfish Taken on 1971 Groundfish Surveys by 20-Fathom Intervals.

Table 2. Percentage Age Composition by Species and Sex of Flatfish Taken on 1971 Groundfish Surveys. The Dominant Year Class is Underlined.

Age	Dover sole		English sole		Petrale sole		Rex sole		Arrowtooth flounder		Sand dab		Sand sole		Flathead sole		Butter sole		Slender sole	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1	-	-	0.1	0.7	-	-	-	-	0.7	1.1	-	-	-	-	-	-	-	-	-	-
2	-	-	1.8	3.9	0.4	1.0	0.3	-	3.0	3.2	2.6	0.5	37.2	25.8	4.0	2.2	-	0.6	6.1	0.6
3	-	0.9	13.7	19.6	17.8	15.8	2.4	1.9	25.4	28.3	12.3	3.3	27.9	23.7	16.0	13.0	3.0	4.8	12.1	4.9
4	1.8	1.0	13.1	23.3	17.5	14.4	3.2	3.2	19.7	16.3	30.3	20.7	23.3	17.2	8.0	4.3	24.2	9.0	31.8	12.3
5	7.3	3.0	16.2	23.3	36.4	32.0	12.9	11.2	10.2	8.4	28.1	24.8	9.3	20.4	36.0	38.0	24.2	48.2	13.6	11.7
6	11.7	7.1	10.5	9.7	8.4	13.4	11.6	10.5	9.3	9.3	15.8	22.6	2.3	8.6	-	13.0	27.3	19.3	22.7	9.5
7	15.9	9.3	14.5	8.6	8.4	6.2	17.9	13.3	12.7	10.6	6.6	19.0	-	2.2	16.0	5.4	12.1	10.8	7.6	9.3
8	16.2	14.5	10.7	3.0	2.9	3.1	18.2	12.7	11.3	8.7	4.0	7.0	-	2.2	4.0	5.4	9.1	4.8	4.6	6.8
9	10.2	12.7	7.0	3.3	1.5	3.4	10.3	11.6	5.0	4.9	-	1.3	-	-	-	-	-	1.2	1.5	12.3
10	14.8	12.3	7.3	3.2	3.6	3.8	15.3	18.5	2.0	5.0	0.4	0.4	-	-	16.0	8.7	-	1.2	-	13.1
11	10.0	8.8	3.0	1.1	2.6	2.4	3.2	4.4	0.7	2.4	-	0.4	-	-	-	3.3	-	-	-	6.8
12	6.9	9.7	0.8	0.5	0.7	2.1	3.7	7.8	-	1.5	-	-	-	-	-	4.3	-	-	-	7.9
13	3.3	6.6	0.4	0.2	-	0.7	0.2	2.2	-	-	-	0.1	-	-	-	1.1	-	-	-	3.0
14	1.3	4.4	0.3	-	-	0.7	0.5	1.6	-	0.5	-	-	-	-	-	-	-	-	-	1.6
15	0.2	3.3	0.1	-	-	0.3	0.2	0.6	-	-	-	-	-	-	-	1.1	-	-	-	-
16	0.2	3.5	0.5	-	-	0.3	0.1	0.2	-	-	-	-	-	-	-	-	-	-	-	0.3
17	0.2	1.4	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	1.1	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-
19	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sam. Size	452	1058	740	572	275	291	876	1454	441	658	228	992	43	94	25	92	33	166	66	367
% of Cth. Sam.	44	52	37	31	65	58	42	46	60	64	65	62	100	100	100	100	89	83	84	87

Species

Instantaneous Mortality Rate

By calculating a regression coefficient between age and the logarithm of numbers caught by age, an estimate of the total instantaneous mortality rate Z is obtained. A complicating factor is that these estimates are based on a catch curve containing several year classes rather than on independent year classes. Estimates vary widely between species, ranging from 0.27 for arrowtooth flounder to 0.79 for butter sole (Table 4). Estimates for Dover sole are 0.38 and 0.28 for males and females, respectively. Independent estimates for Dover sole based on analysis of market sample data are 0.35 and 0.25 for males and females, respectively (ages 9-15).

An independent estimate for English sole females is 0.65 (ages 5-9). The survey estimate is 0.48. Even though the estimates of Z for Dover sole are close, the discrepancy in Z for English sole females suggests caution with respect to estimates of Z for the other species.

Growth Constants

Length-weight constants and Von Bertalanffy growth constants were calculated using market sample and cruise data (Table 3). With the exception of Dover, English, and petrale sole, growth constants should be considered as preliminary.

Exploitable Biomass

Estimates of biomass by age group (sexes combined) are shown in Table 5. That portion retained at 50% retention age by 4½-inch mesh commercial gear amounts to 87% of the Dover sole, 72% of the English sole, and 85% of the petrale sole.[1/] Retention data were not available for the other species. At the end of the 1972 fishing season, an estimate of the exploitation rate will be available.

1/ Percentages are based on biomass estimates made by 3½-inch mesh.

Table 3. Estimates of Length-Weight and Von Bertalanffy Age-Length Growth Constants of Flatfish Taken on the 1971 Groundfish Surveys.

Species	Length-Weight Constants a	b	Von Bertalanffy Age-Length Constants L_∞	K	t_o
Dover sole					
Males	-1.8730	2.8911	44.08	0.2186	-0.02
Females	-1.9927	2.9655	60.70	0.1110	-0.18
English sole					
Males	-2.1067	3.0132	36.30	0.2560	-1.08
Females	-2.6579	3.4003	46.70	0.1430	-4.67
Petrale sole					
Males	-2.3947	3.2812	45.40	0.2018	-1.82
Females	-2.5264	3.3760	54.40	0.2119	+0.08
Rex sole					
Males	-3.0659	3.5428	31.10	0.2274	-0.36
Females	-3.0460	3.5269	38.50	0.1454	-1.19
Arrowtooth flounder					
Males	-2.0566	2.9822	43.10	0.3481	-1.37
Females	-2.5727	3.3160	68.80	0.1562	-0.46
Pacific sanddab					
Males	-2.3662	3.2323	24.60	0.3801	+0.16
Females	-2.6672	3.4708	29.50	0.3073	+0.13
Sand sole					
Males	-1.7681	2.8484	41.70	0.4328	+0.34
Females	-2.1839	3.1285	46.10	0.4565	+0.31
Butter sole					
Males	Insufficient data		Curves fitted by eye		
Females	-1.9896	2.9424			
Slender sole					
Males	-2.5770	3.2440	27.40	0.1634	-2.17
Females	-2.6083	3.2632	29.50	0.1833	-1.44
Flathead sole	Insufficient data				

Table 4. Estimates of Total Instantaneous Mortality Rate Z for Flatfish Taken on the 1971 Groundfish Surveys. Age Range in Parenthesis.

Species	Instantaneous Mortality Rate	
	Males	Females
Dover sole	0.38 (8-14)	0.28 (9-15)
English sole	0.35 (5-12)	0.48 (5- 9)
Petrale sole	0.41 (5-11)	0.35 (5-12)
Rex sole	0.44 (8-12)	0.44 (8-15)
Arrowtooth flounder	0.28 (3-10)	0.27 (3-12)
Pacific sanddab	0.68 (5- 8)	0.71 (5- 9)
Sand sole	0.43 (2- 5)	0.46 (2- 8)
Slender sole	0.45 (4- 8)	0.34 (4-14)
Butter sole	0.38 (5- 8)	0.79 (5-10)
Flathead sole	Insufficient Data	

Table 5. Estimates of Biomass by Species and Age within Species for Flatfish Taken in the 1971 Groundfish Surveys (Weight in Metric Tons).

Age	Dover Sole	English Sole	Petrale Sole	Rex Sole	Arrowtooth Flounder	Sand Dab	Sand Sole	Slender Sole	Butter Sole	Flathead Sole[1/]
1	-	9.8	-	-	4.9	-	-	-	-	-
2	-	83.2	2.4	0.5	45.2	2.3	18.6	0.7	0.1	-
3	1.8	628.8	173.8	20.3	698.9	35.6	35.2	4.9	3.4	-
4	41.4	911.9	304.2	55.9	706.3	298.3	44.0	17.8	12.0	-
5	211.8	1170.5	920.8	302.3	498.1	555.8	54.4	19.3	60.3	-
6	412.1	657.1	412.6	384.7	661.8	540.1	25.3	23.2	34.7	-
7	853.3	796.4	309.8	676.8	977.3	518.6	6.4	22.2	21.9	-
8	1338.5	470.8	157.3	786.2	953.3	222.1	6.7	18.7	12.5	-
9	1257.3	416.6	164.7	700.1	571.7	42.7	-	34.8	2.5	-
10	1578.7	442.4	245.6	1244.8	574.6	15.8	-	40.4	2.8	-
11	1259.9	173.6	174.5	315.4	298.9	14.7	-	22.6	-	-
12	1390.6	65.7	124.8	545.2	192.7	-	-	28.2	-	-
13	989.3	27.7	38.0	146.5	-	3.8	-	11.1	-	-
14	693.1	10.1	39.9	121.4	67.3	-	-	6.5	-	-
15	524.4	5.3	20.1	51.6	-	-	-	-	-	-
16	605.0	20.8	20.5	19.3	-	-	-	1.2	-	-
17	274.7	-	21.1	-	-	-	-	-	-	-
18	223.6	-	-	22.9	-	-	-	-	-	-
19	120.9	-	-	-	-	-	-	-	-	-
20	43.1	-	-	-	-	-	-	-	-	-
21	68.7	-	-	-	-	-	-	-	-	-
22	49.5	-	-	-	-	-	-	-	-	-
Total	12037.7	5890.7	3130.1	5393.9	6251.0	2249.8	190.6	251.6	150.2	328.0

1/ Insufficient data for age breakdown.

SECTION 2: SHRIMP SURVEY

Introduction

Objective of the shrimp survey was to test "pilot" level results in a "production" management situation. This was the first of an anticipated series of annual population estimates within areas surveyed in 1966-67 and important in the commercial fishery. By correlating commercial catch-effort data with estimates we hope to develop a better management rationale for this resource and to help the fishery through more precise predictions of stock status. The welfare of shrimp stocks is of three-state (California-Oregon-Washington) interest because of possible ocean movement of shrimp across state lines and because both fishermen and processors take shrimp caught off Oregon to adjacent states for sale.

Methods

The shrimp survey was made using four chartered shrimp vessels. Trawl nets were provided by the vessel owner. One-half inch mesh innerliners for the codend were provided by the Fish Commission of Oregon. The survey was run within five areas known to contain most of the shrimp found off Oregon. They were: (1) Columbia River to Tillamook Bay; (2) Tillamook Bay to Stonewall Bank; (3) lower Heceta Bank to Cape Arago; (4) Cape Arago to Cape Blanco; and, (5) Cape Blanco to the Rogue River (Figure 3).

Population estimates in each stratum were derived by multiplying the mean catch in pounds and numbers of shrimp per sample tow by an expansion factor (square area of stratum divided by average square area of each sample tow). Age composition was obtained by dissection of carapace length-frequency samples, pooled, and weighted to catches in each stratum.

Results

Results of the survey indicated the 1970 year class (age I) was dominant in all areas (Table 6). Largest populations were found in Areas 2 and 3 (Newport and Coos Bay) with about 9 million pounds each in September. Examination of commercial fishing catch, effort, and age composition data further strengthened these conclusions. An underestimate of biomass was undoubtedly made in Area 5 and probably in Area 4. Reasons for this are unknown. Possibly shrimp were just not fully available, being either off-bottom or in untrawlable areas within and adjacent to survey grounds.

The small (3,090,000 pounds) population estimate in Area 1 contrasts with 35,253,000 and 66,253,000 pounds estimates of biomass there in the fall 1966 and spring 1967. Fishing effort has been relatively light there especially since 1968 and could hardly have caused a decline. Possible explanations for the change are emigration or excessive natural mortality (possibly epidemic disease or parasitism).

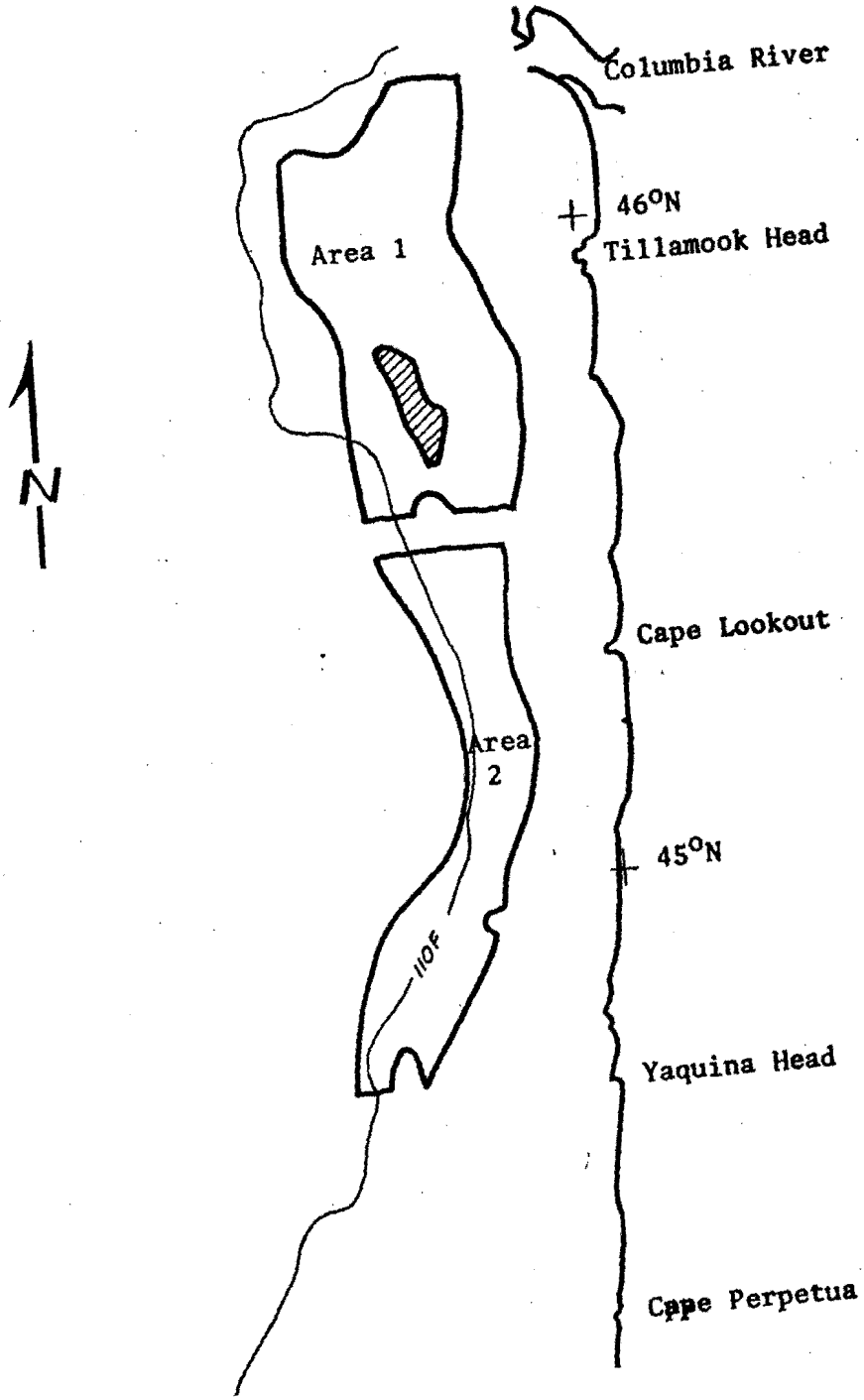

Columbia River
46°N
Tillamook Head
Area 1
N
Cape Lookout
Area 2
45°N
110F
Yaquina Head
Cape Perpetua

Table 6. Summary of Results of 1971 Shrimp Survey Cruise, Showing Estimates of Population by Age and Stratum.

Stratum[1/]	Vessel	Dates	Tows	Biomass by Age (Thousand Pounds) I	II	III+	Total	Number by Age (Millions Shrimp) I	II	III+	Total	No. of Females (Millions)
1	Trask	9/5-7	31	925	997	1,168	3,090	221	125	89	435	244
2	Ruth Ellen	9/4-9	22	5,818	1,800	2,169	9,787	1,308	188	150	1,646	474
3	Kangaroo	9/4-10	26	6,638	1,199	1,192	9,029	1,268	111	80	1,459	603
4	Amak	9/4	9	7	13	42	62	1	1	3	5	4
5	Amak	9/5-6	11	141	29	57	227	23	2	4	29	18
Total			97	13,529	4,038	4,628	22,195	2,821	427	326	3,574	1,343

1/ See text for description of boundaries.