RESOURCE SURVEYS ON THE CONTINENTAL SHELF OFF OREGON

ANNUAL REPORT
July 1, 1972 to June 30, 1973

Robert L. Demory and Jack G. Robinson
Fish Commission of Oregon

National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Commercial Fisheries Research and Development Act
Project No. 1-78-D-2
Contract No. 04-3-208-57

June 1973

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

RESOURCE SURVEYS ON THE CONTINENTAL SHELF OFF OREGON
SECTION 1: GROUNDFISH SURVEY

Introduction

This report summarizes program progress in FY 1973. Activities were directed entirely at completing the second phase of the work started in 1971, i.e., to complete the resource survey of the continental shelf off Oregon between the Columbia River and Cape Blanco.

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

Methods

Fishing Methods

Methods developed during the 1971 survey were followed in 1972 (Demory and Robinson, 1972). There were 65 stations planned for the survey but because of rough bottom only 51 sets were made. We made 8 additional sets on stations occupied in 1971 (Figure 1).

Catch Processing

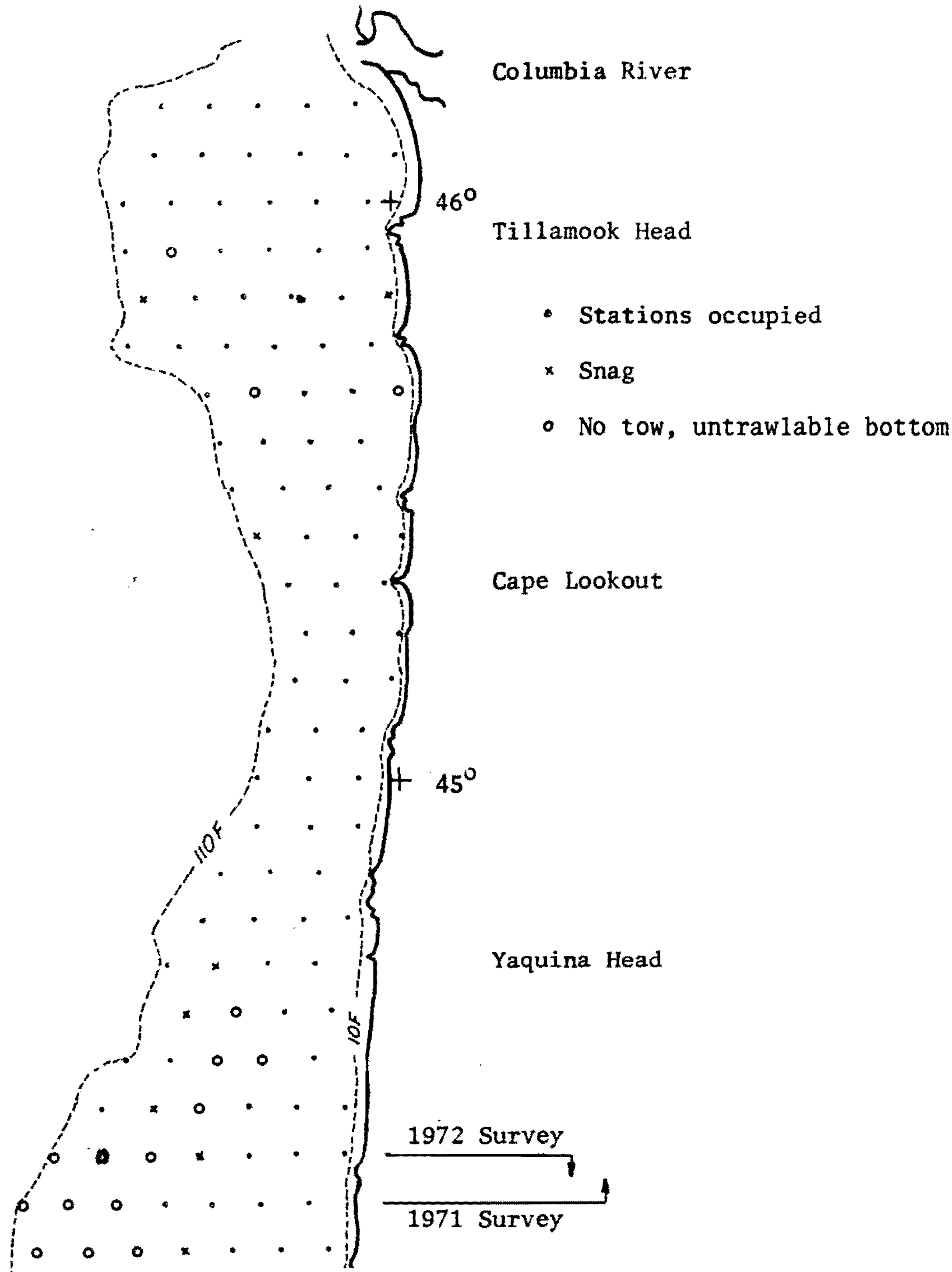
Techniques developed during the 1971 survey for handling and sampling the catch were followed in 1972 (op. cit.).

Estimates of Biomass

Estimates of biomass from the 1972 survey were combined with estimates from the 1971 survey and apply to the entire continental shelf (4240 sq. mi.) as do estimates of exploitable biomass and potential yield.

Exploitable Biomass and Potential Yield

Estimates of exploitable biomass were determined for Dover, English, petrale, and rex sole and Pacific sanddab. Age data (numbers) from the cruise were converted



Columbia River
46°
Tillamook Head
Stations occupied
Snag
No tow, untrawlable bottom
Cape Lookout
45°
110F
Yaquina Head
10F
1972 Survey
1971 Survey

to weight sampled via age-weight curves. This age data was then related to age data from samples of commercial landings (also in terms of weight). The proportion retained between the survey trawl and standard commercial gear was determined for each age. Biomass by age and sex was then summed. Age data from commercial landings of rex sole and sanddab was not available so I set 30 cm as the cut-off length and assumed that everything $\geq$ 30 cm as exploitable. This necessitated putting numbers caught by length in terms of weight caught by length.

Estimates of potential yield were determined by letting fishing mortality rate F equal the natural mortality rate of M (Tiurin, 1965). Estimates of M are: Dover sole, 0.20; English sole, 0.20; petrale sole males, 0.25 and females, 0.20; rex sole, 0.20; and sanddab, 0.25. Estimates of M for Dover and English sole are from Fish Commission data. Estimates for rex and sanddabs are arbitrary and estimates for petrale sole are from Ketchen and Forrester (1966).

Another method used for determining the potential yield is by the Schaffer surplus yield model, $Y = 0.50\ M\ B_o$; where Y = yield, M = natural mortality, and B_o = the virgin or original biomass (Alverson and Pereyra, 1969).

Year Class Strength

Relative year class strength is expressed in percent frequency.

Evaluation of Sampling Techniques

We use a systematic sampling technique to estimate age composition. The ratio of number of fish sampled to number of fish caught varies inversely to catch size. Specifically, I tested for difference in size composition and sex ratio.

Size composition of samples was tested against size composition of the catch by a X^2 test for homogeneity ($P = 0.05$). There were 38 tests made: Dover sole, 20; English sole, 4; rex sole, 9; and sanddab, 5.

Sex ratio was tested by X^2. There were 16 tests made.

The ability of the sample to estimate numbers caught was not tested. I simply set a limit of ± 5 fish as acceptable.

Evaluation of a Small Mesh Trawl

During the cruise, we tested a trawl made of 2½-inch mesh to determine its ability to capture smaller size fish, especially Dover sole, than are caught by the 3½-inch mesh survey trawl. The trawl was rigged the same as, and was the same overall size as, the survey trawl. Testing was done at two different depths to account for differences in depth distribution of some species.

Aging Studies

Otoliths were read twice by each reader (within reader) after agreed upon criteria were set down. This tests the ability of the reader to interpret marks in accordance with criteria. The second readings of each reader was then compared (between readers). This comparison tests whether readers interpret the criteria in a like manner.

Results

Estimates of Biomass

The biomass estimate for the entire survey area is 644 million pounds (Table 1). Of this, nearly 50% (318 million pounds) is outside the 12 mile contiguous zone. Pacific hake accounts for nearly half of the total biomass or 304 million pounds. The rockfish complex amounts to 40 million pounds, 68% of which is outside 12 miles. Flatfish amounts to 193 million pounds, 37% of which is outside 12 miles. The three important commercial species of Dover, English, and petrale sole amount to 118 million pounds, of which 39% is outside the 12 mile zone. Dover sole is the most abundant of the flatfish, followed by English sole, rex sole, and Pacific sanddab.

Table 1. Biomass Estimates, Columbia River - Cape Blanco, Between 10 Fathoms and 110 FAthoms

Species	Continental Shelf (1000's of Pounds)	Outside 12 Miles (1000's of Pounds)	%
Spiny dogfish	7,874	5,495	70
Skate	38,505	14,386	37
Ratfish	26,158	5,357	20
Shad	983	562	57
Cod	1,678	800	48
Hake	303,721	171,786	57
Tomcod	159	5	3
Rockfish			
Bocaccio	2,281	1,428	63
Widow rockfish	533	125	23
Black rockfish	264	0	0
Yellowtail rockfish	4,250	1,269	30
Canary rockfish	5,753	3,040	53
Blackmouth rockfish	1,653	1,305	79
Redstripe rockfish	588	588	100
Pacific ocean perch	1,034	854	83
Stripetail rockfish	1,432	469	33
Splitnose rockfish	306	305	99
Flag rockfish	2,791	2,682	96
Sharpchin rockfish	1,119	1,035	92
Greenstripe rockfish	13,072	10,375	79
Rosethron rockfish	111	91	82
Yellowmouth rockfish	577	577	100
Longjaw rockfish	1,204	1,152	96
Rougheye rockfish	18	17	94
Thornyhead rockfish	3,357	2,271	68
Sablefish	23,086	17,082	74
Lingcod	8,733	2,698	31
Flatfish			
Pacific sanddab	25,396	3,797	15
Arrowtooth flounder	14,577	10,157	70
Slender sole	1,093	882	81
Petrale sole	13,000	3,447	27
Flathead sole	733	614	84
Sand sole	1,548	0	0
Butter sole	705	1	<1
English sole	43,785	7,683	18
Rock sole	487	144	30
Dover sole	61,687	34,919	57
Rex sole	29,294	10,227	35
Starry flounder	498	0	0
Curlfin sole	338	36	11
Total	644,381	317,661	49
Rockfish	40,343	27,583	68
Flatfish	193,141	71,907	37

Exploitable Biomass and Potential Yield

Estimates of exploitable biomass were highest for Dover sole and English sole at 54 and 33 million pounds, respectively. Estimates for petrale sole and rex sole were similar at 10 and about 14 million pounds, respectively. The estimate for sanddabs was about 4 million pounds (Table 2). The portion of sanddabs ≥ 30 cm comprised a small part of the population.

Estimated of yield obtained by relating survey catches to catches by commercial gear, ranged from 11 million pounds for Dover sole to just 1 million pounds for sanddabs. The estimate for English sole is nearly 7 million pounds followed by rex sole at nearly 3 million pounds and petrale sole at 2 million pounds.

By the Schaffer model, the estimate for Dover sole is 6 million pounds, a reduction of 44%. English sole and petrale sole were reduced by 34% and 29% to 4.4 and 1.5 million pounds, respecitvely. The estimate for rex sole was essentially unchanged, but sanddabs increased by nearly 2 million pounds.

Also shown in Table 2 are the commercial landings from the survey area. Dover sole shows considérable potential for increase as does English sole, but petrale sole is fully utilized. Rex sole and sanddabs are little used at present and could support considerable increase.

Regardless of which method is used to determine potential yield, both rely on the accuracy of the biomass estimate and must therefore be considered only as first estimates.

Year Class Strength

Age composition from the two cruises shows relative year class strength in most species of flatfish. A complicating factor is that age composition in 1971 is from the northern area while that of 1972 is from the southern area. Factors which

Table 2. Estimates of Biomass, Exploitable Biomass and Potential Yield of Selected Species (In Millions of Pounds).

Species	Biomass	Exploitable Biomass	Potential Yield		Average of 1971-72 Landings	
			1/	2/	Oregon	Survey Area
Dover sole						
Males	19.3	17.2	3.4	1.9		
Females	42.4	37.2	7.4	4.2		
Total	61.7	54.4	10.8	6.1	5.3	4.3
English sole						
Males	18.8	12.9	2.6	1.9		
Females	25.0	20.4	4.1	2.5		
Total	43.8	33.3	6.7	4.4	2.0	1.4
Petrale sole						
Males	4.6	3.3	0.8	0.6		
Females	8.5	6.7	1.3	0.9		
Total	13.1	10.1	2.1	1.5	2.2	1.2
Rex sole	29.3	13.8	2.8	2.9	1.1	0.6
Pacific sanddab	25.4	3.8	1.0	3.2	0.8	0.6
Total	173.3	115.5	23.4	18.1	18.6	8.1

1/ See text

2/ Schaffer model

determine year class strength may operate at different magnitude or perhaps out of phase between areas. In spite of this, strong year classes are evident (Figure 2). The 1968 year class shows well in English and petrale sole. The 1966 year class is strong for petrale sole, rex sole, sanddab, and butter sole. This particular year class was the greatest ever recorded for English sole. The 1969 year class appears to be strong for arrowtooth flounder and sand sole.

New insight to year class strength will be had when the northern area is resurveyed in September 1973.

Evaluation of Sampling Techniques

There were no significant differences in size composition between samples and the catch from which they were drawn. Although age composition of the sample vs. age composition of the catch was not tested, I assumed that if the sample estimated the size composition of the catch then the age composition of the catch was also estimated.

There were no significant differences in sex ratio ($p = 0.05$).

Numbers caught were estimated with ±5 fish in 33 of 38 cases. In fact, in 30 of the 38 cases, numbers caught were estimated within limits of ±2 fish. There were 5 cases where numbers estimated were in error. In two of these, the proportion of fish sampled was improperly recorded. Two of the remaining 3 cases overestimated the numbers caught by 16 and 69 fish and one sample underestimated the catch by 83 fish. In the 5 cases, sample error ranged from -83 fish to +69 fish. The mean difference was -5 fish.

The severity of sampling error is impossible to access since all catches of flatfish were not counted (Table 3). Catches sampled in their entirety occurred 63% of the time, were 46% of fish sampled, but accounted for only 19% of the total catch. On the other hand, catches sampled at a ratio of 1:10 occurred 5% of the time,

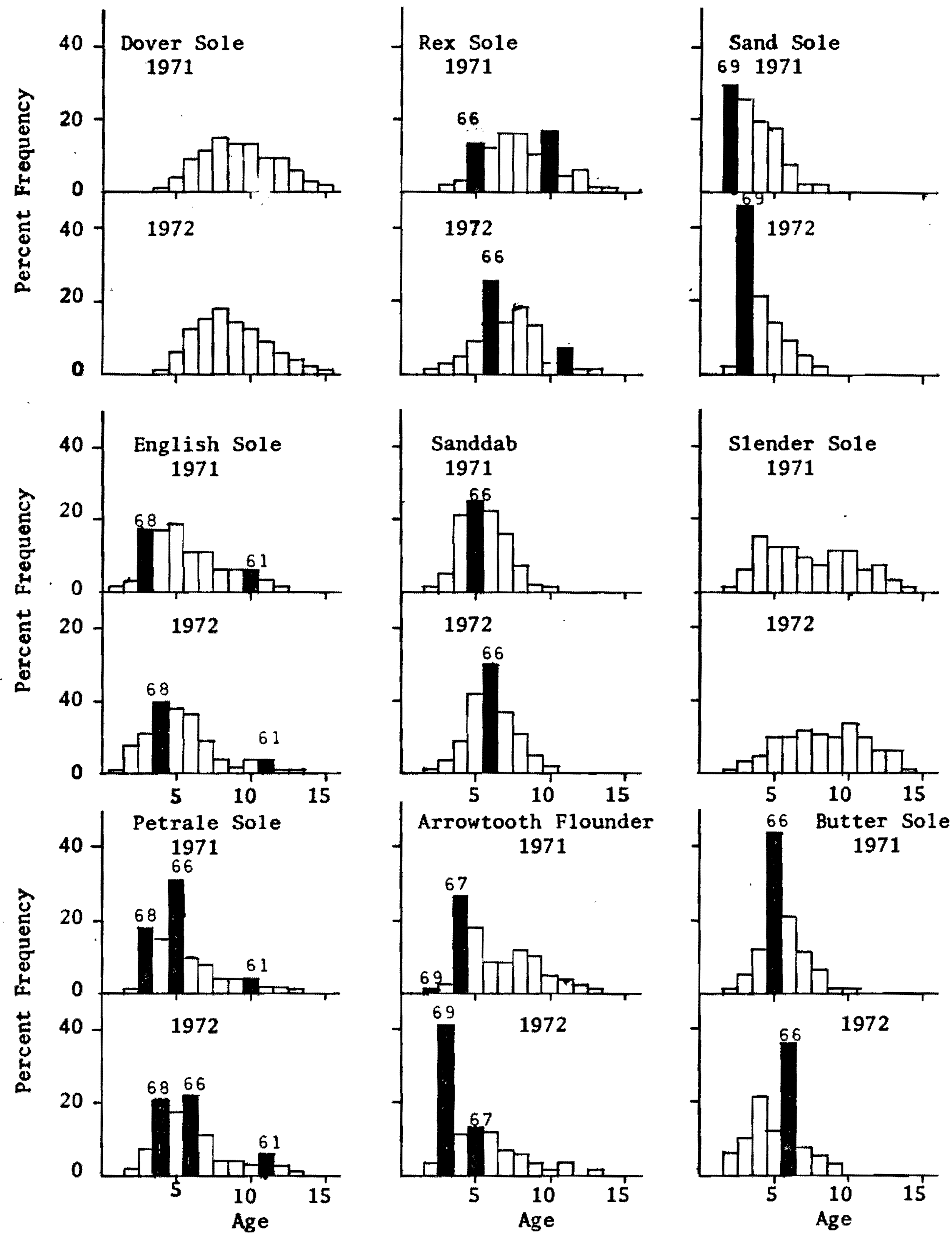


Figure 2. Age Composition of Flatfish from Cruises of 1971 and 1972. Age Frequency is not Shown for Ages Less than 1%.

Table 3. Ratio of Number Sampled to Number Caught, Sample Size, and Extrapolated Catch for 9 Species of Flatfish.

Ratio	Frequency	% of Total Frequency	Sample Size	% of Sample	Extrapolated Catch	% of Catch
1:1	127	63	3,381	46	3,381	19
1:2	26	13	1,245	17	2,490	14
1:3	20	10	1,038	14	3,114	17
1:4	8	4	369	5	1,476	8
1:5	10	5	590	8	2,950	16
1:10	10	5	607	8	6,070	34
1:15	1	<1	100	1	1,500	8
Total	202		7,330		17,981	

were 8% of the fish sampled, but accounted for 34% of the catch. Thus, mistakes in recording proportion sampled and mistakes in counting the number to be sampled have the potential of serious error. Sampling error can be reduced by making sure that the proportion sampled is properly recorded and that instructions to personnel are clearly understood.

Weight caught was not tested, but I assumed that if numbers caught were accurately estimated, then weight caught would be estimated. This was not true in all cases. Of the five cases of sampling error cited above, the error in weight ranged from -7.9 pounds to +45.6 pounds. The mean difference was +13.3 pounds.

Evaluation of a Small Mesh Trawl

Sizes of Dover sole captured by the two trawls were nearly identical even though 7 times as many fish were caught by the 2½-inch mesh trawl (Figure 3). The number of additional small fish caught would not warrant the sacrifice in time required to handle the larger catches thereby reducing the number of hauls.

The smaller mesh was especially adept at catching small English and rex sole and to a lesser extent sanddab. Again the differences in catch rate would require more time than returns would warrant.

Different results may have been obtained had the tests been conducted in an area known to be inhabited by small Dover sole such as off the Umpqua or Columbia rivers.

Aging Studies

Of the nine species of flatfish sampled for age composition during the surveys, six are new to the Fish Commission in regard to aging. Dover, English, and petrale sole have received much study by Pacific coast fishery agencies and will receive no further mention.

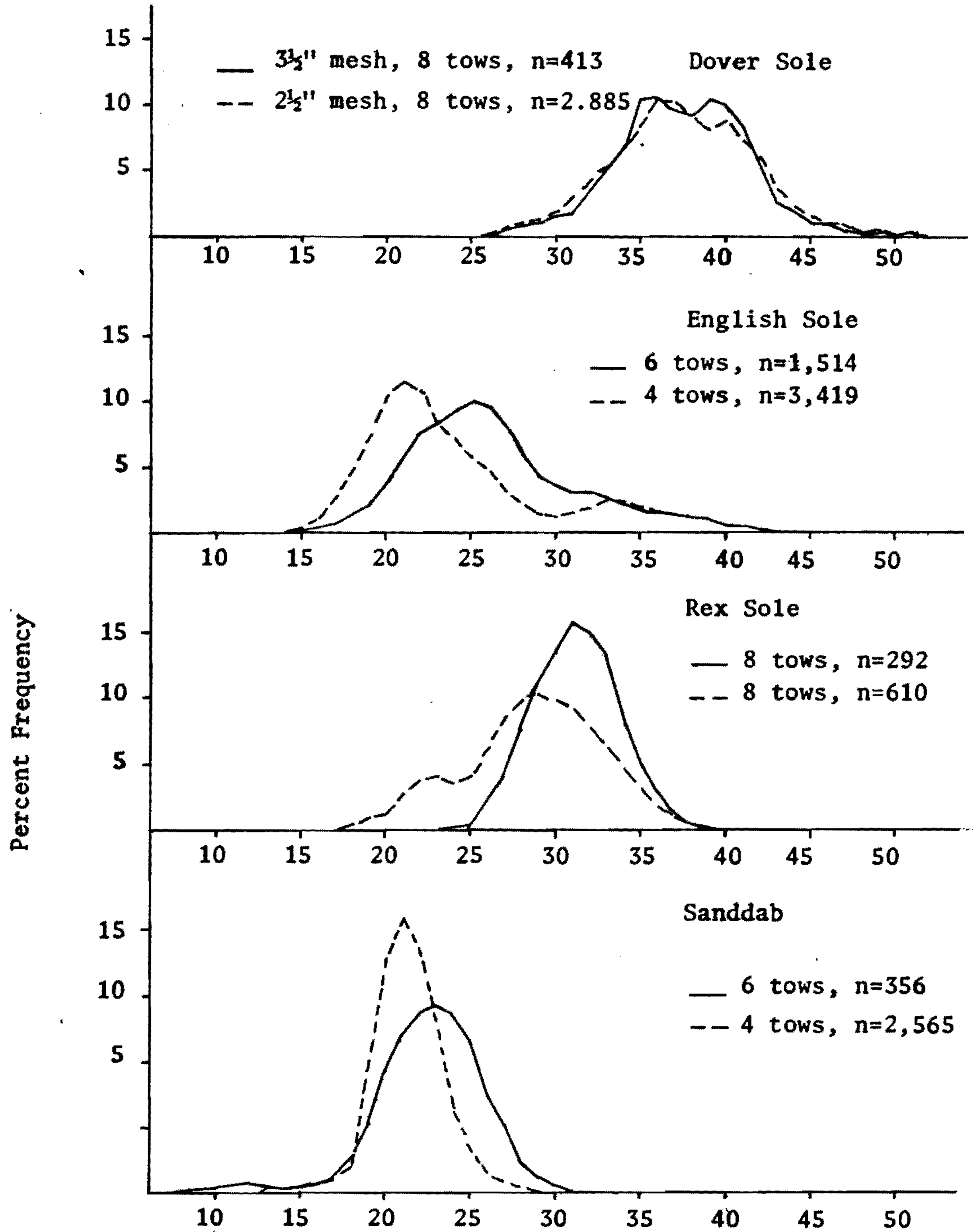


Figure 3. Size Composition of Selected Species Caught by Two Different Mesh Sizes.

The following summary is preliminary in that age structure reading criteria, although established, will undergo revision as we gain more knowledge about the various species, especially early life history, and the location of the first annulus.

Agreement between first and second readings by one person (within) ranged from 44% for sand sole to 91% for butter sole (Table 4). Obvious difficulties appear when the difference within readers is compared. Sanddabs and butter sole showed minor differences of 1 and 4%, respectively. Rex sole, arrowtooth flounder, and sand sole showed moderate differences of 12%, 7%, and 9%, respectively. Slender sole showed a difference of 22%. At a level of ±1year, agreement improved to 80% or better. Differences were less than 4%. This implies that although each reader had trouble applying the criteria the difference in age interpretation did not usually exceed 1 year.

Agreement between readers (second reading only) ranged from 31% for rex sole to 72% for butter sole. At a level of ±1 year, agreement ranged from 73% for rex sole to 96% for butter sole. Agreement at ±1 year between readers is of similar magnitude as agreement of each reader at ±1 year. The implication is that criteria are applied in a similar manner by each reader.

Benefits

Benefits derived from the surveys are difficult to access from a resource point of view in that the fishery operates only on a few species. Species of little or no value at present may one day be of value if high-value species are depleted or standards of acceptance change with regard to underutilized species.

The groundfish staff has been approached on two recent occasions concerning the availability of species that might be suitable for pellets as fish food in agency-operated salmon hatcheries and at a local fish farm. We gave them this information.

Table 4. Percent Age Agreement after Two Readings at Two Levels of Acceptance by Two Readers and Percent Agreement Between Readers

		Percent Agreement Within Reader						Percent Agreement Between Readers		Age Range
		±0			± 1					
Species	No. Read	A	B	Diff.	A	B	Diff	±0	±1	
Rex sole	223	53	65	12	87	89	2	31	73	2-16
Pacific sanddab	201	60	59	1	89	85	4	56	92	2-12
Arrowtooth flounder	199	55	48	7	82	86	2	61	85	2-15
Sand sole	126	53	44	9	90	87	3	42	83	2-11
Butter sole	107	87	91	4	99	99	0	72	96	3-9
Slender sole	164	68	46	22	92	90	2	59	87	1-12

The most significant and gratifying contribution to date is that our survey methods, developed with PL 88-309 funds, are being used by other agencies in British Columbia and Alaska in surveying shrimp resources.

Literature Cited

Alverson, D.L. and W.T. Pereyra. 1969. Demersal fish explorations in the northeastern Pacific ocean - An evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecasts. Fish. Res. Canada Jour. 26(8):1985-2001.

Demory, R.L. and J. G. Robinson. 1972. Resource surveys on the continental shelf off Oregon. Comm. Fish. Res. and Dev. Act Annual Report, July 1, 1971 to June 30, 1972. Fish Comm. Ore. Proc. 13 p.

Ketchen, K.S. and C.R. Forrester. 1966. Population dynamics of the petrale sole, *Eopsetta jordani*, in waters off western Canada, Fish. Res. Bd. Canada, Fish Bull. 153, 195 p.

Tiurin, P.V. 1962. The natural mortality factor and its importance in regulating fisheries. Fish. Res. Bd. Canada, Translation Series 558, 1965.

SECTION 2: SHRIMP SURVEY

Introduction

Objective of the shrimp survey was to test a "pilot" method of determining biomass levels in a production management situation. This was the second of a series of annual population estimates started in 1971 (Demory and Robinson, 1972), within areas important to the commercial fishery (Figure 4). By correlating commercial catch-effort data with results of these surveys, we hope to develop a better management rationale for the shrimp resource and to aid the fishery through more precise predictions of stock status.

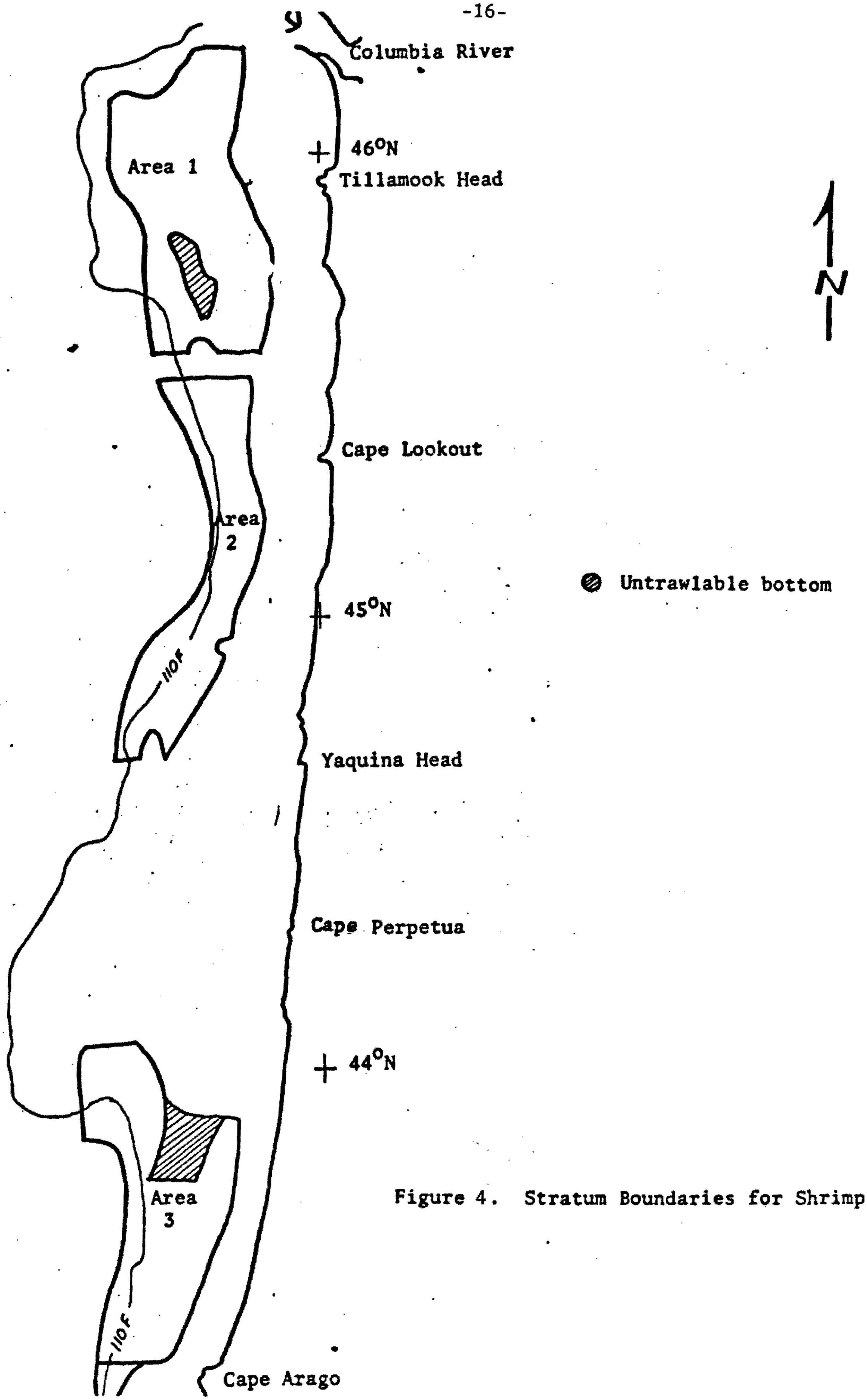


Figure 4. Stratum Boundaries for Shrimp Survey.

Methods

The shrimp survey was made using three chartered shrimp vessels. Trawl nets were provided by us. They were 41-foot (headrope) semiballoon trawls of 1-inch nylon mesh with a 1-inch mesh innerliner in the codend.

The survey was done within three areas known to contain most of the shrimp off Oregon. They were: (1) Columbia River to Tillamook Bay; (2) Tillamook Bay to Stonewall Bank; (3) lower Heceta Bank to Cape Arago. Two small areas between Cape Arago and the Rogue River surveyed in 1971 were dropped from our 1972 survey. Results of surveys within these areas have always been highly variable and unreliable probably because of too much untrawlable bottom.

Population estimates in each of the three strata were derived by multiplying the mean catch in pounds and numbers of shrimp per sample tow by an expansion factor (area of stratum divided by average 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

The 1970 year class (age II) was dominant in all areas. Largest populations were found in areas 2 and 3 (Newport and Coos Bay) with about 9 million pounds and 13 million pounds, respectively, in September (Table 5).

The small (4,081,000 pounds) biomass estimate in area 1 repeated results of the 1971 survey, which also found few (3,090,000 pounds) shrimp in the area.

Benefits

The principal benefit of the survey was to obtain reliable estimates of the age composition of stocks within the survey areas. Also, unbiased estimates of standing crop of shrimp were obtained and a more reliable estimate of the coefficient of catchability (q) derived from data analysis of population distribution. The population estimates were similar to, or higher than, those obtained in 1971, therefore we were able to conclude that the very significant increase in 1972 commercial catch and effort over 1971 and prior years had not been excessive.

Literature Cited

Demory, R.L. and J.G. Robinson. 1972. Resource surveys on the continental shelf off Oregon. Comm. Fish. Res. and Dev. Act. Annual Report, July 1, 1971 to June 30, 1972. Fish Comm. of Ore. Proc. Rept., 13 p.