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USA-USSR OTTER TRAWL SURVEY, FALL 1968

by

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Introduction

The joint otter trawl survey in 1968 was a continuation and expansion of the series begun in 1967 to monitor distribution and abundance of trawl-caught fish. The area covered in 1968 included fishing grounds between the 30 m and 300 m isobaths from Georges Bank to Cape Hatteras (Figure 1).[3]

Operations were conducted aboard the USSR fish scouting vessel Blesk, a side trawler (SRTM) with an overall length of 54.2 m; and aboard the USA fishery research vessel Albatross IV, a stern trawler with an overall length of 57 m. The survey covered the period 10 October-7 November 1968.

In this document we summarize catch per haul of selected species, compare catches of the two vessels, examine the relationship of catch to water temperature, and compare catches in 1967 and 1968.

Materials and methods

Details of gear and methods are given in ICNAF Res. Doc. 68/87; the following description therefore is brief.

Sampling followed a stratified random design (Figure 1). Stratum boundaries were the same in 1967 and 1968; however, the 1967 joint survey covered only strata west and south of 70°W. A sample of the possible stations within each stratum was pre-selected using a table of random numbers, and independent selections were made for each stratum and vessel. A 30-minute otter trawl haul, was made at each selected station.

Blesk used a 27.1 herring trawl with a 27.2 m headrope and a 27.4 m footrope. Five footrope rollers (diameter = about 50 cm) were used at a few of the stations on Georges Bank; otherwise, the trawl was used without rollers. Albatross IV used a No. 36 groundfish trawl with a 20.6 m headrope and a 24.4 m footrope. A set of 19 rollers (diameter = 41 cm) was used on the center 10.7 m section of the footrope for all hauls. The Blesk trawl had a codend of 32 mm mesh twine; the Albatross IV trawl was lined in the codend and top belly with 13 mm mesh twine. (See ICNAF Res. Doc. 68/87 for characteristics of both nets.) Both nets therefore retained most sizes of fish caught. In 1967, the Albatross IV net was fitted with 18 m ground cables; in 1968 no ground cables were used. Also, in 1967 the headrope of the Albatross IV net was 2.4 m longer than in 1968. Towing speed for both vessels was 3.5 k.

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3/ The 1968 joint survey continued north of Georges Bank, to southern Nova Scotia, on a modified sampling scheme; that part of the survey is not discussed here.

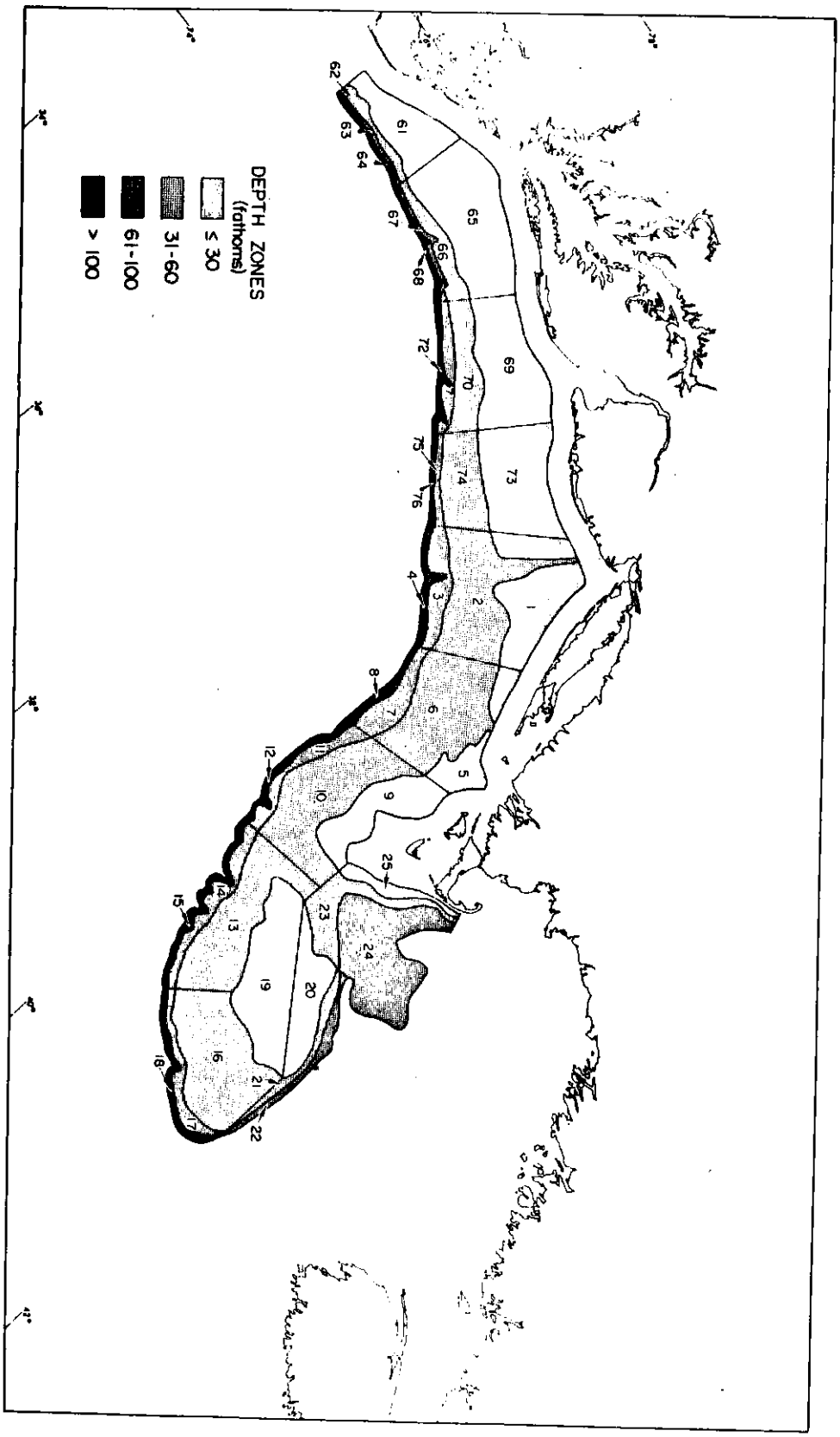

Figure 1. --Sampling strata in the area covered by the USA-USSR otter trawl survey in fall 1968.

Albatross IV, slightly faster than Blesk and using a smaller net, was assigned 193 stations in the sampling area; Blesk was assigned 146 stations (Figure 2). Cruise tracks were laid out so that both vessels would fish the same stratum within the same 48-hour period.

Bathythermograms were obtained at each station and at selected points along the tracks between stations. These provided coincident estimates of the surface to bottom temperature regime in the survey area.

For each haul the total weight and length frequency of the catch (or representative sample therefrom) were recorded, along with position, depth, and other pertinent information, on trawl logs. When catches were sampled, weight and volume (or number) of sample was recorded as well as volume (or number) of the discarded portion of the catch, to permit computation of total weight and length frequency. Procedures for sampling catches are given in ICNAF Res. Doc. 68/87. Close cooperation and communication between scientific groups on the two vessels and partial exchange of personnel insured uniform processing techniques.

Following the survey, the catch data for both vessels were put through the routine groundfish survey data processing system used at Woods Hole which involves careful hand checking and coding of each trawl log, transfer of data to punched cards, and a series of computer audit runs to eliminate any major errors.

Results

I. Distribution of principal species

There were 105 species of fish and five species of invertebrates, for which data were recorded, in catches in the survey area. A relatively small number contributed significantly to the biomass of bottom-trawl catches, however, and it is these that we discuss here.

Catches, by stratum set, in pounds and percentage weight per haul for selected species and in pounds per haul for species groups are given in Tables 1 and 2 and Figure 3. 4/ In the southern part of the area surveyed (strata 61-68 and 1-12) spiny dogfish, silver hake, sea robin, and squid made up much of the catch. This southern part is approximately the same area as was covered in the 1967 survey. Catches of dogfish and skate in 1968 were lower than in 1967 while groundfish, pelagics, and flatfish were taken in about the same amounts in the two years (Table 2 and ICNAF Res. Doc. 68/87). Generally the percentage contribution of the various species was similar in the two years.

In the northern part of the area, which was largely on Georges Bank (strata 13-25), the catch was more evenly divided among the different species rather than being dominated by a few species (Tables 1, 2; Figure 3). Groundfish, flatfish, and skates were the principal groups caught.

The north-south distribution pattern shown in catches presumably is related to temperature, since the water in the southern part of the area generally is warmer than to the north (Figure 4). The bottom temperature pattern in 1968 differed little from that prevailing during the trawl survey of October 1967 (ICNAF Res. Doc. 68/87); however, the temperature was slightly higher in 1968. This effected no marked change in the distribution of fish, although spiny dogfish were concentrated farther north in 1968 than in 1967.

4/ Composition of species groups. Dogfish: all dogfish species; skate: all skates and the torpedo; groundfish: cod, haddock, cusk, and all hakes; pelagic: mackerel, butterfish, scup, and all herrings; flatfish: halibut and all founders.

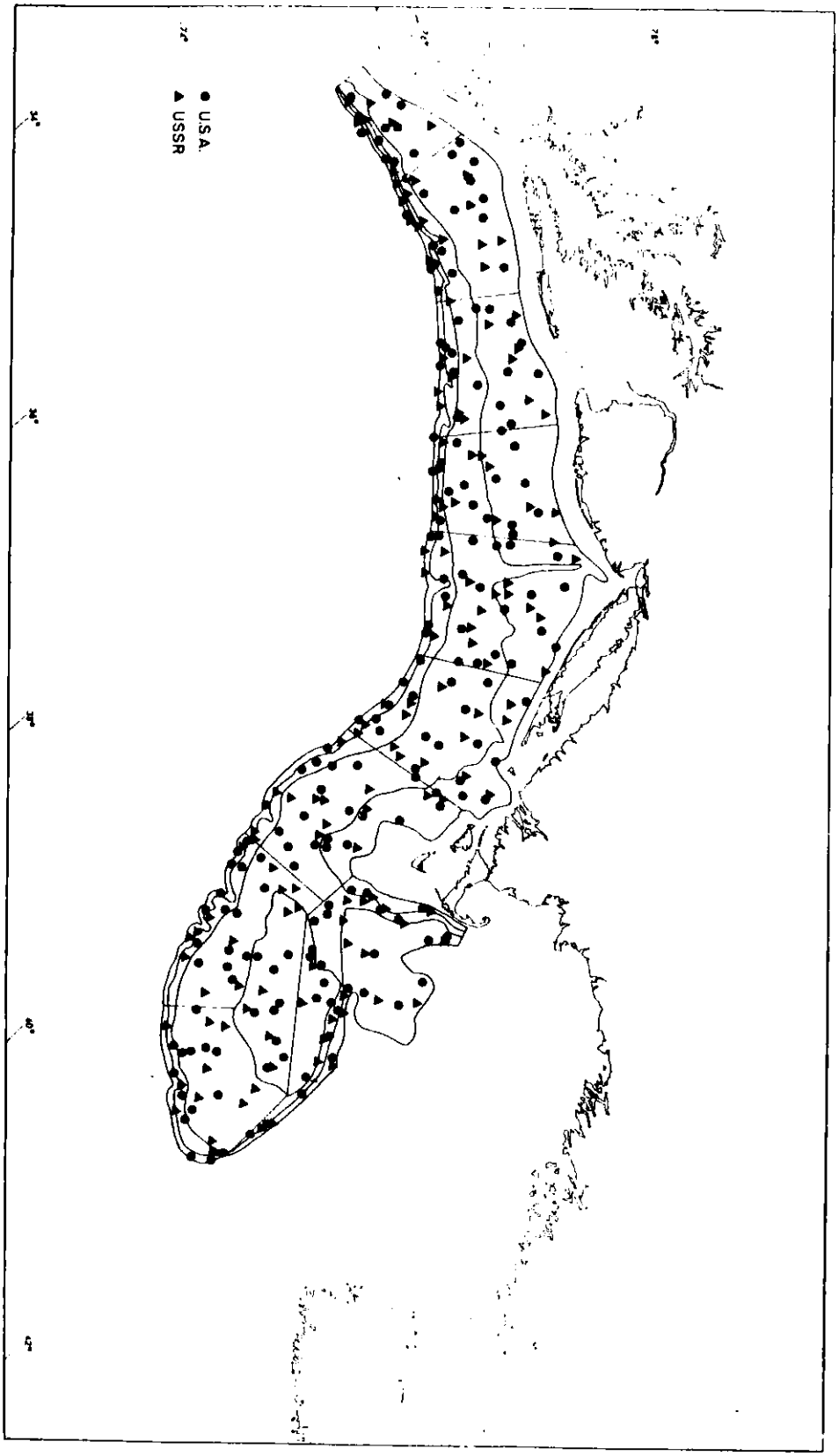

Figure 2.--Otter trawl stations occupied during the USA-USSR survey, fall 1968.

Table 1. --Stratified mean catch in pounds per 30 minute haul for selected species and for all species combined in fall 1968, by stratum set and vessel (USA - Albatross IV; USSR - Blesk).

Species	Stratum Set: 61-68 USA	61-68 USSR	69-72 USA	69-72 USSR	73-76 USA	73-76 USSR	1-4 USA	1-4 USSR	5-8 USA	5-8 USSR	9-12 USA	9-12 USSR	13-15 USA	13-15 USSR	16-18 USA	16-18 USSR	19-20 USA	19-20 USSR	21-25 USA	21-25 USSR
Smooth dogfish	4	13	19	5	4	56	1	-	1	2	1	1	-	-	-	-	-	-	-	-
Spiny dogfish	-	-	1	29	23	9	152	1360	172	395	64	270	2	27	-	-	19	13	24	8
Little skate	-	-	-	-	-	3	-	4	-	1	4	13	9	25	3	7	10	24	6	2
Silver hake	1	4	1	3	5	37	6	96	19	175	8	33	5	11	3	11	4	26	7	12
Cod	-	-	-	-	-	-	2	-	2	13	1	4	-	-	3	18	12	17	26	19
Haddock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	5	8	1	45	29
Red hake	-	-	1	1	5	7	5	16	22	46	2	5	6	20	3	6	1	1	1	14
Spotted hake	11	13	2	2	4	4	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Yellowtail fldr.	-	-	1	-	42	36	35	52	25	5	13	20	15	22	20	1	21	28	6	1
Winter fldr.	-	-	1	-	9	4	2	2	3	23	2	-	-	-	-	2	6	8	7	1
Scup	4	13	-	-	-	-	-	-	2	1	1	8	-	-	-	-	-	-	-	-
Sea robin	32	139	45	39	12	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-
Goosefish	-	-	1	-	3	6	1	13	4	15	2	3	1	-	6	-	-	-	8	3
Lobster	1	-	2	1	3	2	4	3	3	5	4	4	6	1	3	1	3	2	1	-
Sea scallop	-	-	-	-	3	1	5	2	-	-	-	-	-	-	-	-	-	-	-	-
Squid (Loligo)	21	39	26	18	13	14	33	8	30	26	18	41	2	8	2	-	-	2	1	-
Total (all species)	134	302	222	117	163	188	265	1578	336	904	139	435	68	141	92	101	139	164	234	270
No. of hauls	28	22	18	14	16	13	22	17	19	15	21	14	16	12	15	11	15	10	23	18

Table 2. --Stratified mean catch in pounds per 30-minute haul for selected species groups and all species combined in fall 1968, by stratum set and vessel (USA - Albatross IV; USSR - Bleak).

Stratum set	Vessel	Species group					
		Dogfish	Skate	Groundfish	Pelagic	Flatfish	All species
61-68	USA	4.1	0.2	11.7	9.9	3.5	133.8
	USSR	12.3	2.7	16.9	42.5	2.7	302.0
	USA/USSR	0.33	0.07	0.69	0.23	1.30	0.44
69-72	USA	20.4	---	3.7	106.1	10.8	221.6
	USSR	34.3	2.6	5.5	2.8	2.4	116.7
	USA/USSR	0.59	---	0.67	37.89	4.50	1.90
73-76	USA	26.7	1.5	13.5	21.4	63.1	163.3
	USSR	65.8	3.5	48.1	0.9	40.7	187.6
	USA/USSR	0.41	0.42	0.28	23.77	1.55	0.87
1-4	USA	153.2	0.6	15.1	8.6	39.3	264.9
	USSR	1,359.6	4.0	113.5	10.3	55.7	1,577.8
	USA/USSR	0.11	0.15	0.13	0.83	0.70	0.17
5-8	USA	172.6	1.7	52.0	26.2	37.5	335.9
	USSR	396.4	1.0	242.9	175.4	36.4	903.8
	USA/USSR	0.44	1.70	0.21	0.15	1.03	0.37
9-12	USA	64.1	5.8	11.9	6.4	21.6	139.3
	USSR	271.0	13.7	44.5	17.7	28.1	434.7
	USA/USSR	0.24	0.42	0.27	0.36	0.77	0.32
13-15	USA	1.9	17.3	12.1	0.6	19.1	68.0
	USSR	27.4	36.4	31.4	3.9	23.6	141.1
	USA/USSR	0.07	0.48	0.38	0.15	0.81	0.48
16-18	USA	---	18.4	28.6	1.3	21.8	92.3
	USSR	0.2	16.5	41.7	32.7	3.7	101.1
	USA/USSR	---	1.12	0.68	0.04	5.89	0.91
19-20	USA	18.7	34.8	27.3	10.4	29.1	138.8
	USSR	13.2	37.5	46.3	14.6	42.2	163.8
	USA/USSR	1.42	0.93	0.59	0.71	0.69	0.84
21-25	USA	24.1	34.4	95.1	3.4	29.9	234.3
	USSR	7.5	65.0	98.8	4.0	24.6	269.7
	USA/USSR	3.21	0.53	0.96	0.85	1.22	0.87
61-76, 1-12	USA	77.6	1.7	18.4	26.6	28.2	210.5
	USSR	393.5	4.7	81.6	43.7	28.1	633.7
	USA/USSR	0.20	0.36	0.23	0.61	1.00	0.33
13-25	USA	12.5	27.2	45.8	4.0	25.5	143.3
	USSR	11.4	41.2	58.7	13.1	23.8	178.2
	USA/USSR	1.10	0.66	0.78	0.30	1.07	0.80
All strata	USA	54.6	10.7	28.1	18.6	28.2	186.7
	USSR	288.1	17.6	73.5	32.8	26.6	472.2
	USA/USSR	0.21	0.61	0.38	0.57	1.06	0.39

Table 3. --Stratified mean catch in pounds ($\log_e$ scale) per 30-minute haul for selected species and for all species combined in 1968, by stratum set and vessel (USA - Albatross IV; USSR - Blesk).

	Species															
	Spiny dogfish		Silver hake		Red hake		Cod		Haddock		Yellowtail		All species		All species	
Stratum set	USA	USSR	USA	USSR	USA	USSR	USA	USSR	USA	USSR	USA	USSR	USA	USSR	USA / USSR	
61-68	0.028	0.038	0.202	0.225	0.353	0.082	-----	-----	-----	-----	-----	-----	4.390	5.171	0.46	
69-72	0.345	0.406	0.525	0.647	0.343	0.300	-----	-----	-----	-----	0.298	0.092	4.550	4.025	1.70	
73-76	2.155	1.688	1.409	2.833	1.065	1.326	-----	-----	-----	-----	2.331	1.592	4.962	5.134	0.84	
1-4	2.811	3.829	1.567	3.843	1.102	2.063	0.192	-----	-----	-----	2.427	2.495	5.053	6.015	0.38	
5-8	3.681	4.642	2.348	4.320	1.867	2.492	0.336	0.577	0.137	-----	2.200	0.885	5.416	6.293	0.42	
9-12	2.629	3.394	1.524	2.809	0.654	1.049	0.217	0.300	-----	-----	1.448	1.698	4.376	5.149	0.46	
13-15	0.463	1.876	1.580	1.955	1.466	1.600	-----	-----	-----	-----	1.404	1.512	3.943	4.454	0.60	
16-18	-----	0.133	0.936	1.012	0.821	0.815	0.458	1.382	0.816	0.608	1.962	0.537	3.956	4.425	0.63	
19-20	2.538	2.150	1.182	2.153	0.221	0.580	1.404	1.572	0.353	1.913	1.815	2.018	4.770	4.942	0.84	
21-25	1.850	0.549	1.344	1.426	0.286	0.483	1.910	1.594	2.773	2.692	0.675	0.243	5.306	5.290	1.02	
61-68, 1-12																
Mean	1.979	2.428	1.272	2.486	0.842	1.242	0.134	0.153	-0.023	-----	1.449	1.158	4.788	5.360	0.56	
Variance	0.014	0.026	0.006	0.017	0.010	0.017	0.003	0.007	0.001	-----	0.017	0.026	0.008	0.014		
*Ratio of means: (USA/USSR)	0.64		0.30		0.67		0.83		----		1.34		0.56			
13-25																
Mean	1.295	1.121	1.262	1.619	0.645	0.821	1.048	1.201	1.152	1.040	1.400	1.008	4.578	4.724	0.86	
Variance	0.023	0.024	0.014	0.031	0.011	0.026	0.032	0.040	0.030	0.028	0.038	0.034	0.012	0.028		
*Ratio of means: (USA/USSR)	1.20		0.70		0.84		0.86		1.12		1.48		0.86			

* The ratios are the antilogs of the differences between means, USA-USSR.

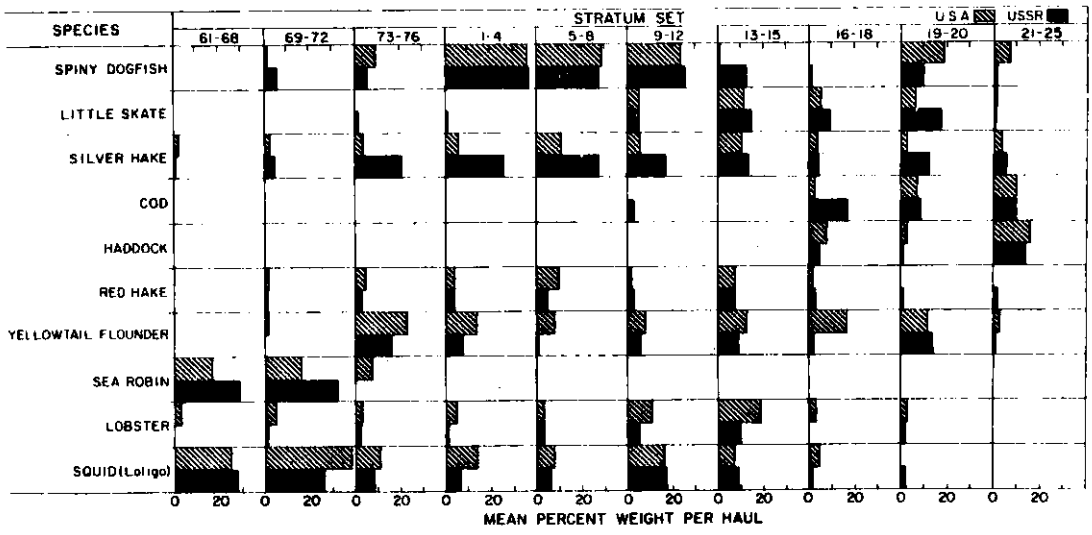

Figure 3. --Stratified mean percentage contribution of weight per haul of selected species in ten stratum sets for the USA and USSR research vessels in the fall survey, 1968.

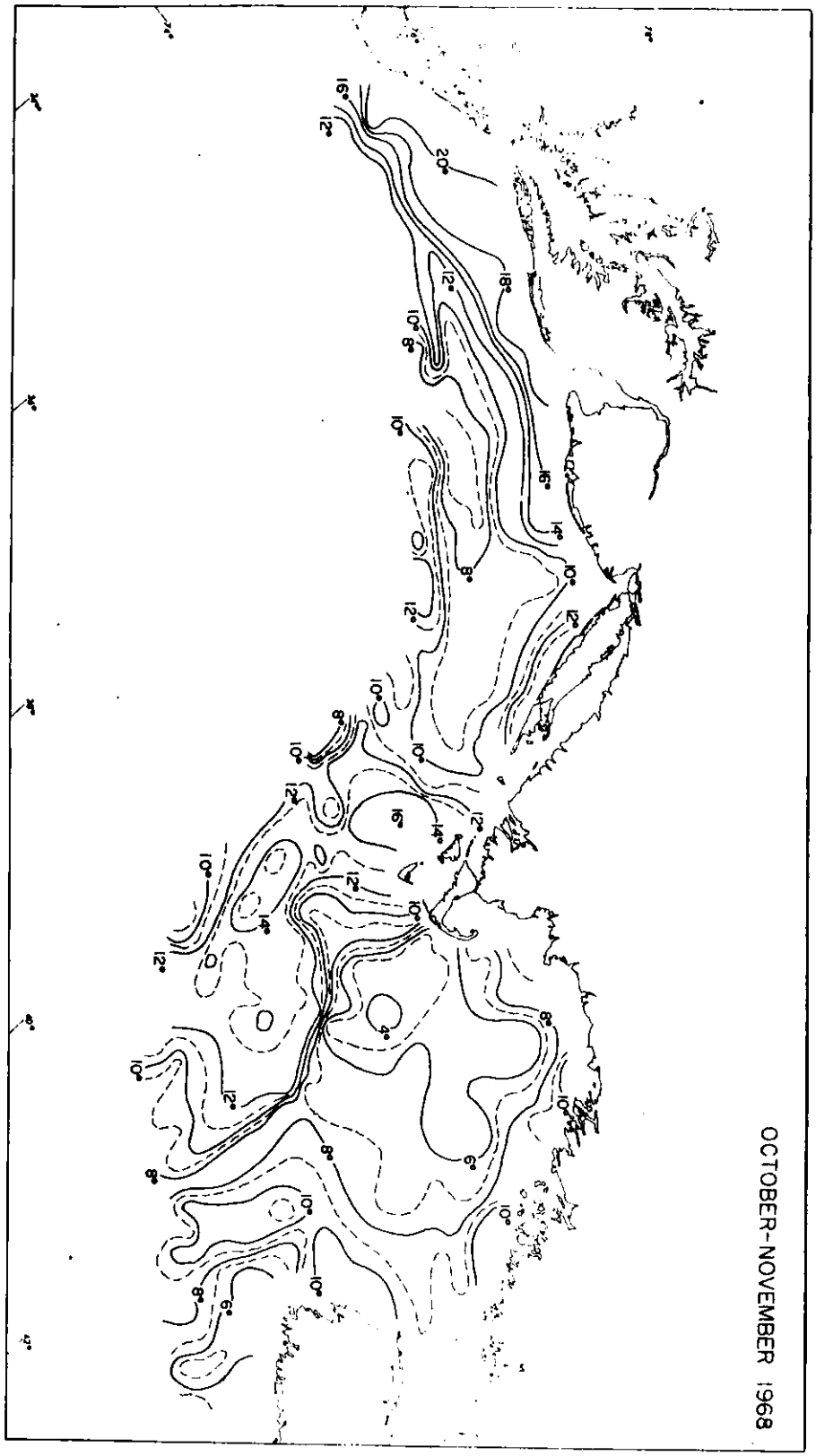

Figure 4. --Bottom temperature (°C) in fall 1968, based on bathythermograms obtained during the USA-USSR otter trawl survey.

II. Fishing power of Albatross IV vs. Blesk

Blesk with fairly high consistency made bigger total catches than Albatross IV (Table 1-3). We attribute this largely to the greater area covered by the Blesk trawl.[5/] However, Blesk caught about the same amount as Albatross IV of some species such as yellowtail, squid, cod, and haddock. This may have stemmed, in part, from differences in trawl design and rigging and their bearing on the behavior of fish. In general, however, the percentage composition of the different species in catches was similar for the two vessels (Figure 3).

Ratios of Albatross IV catches to Blesk catches for the species groups indicate that Blesk caught more of all groups except flatfish (Table 2); catches of the latter were about equal for the two vessels. Pelagic fish show the greatest variation in the catch ratios (Table 2). This is not surprising in view of thehigh schooling tendency in pelagic species.

The catch data on log scale offer a more precise measure of relative fishing power of the two vessels (Table 3). In the southern part of the survey (strata 61-76, 1-12) Blesk caught more of all species listed, except for yellowtail, than did Albatross IV (Table 3). In the Georges Bank area (strata 13-25) the relative fishing power of Blesk decreased and this may be related to the change in species composition.

The catch data for silver hake and red hake for both 1967 and 1968 show some indication that the relative fishing power of the USSR gear was greater at higher levels of abundance (Figure 5). Why this should be so is unknown; however it may be related to the behavior of schooling fish at various abundance levels. In any case, it brings into question an assumption that the simple multiplicative model relating fishing power of two vessels holds for all species at all levels of abundance.

III. Abundance in 1968 vs. 1967

Since the survey in 1968 covered strata 61-76 and 1-12 (Figure 1) which was very nearly the area covered in fall 1967, a comparison between years i possible for part of the survey (Figure 5). These data, for spiny dogfish, silver hake, red hake, and all species combined, indicate that catches were slightly lower in 1968. This was true for spiny dogfish, in particular, and, in strata 61-72, for silver hake. Abundance of silver hake in strata 73-76, 1-4, and 5-12 was similar in the two years; landings per day by the USA commercial fleet in strata 5-12 also was similar in these years.

The ratio of catches per haul of all species of the USA vessel to the USSR vessel in 1967 plotted against the same ratio for 1968 shows catch comparisons for the individual southern stratum sets and for all southern strata combined (Figure 6). Most of the points fall reasonably close to the diagonal, as would be expected if relative fishing power were about the same in each year. One point, however, (for stratum set 69-72) indicates that Albatross IV catches were much larger than those of the USSR vessel in 1968 than in 1967. Detailed catch information for this stratum set shows that large catches there of butterfish by Albatross IV in 1968 and small catches of this species by Blesk caused this deviation. This illustrates again the difficulty of making quantitative comparisons of fishing power, because of large variation in catch data.

5/ Acoustical measurements in 1968 of the trawls under tow indicated that the wing-spread of the Blesk trawl was 1.25 times, and headrope height two times that of the Albatross IV trawl, for a total mouth area of approximately twice that of the Albatross IV net.

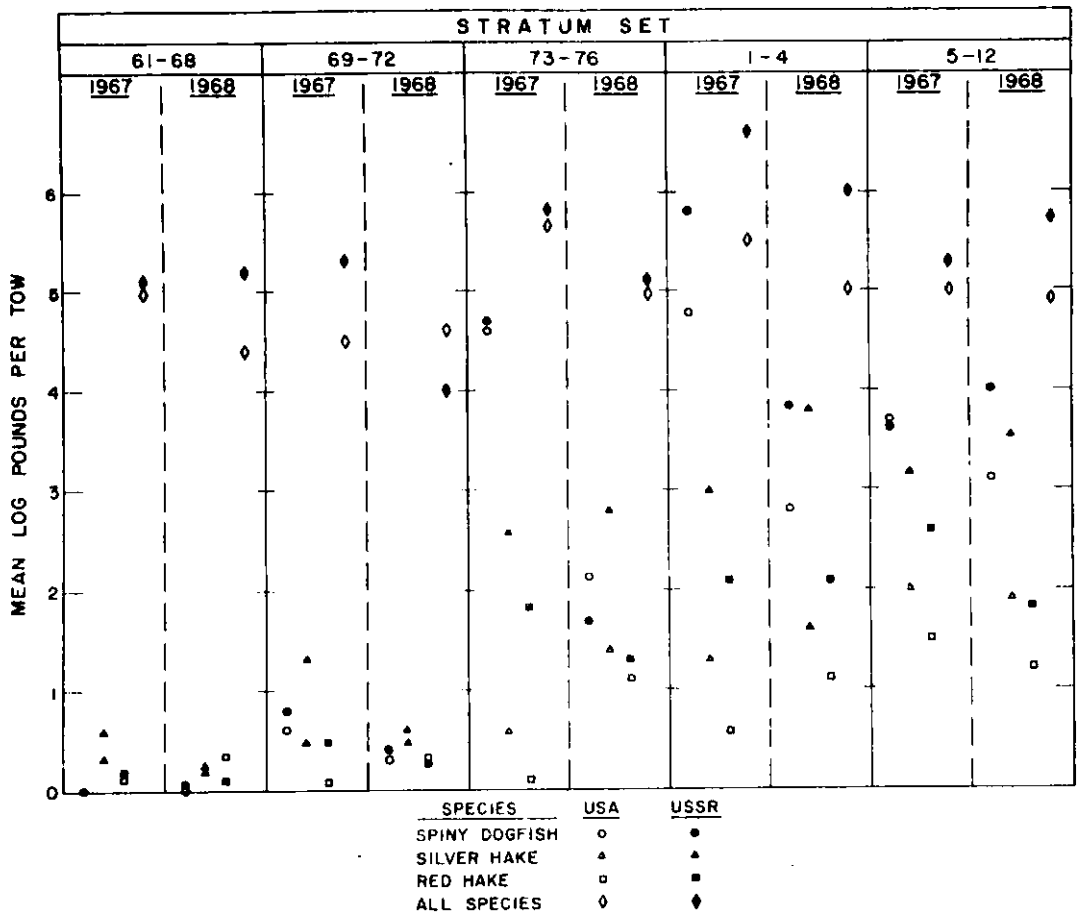

Figure 5. --Stratified mean catch in pounds per haul (log scale) of spiny dogfish, silver hake, red hake, and all species combined for the USA and USSR vessels in 1967 and 1968 in five stratum sets. (In 1967 only the area west of 70°W in strata 9-12 was included in stratum set 5-12. In 1968 all of the area within these four strata was included.)

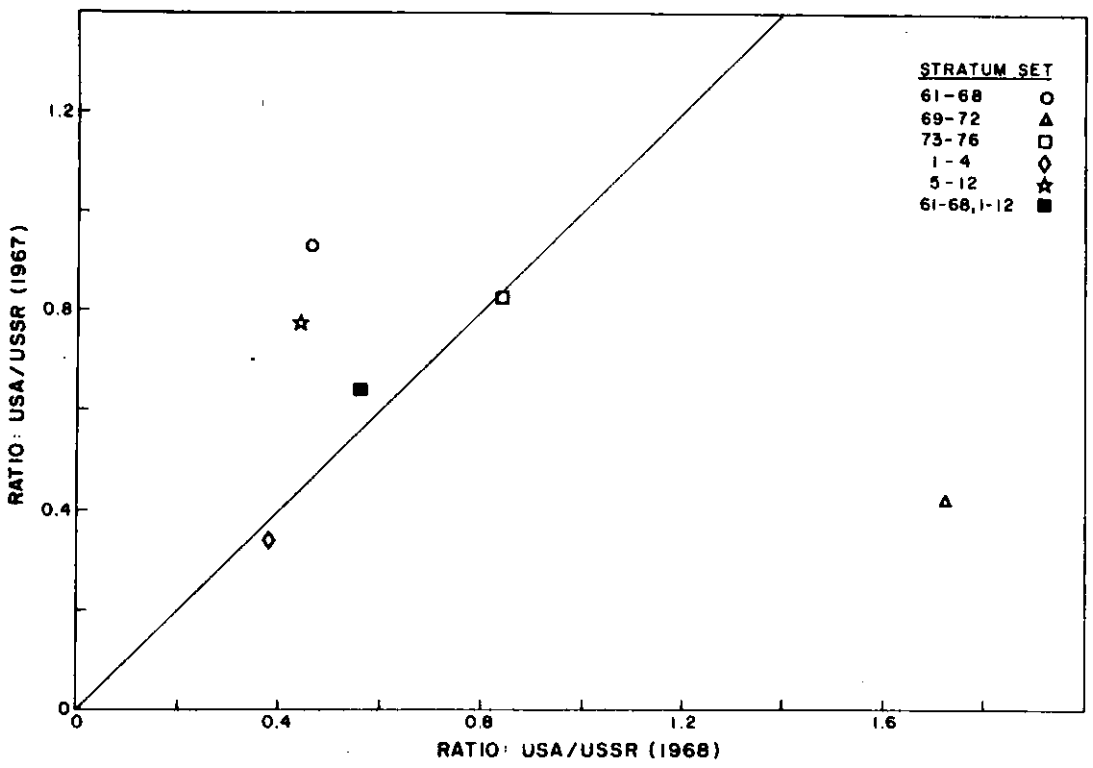

Figure 6. --Ratio of stratified mean catch per haul in pounds (based on difference between stratified means on log scale) of the USA and USSR vessels in the 1967 plotted against the same ratios for 1968, in the five southern stratum sets (open symbols) and all southern strata combined (solid symbols).