

INTER-AMERICAN TROPICAL TUNA COMMISSION

D A T A R E P O R T

DATA COLLECTED ON TUNA SPAWNING SURVEY CRUISE

July 1 - 20, 1957

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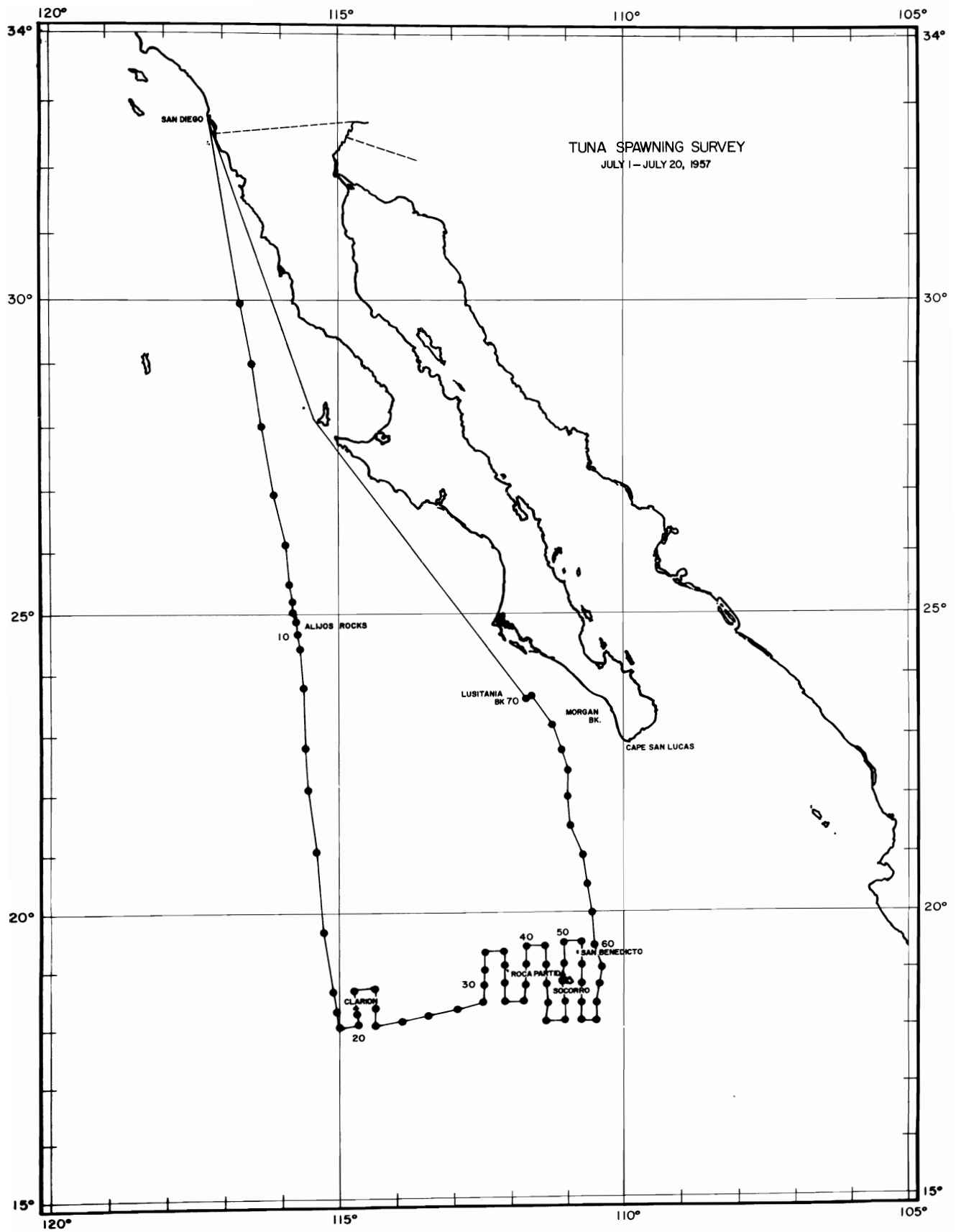


Figure 1. Track of the Cruise

## I N T R O D U C T I O N

Studies of gonads of yellowfin and skipjack tunas (Neothunnus macropterus and Katsuwonus pelamis) carried out by the Inter-American Tropical Tuna Commission indicate that during the summer months the offshore area in the region of the Revilla Gigedo Islands is a spawning location for these two species (Schaefer and Orange, 1956). In July of 1957 a cruise "TUNA SPAWNING SURVEY" was made aboard the vessel ORCA to make plankton hauls and to collect ancillary data for the primary purpose of surveying abundance of tuna larvae in this region.

The Scripps Institution of Oceanography vessel ORCA was employed by the Commission for this cruise. The vessel was under the command of Capt. C. W. Colbeth.

### SCIENTIFIC PERSONNEL

Scientific personnel were:

Richard C. Hennemuth, Field Party Chief

Witold L. Klawe

Paul N. Sund

Robert T. Umlor

### OBJECTIVES

Primary objective of this cruise was to determine, from the occurrence of larvae and juveniles in plankton hauls and night light collections, whether or not the yellowfin and skipjack tunas spawn in waters adjacent to the Revilla Gigedo Islands and tuna fishing banks off the Pacific coast of Baja California. Secondary objectives were: (1) the rearing of juvenile tunas in shipboard aquaria, (2) tagging of all viable tunas caught by trolling, (3) examination of stomach contents of fish captured and (4) collection of sea-temperature data.

### SCHEDULE

The vessel departed from San Diego on July 1, 1957, proceeded to the Islands area via Alijos Rocks and occupied 16 stations en route. Commencing July 6, the main pattern of 44 stations, encompassing the Revilla Gigedo Islands, was occupied

and completed by July 14. During this period two days were spent at anchorage at Clarion and Socorro Islands. From July 14 to July 15 a series of seven stations was occupied en route from the Islands area to the fishing banks off Baja California (Morgan and Lusitania Banks). Three stations were occupied in the vicinity of these banks and completed on July 16. The vessel then proceeded directly to San Diego, arriving on July 20. Track of the cruise is shown on Figure 1.

## O P E R A T I O N S

### Zooplankton Standing Crop

Measurements were made of the standing crop of zooplankton by means of plankton hauls, using gear and techniques comparable to those presently employed by the California Cooperative Oceanic Fishery Investigations. Plankton nets used during this cruise were of standard dimensions, i.e. one-meter (mouth diameter), and made entirely of nylon, 40 GGN nylon grit gauze in the body and 56 GGN nylon grit gauze in the rear section and cod-end bag. An Atlas flow meter was mounted in the mouth of the nets to record the volume of the sea water filtered by the net. Flow meters were calibrated before and after the cruise.

Plankton net tows employed during the cruise were: deep oblique hauls with 450 and 200 meter wire length, and horizontal surface hauls. During the oblique tows, the nets were lowered at a rate of 50 meters per minute, while the vessel was slowly underway, and retrieved at a rate of 20 meters per minute. Collections at the surface were made by towing the net just under the surface of the water for 15 minutes.

Single 450-meter hauls were taken at stations en route to and from the Islands area. Multiple tows were taken at stations near Alijos Rocks and within the Islands and fishing bank areas as follows: 200-meter oblique tows and surface hauls at all stations, with additional 450-meter oblique tows at alternate stations. A total of 145 net tows was completed during the cruise: 43 - 450m., 48 - 200m., 2 - 100m. oblique tows (depths did not permit deeper hauls), and 52 surface tows.

Zooplankton collections were preserved in 4% buffered formalin. Ashore, the collections were filtered and the total "wet" volumes of plankton obtained at each station were measured by displacement. The volume of water sampled by each haul was determined by a method described by the South Pacific Fishery Investigations of the U. S. Fish and Wildlife Service (1953) and the displacement volumes were then converted into terms of the volumes of organisms, in cubic centimeters, collected from each 1000 cubic meters of sea water strained. Only organisms smaller than 5 cm. in total length are taken into consideration. The values of zooplankton standing crop are presented in Table 1.

#### Presence of Tuna Larvae in the Plankton Collections

At least two species of tunas are present in the zooplankton collections made during this cruise. In addition to the identified larvae (Neothunnus macropterus and Auxis thazard) there is a small unidentified group consisting in the main of small, less than 3 mm., and damaged larvae. The data on the number of different tuna larvae caught in the individual plankton tows are presented in Table 2.

#### Night Light Stations

Seven night light stations were made in the immediate vicinities of the Alijos Rocks, Clarion and Socorro Islands, Roca Partida, Morgan and Lusitania Banks. Dip-net collections under the night light yielded many species of fish, including sauries, flying fish, needle fish, lantern fish, half-beaks, dolphin-fish, mullets and other species, but did not include any juveniles of commercial tunas. About ten juveniles of the frigate mackerel, Auxis, were caught at the station off Socorro Island. An additional specimen of Auxis was captured at the station near Lusitania Bank.

An attempt was made to rear these young Auxis in shipboard aquaria. This project was not successful.

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### Bathythermograph Casts

Bathythermograph casts were made to 900 feet (depth permitting) at each station, and at intervals between stations when they were more than 30 miles apart. Table 3 lists the positions of these casts. In addition to the position of the cast, surface temperature and depth of the mixed layer are listed. Distribution of the surface temperatures are shown in Figures 2 and 5. Temperatures at the depths of 150 meters and 250 meters are shown in Figures 3 and 4. A thermograph for continuous recording of surface temperature was in operation during the cruise.

### Other Observations

Trolling jigs were trailed at all times when underway. Six yellowfin tuna, one albacore, several dolphin-fish, yellowtail, wahoo and black skipjack were caught.

None of the yellowfin tuna were deemed viable enough for tagging.

Stomachs of six yellowfin were preserved for shoreside analysis. Stomachs of all other large fish caught by the jigs, handline and dip-net, were examined for presence of tuna juveniles, none of which were found.

A 5-lb. black skipjack, Euthynnus lineatus, caught just off Magdalena Bay, proved to be a running ripe male.

Most of the biological specimens other than tunas, collected during this cruise have been distributed to specialists working with different groups.

### R E F E R E N C E S

Schaefer, Milner B., and Craig J. Orange

- 1956 Studies of the sexual development and spawning of yellowfin tuna (Neothunnus macropterus) and skipjack (Katsuwonus pelamis) in three areas of the Eastern Pacific Ocean, by examination of gonads. Inter-Amer. Trop. Tuna Comm., Bull., Vol. 1, No.6, pp.281-349.

South Pacific Fishery Investigations, U.S. Fish and Wildlife Service

- 1953 Zooplankton volumes off the Pacific coast, 1952. U.S. Fish and Wildlife Service, Spec.Sci.Rep., Fish. No.100, 41 pp.

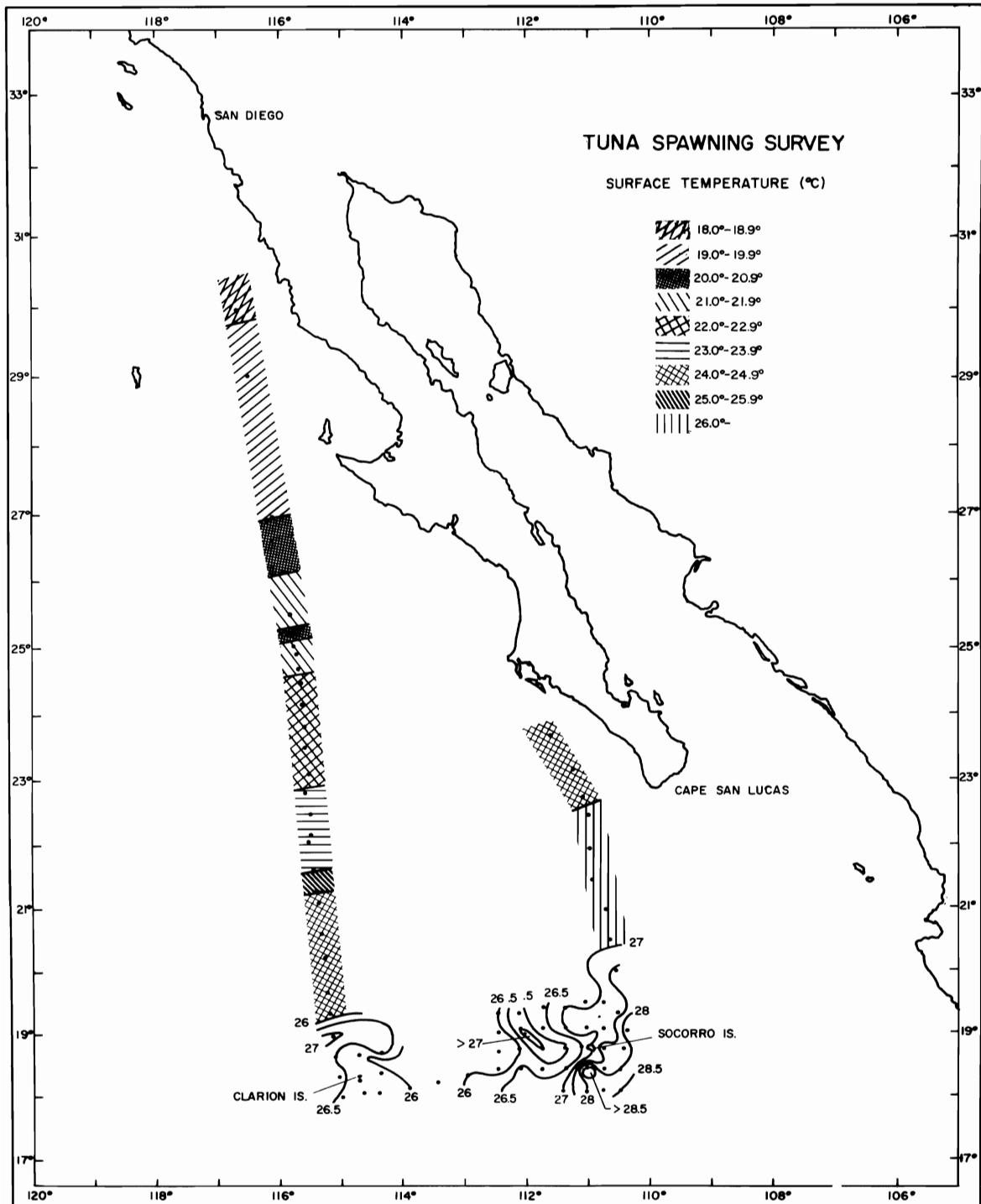


Figure 2.



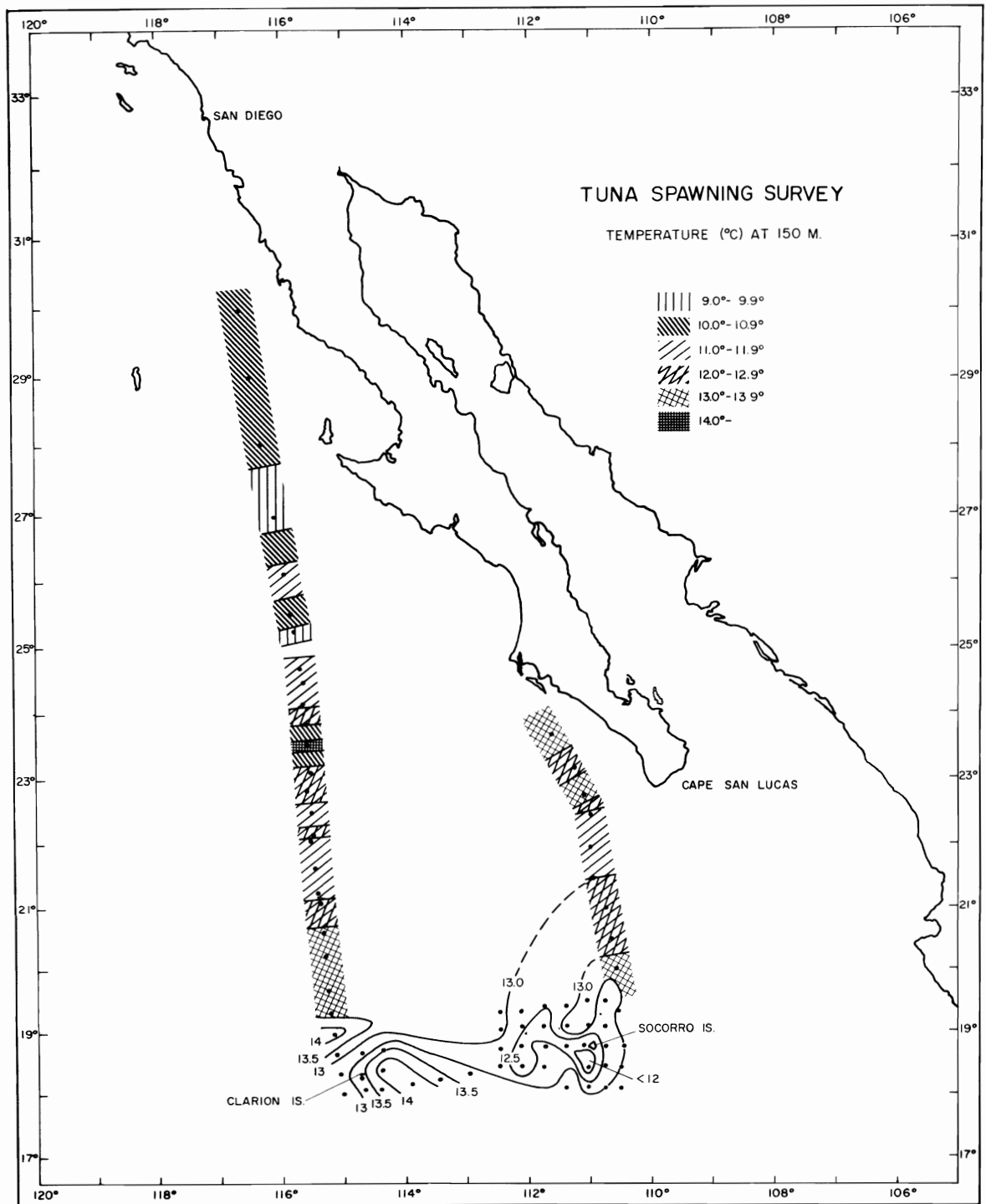


Figure 3.

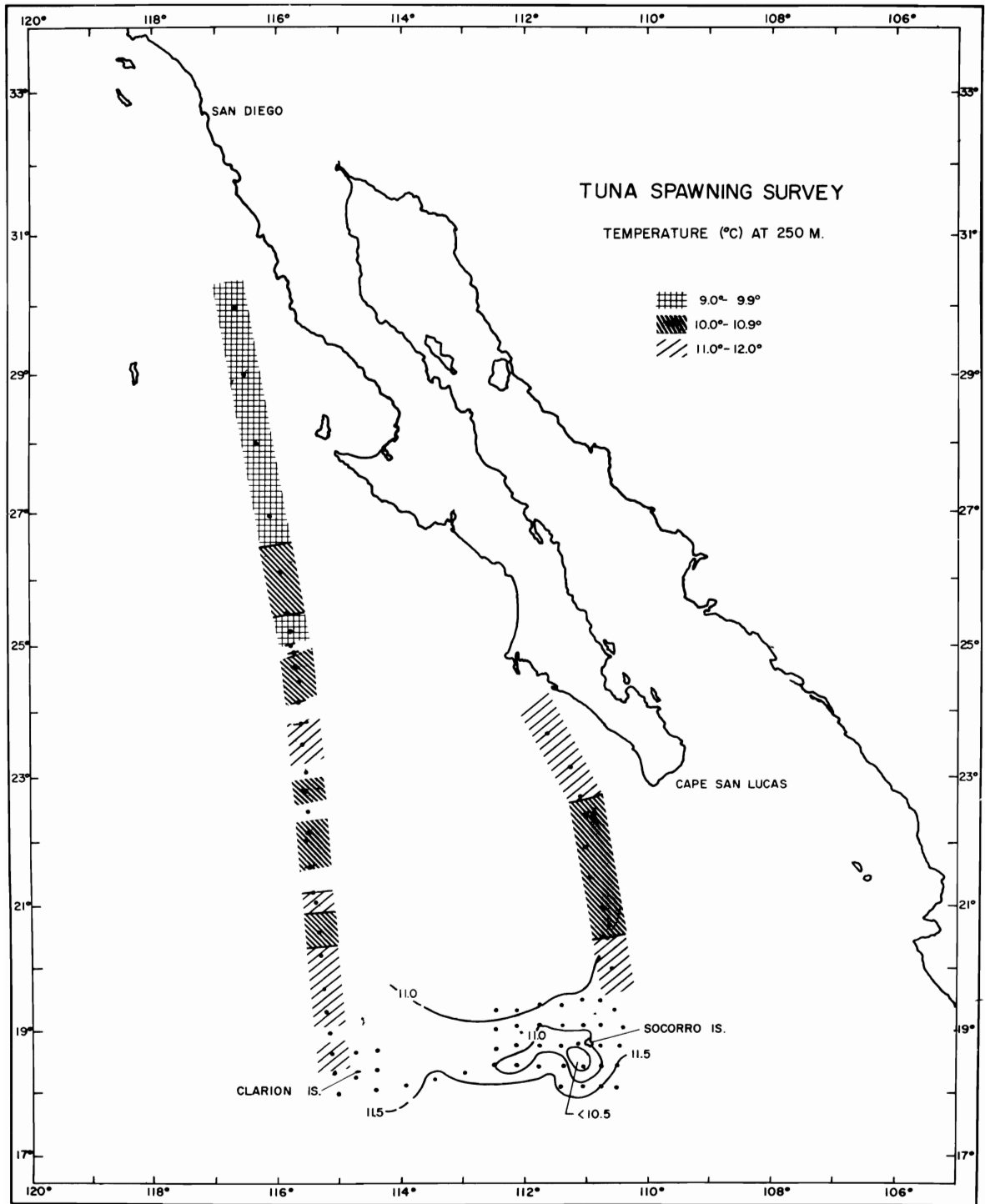


Figure 4.

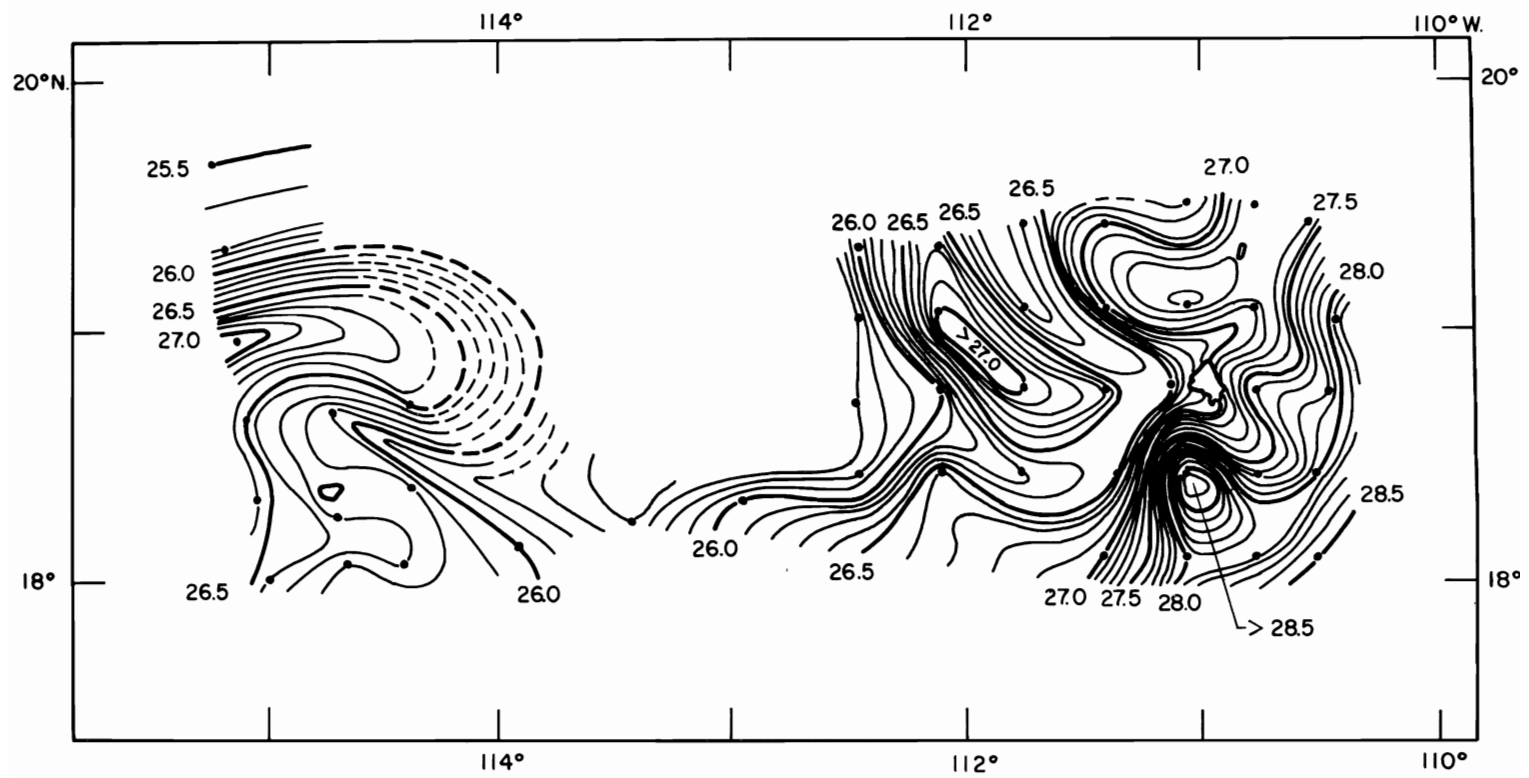


Figure 5. Surface Temperature in the Region of the Revillagigedo Islands

TABLE 1. TUNA SPAWNING SURVEY - Zooplankton Collections

Station	Position		Date July, 1957	Time		Vol. of water <sub>3</sub> strained in m <sup>3</sup>	Depth of haul in m.	Volume of small <sub>3</sub> org. per 1000 m <sup>3</sup> strained	
	Latitude N.	Long. W		Start	End			Total cc.	Small org.
1	29°58	116°42	2	0520	0553	772.8	319.0	37.5	37.5
2	29°00	116°30	2	1235	1308	726.6	319.0	27.5	27.5
3	28°00	116°20	2	2155	2230	818.4	310.0	69.6	69.6
4	26°56	116°08	3	0521	0545	745.4	316.0	56.3	56.3
5	26°06	115°58	3	1210	1243	739.6	316.0	67.9	31.1
6	25°29	115°52	3	1648	1703	355.4	141.0	47.7	47.7
6	25°29	115°52	3	1720	1735	607.9	0	59.1	59.1
7	25°12	115°48	3	1935	2008	914.4	324.0	120.3	74.4
7	25°12	115°48	3	2010	2026	344.4	147.5	342.6	52.3
7	25°12	115°48	3	2035	2050	415.7	0	288.7	110.7
8	25°00	115°48	4	0745	0753	285.3	70.5	128.4	128.4
8	25°00	115°48	4	0755	0811	864.8	0	35.1	35.1
9	24°54	115°44	4	0942	0950	427.0	67.0	76.3	76.3
9	24°54	115°44	4	0918	0933	445.5	0	28.1	28.1
10	24°40	115°43	4	1150	1221	702.4	320.0	14.9	14.9
10	24°40	115°43	4	1225	1239	316.6	142.0	28.4	28.4
10	24°40	115°43	4	1243	1258	439.8	0	5.7	5.7
11	24°27	115°40	4	1444	1458	334.4	140.5	32.9	32.9
11	24°27	115°40	4	1501	1515	441.6	0	7.9	7.9
12	23°48	115°37	4	1923	1955	921.3	312.5	49.9	22.8
13	22°48	115°35	5	0243	0315	926.1	313.5	63.7	58.3
14	22°02	115°32	5	1004	1037	936.3	315.5	42.7	42.7
15	21°04	115°24	5	1912	1944	909.9	311.5	22.0	22.0
16	19°40	115°15	6	0530	0602	938.1	315.5	16.0	11.7
17	18°38	115°06	6	1315	1348	737.8	315.0	15.6	15.6
17	18°38	115°06	6	1350	1405	345.3	142.0	26.1	26.1
17	18°38	115°06	6	1405	1419	426.3	0	44.6	44.6
18	18°19	115°03	6	1730	1745	339.0	140.5	50.1	50.1
18	18°19	115°03	6	1752	1807	518.2	0	100.3	100.3
19	18°00	115°00	6	2105	2137	827.2	317.0	19.5	19.5
19	18°00	115°00	6	2138	2154	210.6	142.0	41.9	41.9
19	18°00	115°00	6	2200	2215	522.3	0	21.1	21.1
20	18°03	114°39	7	0120	0134	563.0	138.5	13.3	13.3

TABLE 1, No.2

Station	Position		Date July, 1957	Time		Vol. of water strained in m <sup>3</sup>	Depth of haul in m.	Volume of small org. per 1000 m <sup>3</sup> strained	
	Latitude N.	Long. W.		Start	End			Total cc.	Small org.
20	18°03	114°39	7	0136	0150	681.2	0	54.3	54.3
21	18°15	114°42	7	0434	0506	706.1	316.0	14.9	14.9
21	18°15	114°42	7	0515	0529	342.9	139.0	29.2	29.2
21	18°15	114°42	7	0532	0546	447.6	0	38.0	38.0
22	18°40	114°43	8	0045	0100	337.1	141.5	43.0	43.0
22	18°40	114°43	8	0105	0119	676.2	0	17.7	17.7
23	18°42	114°22	8	0321	0354	911.1	312.5	15.4	15.4
23	18°42	114°22	8	0356	0410	331.1	142.0	60.4	60.4
23	18°42	114°22	8	0414	0429	753.3	0	30.5	30.5
24	18°22	114°22	8	0658	0713	557.6	144.0	17.9	17.9
24	18°22	114°22	8	0717	0732	583.6	0	39.4	39.4
25	18°03	114°22	8	0940	1013	690.4	320.0	15.9	15.9
25	18°03	114°22	8	1025	1039	335.9	141.5	35.7	35.7
25	18°03	114°22	8	1041	1056	477.0	0	6.3	6.3
26	18°08	113°54	8	1419	1433	323.4	140.0	10.8	10.8
26	18°08	113°54	8	1435	1449	500.0*	0	10.0	10.0
27	18°13	113°26	8	1819	1852	75319	299.5	21.2	21.2
27	18°13	113°26	8	1856	1910	325.3	139.0	30.7	30.7
27	18°13	113°26	8	1913	1928	523.5	0	42.0	42.0
28	18°19	112°57	8	2241	2254	300.5	138.0	54.9	54.9
28	18°19	112°57	8	2258	2314	306.4	0	42.4	42.4
29	18°26	112°28	9	0230	0303	567.0	310.0	25.6	25.6
29	18°26	112°28	9	0305	0320	303.7	137.5	42.8	42.8
29	18°26	112°28	9	0322	0336	414.0	0	106.3	106.3
30	18°42	112°28	9	0527	0541	527.2	142.0	30.3	30.3
30	18°42	112°28	9	0544	0558	489.7	0	24.5	24.5
31	19°01	112°28	9	0819	0851	672.4	309.0	8.9	8.9
31	19°01	112°28	9	0858	0913	324.1	138.0	13.9	10.8
31	19°01	112°28	9	0953	1008	407.0	0	3.7	3.7
32	19°20	112°28	9	1230	1244	290.2	131.5	17.2	17.2
32	19°20	112°28	9	1301	1315	427.8	0	11.7	11.7
33	19°20	112°07	9	1520	1553	635.7	314.5	10.2	10.2
33	19°20	112°07	9	1554	1609	289.3	139.0	22.5	22.5
33	19°20	112°07	9	1611	1625	655.9	0	17.5	17.5

TABLE 1, No.3

Station	Position		Date July, 1957	Time		Vol. of water strained in m <sup>3</sup>	Depth of haul in m.	Volume of small org. per 1000 m <sup>3</sup> strained	
	Latitude N.	Long. W.		Start	End			Total cc.	Small org.
34	19°04	112°07	9	1756	1810	243.6	140.0	16.4	16.4
34	19°04	112°07	9	1815	1829	373.0	0	36.2	36.2
35	18°46	112°07	9-10	2330	0010	339.7	310.0	25.7	25.7
35	18°46	112°07	10	0014	0031	236.5	138.5	59.2	59.2
35	18°46	112°07	10	0032	0047	333.5	0	33.0	33.0
36	18°26	112°06	10	0311	0325	256.8	138.0	4.7	3.9
36	18°26	112°06	10	0328	0343	424.1	0	34.2	34.2
37	18°26	111°46	10	0603	0633	542.2	317.0	8.6	8.6
37	18°26	111°46	10	0637	0653	296.3	137.0	11.8	11.8
37	18°26	111°46	10	0653	0707	417.9	0	21.5	21.5
38	18°46	111°45	10	0928	0941	242.8	141.0	32.9	32.9
38	18°46	111°45	10	0944	0959	380.0	0	23.7	23.7
39	19°05	111°45	10	1224	1257	399.1	312.0	36.3	23.8
39	19°05	111°45	10	1300	1314	218.5	140.0	32.0	32.0
39	19°05	111°45	10	1321	1336	387.6	0	28.4	28.4
40	19°25	111°45	10	1609	1624	234.1	139.0	19.2	19.2
40	19°25	111°45	10	1626	1631	342.9	0	49.6	49.6
41	19°25	111°24	10	1906	1938	386.3	309.0	46.6	46.6
41	19°25	111°24	10	1940	1954	189.2	141.0	48.1	48.1
41	19°25	111°24	10	1957	2002	272.7	0	51.3	51.3
42	19°05	111°23	10	2251	2306	423.6	142.0	94.4	94.4
42	19°05	111°23	10	2309	2324	618.9	0	155.1	155.1
43	18°45	111°23	11	0144	0216	825.7	318.0	42.4	42.4
43	18°45	111°23	11	0221	0235	394.0	134.0	88.8	88.8
43	18°45	111°23	11	0239	0254	549.5	0	200.2	200.2
44	18°26	111°21	11	0509	0523	389.5	137.0	97.6	78.3
44	18°26	111°21	11	0527	0542	681.5	0	91.0	91.0
45	18°06	111°24	11	0800	0833	740.5	319.0	20.3	20.3
45	18°06	111°24	11	0835	0851	387.5	136.5	61.2	61.2
45	18°06	111°24	11	0855	0910	583.9	0	13.7	13.7
46	18°06	111°03	11	1131	1146	38715	13915	27.1	27.1
46	18°06	111°03	11	1207	1221	509.2	0	8.8	8.8
47	18°26	111°03	11	1423	1455	737.2	316.0	35.9	35.9
47	18°26	111°03	11	1458	1512	379.6	139.0	72.4	72.4

TABLE 1, No.4

Station	Position		Date July, 1957	Time		Vol. of water <sub>3</sub> strained in m <sup>3</sup>	Depth of haul in m.	Volume of small org, per 1000 m <sup>3</sup> strained	
	Latitude N.	Long. W.		Start	End			Total cc.	Small org.
47	18°26	111°03	11	1516	1531	539.4	0	98.3	98.3
48	18°47	111°07	12	2244	2258	382.7	141.0	118.9	94.1
48	18°47	111°07	12	2302	2317	506.0	0	243.1	243.1
49	19°06	111°03	13	0145	0218	802.9	317.0	57.3	57.3
49	19°06	111°03	13	0220	0235	385.1	139.5	140.2	101.3
49	19°06	111°03	13	0235	0249	510.4	0	134.2	134.2
50	19°30	111°05	13	0509	0523	407.6	136.0	38.0	38.0
50	19°30	111°05	13	0526	0541	606.7	0	47.8	47.8
51	19°30	110°46	13	0746	0818	814.5	320.0	53.4	43.5
51	19°30	110°46	13	0826	0840	387.2	141.0	114.9	83.9
51	19°30	110°46	13	0840	0855	601.0	0	46.6	46.6
52	19°05	110°46	13	1239	1253	382.1	141.0	83.7	68.0
52	19°05	110°46	13	1256	1311	585.1	0	26.5	26.5
53	18°45	110°46	13	1450	1523	321.4	302.5	37.7	37.7
53	18°45	110°46	13	1526	1540	386.3	140.0	204.5	155.3
53	18°45	110°46	13	1540	1554	579.8	0	84.5	84.5
54	18°26	110°45	13	1805	1820	859.6	137.0	20.9	20.9
54	18°26	110°45	13	1823	1837	650.5	0	49.2	49.2
55	18°06	110°46	13	2101	2133	786.4	316.0	67.4	63.6
55	18°06	110°46	13	2138	2152	377.3	141.0	127.2	127.2
55	18°06	110°46	13	2156	2211	534.0	0	327.7	327.7
56	18°06	110°30	14	0008	0022	402.7	135.5	81.9	81.9
56	18°06	110°30	14	0025	0040	566.5	0	176.5	176.5
57	18°26	110°30	14	0254	0326	839.0	311.5	46.5	46.5
57	18°26	110°30	14	0329	0343	384.7	140.5	85.8	85.8
57	18°26	110°30	14	0346	0400	596.2	0	90.6	90.6
58	18°45	110°27	14	0621	0636	411.2	139.5	136.2	104.6
58	18°45	110°27	14	0640	0654	612.1	0	47.4	47.4
59	19°02	110°24	14	0917	0932	762.7	317.5	87.8	87.8
59	19°02	110°24	14	0954	1009	373.9	141.0	200.6	171.2
59	19°02	110°24	14	1013	1028	543.6	0	20.2	20.2
60	19°25	110°32	14	1317	1331	396.7	140.5	201.7	201.7
60	19°25	100°32	14	1334	1348	531.3	0	186.3	186.3

TABLE 1, No.5

Station	Position		Date July, 1957	Time		Vol. of water <sub>3</sub> strained in m <sup>3</sup>	Depth of haul in m.	Volume of small <sub>3</sub> org. per 1000 m <sup>3</sup> strained	
	Latitude N.	Long. W.		Start	End			Total cc.	Small org.
61	20°00	110°35	14	1716	1749	819.9	312.0	49.4	49.4
62	20°29	110°39	14	2104	2136	795.9	317.0	59.1	59.1
63	20°58	110°44	15	0056	0128	709.5	312.5	459.5	403.1
64	21°27	110°57	15	0542	0614	837.5	317.5	107.5	107.5
65	21°56	111°00	15	1000	1033	830.8	315.5	198.6	198.6
66	22°26	111°00	15	1416	1448	824.3	312.5	180.8	180.8
67	22°43	111°06	15	1835	1907	819.0	318.0	155.1	142.9
68	23°09	111°15	15	2325	2339	364.2	141.5	233.4	233.4
68	23°09	111°15	15	2345	2400	514.9	0	139.8	139.8
69	23°39	111°38	16	2006	2039	772.8	317.0	139.8	139.8
70	23°36	111°42	16	2155	2210	500.0	0	208.0	208.0

\* Estimated (No current meter reading)



TABLE 2. TUNA SPAWNING SURVEY - Number of Tuna Larvae in Plankton Collections.

Station	Position		Depth of haul in m.	<u>Neothunnus</u>	<u>Auxis</u>	Uniden- tified
	Latitude N.	Long. W.				
1	29°58	116°42	319			
2	29°00	116°30	319			
3	28°00	116°20	310			
4	26°56	116°08	316			
5	26°26	115°58	316			
6	25°29	115°52	141			
6	"	"	0			
7	25°12	115°48	324			
7	"	"	148			
7	"	"	0			
8	25°00	115°48	71			
8	"	"	0			
9	24°54	115°44	67			
9	"	"	0			
10	24°40	115°43	320			
10	"	"	142			
10	"	"	0			
11	24°27	115°40	141			
11	"	"	0			
12	23°48	115°37	313			
13	22°48	115°35	314			
14	22°02	115°32	316			
15	21°04	115°24	312			
16	19°40	115°15	316			
17	18°38	115°06	315			
17	"	"	142			
17	"	"	0			
18	18°19	115°03	141			
18	"	"	0			2
19	18°00	115°00	317			
19	"	"	142			
19	"	"	0			
20	18°03	114°39	139			
20	"	"	0	1	1	
21	18°15	114°42	316			
21	"	"	139			
21	"	"	0			
22	18°40	114°43	142			
22	"	"	0		1	
23	18°42	114°22	313			
23	"	"	142			
23	"	"	0	1		
24	18°22	114°22	144			3
24	"	"	0			
25	18°03	114°22	320			
25	"	"	142			
25	"	"	0			
26	18°08	113°54	140			
26	"	"	0			

TABLE 2. No. 2

Station	Position		Depth of haul in m.			Uniden- tified
	Latitude N.	Long. W.		<u>Neothunnus</u>	<u>Auxis</u>	
27	18°13	113°26	300			
27	"	"	139			
27	"	"	0			
28	18°19	112°57	138			
28	"	"	0			
29	18°26	112°28	310			
29	"	"	138			
29	"	"	0			
30	18°42	112°28	142			
30	"	"	0			
31	19°01	112°28	309			
31	"	"	138			
31	"	"	0			
32	19°20	112°28	132			
32	"	"	0			
33	19°20	112°07	315	2	13	
33	"	"	139		6	
33	"	"	0		4	
34	19°04	112°07	140			
34	"	"	0			
35	18°46	112°07	310			
35	"	"	139			
35	"	"	0			
36	18°26	112°06	138			
36	"	"	0		1	
37	18°26	111°46	317			
37	"	"	137			
37	"	"	0		7	
38	18°46	111°45	141		4	4
38	"	"	0			
39	19°05	111°45	312			
39	"	"	140			
39	"	"	0			
40	19°25	111°45	139		1	
40	"	"	0		1	
41	19°25	111°24	309			
41	"	"	141			
41	"	"	0		1	
42	19°05	111°23	142		16	
42	"	"	0			
43	18°45	111°23	318		2	
43	"	"	134			
43	"	"	0			
44	18°26	111°21	137		3	
44	"	"	0		8	
45	18°06	111°24	319		1	
45	"	"	137		7	
45	"	"	0		5	
46	18°06	111°03	140		1	
46	"	"	0		5	

TABLE 2, No. 3

Station	Position Latitude N. Long.W.	Depth of haul in m.	<u>Neothunnus</u>	<u>Auxis</u>	Uniden- tified
47	18°26	111°03	316		
47	"	"	139		
47	"	"	0	300-400	
48	18°47	111°07	141		
48	"	"	0		
49	19°06	111°03	317		
49	"	"	140		
49	"	"	0		
50	19°30	111°05	136		
50	"	"	0		
51	19°30	111°05	320		
51	"	"	141		
51	"	"	0		
51	"	"	0		
52	19°05	110°46	141		
52	"	"	0		
53	18°45	110°46	303		
53	"	"	140		
53	"	"	0		
54	18°26	110°45	137		
54	"	"	0		
55	18°06	110°46	316		
55	"	"	141		
55	"	"	0		
55	"	"	0		
56	18°06	110°30	136		
56	"	"	0		
57	18°26	110°30	312		
57	"	"	141		
57	"	"	0		
57	"	"	0		
58	18°45	110°27	140		
58	"	"	0		
59	19°02	110°24	318		
59	"	"	141		
59	"	"	0		
59	"	"	0		
60	19°25	110°32	141		
60	"	"	0		
61	20°00	110°35	312		
62	20°29	110°39	317		
63	20°58	110°44	313		
64	21°27	110°57	318		
65	21°56	111°00	316		
66	22°26	111°00	313		
67	22°43	111°06	318		
68	23°09	111°15	142		
68	"	"	0		
68	"	"	0		
69	23°39	111°38	317		
70	23°36	111°42	0		

TABLE 3. . TUNA SPawning SURVEY -- Bathythermograph Casts

BT Slide No.	Position Latitude N. Long. W.	Date July, 1957.	Surface temp. °C	Depth of mixed layer in m.
1-0	29°58 116°42	2	18.1	*
1-1	29°58 116°42	2	18.5	22
2-0	29°00 116°30	2	19.1	23
3-0	28°00 116°20	3	19.2	*
4-0	26°56 116°08	3	20.0	18
5-0	26°06 115°58	3	21.1	28
6-0	25°29 115.52	4	21.5	15
7-0	25°12 115°48	4	21.1	18
8-0	25°00 115°48	4	21.4	15
9-0	24°54 115°44	4	21.6	8
10-0	24°40 115°43	4	22.0	17
11-0	24°27 115°40	4	22.8	19
11-1	24°07 115°40	5	23.8	23
12-0	23°48 115°37	5	23.0	*
12-1	23°30 115°36	5	23.0	22
12-2	23°05 115°32	5	22.7	12
13-0	22°48 115°35	5	22.9	0
13-1	22°28 115°32	5	23.4	11
13-2	22°08 115°30	5	23.2	15
14-0	22°02 115°32	5	23.6	0
14-1	21°37 115°28	5	24.5	0
14-2	21°14 115°25	6	24.7	11
15-0	21°04 115°23	6	25.3	26
15-1	20°36 115°20	6	25.3	35
15-2	20°14 115°17	6	25.4	0
16-0	19°40 115°15	6	25.6	60
16-1	19°19 115°12	6	26.1	28
16-2	18°57 115°09	6	26.8	15
17-0	18°38 115°06	6	26.5	0
18-0	18°19 115°03	7	26.4	12
19-0	18°00 115°00	7	25.9	14
20-0	18°03 114°39	7	25.2	15
21-0	18°15 114°42	7	26.0	12
22-0	18°40 114°43	8	26.3	10
23-0	18°42 114°22	8	26.2	16
24-0	18°22 114°22	8	26.4	17
25-0	18°03 114°24	8	26.3	32
26-0	18°08 113°54	8	27.9	25
27-0	18°13 113°26	9	26.4	0
28-0	18°19 112°58	9	26.4	12
29-0	18°26 112°28	9	26.0	0
30-0	18°42 112°28	9	25.7	8
31-0	19°02 112°28	9	25.8	35
32-0	19°20 112°28	9	25.7	0
33-0	19°20 112°07	9	26.9	0
34-0	19°04 112°07	10	26.9	0
35-0	18°46 112°07	10	26.0	0

\* Value questionable, slide defective

TABLE 3. No. 2

BT slide No.	Position		Date July, 1957	Surface temp. °C	Depth of mixed layer in m.
	Latitude N.	Long. W.			
36-0	18°26	112°06	10	26.0	9
37-0	18°26	111°46	10	26.5	0
38-0	18°46	111°45	10	26.8	0
39-0	19°05	111°45	10	27.6	13
40-0	19°25	111°45	11	27.4	0
41-0	19°25	111°24	11	26.8	0
42-0	19°05	111°23	11	26.8	8
43-0	18°46	111°24	11	26.4	10
44-0	18°26	111°21	11	26.2	0
45-0	18°06	111°24	11	26.7	11
46-0	18°06	111°03	11	28.2	0
47-0	18°26	111°03	11	28.8	0
48-0	18°42	111°08	13	26.5	0
49-0	19°06	111°06	13	27.2	9
50-0	19°30	111°05	13	26.7	0
51-0	19°30	110°46	13	26.6	0
52-0	19°06	110°46	13	29.4	0
53-0	18°45	110°46	13	29.7	0
54-0	18°26	110°45	14	29.0	0
55-0	18°06	110°46	14	28.2	0
56-0	18°06	110°30	14	28.4	0
57-0	18°26	110°30	14	27.9	0
58-0	18°45	110°27	14	27.8	0
59-0	19°02	110°24	14	28.5	11
60-0	19°26	110°32	14	28.5	0
61-0	20°00	110°35	15	27.6	8
62-0	20°29	110°39	15	26.6	11
63-0	20°58	110°44	15	26.5	15
64-0	21°27	110°57	15	26.0	9
65-0	21°56	111°00	15	27.4	21
66-0	22°26	111°00	15	27.7	10
67-0	22°43	111°06	16	25.4	18
68-0	23°09	111°15	16	25.4	16
69-0	23°39	111°38	17	25.2	7

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