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CONSTRUCTION AND CATCH SELECTIVITY OF ALBACORE GILL NETS USED IN THE CENTRAL NORTH PACIFIC

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CONTENTS

INTRODUCTION

A comprehensive study of the resources of the albacore tuna, Germo alalunga (Bonnaterre), north and northeast of the Hawaiian Island chain under Public Laws 329 and 466 (the latter known as the Saltonstall-Kennedy Act) has been made by the Pacific Oceanic Fisheries Investigations (POFI) of the U. S. Bureau of Commercial Fisheries. One of the important objectives of the study has been to uncover concentrations of albacore of commercial magnitude. It is likely such a concentration was brought to light by cruises in 1955 and 1956 (fig. 1).

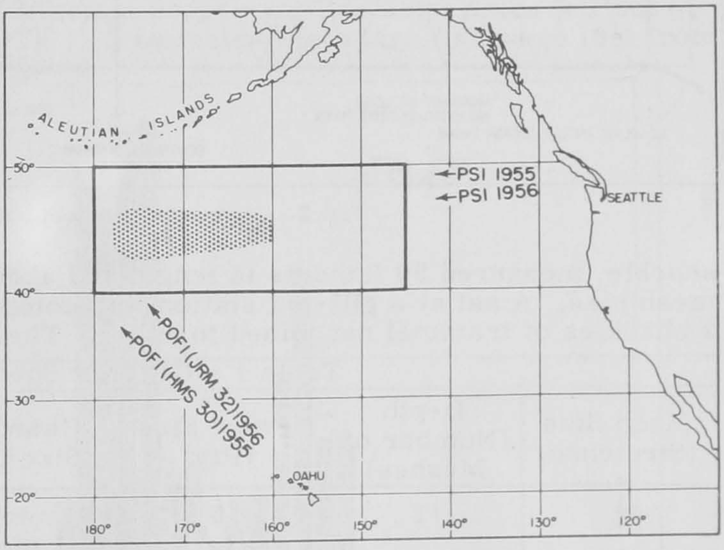

Fig. 1 - Outline of the general region surveyed during 1955 and 1956 by Pacific Oceanic Fishery Investigations and Pacific Salmon Investigations. The area of albacore concentrations is shaded.

The principal gear that made this discovery possible was the gill net, and events leading up to its use by POFI in the North Pacific began in 1955. During the summer of that year, the POFI research vessel Hugh M. Smith (cruise 30) surveyed the central North Pacific (fig. 1) with vessels of Pacific Salmon Investigations (PSI) of the U. S. Fish and Wildlife Service (Powell and Peterson 1957). The Hugh M. Smith conducted hydrographic stations while determining the distribution and abundance of albacore tuna with trolling gear. The PSI vessels attempted to delineate the distribution of high-seas salmon by gill-netting at night. Catches of albacore on the trolling gear were mediocre. However, albacore were taken in the salmon gill nets at the more southern stations (48° N.-45° N.) of the PSI vessels. A few of those catches were impressive, particularly since most of the fish were not gilled, but entangled in the small-meshed salmon nets[1/]. The following year, during the same period and in the same area, the POFI research vessel John R. Manning made a fishing survey (cruise 32) in cooperation with PSI. Gill-netting was extended farther south (43° N.) by POFI where a greater abundance of albacore was anticipated and larger mesh sizes more suitable for albacore were used. Again albacore were found concentrated in about the same area, and were taken in that vessel's gill nets in near-commercial quantities.

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1/ Personal communication to Director, POFI, Honolulu, T.H., from Chief, Pacific Salmon Investigations, Seattle, Wash., September 20, 1955.

TYPE OF GEAR USED

The gill nets fished by POFI were of a design currently in use in the salmon fishery of the northwest coast of America. In addition, trammel nets designed specifically by POFI gear specialists for albacore fishing were utilized. The construction details of both types of nets are shown in figure 2. A unit of gear, the

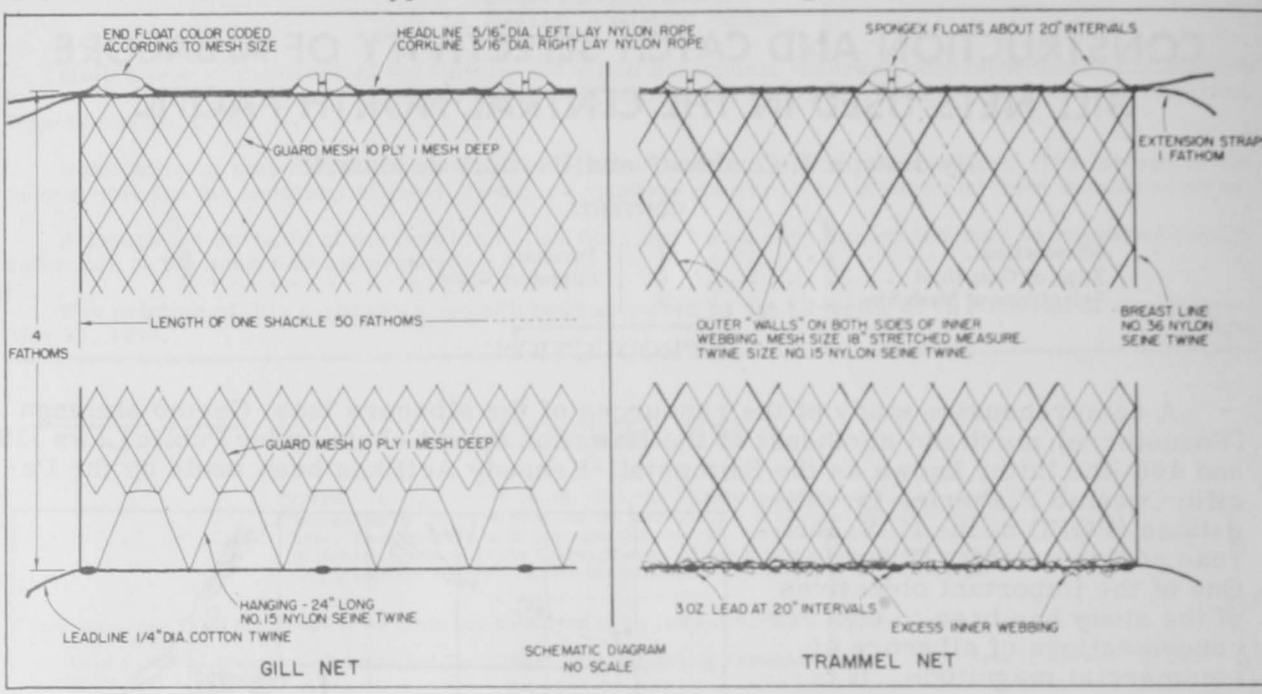

Fig. 2 - Construction details of POFI albacore nets.

shackle, measured 50 fathoms in length and about 4 fathoms in depth regardless of mesh size. A set at a gill-net station was composed of 12 shackles of gill net and 2 shackles of trammel net joined together. The mesh sizes of the gill-net shackles

Table 1 - Gill-Net Specifications

Mesh Size (Stretched)	Depth (Number of Meshes)	Twine Size (Ply)	Guard Mesh (Size and Ply)	Type Hanging (Leadline)
$4\frac{1}{2}$	71	5	1 mesh-10 ply, 1 mesh-8 ply	2 mesh/hanging, skip 1
$5\frac{1}{2}$"	59	5	"	"
$6\frac{1}{2}$"	51	6	"	"
$7\frac{1}{2}$"	45	8	"	2 mesh/hanging, skip 0

were $4\frac{1}{2}$ inches, $5\frac{1}{2}$ inches, $6\frac{1}{2}$ inches, and $7\frac{1}{2}$ inches (stretched mesh). Construction details of the gill-net and trammel-net shackles are summarized in tables 1 and 2, respectively. Nets were hung in a conventional manner with the webbing 50 percent

Table 2 - Trammel-Net Specifications

Inner Net			Outer Net		
Mesh Size (Stretched)	Depth (Number of Meshes)	Twine Size (Ply)	Mesh Size (Stretched)	Depth (Number of Meshes)	Twine Size (Number)
$4\frac{1}{2}$"	124	5	18"	20	15
$6\frac{1}{2}$"	86	6	19"	19	15

on the corkline so that 100 fathoms of netting (stretched mesh) were hung on 50 fathoms of corkline. Trammel nets differed from the gill nets in the addition of large-mesh outer "walls," which enclosed the inner webbing. These outer walls of webbing were evenly spaced opposite to each other to allow fish to push the inner webbing through the walls and thus pocket themselves.

Except for the leadline, the nets were made of nylon, and dyed green or grey-green to make them less conspicuous in the water. The webbing was constructed of bonded double-knotted salmon twine, headlines and corklines of 3-strand spun rope, and breastlines, seizings, and hangings of spun twine.

SELECTIVITY OF MESH SIZE

The manner in which albacore were captured during the summer cruise of the *John R. Manning* was not the same for the various meshes of a set. Smaller meshes of the gill nets captured fish more by entangling than gilling and the trammel meshes captured entirely by entangling rather than pocketing. When a set of nets was retrieved, the tension placed on the shackle coming aboard was sufficient to disentangle the fish and those not properly gilled sometimes fell out of the net before reaching the vessel. Table 3 indicates that more fish were lost from the smaller meshes than from the nets of larger meshes during retrieving. The absence of fish loss from the trammel mesh probably attests to the entangling efficiency of its multiple meshes.

Table 3 - The Number of Fish Lost per Mesh Size of Gill Net as the Retrieved Gear Neared the Vessel
(The figures in parentheses give the loss per shackle.)

Mesh	$4\frac{1}{2}$"	$5\frac{1}{2}$"	$6\frac{1}{2}$"	$7\frac{1}{2}$"
Number Lost .	7(0.21)	11(0.25)	5(0.09)	1(0.03)

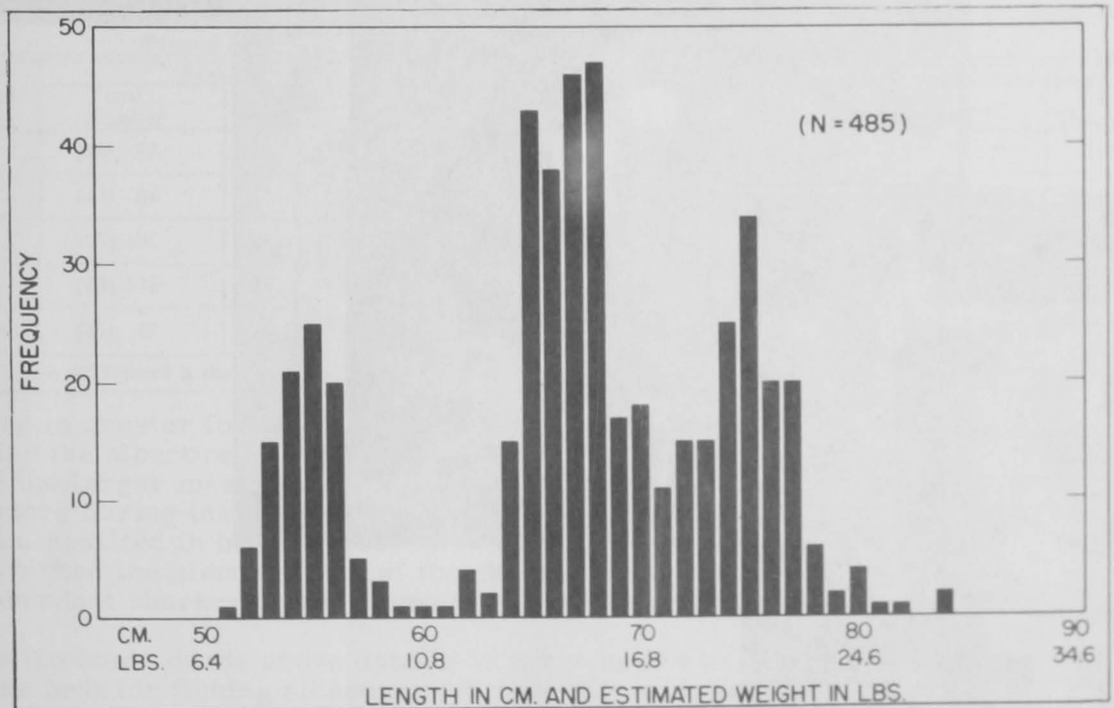

Fig. 3 - Length frequencies and estimated weight of albacore tuna taken in gill nets during cruise 32 of the research vessel *John R. Manning*.

Three size groups of albacore covering a size range of 51 cm. (20 inches) to 84 cm. (33 inches) fork length (fig. 3) were sampled by the gill nets of the *John R. Manning*. Table 4 shows that over this size range a progressive shift toward larger

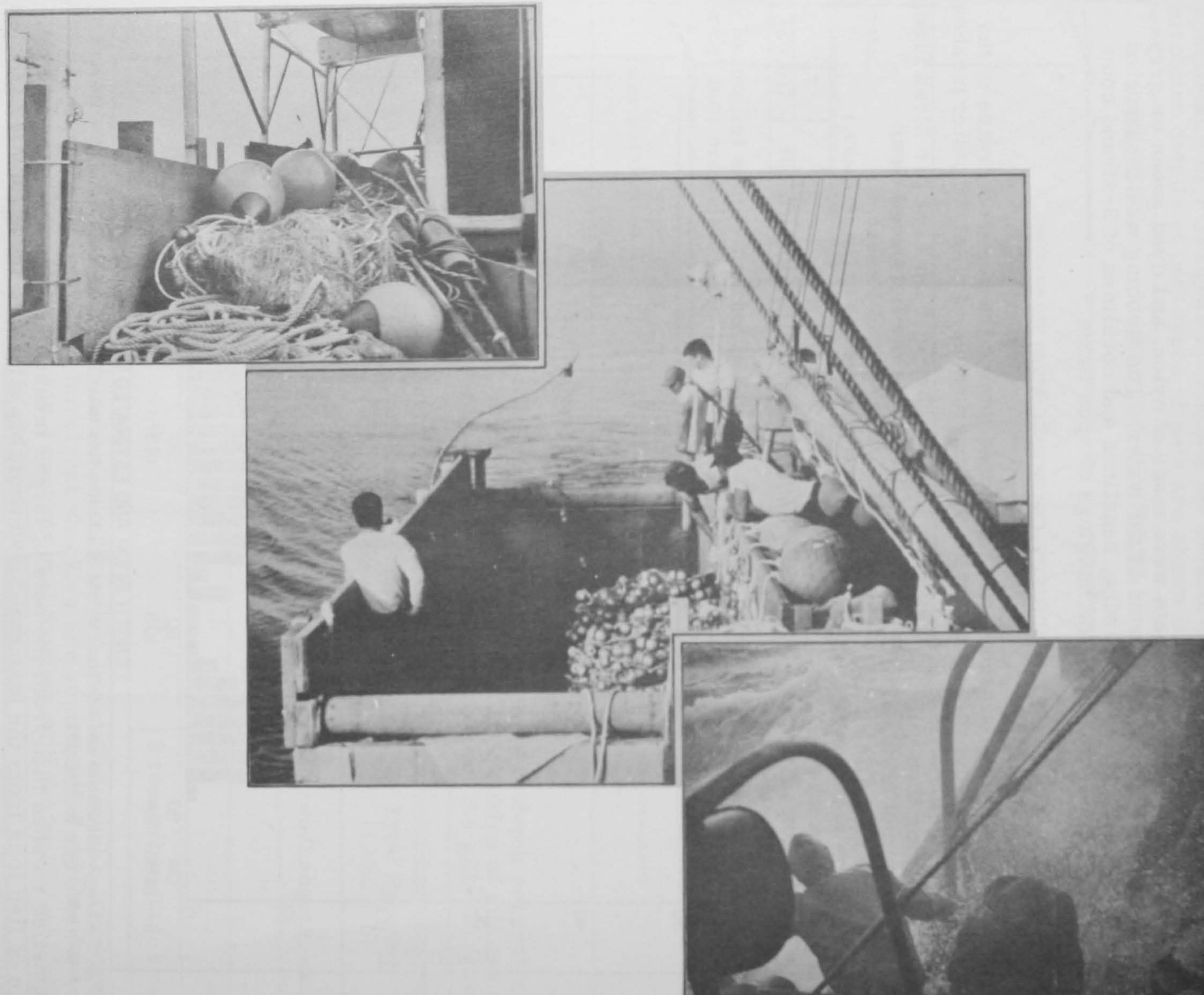

Fig. 4 - Upper left panel: Gill nets stacked in the bins of the charter vessel Paragon. Middle panel: Laying gill nets, John R. Manning. Bottom panel: Retrieving gill nets in the North Pacific, John R. Manning.

fish accompanied an increase in mesh sizes from $5\frac{1}{2}$ inches to $7\frac{1}{2}$ inches. This shift was so great in the case of the largest mesh that the small size group (51-60 cm. or 20-23 inches) was almost missing from the catch. In contrast, the smallest mesh ($4\frac{1}{2}$ inches) captured fish from all three size groups sampled (51-60 cm. or 20-23 inches, 61-70 cm. or 24-28 inches, and 71-80 cm. or 28-31 inches) and small fish were not emphasized in the catch. As in the case of the trammel nets it appeared that the $4\frac{1}{2}$-inch mesh captured albacore entirely by entangling.

Table 4 - Length Frequency of Albacore per Mesh Size

Shackel	Fork Length in cm.																																		Totals
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	
$4\frac{1}{2}$	-	-	1	3	2	6	-	-	-	1	-	-	-	2	5	8	4	3	4	-	1	-	1	3	3	5	3	1	-	-	-	-	-	1	57
$5\frac{1}{2}$	-	6	10	8	7	4	2	1	-	-	-	1	1	2	5	-	6	8	3	2	2	2	1	4	5	-	3	-	-	-	-	-	-	-	83
$6\frac{1}{2}$	1	-	2	9	14	6	3	2	-	-	1	3	-	7	19	18	21	16	6	11	6	4	4	4	12	6	4	1	-	2	-	-	-	-	182
$7\frac{1}{2}$	-	-	-	-	1	-	-	-	-	-	-	-	1	3	10	8	12	19	3	5	2	6	7	5	8	5	8	3	2	2	-	-	-	1	111
Trammel	-	-	2	1	1	4	-	-	1	-	-	-	-	1	3	4	3	1	1	-	-	3	2	7	5	4	2	1	-	-	1	-	-	-	47
Totals	1	6	15	21	25	20	5	3	1	1	1	4	2	15	42	38	46	47	17	18	11	15	15	23	33	20	20	6	2	4	1	-	-	2	480

The progressive shift in fish size with increase in mesh size and the ability of the larger meshes to gill rather than entangle affect the commercial potentialities of the individual meshes. Of the meshes fished, the $7\frac{1}{2}$ inch stands far above the others in efficiency in catch when measured both by numbers and by weight of fish caught per shackle (table 5). This efficiency is further emphazised in that average

Table 5 - Catch per Mesh Size Within the Area of Abundance (42°-46° N., 175°-155° W.)
(Figures in Parentheses were Determined from the Four Largest Catches[1/])

Mesh Size (Stretched Measure)	Albacore		Weight in Pounds			Percentage of Albacore Above 10 Lbs.	No. of Sharks	
	Total Number	Number Per Shackle	Total	Per Shackle	Avg. Fish		Total	Per Shackle
$4\frac{1}{2}$''	(35) 57	(4.4) 2.0	855	(61) 30	$15\frac{1}{2}$''	79	57	1.9
$5\frac{1}{2}$''	(48) 84	(4.8) 2.2	1,054	(56) 28	$12\frac{1}{2}$''	54	57	1.4
$6\frac{1}{2}$''	(105) 186	(8.0) 3.7	2,642	(110) 56	$14\frac{1}{2}$''	80	56	1.1
$7\frac{1}{2}$''	(78) 118	(9.8) 4.2	1,929	(172) 69	$17\frac{1}{2}$''	99	22	0.7
Trammel	(25) 47	(5.0) 2.8	773	(78) 45	$16\frac{1}{2}$''	80	28	1.6

1/ Included in all figures is the catch for a set which took 10 albacore, but had a soaking time of only $2\frac{1}{2}$ hours.

fish size is greater for this mesh and almost all fish taken exceeded 10 pounds. Below this size albacore are often not acceptable to canners. Another attractive feature of the larger mesh is a lower shark catch per shackle, for while shark damage to albacore during the cruise was negligible, their removal from the nets required time and resulted in broken meshes. Presumably, the larger mesh of the $7\frac{1}{2}$-inch net permitted the slender form of the great blue Prionace glauca (Linnaeus)--the most abundant shark--to pass through rather than gill in the net.

On the basis of the above data, it is not possible to establish what mesh size would be best for fishing albacore commercially with gill nets in the central North Pacific, since our most efficient mesh was also the largest used. Powell et al (1952) captured albacore of the same size range in the eastern North Pacific using gill nets with mesh sizes of $7\frac{1}{2}$ inches, $8\frac{1}{2}$ inches, and $9\frac{1}{2}$ inches. His data showed that the $7\frac{1}{2}$-inch and $8\frac{1}{2}$-inch meshes fished with about the same success but the $9\frac{1}{2}$-inch mesh experienced a considerable decrease in catch. From Powell's and our own observations we conclude that the most efficient mesh size with respect to commercial gain would lie between $7\frac{1}{2}$ inches and $8\frac{1}{2}$ inches.

As the gill net was retrieved aboard the John R. Manning, an observer recorded the depth of each albacore in the net by arbitrarily dividing the total depth of the net (by sight) into thirds. A summary of these observations showed that during the cruise, 41 percent of the catch was taken in the upper third of the net, 35 percent in the middle, and 24 percent in the lower third. Thus, most of the fish were captured near the top of the net, but the one quarter near the bottom would suggest that if the net had been deeper, more fish might have been taken. Powell et al (1952) also recorded the depth distribution of fish in their nets and found that the majority of the albacore were taken near the surface between 1 and 3 fathoms in depth, that is, within the depth (4 fathoms) of the POFI nets. However, several fish were captured near the leadline and it is possible that in some instances the 100-mesh nets, which are about twice the depth of the POFI nets, did not fish the entire vertical distribution of albacore. The depth of net from which the greatest commercial advantage could be realized cannot be ascertained from the above data since such factors as cost of netting, ease of retrieving, net storage area aboard the vessel, etc., must be considered. Without such considerations, a compromise between the gears used by Powell and POFI or 75 meshes would not seem unreasonable.

SUMMARY

If we consider our data comparable with that of Powell, the most productive net with which to fish albacore commercially in the central North Pacific would have a mesh size between $7\frac{1}{2}$ inches and $8\frac{1}{2}$ inches and a depth of 75 meshes.

LITERATURE CITED

POWELL, DONALD E.; ALVERSON, DAYTON L.; and LIVINGSTON, ROBERT, Jr.
1952. North Pacific Albacore Tuna Exploration--1950. U. S. Fish and Wildlife Service, Fishery Leaflet 402, 56 pp.

________, and PETERSON, ALVIN E.
1957. Experimental Fishing to Determine Distribution of Salmon in the North Pacific Ocean, 1955. U. S. Fish and Wildlife Service, Special Scientific Report: Fisheries No. 205, 30 pp.

TESTER, ALBERT L.
1956. The Where and Why of Albacore, Pacific Fisherman, vol. 54, no. 4, pp. 21-24.

LITHUANIAN FISHERMEN TESTING ELECTRICAL FISHING IN BALTIC

Lithuanian fishermen are testing an electrical fishing method in the Baltic in which fish are caught by electrifying patches of water. Special electrodes connected to a generator aboard the fishing vessel are lowered into the water. When current flows between them, fish within several dozen yards of the anode are attracted towards it and when sufficient fish have congregated, they are pumped by a powerful pump to the deck of the vessel. Only bigger fish are attracted and one such installation is stated to be able to service 7 trawlers at the same time (Fisheries Newsletter, July 1958).