Catches of up to 18 metric tons of yellowfin and 17 metric tons of skipjack per set were made with a new experimental 550-meter purse seine.

EXPERIMENTAL PURSE SEINING FOR TUNAS IN PORTUGUESE WEST AFRICA 1/

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(Translated from Portuguese by John P. Wise*)

Capture of tuna by purse seines was made possible by technical advances in two fields--the discovery of new fibers for making nets and the invention of mechanical devices for hauling nets. Before these developments, ordinary purse seines had been used to capture the tunas so abundant in various parts of the world. Good results were achieved only occasionally. It was soon recognized that future attempts could only be profitable with gear designed especially for the purpose. This gear, if possible to construct, would consist of larger nets made of stronger twine. However it would be difficult to handle; actually, such nets made of traditional fibers would be too heavy for manpower alone to manage.

The first step toward solving the problem appeared in the development of synthetic fibers, much stronger and lighter than vegetable fibers. This made possible the construction of larger and stronger--yet lighter nets. Although the weight problem had been solved, the larger nets made manual handling slow and exhausting.

The second step was the development of the mechanical hauler or power block. This gear is handled easily and is relatively simple to install without major modifications of traditional vessels. It opened the way to fishing with large purse seines; seining for tunas became practical. Now seining is practiced profitably in all countries that have proper oceanographic conditions along their coasts or in nearby waters.

In Angola, Portuguese West Africa, a live-bait fishery for tunas has existed for several years. Some owners and captains of traditional seiners have tried to catch tunas with nets normally used for sardines and other pelagic fish. Although some catches were made, the idea was not followed up for practical reasons. Larger and stronger nets were needed, but these could not be handled in the ordinary manner.

At the beginning of 1961, following its policy of experimentation and practical demonstration of new fishing methods, the Marine Biology Mission installed on its research vessel "Sardinella" a mechanical hauler for purse seines. (See "Notas Mimeografadas do Centro de Biologia Piscatória," No. 34.) In 1963, a tuna purse seine was bought from an American firm that was designed with the Sardinella's available power and power block in mind.

MATERIALS

The Sardinella is a wooden "Portuguese seiner" type built in Angola in 1958:

Maximum length	23.1 meters
Length between perpendiculars	19.1 meters
Draft midships	2.4 meters
Beam	5.3 meters
Tonnage	123.26 gross tons

The main motor is a Bohn and Kahler 6-cylinder diesel developing 160 hp. at 600

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1/"Ensaios de pesca de 'atum' em Angola com rede de cercar para bordo."

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r.p.m., for a speed of about 7 knots. The power block is American made, "Marco Type 28F - 2000 GR," with a pulling force of about 800 kilograms and a drum capacity of about 90 centimeters (maximum circumference of compressed net). (For more details, see "Notas Mimeografadas do Centro de Biologia Piscatória," No. 34.)

As would be expected, the Sardinella also had a mechanical winch driven by a 30-hp. auxiliary motor. This low horsepower and the winch's bad condition necessitated some changes. We thought first of a hydraulic winch, but its larger size and possible parts and maintenance problems made us settle for an ordinary mechanical winch made in Angola. This is driven from the main engine and has two speeds and two gypsies of different sizes on each side.

It was first proposed that we design a net for seining tuna from the Sardinella and that it be constructed in Angola. This would have meant a typical machine-knotted net. Because the net was the first of its sort for seining tuna in Portugal and there was no unanimous opinion on the best type, we were compelled to design it from general information about seines and our knowledge of Angola tunas. We thought the "American purse seine" used in Portugal would be a suitable base. This seine has the following characteristics:

Length of cork line		675 meters
Depth (slack)		75 meters
Overall mesh (bar)		40 millimeters
Bag	Length	75 meters
	Depth	30 meters
	Mesh (bar)	30 millimeters
Cork line selvage (bar)		40 millimeters
Lead line selvage (bar)		80 millimeters

The webbing is nylon twine, about 1,000 meters/kilogram overall, and about 800 meters/kilogram in the bag and selvages. We considered modifying the bag's design to the Icelandic type, cut in steps, because we believe this is the only proper type for mechanical hauling.

However, we decided later that our power block and vessel could not handle the weight involved. Finally, we turned to the idea of a knotless net, ending the notion of having it made in Angola. The most efficient knotless mesh, principally from the standpoint of strength, seemed to be the American "Trilock nylon combination." We ordered one from the United States Net and Twine Co., Inc.; it was made under the direction of Borti Petrich.

The net is about 550 meters long and 70 meters deep. Its total weight, including leads and floats, is about 6,500 kilograms. The purse line is nylon with an outer winding on an inner core for extra strength; it is the American type "Samson 2 in 1," 25.4 millimeters in diameter and 580 meters long. We had to use this rather than steel cable because it was impossible to mount the necessary winch for steel on the Sardinella. We still believe that the purse lines normally should be steel, although the substitute proved satisfactory in all respects.

The net is divided in two parts by a splitting arrangement ("zipper"), making it possible to divide the catch in case of a large set. This arrangement is simply a line of small rings running up a reinforced strip of netting. A line made fast to the lead line passes through the rings with its free end passing out at the cork line; a pull on this line splits the net. This system is commonly used in the U. S. It was incorporated in our gear at the manufacturer's suggestion.

There are two other important design features:

a) Unlike the classic Portuguese net, the net does not form pockets at the bow and stern of the vessel. For this reason, taking the basic idea from Mr. Petrich, we had installed along the extreme end of the net and along the side of the bag a line of small rings through which passes an auxiliary line. When drying up is nearly completed, this line is pulled in when necessary. This pulls the net together--bunching up the corks and forming a large pocket under the cork line--and prevents fish from jumping out of the net when they are crowded by it. The same rig was installed on the other end of the net and along the cork line of the center of the bag; however, the latter had to be removed because it created problems during hauling.

b) There are 20 small rings along the lead line under the bag. This permits fastening the bag securely to the vessel's rail while brailing.

Because we were forced to use a net whose weight and volume were adapted to the existing vessel and power block, we not only had to choose a knotless net but also to limit the twine's diameter to a minimum. We found the net efficient for fishing, but it was too weak under certain conditions. In the future, we could have larger meshes and heavier twine, maintaining the gear's weight and volume about the same. Nonetheless, after using the net, we consider it very good, subject to the limitations mentioned.

OPERATIONS

The Sardinella's limitations led us to select a "European system" fishing method--seining with live bait. This is distinguished from the "American system," which does not use bait. The low power of the vessel's motor (160 hp.) does not permit speeds of more than 7 or $7\frac{1}{2}$ knots, just about eliminating chasing or seining moving schools. In the European system, the bait boat acts as a "brake" on the school; it works closely with the seine vessel and permits the latter to make sets on schools stopped by the live bait.

The low power (about 25 hp.) of the available bait boats allowed speeds of only $5\frac{1}{2}$ or 6 knots. This, plus the small holding capacity of the bait tank (about 1.5 cubic meters), ruled out scouting for fish over large areas. These boats can work at sea only 12 to 14 hours and are limited to operating close to port--on the continental shelf, or a little beyond. This limited our operations and the information we could obtain on possible offshore tuna fishing.

The net's design considered many factors; it should have been restricted to catching small schools of small to medium fish. On one occasion, to test the net, we deliberately ignored the limitation and made a set around an estimated 30-ton school of large fish, about 40 kilograms each. Although we caught 18 tons, we proved in fact what we knew in theory--the larger part of the school escaped by breaking through the net.

It is well known that one principal cause of the movements of tunas is related to the water's temperature and salinity. Tunas are limited in their ability to withstand large changes in temperature and salinity, and their migrations are affected by these and other factors. Our knowledge of local oceanographic conditions is somewhat limited. This, and the vessel's limited range, did not allow us to select the best fishing grounds. Our scouting was held to traditional methods--looking for birds, surface or subsurface schools, or just prospecting where tunas have been found.

Around Baia Farta, the tunas come from the north and begin to show up around mid-September; they stay until the end of April or the beginning of May, when the cooling surface waters sends them north again. It seemed obvious to us that the best months for finding large concentrations are October to January, especially November-December. However, reasons beyond our control made it impossible to begin then. The first trials for testing gear and training ran from the latter part of December 1964 to early January 1965. Only then, in mid-January, was it possible to have everything ready to begin the actual fishing experiments.

To sum up, we had to limit our work in several ways:

a) to seine with the aid of live bait;

b) to start in January, past the peak of the season;

c) to catch fish of 15 to 20 kilograms in small or medium schools;

d) to scout within 30 or 40 miles of port; and,

e) to scout for tunas only in the usual places and by the traditional methods.

The operations were carried out in the following sequence.

1. Dummy sets, without attempting to catch fish, were made from the Sardinella;

2. Dummy sets, without attempting to catch fish--the Sardinella working with live bait launch;

3. Fishing sets, seining tuna schools with the aid of live bait.

The first group was carried out to test gear and to give the crew sufficient practice in handling the new net. These tests were conducted over known areas of clean bottom at or near the entrance to Baia Farta, under various weather and sea conditions, until we were convinced that men and gear were ready for the next phase.

After the first phase, we worked on getting he two fishing vessels and their crews (with asically different habits) to function together s a single unit.

When we were ready to scout and fish with he seine vessel working with the bait boat, e began the third phase. We set up certain perational procedures:

1. The two vessels operated as a single ishing unit;

2. The bait boat scouted in the usual man- er for pole-and-line fishing;

3. The seine vessel followed the bait boat t a determined distance, directly astern when ossible;

4. The boats were in constant contact by alkie-talkie radio;

5. Scouting was carried out visually from oth vessels--by looking for birds or jump- ng fish;

6. A Marine Biology Mission scientist in charge of the joint operation was aboard the bait boat;

7. When the bait boat sighted signs or actual fish, it began operations as if it were going to fish by the usual method;

8. The scientist aboard followed developments closely and decided the appropriate time to radio the seine vessel to begin setting;

9. A firm rule held that the bait boat should chum and prepare the fish without, however, fishing;

10. Rules had been set up for setting the seine: the set should be begun as far as possible from the bait boat, made rapidly, and the seine should be closed as close as possible to the stern of the bait boat;

11. Rules were set for the bait boat: Continue chumming generously, without stopping, during seine set until rings were aboard seine vessel; steam around inside seine, find best

Details of Sets Nos. 10-25 of the Experimental Purse Seine[1]

et o.	Date (1965)	Catch: Species	Catch: Weight (Kg.)	Observations
0	12 Jan.	Skipjack	400	Set too close to bait boat - fish dived
1	12 Jan.	-	0	Attempted to set without chumming
2	12 Jan.	Skipjack	2,000	Small school - good set
3	16 Jan.	Skipjack Frigate mackerel (few) Yellowfin (3)	17,000	Good set - only a few escaped
4	19 Jan.	Skipjack Frigate mackerel (few) Shark (1)	450	Big school - bad set with large opening - radio failed
5	27 Jan.	Dolphin (many) Yellowfin (14) Skipjack (6) Shark (2)	500	Good set
6	27 Jan.	Yellowfin Bigeye (2)	18,000	Big school - good set - many fish broke through net
7	2 Feb.	Skipjack Frigate mackerel (few) Yellowfin Shark (20)	16,000	Big school - set with large opening - many fish escaped
8	20 Feb.	Yellowfin (1,500 kg.) Skipjack (1,000 kg.)	2,500	Big school - fish dived because bait died as net was set
9	6 Mar.	Skipjack Yellowfin (few) Bigeye (few) Shark (1)	250	Few fish - not feeding well - good set
0	17 Mar.	Skipjack Frigate mackerel (few)	150	Few fish - not feeding well - good set
1	17 Mar.	Skipjack	150	Few fish - not feeding well - good set
2	30 Mar.	Skipjack Little tuna (few)	5,000	Small school - good set
3	30 Mar.	Skipjack Yellowfin Jack	300	Few fish - not feeding well - good set
4	2 Apr.	Skipjack	50	Few fish - not feeding well - good set
5	2 Apr.	Skipjack	700	Few fish - not feeding well - good set

All sets within 15 miles of 13°00' E. and 12°35' S., except No. 18 about 40 miles southeasterly of this position. None over 20 miles from the coast.

position to prevent escape of fish--remembering the bait boat should stay away from net itself, especially from opening, try to guide school into the circle, especially when net is almost closed (these maneuvers produced excellent results in preventing escape of fish during setting and pursing);

12. Once pursing is completed, the bait boat leaves the circle and, by means of a tow line, helps the seine vessel keep away from body of the net as it is lifted by power block;

13. When this operation is over, the bait boat helps with the drying up by taking part of the cork line aboard; when there are plenty of fish, this operation keeps tunas from sinking cork line and escaping over it.

The total number of sets made was 25: six dummies were carried out for practice with the gear and training the Sardinella crew; 3 for practice with two vessels operating together; and 16 (numbered 10-25), actually fishing with live bait and the seine.

Species captured in order of value were: skipjack (Katsuwonus pelamis), yellowfin (Thunnus albacares), frigate mackerel (Auxis thazard), bigeye (Thunnus obesus), little tuna (Euthynnus alletteratus), dolphin (Coryphaena hippurus), jack (Caranx angolensis), and sharks (various species).

The total capture for the 16 sets was 63,500 kilograms, or about 4 metric tons average per set. Skipjack (42,000 kilograms) and yellowfin (19,000 kilograms) made up almost the whole catch, with only 2,500 kilograms of other fish.[2/] Because of the small number of sets, it is not now possible to draw conclusions about the economic yields. Study of this question will be feasible in the near future only after an intense campaign set up as in commercial fishing and covering a whole season. The relatively low capture per set (3,968 kilograms) was due to the experimental nature of the work, attempts to set as frequently as possible in all conditions to test the net, and problems previously mentioned. (See observations in table.)

CONCLUSIONS

1. It is possible to catch tunas by purse seine on coast of Angola.

2. Practical results were obtained using "European system"--seining with aid of live bait.

3. The length and height of the net used were adequate to capture tunas at surface and below it.

4. The twine used and the knotless net proved adequate for small and medium schools (to 20 metric tons) of fish up to about 15 kilograms.

5. The mesh used, 7 centimeters stretched, could be a centimeter larger without danger of gilling the smallest fish caught (about 1.5 kilograms). To capture larger schools and/or larger fish, it would be advisable to double diameter of the twine.

6. The design of the net bag was completely satisfactory with regard to strength, even for fish averaging 40 kilograms.

7. We believe an increase in number of corks or use of larger corks would increase buoyancy of net, which appeared insufficient at times.

8. Observations made on fish of same species and size, landed on same day and place with same number of fishing hours and methods of handling aboard, but caught by different methods--seining and live bait--showed that seined fish were "riper." The seined fish could be processed immediately by the factory, while hook-and-line fish had to lay over until the next day. We believe this "hardening" is due to the struggles of seined fish during capture and lifting aboard.

9. It is not yet possible to say whether seining is economically practical because of the experimental nature of this work. A further study covering at least a whole season and carried out on commercial fishing lines is necessary.

2/Fernando Correia da Costa mentioned in conversation that this work was carried on from November 1965 to February 1966, with about 20 more sets. Catches were about the same order of magnitude, but skipjack predominated even more heavily--Trans.

Note: The listing of the materials and dimensions of the seine net is attached as appendix to reprint (Separate No. 782) of this article. For free copy of the Separate, write to Office of Information, U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington, D. C. 20240.