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JAPANESE OFFSHORE TRAWLING

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
NATURAL RESOURCES SECTION
REPORT NO 138
TOKYO 1950

REPORT NUMBER 138

December 1950

JAPANESE OFFSHORE TRAWLING

by
Lt Comdr François Bourgois

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
Natural Resources Section

NATURAL RESOURCES SECTION
REPORT NUMBER 138
December 1950

JAPANESE OFFSHORE TRAWLING

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This catch was taken almost entirely in the East China and Yellow seas, where the trawlers gradually extended their operations as the fishery developed farther from their bases. But as operations in this area reached their peak the catch per vessel began to decline, the resources being affected by the intensive exploitation. Seeking new fishing grounds, the Japanese extended their trawling operations to other areas: westward to the South China Sea and the Gulf of Tonkin, northward to the northern portion of the Japan Sea and farther, to Kamchatka and the Bering Sea (Figure 1). They also made numerous attempts to discover new suitable fishing grounds in various parts of the world. Some of these trials met with success and led to the formation of fishing companies with Japanese capital in Argentina and Mexico.

World War II brought an end to the expansion of the Japanese trawl fishery. Nearly all offshore trawlers were destroyed between 1941 and August 1945. Present operations of Japanese offshore trawlers are restricted to the eastern part of the East China Sea, where a newly built trawling fleet is operating. In 1948 it caught approximately 203,000 metric tons of fish, slightly less than the prewar catch of the Japanese trawlers in the East China and Yellow seas.

FISHING GEAR OF OFFSHORE TRAWLERS

1. Terminology

Trawling is any method of fishing by means of a net dragged on the sea bottom by a vessel. This net, called a trawl net, consists of a conical bag with its sides prolonged by two long wings to which are fixed the towing ropes. When the net is towed, the wings are kept spread apart by a device which varies with the type of trawl used. The fish encountered by the wings are directed by them toward the bag part, or belly, of the net and thus are caught.

Trawling is practiced by Japanese vessels of various sizes and tonnage using different types of nets. The fishing gear of Japanese offshore trawlers is limited to two kinds of trawl. One of these, the otter trawl, is a Western gear introduced into Japan from England at the beginning of this century. The other, called in Japan "teguriami" 4/, is, according to Japanese tradition, of native origin; it is an enlarged and modernized version of the old hand trawl which bore the same name. The methods of operating the "teguri" nets, however, are similar to those for two types of nets used in Europe and known as the Danish seine and the bull trawl; the smaller type of "teguri" is operated like a Danish seine and the larger like a bull trawl. The gear are described under the European names in this report. The Japanese usually do not distinguish in name between the two types. When such a distinction is necessary, they specify whether the net is towed by one vessel (Danish seine) or by two (bull trawl).

2. Danish Seine

Although widely used in the coastal area of Japan, the Danish seine is little used west of longitude 130°E, in the area exploited since the Surrender by Japanese offshore trawlers. Japanese vessels operating until 1941 in the Japan Sea off the coast of USSR were fishing with Danish seines.

The Danish seine is operated by one vessel. The net is laid on the sea bottom with the wings spread; when the seine is towed, the wings close slowly and tend to drive the fish into the belly of the net. The tow ropes, by stirring up the mud on the bottom, also assist in driving the fish into the net.

Construction of Net: The dimensions and details of construction of the Danish seine vary widely. The size of the net depends in general on the tonnage of the fishing

4/ "Teguriami" is the name given to these nets by fishermen. In all official documents, this gear is called "Kisensokobikiami", i e, "net dragged on the bottom by steam vessel". The word trawler is applied by the Japanese to the otter trawl only. See glossary for definitions of Japanese technical terms.

CORRECTION

THIS DOCUMENT

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TO ASSURE LEGIBILITY

NATURAL RESOURCES SECTION
REPORT NUMBER 138
December 1950

JAPANESE OFFSHORE TRAWLING

by
Lt Comdr François Bourgois 1/

SUMMARY

1. A trawl is a bag-shaped net towed by one or two vessels (trawlers) and used to catch the fish living on, or close to, the sea bottom.

2. The modern Japanese vessels operating in offshore waters use two principal types of trawl: the otter trawl, which is used by ships of more than 200 gross tons and is towed by one vessel, and the bull trawl towed by two vessels operating as a team. In addition, another net, called in this report Danish seine, and similar in construction to the bull trawl but operated by one boat, was used in certain offshore areas although it is primarily a coastal fishing gear.

3. Because the trawl, when used indiscriminately, can be harmful to the fish resources, the operation of this fishing gear is restricted by certain regulations. Trawling is prohibited in certain coastal areas. All trawling operations are subject to the delivery of a license issued by the Ministry of Agriculture and Forestry and are confined within the area for which the license has been issued.

4. Prior to 1940, the normal fishing grounds of Japanese offshore trawlers were situated on the continental shelf of southeast Asia and included the East China and Yellow seas, the South China Sea, and the Gulf of Tonkin. Some offshore fishing was also done in the northwestern portion of the Japan Sea.

5. In addition, between 1937 and 1941, Japanese fishing companies operated trawlers under Argentine and Mexican flags off the coasts of South and Central America.

6. Trawlers also were used in association with factory ships from 1933 to 1941 in the Bering Sea and in 1942-43 off the west coast of Kamchatka in the Sea of Okhotsk.

7. Since the Surrender of Japan to the Allied Powers, the Japanese offshore trawling fleet which had been almost completely destroyed during World War II has been reconstructed. Present trawling operations are confined within the fishing areas authorized by the Supreme Commander for the Allied Powers. The authorized area includes the eastern portion of the East China Sea which is at present the only fishing ground where offshore trawlers are operating. The actual catch in this area is comparable in quantity to the prewar output of trawlers in the East China and Yellow seas.

8. Available data indicate that the present fishing effort cannot be maintained without causing a depletion of the resources, so the trawling fleet is being reduced in number. A program of research has been implemented to determine what fishing effort is compatible with a maximum sustained production.

1/ This report was prepared by Lieutenant Commander Francois Bourgois (FLE), Administrateur de l'Inscription Maritime (French Navy), attached to the Fisheries Division, Natural Resources Section. Mr Misuho Ohno, Fisheries Division, assisted materially in the compilation of the data. The principal illustrations were prepared by Messrs Saburo Satouchi, artist, and Katsuyuki Kita, draftsman, Fisheries Division.

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List of Natural Resources Section Reports and Preliminary Studies

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INTRODUCTION

1. Purpose and Sources

This report describes the fishing operations of the modern Japanese trawlers in the various areas which have been exploited by this type of vessel. It excludes the puraly coastal fishing operations by small vessels around the islands of Japan and the coast of Korea, and also near Sakhalin and the Kuril islands.

The data included have been compiled from the official statistics of the Ministry of Agriculture and Forestry, the records of fishing companies and associations, and the principal Japanese publications dealing with this subject.

Because of numerous inconsistencies in the collection and recording procedures used by the Japanese, statistical data are incomplete. Estimates have been included, after cross-checking, when they appeared sufficiently reliable to help give a clear picture of the actual nature and scope of Japanese trawling operations.

The descriptions of fishing gear are based on data and records supplied by the fishing companies and have been checked by direct observation in the field.

2. Origins and Scope of Japanese Offshore Trawling

Since their early history, the Japanese have fished in their coastal waters by means of nets dragged on the sea bottom. The vessels engaged in this type of fishery were small craft using more or less primitive types of trawl. The narrowness of the continental shelf bordering the islands of Japan precludes the use of a trawl at a great distance from the shore. Offshore trawling therefore was not practiced by the Japanese until the introduction from Europe of types of trawl suitable for large vessels capable of seeking their fishing grounds farther from Japan, on the shelf of the Asiatic continent. This innovation was made in the early years of the 20th century; the first modern trawler used successfully in Japanese waters (in 1908) was an otter trawler built in England.

In its early stage, modern trawling was practiced by the Japanese in their coastal waters, but it became an offshore fishery as early as 1909 when regulations implemented to protect the coastal fisheries forbade the use of the otter trawl in the coastal area of Japan.

Encouraged by the government, the otter trawling industry developed rapidly, and the Japanese trawling fleet (Table 1) included an estimated 150 otter trawlers in 1912. This development, however, was interrupted during World War I, as the shipowners found it profitable to sell their trawlers to the Allies, who needed this type of vessel for use as patrol boats or mine sweepers. Japanese offshore trawling was resumed in 1919, and the otter trawler fleet again increased steadily until 1923 when it included 70 vessels, the maximum allowed by government regulation 2/.

Since about 1921, the bull trawl has been used concurrently with the otter trawl in the offshore fishing areas. This type of net is also in use in European countries, but the Japanese claim that it developed separately in Japan. As the number of bull trawlers was not limited by law, this fishery gradually acquired importance until it greatly exceeded otter trawling.

Accurate figures are not available because statistics on Japanese trawling are incomplete and often unreliable, but the annual catch between 1932 and 1937 is estimated at 44,000 metric tons 3/ by the otter trawlers and 196,000 tons by the offshore bull trawlers. The total amount, 240,000 metric tons, was about one-third of all Japanese offshore fisheries, but only 0.55 percent of the total Japanese fish production.

2/ This regulation was implemented in 1917. (See "Japanese Regulations on Trawling".)
3/ See glossary for conversion of metric to English units of measurement.

This catch was taken almost entirely in the East China and Yellow seas, where the trawlers gradually extended their operations as the fishery developed farther from their bases. But as operations in this area reached their peak the catch per vessel began to decline, the resources being affected by the intensive exploitation. Seeking new fishing grounds, the Japanese extended their trawling operations to other areas: westward to the South China Sea and the Gulf of Tonkin, northward to the northern portion of the Japan Sea and farther, to Kamchatka and the Bering Sea (Figure 1). They also made numerous attempts to discover new suitable fishing grounds in various parts of the world. Some of these trials met with success and led to the formation of fishing companies with Japanese capital in Argentina and Mexico.

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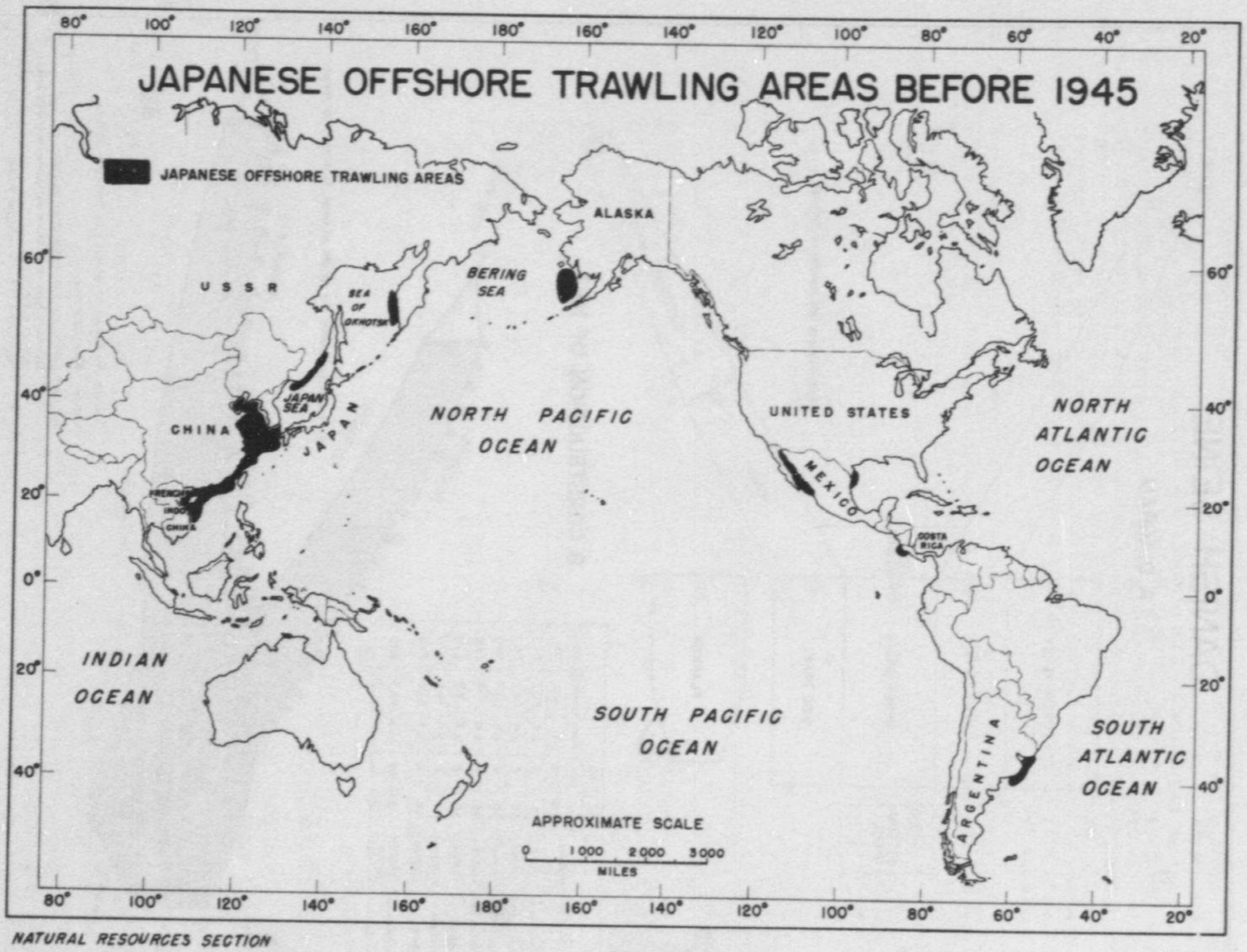
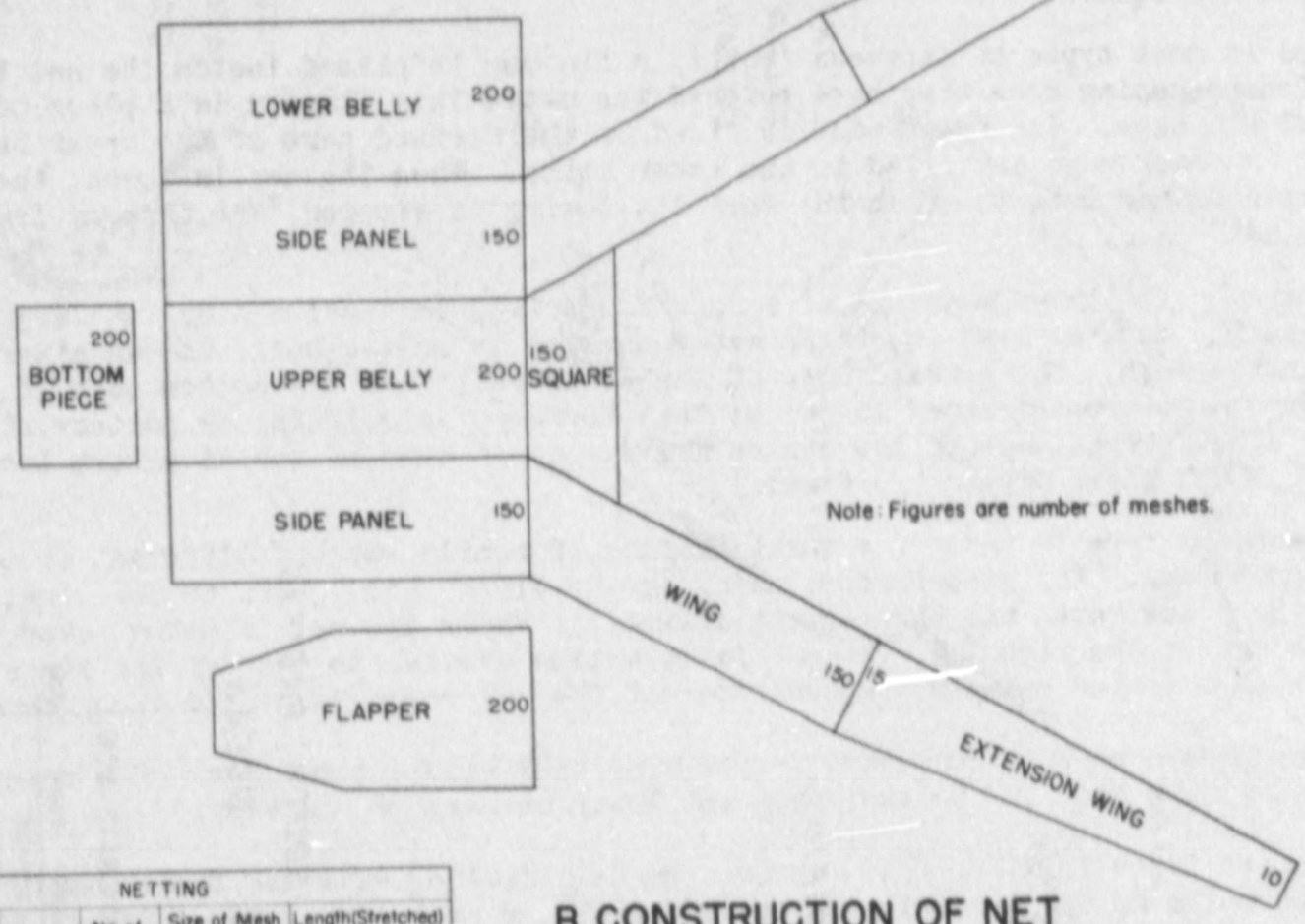


NATURAL RESOURCES SECTION

Figure 1

DANISH SEINE

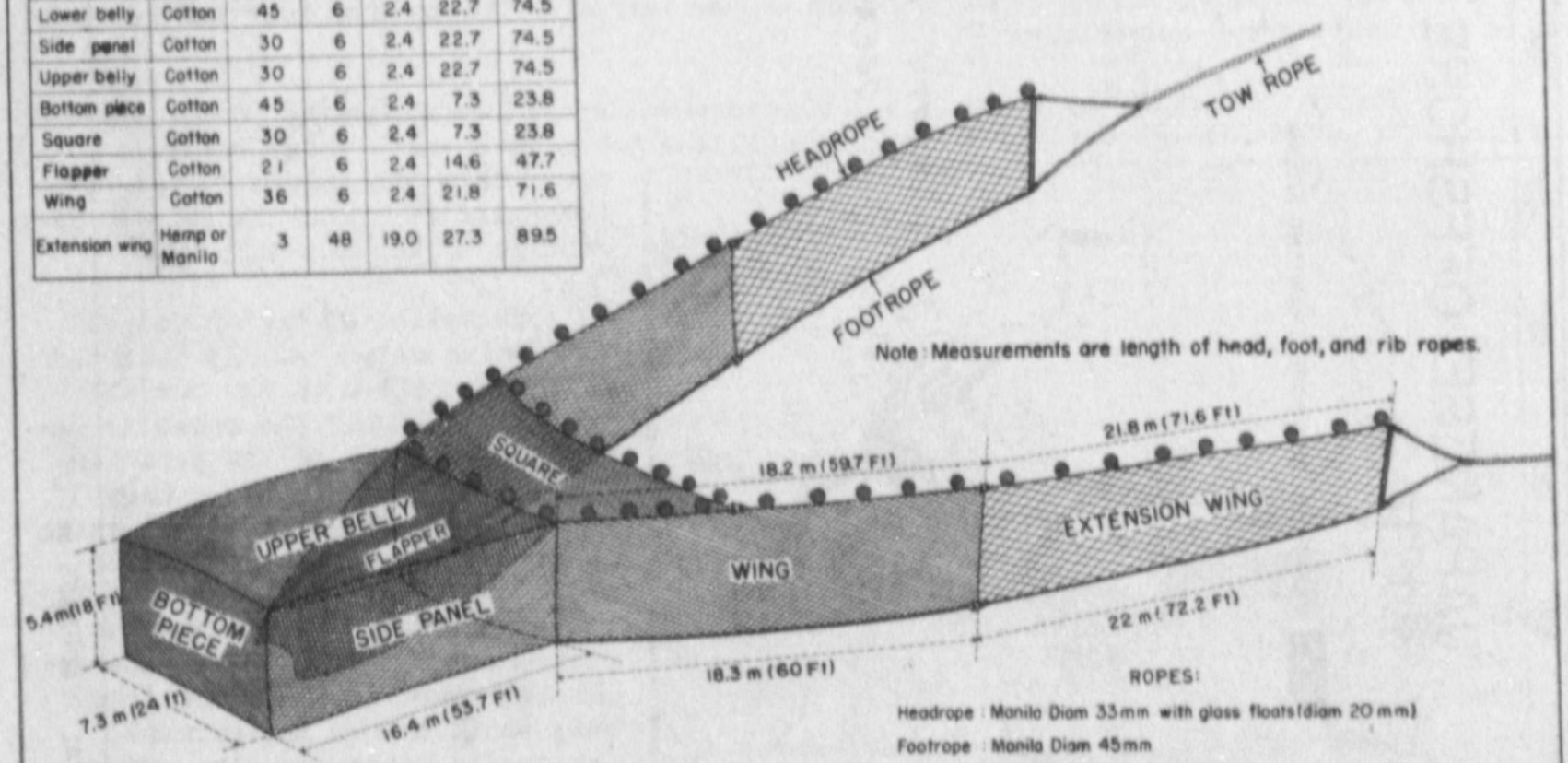
A. DIAGRAM



Note: Figures are number of meshes.

NETTING						
Part of Net	Material	No of Strands	Size of Mesh (cm)	Size of Mesh (ft)	Length(Stretched) (m)	Length(Stretched) (ft)
Lower belly	Cotton	45	6	2.4	22.7	74.5
Side panel	Cotton	30	6	2.4	22.7	74.5
Upper belly	Cotton	30	6	2.4	22.7	74.5
Bottom piece	Cotton	45	6	2.4	7.3	23.8
Square	Cotton	30	6	2.4	7.3	23.8
Flapper	Cotton	21	6	2.4	14.6	47.7
Wing	Cotton	36	6	2.4	21.8	71.6
Extension wing	Hemp or Manila	3	48	19.0	27.3	89.5

B. CONSTRUCTION OF NET



Note: Measurements are length of head, foot, and rib ropes.

ROPES:

Headrope: Manila Diam 33mm with glass floats(diam 20 mm)

Footrope: Manila Diam 45mm

Tow rope: 6 pieces of manila rope shackled together
Diameters from 45 to 25mm decreasing from wing to ship
chain of about 37 kg
Total length of tow rope: about 900 m

Note: Measurements have been converted from shaku.

NATURAL RESOURCES SECTION

Figure 2

boat. The netting is commonly of cotton twine; the mesh is often of uniform size except for the wings. The belly is composed of four parts: a lower belly, an upper belly, and two side panels (Figure 2). Seams are reinforced by rib ropes. The belly usually has no taper. The posterior end of the belly is closed by a square piece of netting which forms the bottom of the net. The upper belly is prolonged by a piece of netting overhanging forward, called the square.

As in most types of Japanese trawls, a flapper is placed inside the net to prevent the fish from escaping once they have entered the net. This flapper is a piece of netting trapezoidal in shape. Its front edge is fixed on the forward part of the upper belly; the corners of its back edge are fixed to the lower belly. When the net is towed, the flapper balloons upwards and lets the fish in; when the towing is stopped, the flapper drops and closes the net.

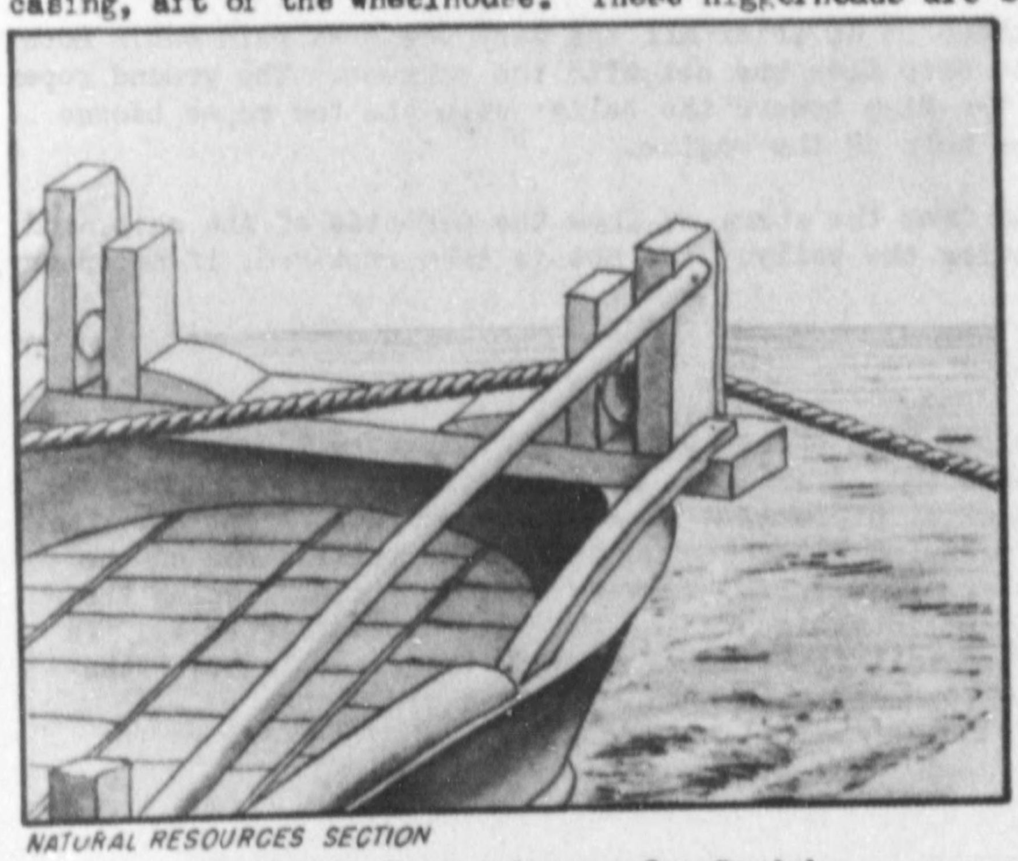
Each of the wings consists of a forward section (extension wing) of large mesh netting, usually made by hand in coarse material such as native hemp, and an after section of finer cotton mesh. The forward edge of the lower belly and the bottom edge of the wings are lashed to a footrope wrapped in twine; this footrope is weighted by pottery sinkers or by chains. The forward edge of the square and the upper edge of the wings are lashed to a headrope to which glass floats are fixed.

Each tow rope is made of several lengths of manila rope of different diameter shackled end to end. The ground rope, which is the first third, next to the wing, of the total length of tow rope, has the largest diameter. While the net is being towed, this ground rope drives the fish into the net in an action similar to that of the wings. A short chain is shackled between the remainder of the tow rope (warp) and the ground rope.

The ground rope is connected to the wing by a bridle consisting of a spreader with a line running from each end to the upper and lower corners of the wing.

Danish Seine Trawler: The Japanese vessels fishing with the Danish seine are wooden ships built in the traditional Japanese style, with bottoms shaped like a wide open V and flat sides. The same type of vessel also is used for fishing with a bull trawl 5/. Two heavy wooden beams rising above the poop of the Danish seine trawler bear the rollers used for hauling the net (Figure 3).

The net is hauled by means of two niggerheads located on each side of the engine casing, aft of the wheelhouse. These niggerheads are borne by a shaft which receives power from the ship's engine by a transmission belt. The engine is usually of the hot-bulb type.

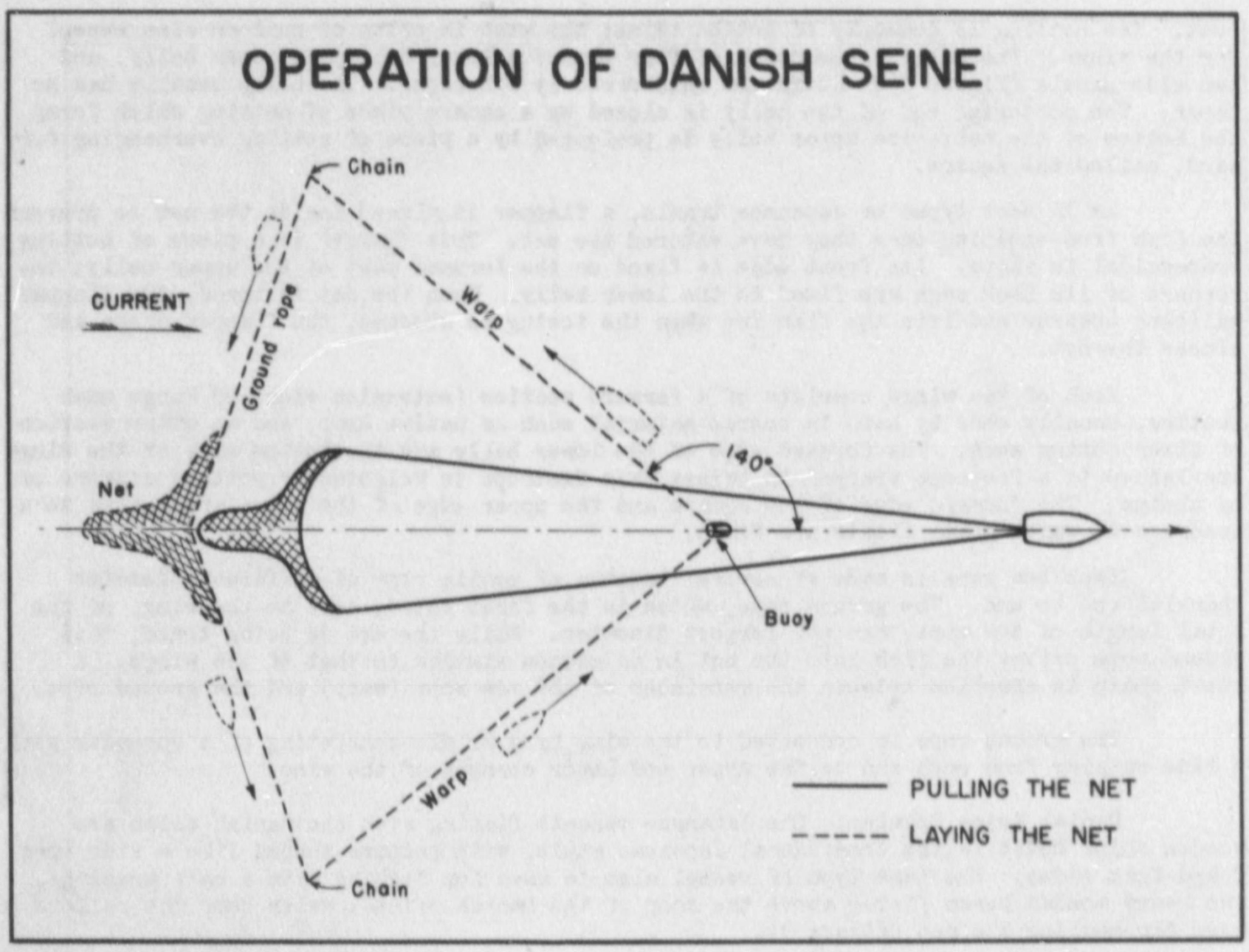


NATURAL RESOURCES SECTION

Figure 3. - Towing beams of a Danish seine trawler

Operation of Danish Seine: The Danish seine usually is towed in the direction of the current (Figure 4). When the seine is being set, the end of the portside tow rope is shackled to a buoy (generally a 55-gallon drum) which is lowered into the water. The ship then sails on a course at 140 to 150 degrees from the current, paying out the warp. When the warp has been cast in the water, the ship sails across the current, casting in succession the ground rope, the portside wing of the net, the belly, and the starboard wing and ground rope. When this is done,

5/ See Figure 9.



NATURAL RESOURCES SECTION

Figure 4

the ship sails toward the buoy and picks it up after all the warp has been paid out. Both the lines are then made fast, and the ship tows the net with the current. The ground ropes and the wings close slowly, chasing the fish toward the belly; when the tow ropes become parallel, they are hauled in with the help of the engine.

The net is pulled in by hand from the stern or from the portside of the ship, and the fish are dumped on deck by upsetting the belly. The net is then repaired, if necessary, and made ready for another casting.

3. Bull Trawl

The bull trawl is the principal type of net used by the Japanese trawlers operating in offshore waters. The Japanese bull trawl does not differ basically in construction from the Danish seine. The principal difference lies in the mode of operation: the bull trawl is towed by two vessels following a parallel course, each pulling one of the trawling warps. The warps and wings are thus spread between the two ships, keeping the mouth of the net open and sweeping a considerable area of the sea bottom (Figure 5). In Europe this mode of operation is called bull trawling because of the resemblance of the pair of vessels working together to a team of bulls harnessed to a plough.6/

6/ A trawl operated in a similar manner was used commonly on the coast of California until about 1938. This net was called "paranzella" by local fishermen.

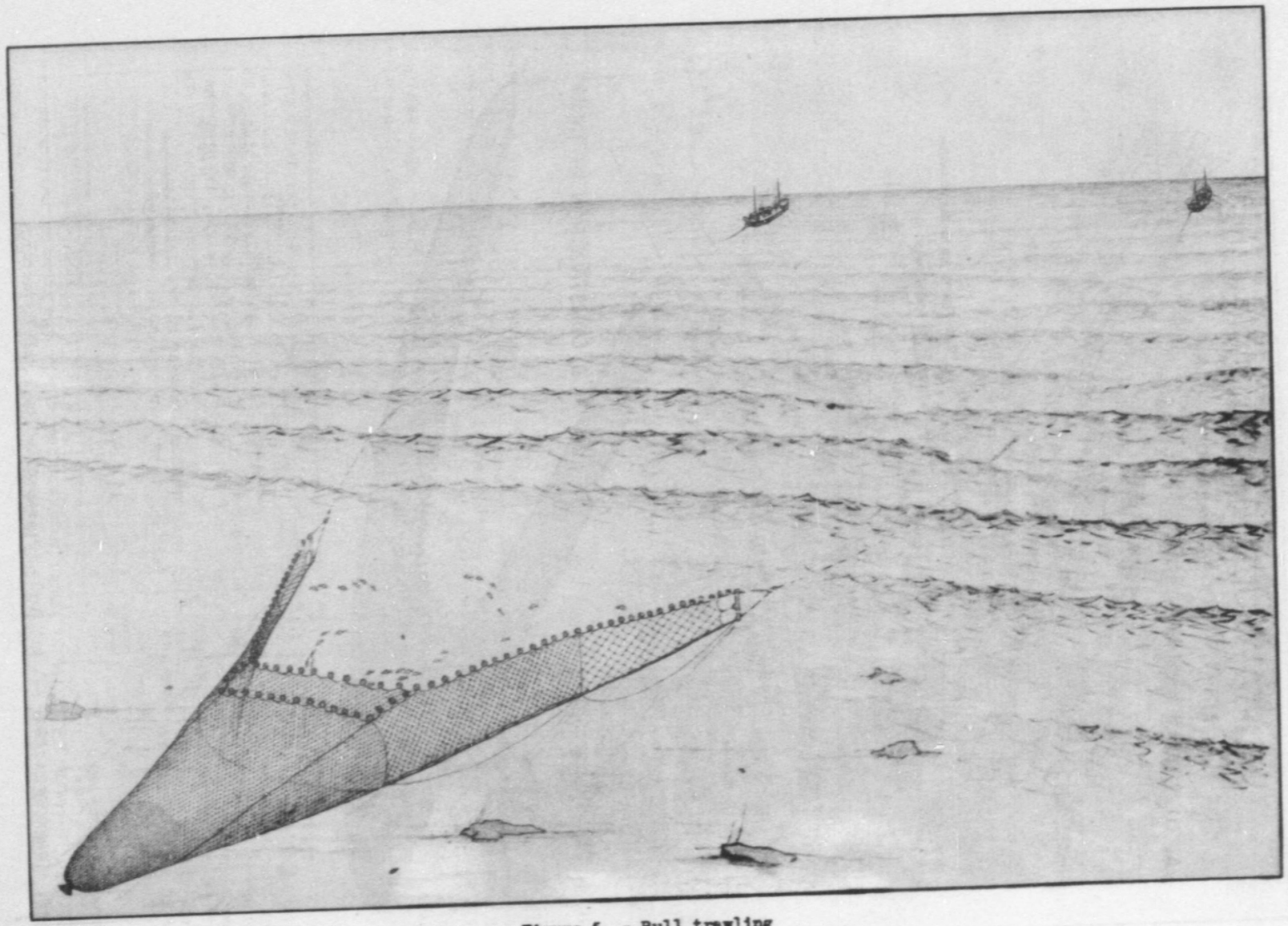
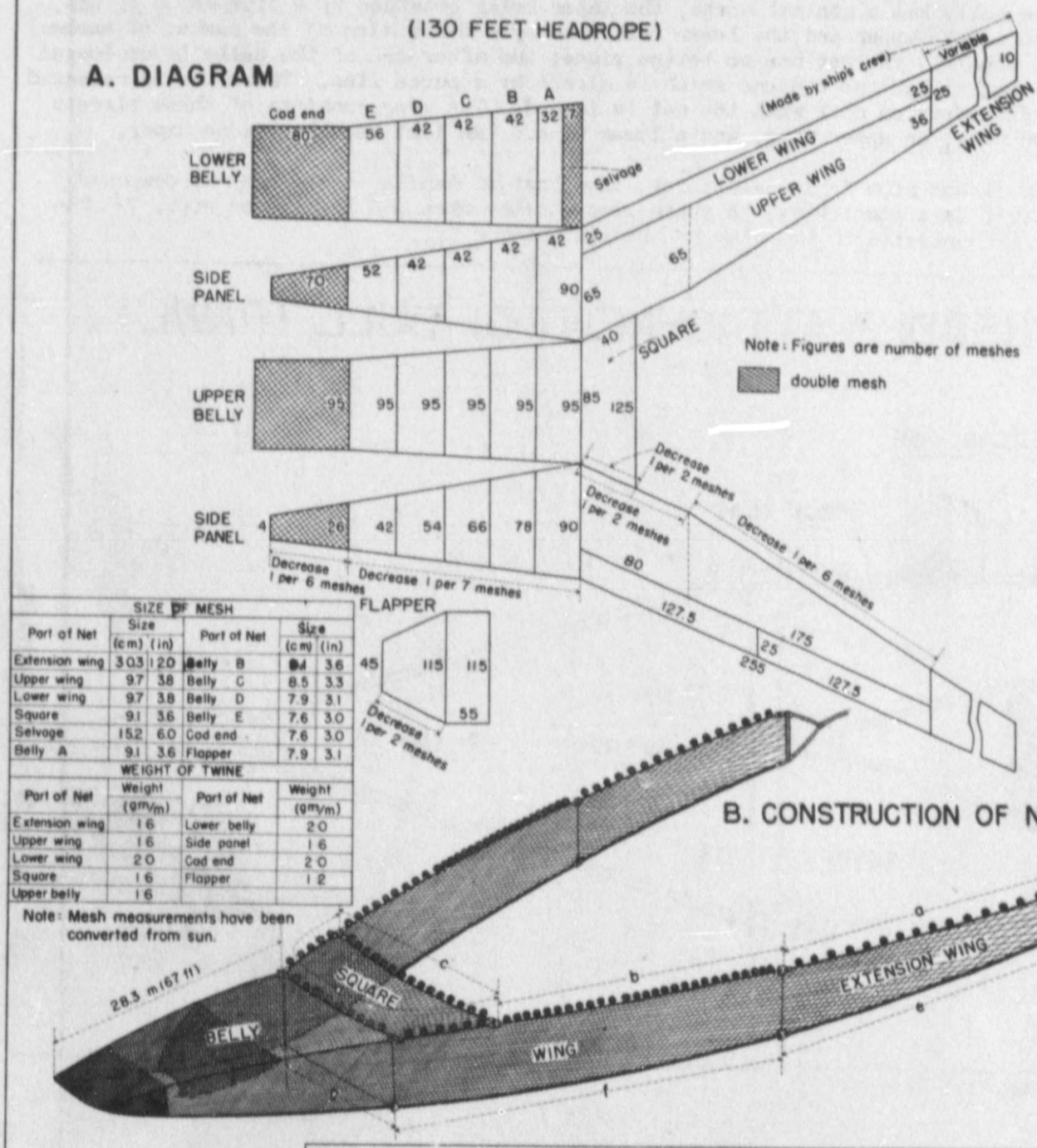


Figure 5. - Bull trawling

BULL TRAWL

(130 FEET HEADROPE)

A. DIAGRAM



SIZE OF MESH					
Part of Net	Size (cm)	(in)	Part of Net	Size (cm)	(in)
Extension wing	30.3	12.0	Belly B	9.4	3.6
Upper wing	9.7	3.8	Belly C	8.5	3.3
Lower wing	9.7	3.8	Belly D	7.9	3.1
Square	9.1	3.6	Belly E	7.6	3.0
Selvage	15.2	6.0	Cod end	7.6	3.0
Belly A	9.1	3.6	Flapper	7.9	3.1

WEIGHT OF TWINE			
Part of Net	Weight (gm/m)	Part of Net	Weight (gm/m)
Extension wing	1.6	Lower belly	2.0
Upper wing	1.6	Side panel	1.6
Lower wing	2.0	Cod end	2.0
Square	1.6	Flapper	1.2
Upper belly	1.6		

Note: Mesh measurements have been converted from sun.

B. CONSTRUCTION OF NET

WIRES AND ROPES								
Line	Material	Strand	Diam (mm)	Sections	Number	Length m	Length ft	Remarks
Headrope	Wire	6	8	Extension wing a	2	15.2	50	Floats: Sect a, No 14, Diam (cm) 20; b, 28, 15; c, 18, 15; d, 14, 15. Wire wrapped with manila twine. Each section shackled to the other
				Wing b	2	16.7	55	
				Square c	1	8.4	28	
				Belly d	1	11.2	37	
Footrope	Wire	6	15	Extension wing e	2	15.5	51	Wrapped with manila ropes. Sometimes weighted by chain
				Wing f	2	17.0	56	
				Belly g	1	6.0	20	
Rib lines	Wire	6	8		4	20	65	Lashed along each seam of the belly
Ground rope	Compound	6	32			75		Shackled to warp
	Manila rope	3	42			150		Shackled to spreader
Warp	Wire	6	15			300		A chain 2 m long weighing about 20 kg is sometimes shackled between warp and ground rope.
Chain	Iron					2		Weight 20 to 30 kg (omitted since the war)

Note: Measurements have been converted from shaku.

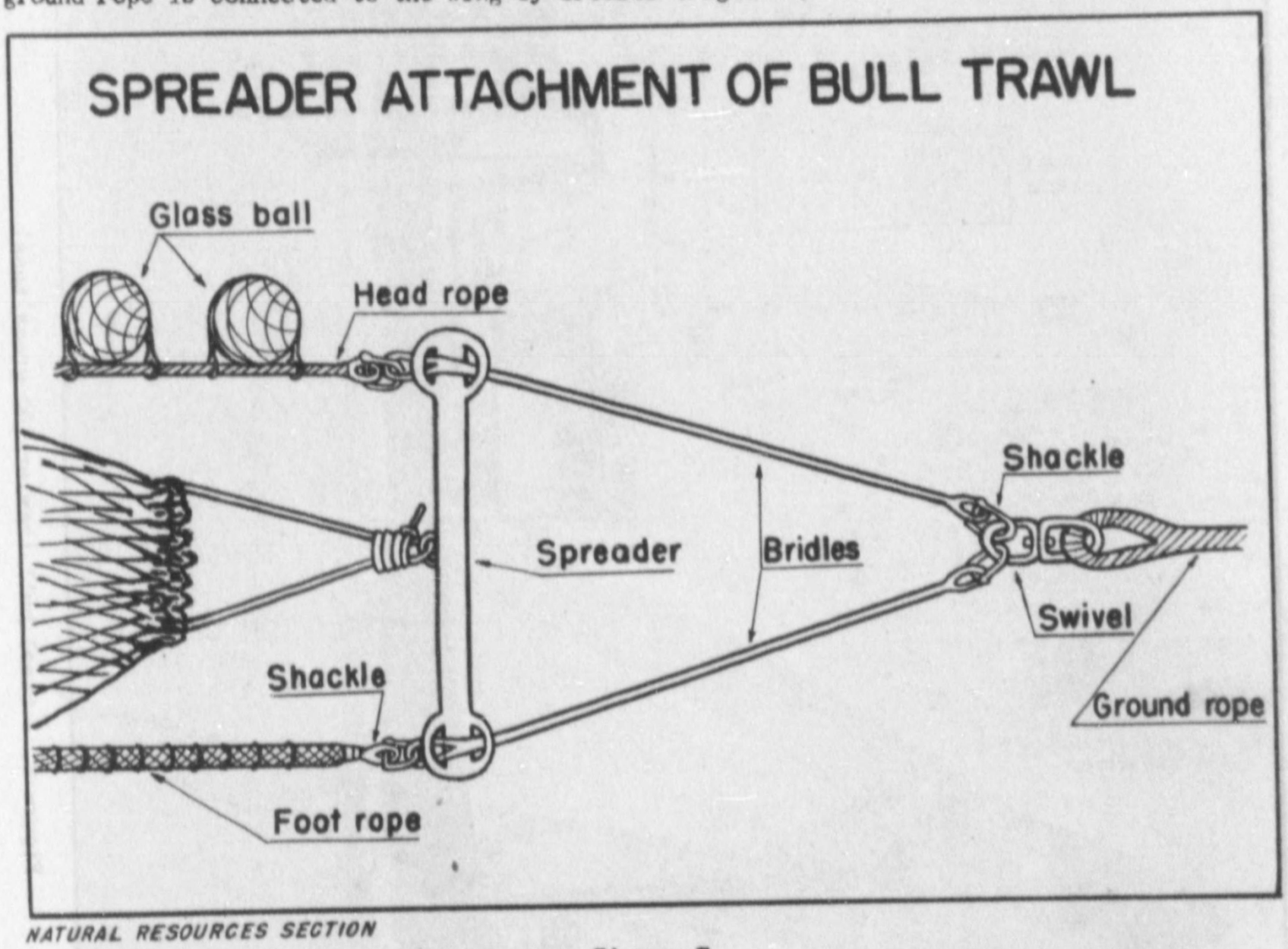
NATURAL RESOURCES SECTION

Figure 6

Construction of Net: The smaller types of bull trawl, like the Danish seine, are made of cotton twine. Tarred Manila twine is used for the larger nets (Figure 6).

The belly has a conical shape, the taper being obtained by a diminution of the size of mesh in the upper and the lower belly and by a diminution of the number of meshes in the side panels. The net has no bottom piece; the after end of the belly is prolonged by a square bag called the cod end which is closed by a purse line. This line is released to let the fish drop on deck when the net is landed. The wing consists of three pieces: an extension wing, an upper wing, and a lower wing. The last usually has no taper.

The ground rope is in two pieces, the first of Manila, the second of compound wire. The warp is a steel wire. A chain connects the warp and the ground rope. 7/ The ground rope is connected to the wing by bridles (Figure 7).

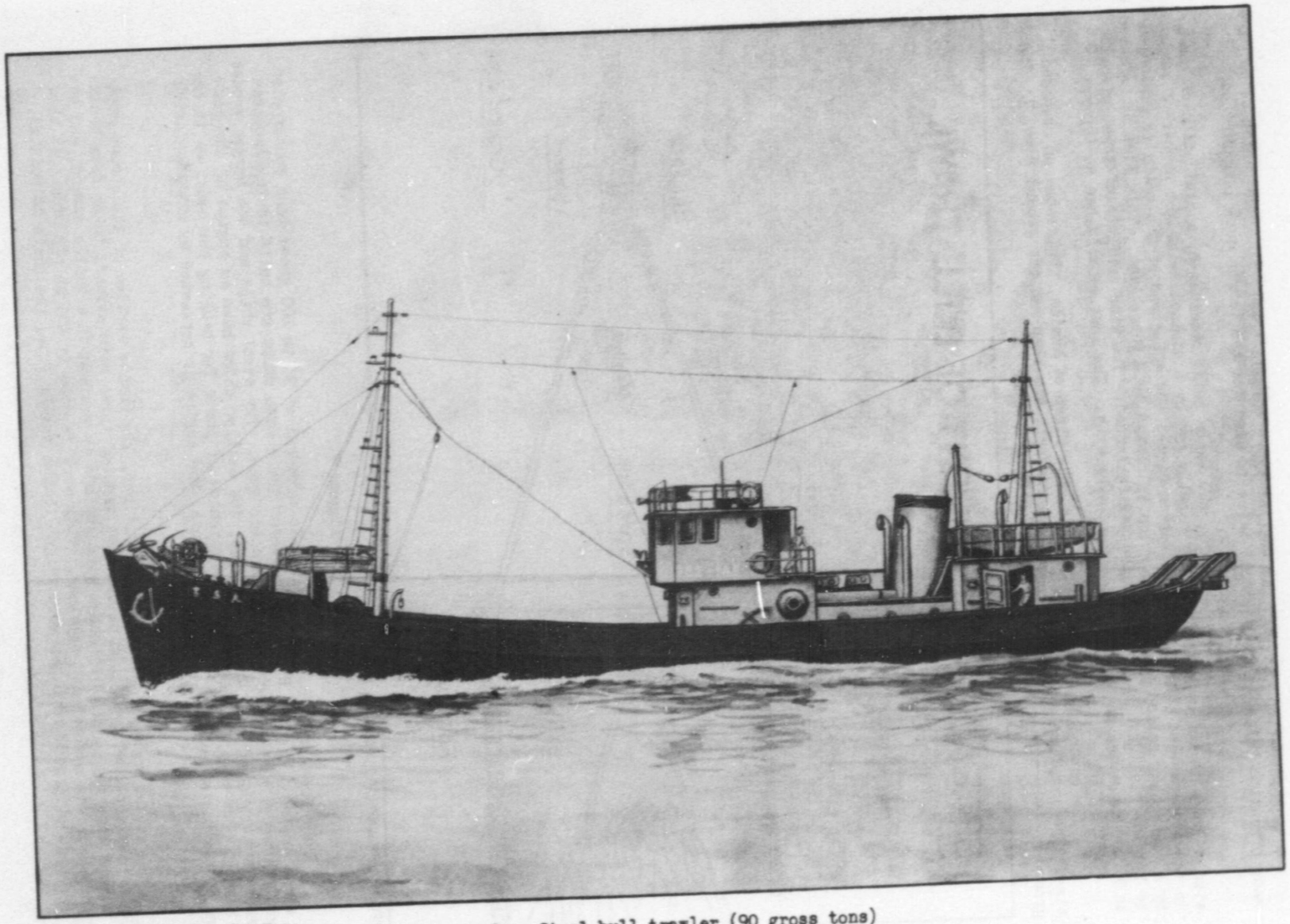


NATURAL RESOURCES SECTION

Figure 7

Bull Trawler: The bull trawler is a vessel of 30 to 100 gross tons constructed of steel or wood (Figures 8 and 9). Some of the wooden ships are built in the Japanese style (Figure 9); others are of the European type. The steel ships and the larger wooden vessels are equipped with a Diesel engine; the smaller ships have an engine of the hot-bulb type. The engine also is used as a source of power for hauling the nets, as in the case of the Danish seiner. For that purpose, the engine is connected by a transmission

7/ In the past decade, under wartime conditions, the Manila section of the ground rope has been replaced by a combination rope made of three wire strands taken from a six-strand wire rope. Each of these wire strands is wrapped in a Manila strand, and the three strands are twisted together. This work is done by the ship's crew. As this new type of ground rope has more weight than a Manila line, the chain is omitted.



NATURAL RESOURCES SECTION

Figure 8. - Steel hull trawler (90 gross tons)

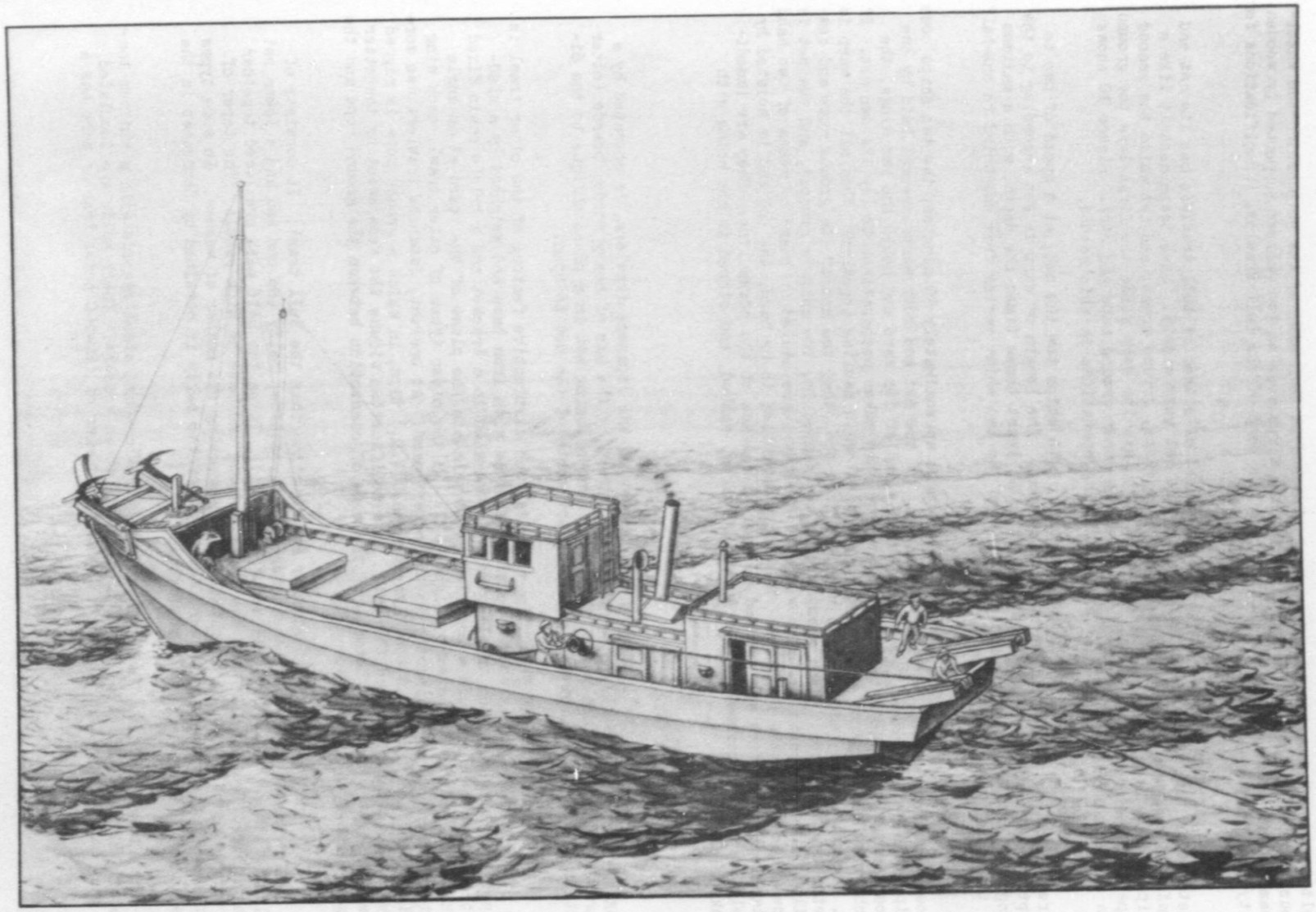


Figure 9. - Wooden hull trawler

belt to a shaft bearing two niggerheads located on each side of the ship behind the wheelhouse. When the net is being hauled in, the warps rest on two rollers supported by wooden beams slanting upward and projecting over the poop of the bull trawler. Specifications for a typical bull trawler are listed in Table 2.

Operation of Bull Trawl: Each vessel of a team of bull trawlers has its net and casts it in turn. The methods of laying the net vary widely. Some teams cast it like a Danish seine, one of the vessels laying the warps, ground ropes, and net while the second ship waits. In other teams, the second ship lays its warp while the first lays the ground rope shackled to this warp, the net, and the other ground rope and warp. Figure 10 shows the different stages of the laying and towing operations in this method.

When the bull trawl has been cast, both ships tow the net, at a speed of two to three knots, usually with the wind or current. The length of warp is set according to the depth and the nature of the bottom. It is at least three times the depth, with a maximum length of 600 meters. The distance between the two ships varies from one-third to one-half of the total length of warp.

At the end of the towing, which lasts approximately 90 minutes, the two ships come close together for the hauling of the net. If the net and both warps are all laid by one ship, this ship receives from the other the end of its warp and hauls the two wings, the ground ropes, and the net, while the second ship makes preparations to lay its own net. If each vessel laid one of the warps, both ships begin hauling together. When all the warp is in, the ship which laid the net receives from the other the end of its ground rope and completes the operation. Both ground ropes are hauled in, the ship is stopped, and the net is pulled in on the portside. The wings of the trawl are hauled on board by means of two hand ropes shackled to the footrope. The belly is pulled in by hand, the cod end is hoisted by a tackle, and the fish are dropped on deck by release of the purse line. They are immediately sorted by species, packed in wooden cases, washed, and stored in the holds with flaked ice.

4. Otter Trawl

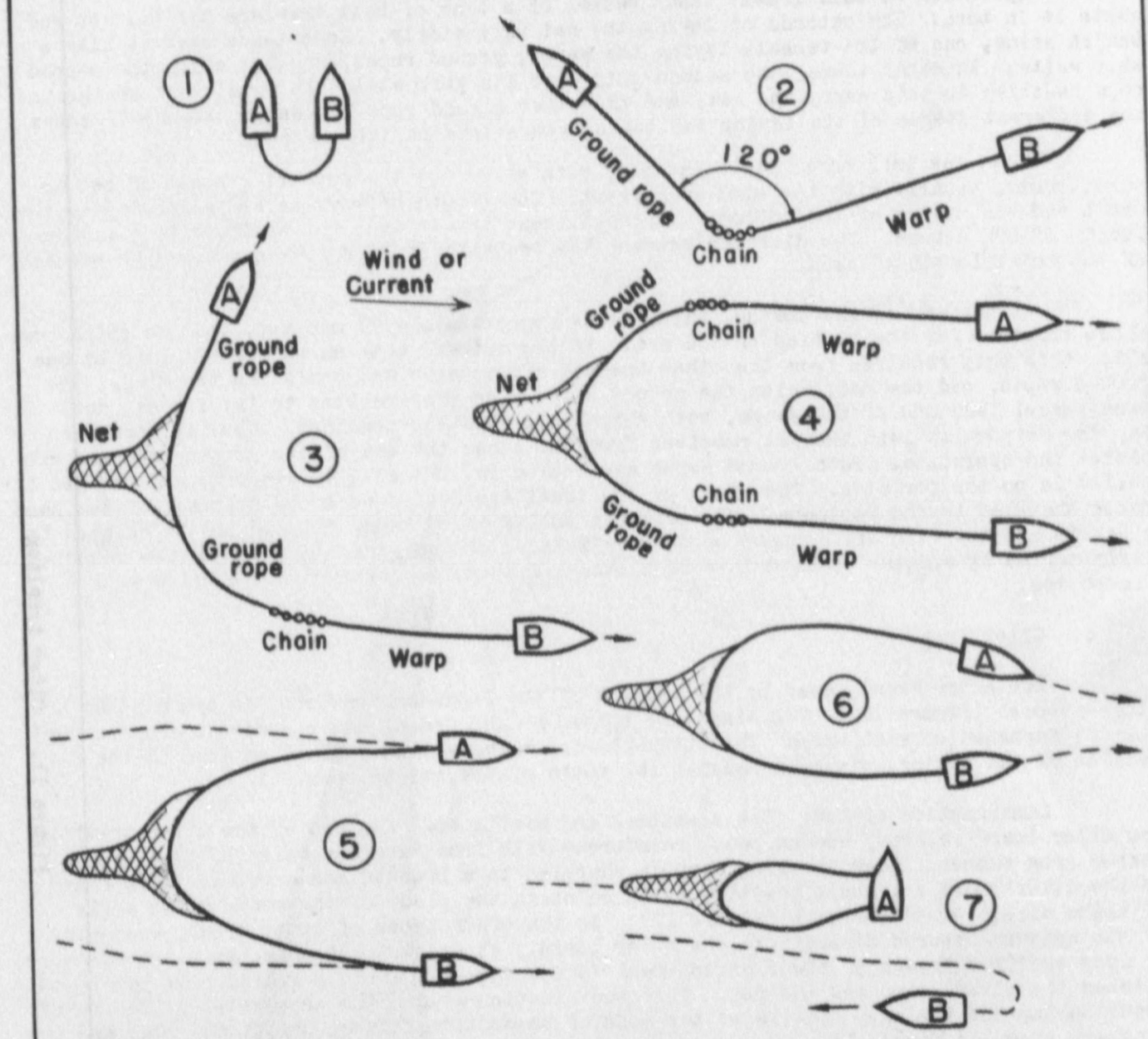
The otter trawl, used by the largest of the Japanese trawlers, is operated by a single vessel (Figure 11). The wings are spread by the use of heavy wooden boards (otter boards) fastened on each warp. The otter boards, being set in a plane oblique to the direction of the towing, diverge, causing the mouth of the net to open.

Construction of Net: The essential and distinctive feature of the otter trawl is the otter board, a heavy wooden panel reinforced with iron bars and weighted by a sled-shaped iron runner. Each trawling warp is shackled to a bracket and a bridle chain fixed to the otter board in such a position as to maintain the plane of the board at an angle with the direction of the warp (Figure 12). In the older types of otter trawl, each wing of the net was secured directly to the otter board. At present, Japanese trawlers use more or less modified trawls of the Vigneron-Dahl (V.D.) type, in which a ground rope is rigged between the otter board and the net. This modification widens the area swept by the otter trawl during the towing. Details of the mode of connection between the ground rope and the wing are shown in Figure 13.

The net itself is of simpler construction than the bull trawl. It consists of two half nets, an upper net consisting of wing, square, belly and cod end and a lower net including wings, belly, and cod end (Figure 14). These two half nets are laced together along their outer margin; thus the belly and cod end have no side panels. The taper of the wings and of the belly is obtained by decreasing the number of meshes. In some types of Japanese otter trawls, however, the taper of the belly is obtained by decreases in the size as well as in the number of meshes.

Otter Trawler: The Japanese otter trawlers are steel vessels with a minimum tonnage of 200 tons (Table 2). Most of them are steam vessels. Their holds are insulated, and they carry their fish in ice. The large trawler of 400-500 gross tons or more has a

OPERATION OF BULL TRAWL



① Trawler B sends its warp to A which shackles it to the qround rope

② Trawler B lays the warp; trawler A lays the ground rope

③ Trawler A has cast its net and lays the portside ground rope, trawler B waits

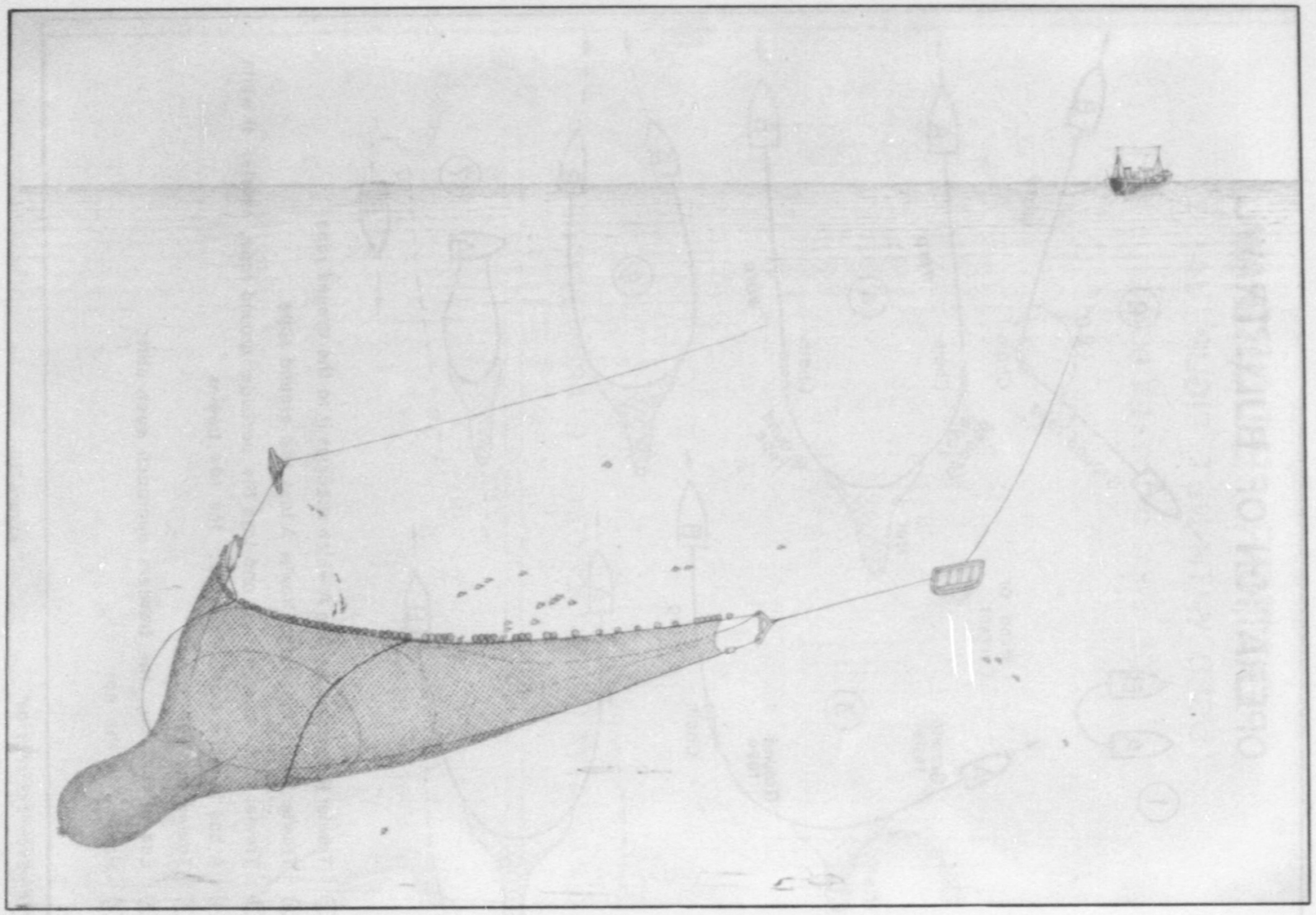
④ A has laid the portside warp; the tow begins

⑤ Towing the bull trawl

⑥ End of the tow; the trawlers approach each other

⑦ Hauling in the net

Figure 10



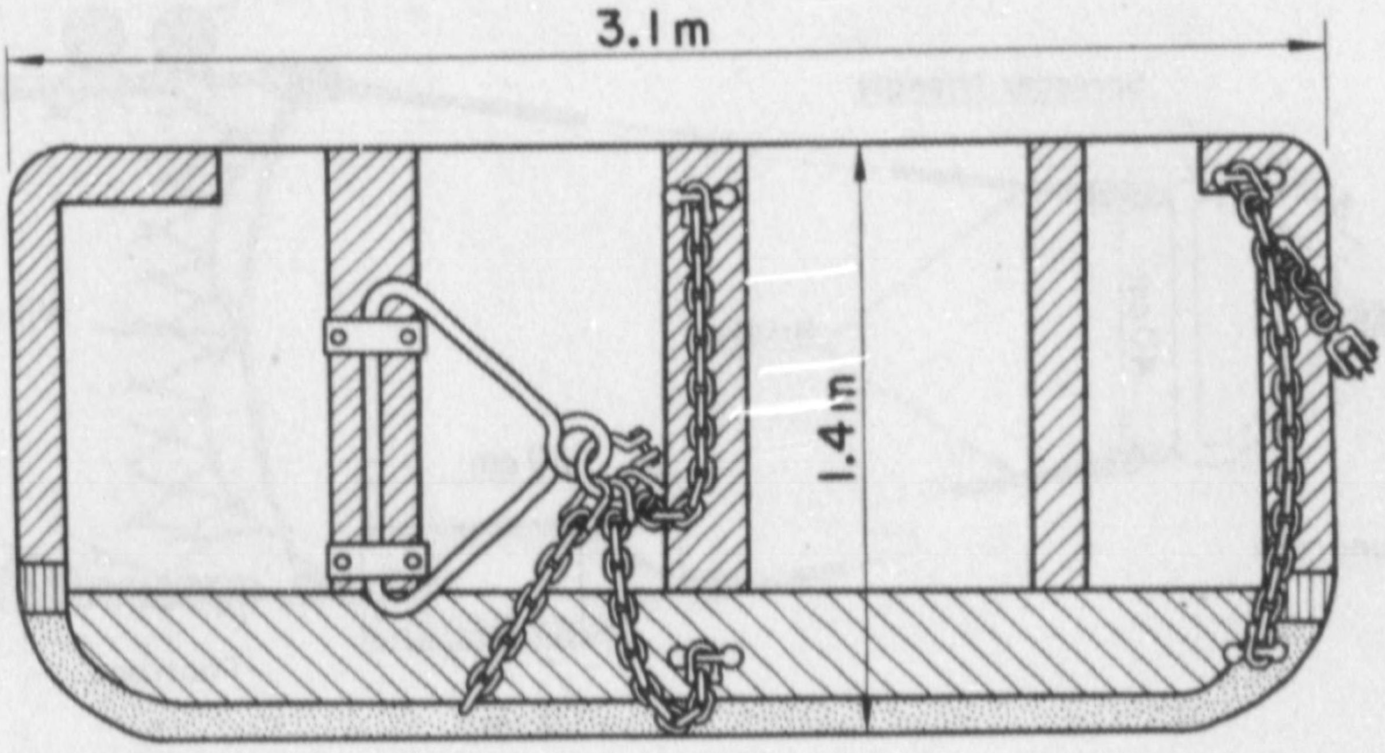
NATURAL RESOURCES SECTION

Figure 11. - Otter trawling

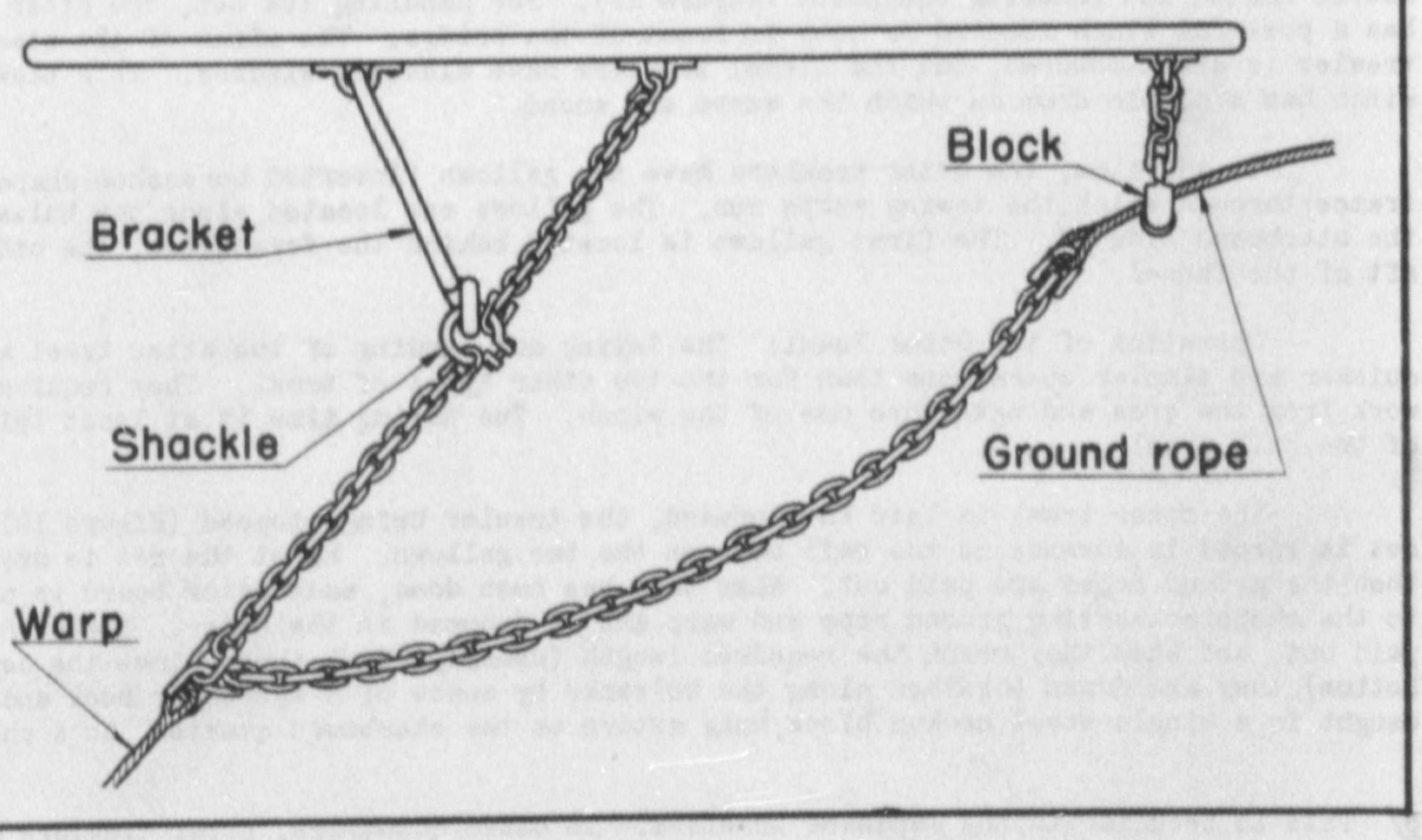
OTTER BOARD

(USED WITH NET, FIGURE 14)

SIDE VIEW OF OTTER BOARD

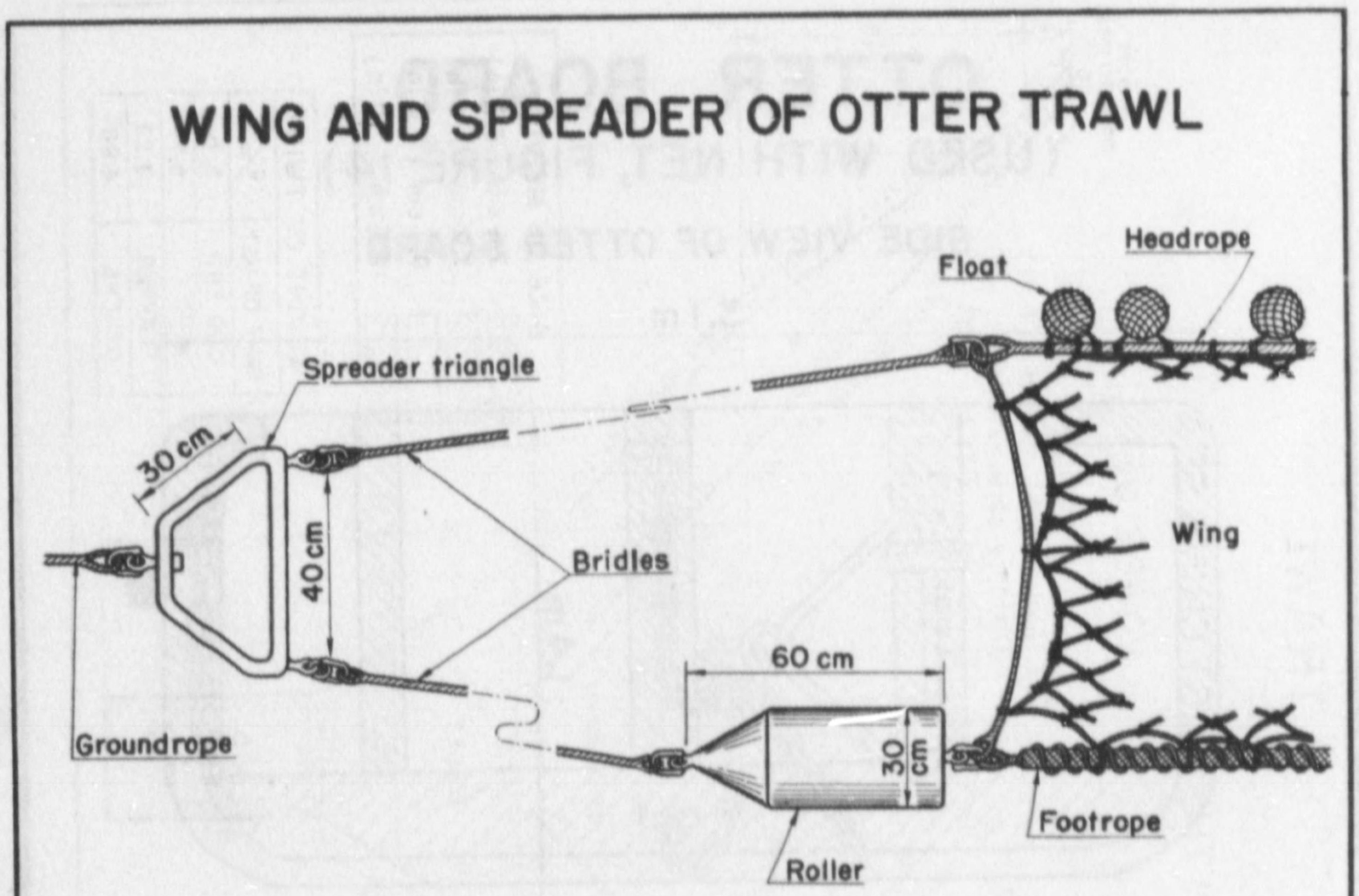


ATTACHMENT OF OTTER BOARD TO WARP



NATURAL RESOURCES SECTION

Figure 12



NATURAL RESOURCES SECTION

Figure 13

Diesel engine and freezing equipment (Figure 15). For handling its net, the otter trawler has a powerful winch located on deck in front of the bridge. The winch of the steam trawler is steam-powered, but the Diesel trawlers have electric winches. This trawling winch has a double drum on which the warps are wound.

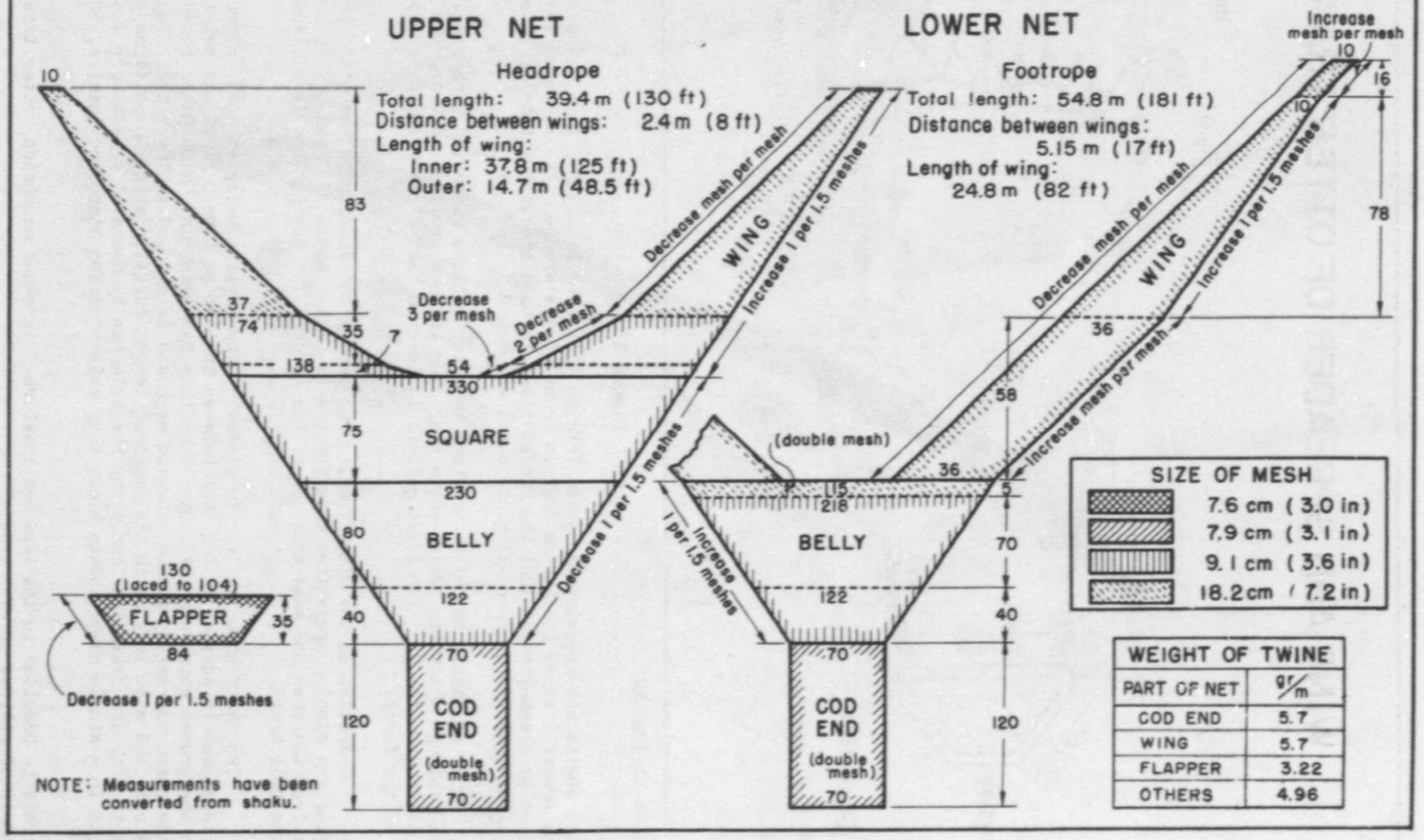
In addition, the otter trawlers have two gallows (inverted horseshoe-shaped frames) through which the towing warps run. The gallows are located along the bulwarks of the starboard side 8/. The first gallows is located behind the forecastle, the other is aft of the funnel.

Operation of the Otter Trawl: The laying and landing of the otter trawl are quicker and simpler operations than for the two other types of trawl. They require less work from the crew and make more use of the winch. The towing time is at least twice that of the bull trawl.

The otter trawl is laid to windward, the trawler being stopped (Figure 16). The net is spread in advance on the rail between the two gallows. First the net is dropped; then the ground ropes are paid out. When this has been done, each otter board is shackled to the chain connecting ground rope and warp and is dropped in the water. The warps are paid out, and when they reach the required length (usually about three times the depth of bottom) they are drawn together along the bulwarks by means of a messenger hook and are caught in a single steel hookup block, hung astern on the starboard quarter, to a chain

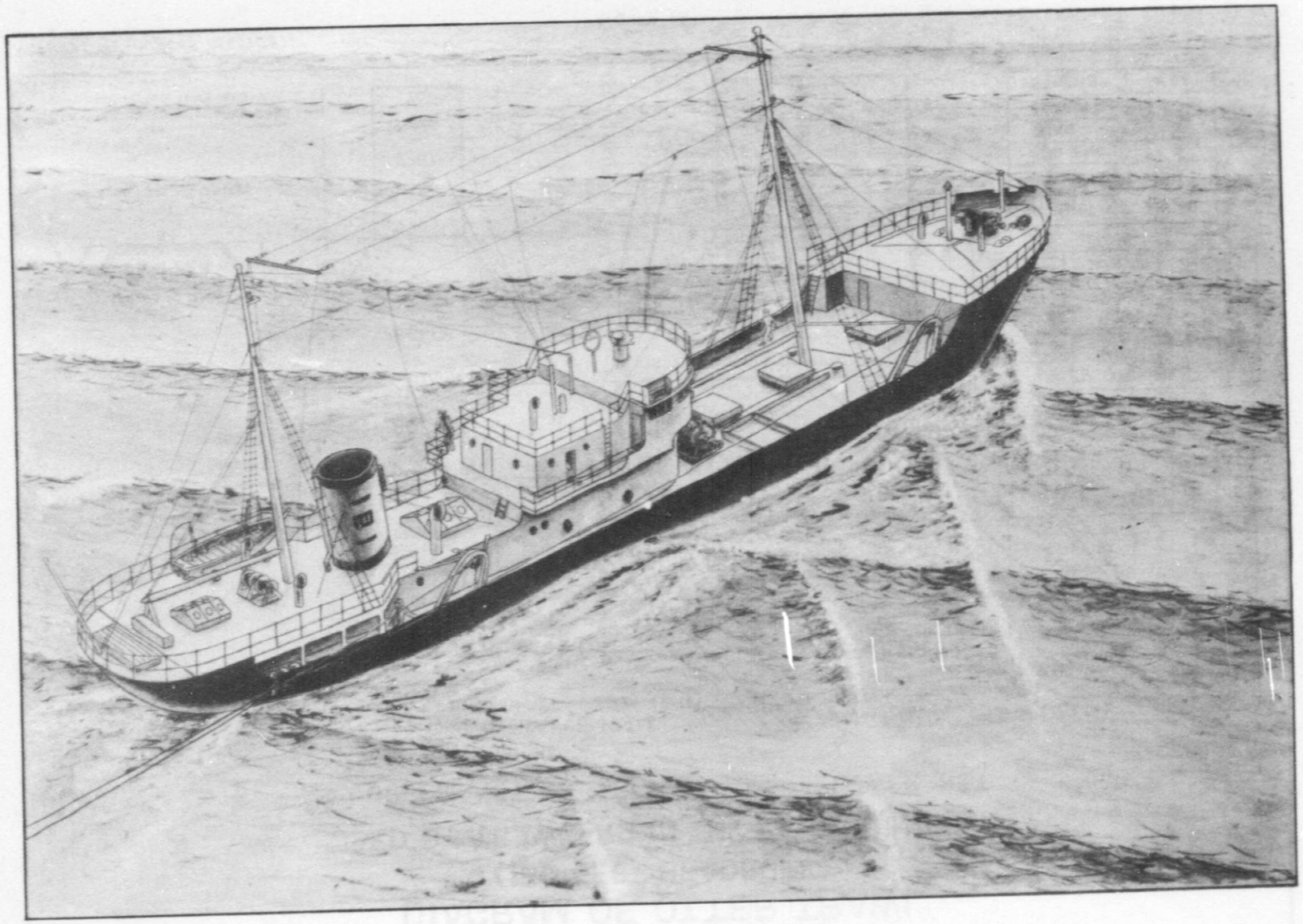
8/ This is peculiar to the Japanese trawlers. In other countries, otter trawlers have a pair of gallows on each side.

DIAGRAM OF OTTER TRAWL
(130 FEET HEADROPE)
USED BY TRAWLERS IN THE EAST CHINA SEA



WEIGHT OF TWINE	
PART OF NET	gr/m
COD END	5.7
WING	5.7
FLAPPER	3.22
OTHERS	4.96

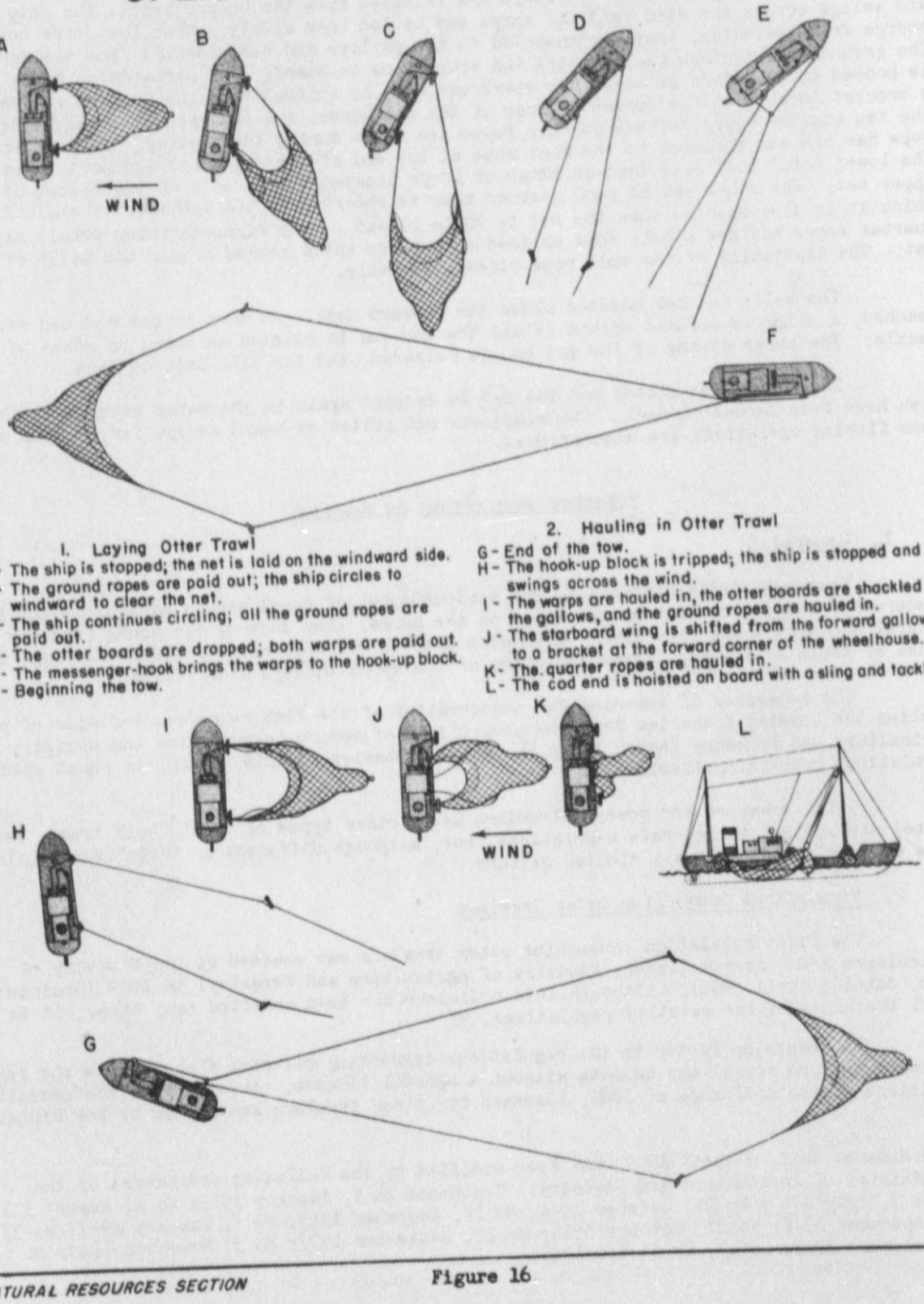
Figure 14



NATURAL RESOURCES SECTION

Figure 15. - Modern otter trawler of 500 gross tons

OPERATION OF OTTER TRAWL



1. Laying Otter Trawl

A - The ship is stopped; the net is laid on the windward side.
B - The ground ropes are paid out; the ship circles to windward to clear the net.
C - The ship continues circling; all the ground ropes are paid out.
D - The otter boards are dropped; both warps are paid out.
E - The messenger-hook brings the warps to the hook-up block.
F - Beginning the tow.

2. Hauling in Otter Trawl

G - End of the tow.
H - The hook-up block is tripped; the ship is stopped and swings across the wind.
I - The warps are hauled in, the otter boards are shackled to the gallows, and the ground ropes are hauled in.
J - The starboard wing is shifted from the forward gallows to a bracket at the forward corner of the wheelhouse.
K - The quarter ropes are hauled in.
L - The cod end is hoisted on board with a sling and tackle.

NATURAL RESOURCES SECTION

Figure 16

fixed on the ship's frame. The net is then towed for three or four hours. The towing speed of Japanese trawlers usually does not exceed three knots.

For landing the net, the warps are released from the hookup block, the ship stops and swings across the wind, and the warps are hauled back slowly. When the otter boards emerge from the water, they are shackled to the gallows and disconnected from the warps. The ground rope is then hauled until the wings come on board. The portside or after wing is hooked to the stern gallows, the starboard wing is shifted from the forward gallows to a bracket located on the forward corner of the deckhouse, and the net is closed by hauling the two quarter ropes. These quarter ropes are slack during the fishing. Each quarter rope has one end shackled to the foot rope at the end of the starboard and port bosoms of the lower net. They pass through rings or loops located at the ends of the bosoms of the upper net. The other end of each quarter rope is shackled to the spreader triangle from which it is disconnected when the net is to be closed. Many Japanese otter trawls have no quarter ropes but use a bull rope spliced on a strap which passes around the belly of the net. The tightening of the bull rope closes the belly.

The belly is then hoisted above the forward deck. As soon as the cod end can be reached, a sling is secured around it and the cod end is hoisted on board by means of a tackle. The purse string of the cod end is released, and the fish drop on deck.

The cod end is closed and the net is dropped again in the water as soon as the fish have been landed on deck. The wings are not pulled on board except for mending or when fishing operations are discontinued.

JAPANESE REGULATIONS ON TRAWLING

1. General

When used indiscriminately, the various types of trawl can be harmful to the fish resources. Dragged on bottoms too close to the shore, they destroy the young fish and the natural shelters where they live. Even when used in offshore waters, the trawls may, because of their efficiency, cause depletion of the stock through overfishing.

The necessity of insuring the conservation of the fish resources and also of protecting the coastal fisheries from the competition of modern trawlers led the Ministry of Agriculture and Forestry (which is in charge of fisheries administration) to enact special regulations concerning trawlers.

Otter trawlers and powered trawlers using other types of trawl (bull trawl, Danish seine) are subject to separate regulations, but, although different in their details, both sets of regulations follow a similar pattern.

2. Regulations Concerning Otter Trawlers

The first regulation concerning otter trawlers was enacted by the Ministry of Agriculture and Commerce (later, Ministry of Agriculture and Forestry) in 1909 (Ordinance No 3, dated 6 April 1909). Although this ordinance has been modified many times, it is still the basis of the existing regulations. 9/

The governing factor in the regulations concerning offshore fisheries is the requirement that no vessel may operate without a special license. According to the essential provisions of the ordinance of 1909, licenses for otter trawlers are issued by the Ministry

9/ Ordinance No 3, 6 April 1909, has been modified by the following ordinances of the Ministry of Agriculture and Forestry: Ordinance No 5, January 1911; No 4, August 1912; No 9, July 1913; No 25, October 1914, No 27, December 1915; No 1, January 1917; No 35, September 1918; No 21, October 1924; No 42, September 1937; No 3, November 1943; No 6, December 1943; No 47, September 1946.

of Agriculture and Forestry. An otter trawler is permitted to operate only within specified areas mentioned on its license. The license also specifies the harbors where the catch may be landed.

In addition, trawling is prohibited altogether on certain fishing grounds designated by decisions of the Ministry of Agriculture and Forestry (Figure 17). In 1909 these prohibited areas included the coastal area of Japan Proper; for that reason the otter trawlers fished in the Korea Strait and in the East China Sea. As the number of trawlers increased, part of the Korea Strait was included in the prohibited area. When otter trawling expanded in the East China Sea, the forbidden area came to include the coastal waters of Korea and the northwest coast of Formosa.

In order to induce the otter trawlers to operate far from the coast, certain minimum characteristics were made compulsory in 1917 for this type of trawler. Since then, otter trawlers have been required to have a minimum gross tonnage of 200 tons, a cruising range of at least 2,000 nautical miles, and a maximum speed of at least 11 knots.

At the same time, in order to prevent overfishing the total number of licenses to be issued to otter trawlers was restricted to 70. In 1924, in order to permit the development of otter trawling in the South China Sea, this limitation was made applicable only to the licenses issued for the East China and Yellow seas.

3. Regulations Concerning Other Types of Trawlers

As offshore bull trawling developed later than otter trawling, regulations concerning this fishery were not enacted until 1921. They apply to all powered trawlers other then otter trawlers. The initial ordinance has since been abrogated and replaced by Ordinance No 20, dated 25 July 1934, which is the basis of the present regulations. 10/

As in the case of the otter trawler, licenses are issued by the Ministry of Agriculture and Forestry. Formerly licenses for coastal vessels could be delivered by prefectural governments, but since 1947 this authority has been restricted to the delivery of licenses for small fishing craft only. The total number of licenses is not limited.

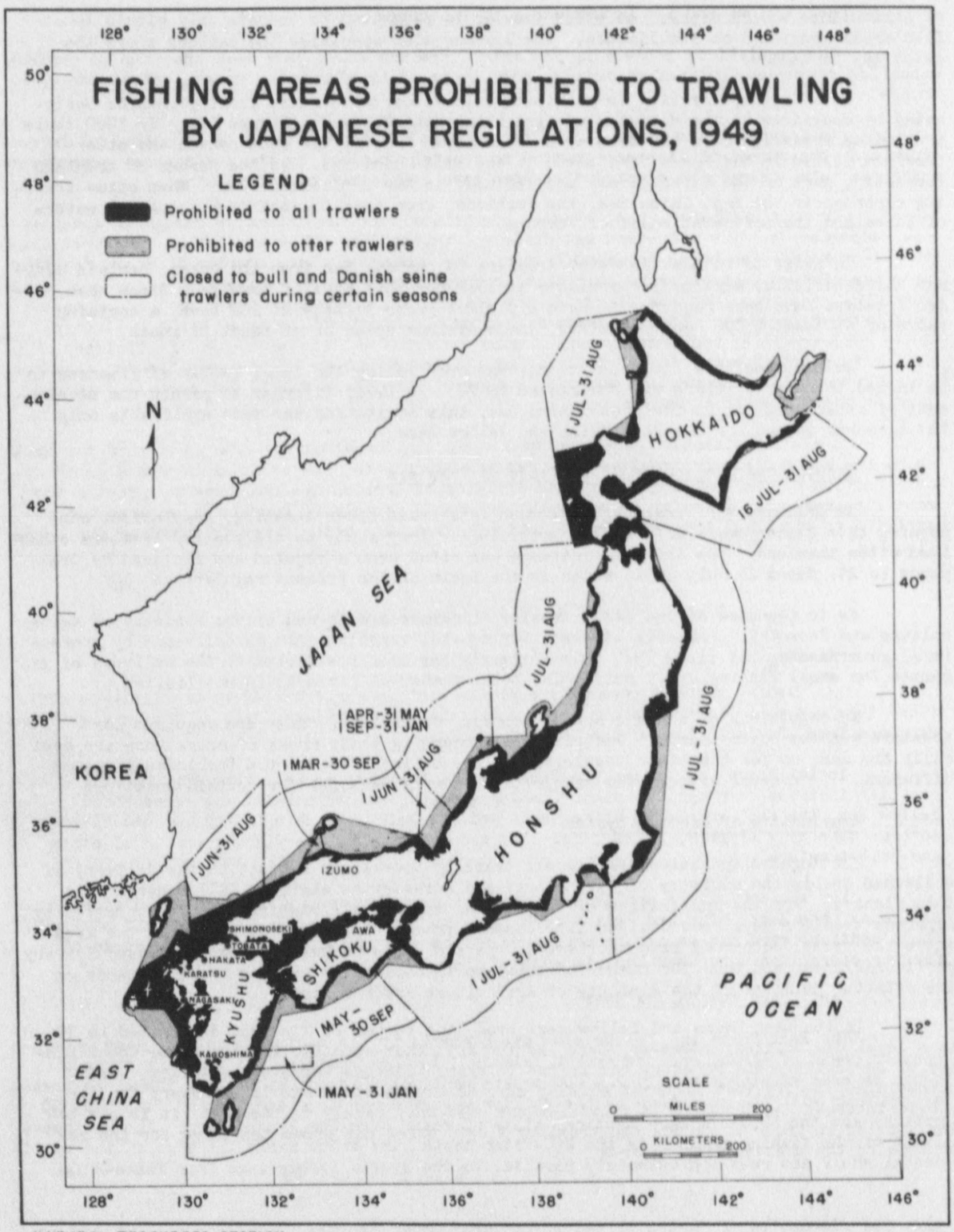
No conditions of minimum speed, tonnage, or cruising range are required for trawlers without otter boards. Restrictions concerning their areas of operations are basically the same as for the otter trawlers, but the delimitation of the forbidden areas is different. In coastal waters, the prohibition is only seasonal for certain locations.

4. Application of License System

The legal dispositions making all trawling operations subject to the delivery of a license enable the Ministry of Agriculture and Forestry to exercise full control over this fishery. For the application of the license system, all fishing grounds exploited by Japanese trawlers have been divided into license areas. Each license specifies the area where the vessel concerned is authorized to operate. The number of licenses issued for any particular area, and thus the number of trawlers authorized to operate there, depends on the existing policies of the Ministry of Agriculture and Forestry.

In the East China and Yellow seas area, the number of licenses is limited to 70 by a legal disposition. However, here, as for any other specific fishing area, the Ministry of Agriculture and Forestry can refuse to grant licenses whenever necessary. Ordinances also specify that licenses already granted may be withdrawn if necessary for the public interest. Although this provision was used only rarely in the past, it is now being applied in order to reduce the trawling fleet, which has grown too large for the resources of the present fishing area.

10/ Modifying ordinances have been issued on 8 September 1937, 19 October 1942, 3 March 1944, 6 September 1946, and 23 April 1947.



NATURAL RESOURCES SECTION

Figure 17

5. Regulations and the Conservation of Resources

The regulations concerning the otter trawlers would have been adequate to protect the fish resources, but unfortunately other types of trawlers are not subject to the same rules.

In Japanese home waters, even though most of the coastal area is closed to large trawlers, the number of licenses granted to coastal trawlers by the prefectural governments has been rather large and coastal fishermen have complained of overfishing.

In most offshore areas, trawler operations were not intensive enough to endanger the resources, but the situation was different in the East China and Yellow seas area which is closer to trawler bases in Japan Proper. The number of otter trawler licenses for this area was limited, but offshore bull trawler operations were not subject to a regulation before 1921, and even then the new ordinance did not set a specific limit on the number of bull trawler licenses. Fishing companies which could not obtain otter trawler licenses built bull trawlers, and these vessels became numerous in this area. As the Ministry of Agriculture and Forestry failed to limit or reduce the number of licenses issued, overfishing occurred. 11/ The problem was still unsolved when World War II reduced all Japanese trawler activities to a minimum.

A similar situation has developed since the Surrender, in the portion of the East China Sea where offshore trawlers have resumed operations. Eager to encourage a quick reconstruction of the trawling fleet, the Ministry of Agriculture and Forestry granted too many licenses, thus allowing an excessive number of vessels to operate in an area too restricted to withstand intensive exploitation. Steps are being taken to withdraw the excess licenses.

NORMAL OPERATIONS OF TRAWLERS BEFORE WORLD WAR II

1. General

The fishing grounds generally exploited before World War II by the Japanese offshore trawlers were located on the continental shelf of southeast Asia. Fishing operations extended from the Japan Sea to the South China Sea.

In the Japan Sea, where the Danish seine trawlers worked, trawling operations had peculiar features. In all the other fishing grounds, which included the Korea Strait, the Yellow Sea, the East and South China seas, and the Gulf of Tonkin, resources and fishing methods were very similar. This large area was essentially the fishing ground of otter and bull trawlers.

For the convenient application of the license system, this areas was divided into sections: the East China and Yellow seas 12/, the South China Sea, and the Gulf of Tonkin. These sections were not as a rule exploited by the same ships, and separate records of fishing operations have been kept in each of them.

2. East China and Yellow Seas

The East China and Yellow seas are bordered by the eastern coast of China, the western coast of Korea, and the Ryukyu Islands. In these waters, the trawling grounds cover an area of approximately 200,000 square nautical miles; they include the whole area of two seas with the exception of the shallow waters close to shore (depths less than 20 meters) and the 50,000 square nautical miles of water over the Ryukyu Deep. The southeast limit of the fishing grounds is the 200-meter depth line which marks the edge of the continental shelf and runs approximately parallel to the Ryukyu Archipelago from Fukae-shima

11/ See discussion of "Catch by Otter Trawlers" under "Normal Operations of Trawlers Before World War II".
12/ This license area included a part of the Korea Strait.

(Fukae Island), west of Kyushu, to Formosa. The East China and Yellow seas license area extended westward to the Strait of Formosa, where its southern limit was latitude 25°N.

General Conditions: Climatic conditions, continental in the Gulf of Chihli and north Yellow Sea, are under the influence of the monsoons in the greater part of the fishing area The warm waters of a branch of the "Kuroshio" (Black current) flow over the southern part of the fishing area in a northeasterly direction and enter the Japan Sea through the Korea Strait. The sea bottom of the trawling grounds slopes gradually from the 20-meter to the 200-meter depth line, with one notch in a north-northwest direction from Quelpart Island (Saishuto). Bottoms are mud mixed with a variable proportion of sand which generally increases with the depth or the distance from the shore. Waters close to the China coast are muddy from the alluvions of large rivers flowing from the continent; they are often rich in organic matter and planktonic life. The fauna, more or less typical of temperate waters, is varied but not extremely rich.

As a whole these conditions, especially the nature and the depth of the bottom, are suitable for trawling. The proximity of the area to Japan has made it the main fishing ground of Japanese offshore trawlers. The number of trawlers operating there and the total amount of their catch always exceeded the number of vessels and the catch in all other Japanese trawling areas combined.

Operations of Otter Trawlers: The otter trawlers were the first offshore vessels which began the exploitation of the East China and Yellow seas area. Since 1918, their number has been limited to 70 by law. Between 1923 and 1937, the number of otter trawlers fishing in this area rarely dropped below the legal maximum (Table 1). It decreased after 1937 when the war between Japan and China interfered with fishing operations.

The principal bases of the otter trawlers were Shimonoseki in Yamaguchi Prefecture, Tobata and Hakata in Fukuoka Prefecture, and Nagasaki in Nagasaki Prefecture. Shimonoseki and Tobata were the most important. In addition, a few Japanese otter trawlers were based in Shanghai starting in 1939.

Before 1918, the tonnage of most Japanese otter trawlers did not exceed 100 gross tons. The minimum legal tonnage was fixed at 200 gross tons in 1918, and since then the size of the ships above this minimum has increased constantly. In 1928, most of the otter trawlers fishing in the East China and Yellow seas were about 250 gross tons, with steam engines of about 480 horsepower. In the early 1930's, large fishing companies began using trawlers of about 400 tons equipped with 550 horsepower Diesel engines. In 1937, the 70 otter trawlers licensed for operations in the East China and Yellow seas included at least 12 large Diesel trawlers of 400 to 500 gross tons.

Most of the otter trawlers belonged to large fishing companies. The most important companies were the Kyodo Gyogyo Co 13/, which at one time owned more than 80 percent of the total number of the licenses, and the Hayashikane Shoten Co 14/.

The steam otter trawlers, which kept their fish in flaked ice, stayed at sea for about 15 days. Allowing for the time spent in harbor for unloading fish and loading ice and supplies, and the annual laying up for survey and repairs, this meant an average of 19 fishing trips per year in normal operating conditions.

The Diesel otter trawlers, which were fitted with freezing plants, made longer fishing trips, staying at sea 30 to 40 days. They froze their catch and stored it in refrigerated holds. The freezing process was rather slow, requiring four hours for complete freezing. 15/

13/ Renamed Nippon Suisan Co in 1937
14/ Renamed Taiyo Gyogyo Co in 1945
15/ A brief description of the freezing process is given under "Combined Operations of Trawlers and Factory Ships".

Catch by Otter Trawlers: The catch by otter trawlers in the East China and Yellow seas includes a great variety of fish species. Among these, the more valued on the Japanese market are what Japanese trawl fishermen call "akamono" (red fish). The "akamono" include several species of sea bream, blanquillo, snapper, and gurnard. Other fish less valued but commonly found on the trawling grounds are croakers, lizard fish, flatfish, and ribbonfish. In addition, a prawn, Peneaus orientalis, highly regarded by the Japanese, is caught in the northern part of the fishing area. Rays and sharks, which have a lower market value, are caught with the other fish although not predominant in the catch. The classifications in use in the fish markets of the trawling harbors are shown in Table A.

TABLE A. - PRINCIPAL SPECIES OF FISH CAUGHT BY TRAWLERS IN EAST CHINA AND YELLOW SEAS a/

Japanese b/	Scientific Name	Nearest English Equivalent
Taisho ebi 大正蝦	Peneaus orientalis	Prawn
Madai 眞鯛	Pagrosomus major	Sea bream, porgy
Chidai 血鯛	Evynnis japonicus	Sea bream, porgy
Managatsuo 鯧	Stromateus argenteus	Butterfish
Amadai 甘鯛	Branchiostegus japonicus	Blanquillo
Itoyori 絲撚	Nemipterus virgatus	Red snapper
Renkodai 連子鯛	Taius tumifrons	Sea bream
Hobo 鮫魴	Chelidonichthys kumu	Gurnard
Nibe 鮸	Nibea mitsukurii	Croaker
Hamo 鱧	Muraenesox cinereus	Conger eel
Akashita 赤舌鮃	Areliscus joyneri	Sole
Shizu しず	Psenopsis anomala	Butterfish

(Cont'd)

TABLE A. - PRINCIPAL SPECIES OF FISH CAUGHT BY TRAWLERS IN EAST CHINA AND YELLOW SEAS (Cont'd)

Japanese	Scientific Name	Nearest English Equivalent
Shiroguchi 白石頭魚	Nibea argentata	Croaker
Kuroguchi 黒石頭魚	N. nibe	Croaker
Kiguchi 黄石頭魚	Pseudosciaena manchurica	Croaker
Hirame, jo-karei 鮃, 上鮃	c/	Flatfish (high-grade)
Anago 穴子	Astroconger myriaster	Conger eel
Eso 狗母魚	Saurida argyrophanes	Lizard fish
Kanagashira 金頭	Lepidotrigla microptera	Gurnard
Tachi uo 太刀魚	Trichiurus haumela	Ribbonfish
Kochi 鯒	Platycephalus indicus	Flathead
Ge-karei 下鮃	c/	Flatfish (low-grade)
Jo-fuka 上鱶	c/	Sharks (high-grade)
Aka ei 赤鱏	Dasyatis akajei	Sting ray
Ge-fuka 下鱶	c/	Sharks (low-grade)
Ge-ei 下鱏	c/	Rays (low-grade)

(Cont'd)

TABLE A. - PRINCIPAL SPECIES OF FISH CAUGHT BY TRAWLERS IN EAST CHINA AND YELLOW SEAS (Cont'd)

Japanese	Scientific Name	Nearest English Equivalent
Same 鮫	c/	Guitarfish, angel shark, saw shark, and some other low-grade sharks

a/ Listed in approximate order of commercial value, variable with location, season, and size of fish.
b/ Name commonly used in trawling harbors. Same fish may have different vernacular names in Tokyo.
c/ Includes several species

The more valued species are eaten fresh by the Japanese consumers. The less valued fish are processed in plants at Tobata, Shimonoseki, and Osaka into fish paste and fish cake for human consumption. The fish cake of the best quality is made of croakers and lizard fish. Other fish cakes and pastes include rays and sharks. Lower-quality products include a higher proportion of this type of meat.

Although the entire trawling area previously described was exploited, the trawlers usually selected certain more or less well defined zones corresponding to local concentrations of fish. Evidence based on the seasonal shifting of these zones indicates that the location and the density of the fish concentrations vary in relation with the distribution of bottom temperatures in the East China and Yellow seas. Studies based on reports from otter trawlers have been undertaken to determine the conditions under which the concentrations occur, the probable migrations of the fish, and their spawning grounds. 16/ Because available data are inadequate, the conclusions of the studies published to date are largely hypothetical.

The catches of the trawlers include such a great variety of important species widely distributed over the trawling area that an attempt to analyze this distribution would lead to intricate considerations beyond the scope of this report. Available data on otter trawler operations during 1937-39 have been combined in Figure 18 to give an outline of the fishing grounds most frequented and show how they shift with the seasons.

The amount of fish caught annually by otter trawlers in the East China and Yellow seas has varied considerably in the course of the 18 or 20 years during which the Japanese trawlers exploited this entire area (Table 3). At the beginning of this period (1922), the total catch did not exceed 35,000 metric tons. As fishing methods improved, the annual the catch increased gradually and reached its peak in 1929, when it amounted to approximately 62,000 metric tons. It then decreased from year to year until Japanese trawling operations were reduced to a minimum by the war.

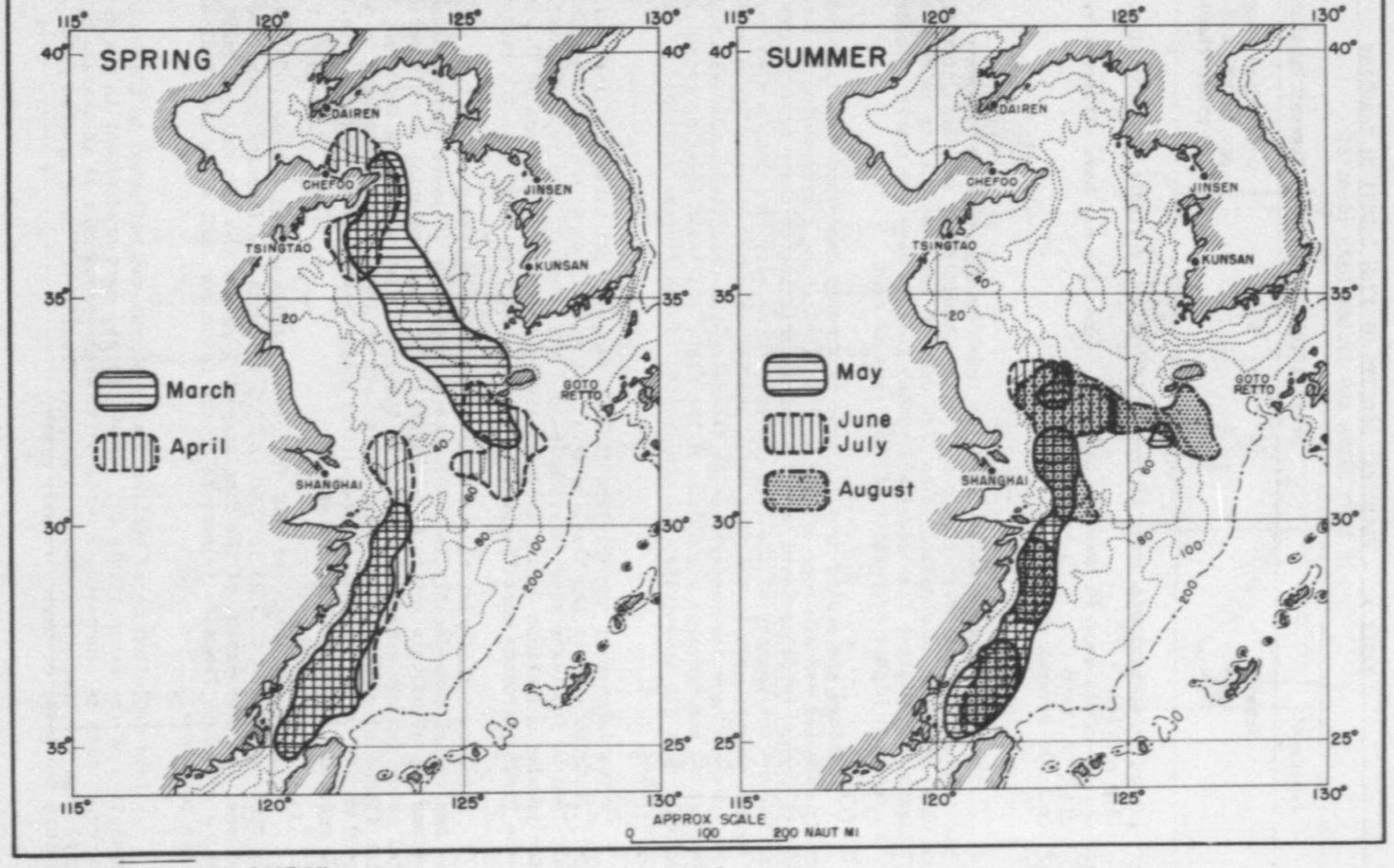
The average catch per haul followed a similar trend (Figure 19). Its steady rise from 0.42 metric ton in 1923 to 0.90 in 1931 reflects the increase in the tonnage of the trawlers, the improvement of the fishing gear 17/, and the increasing knowledge of the best fishing grounds. The steady decrease of the catch per haul after 1931 indicates depletion of the resources.

This depletion began earlier than 1931 and was reflected in the variation of the composition of the catch (Table 4). Some species, once predominant in the catch of trawlers, were taken in decreasing amounts until their proportion in an average haul became negligible and the trawlers turned gradually to fishing for other species in an attempt to maintain the level of their over-all catch.

16/ See Bibliography: Satouchi, 1937; Kasahara, 1948; Yamamoto, 1949.
17/ The Japanese began to use the V.D. type of otter trawl about 1925-26.

FISHING GROUNDS OF OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS

SEASONAL VARIATIONS, JANUARY 1937-DECEMBER 1939

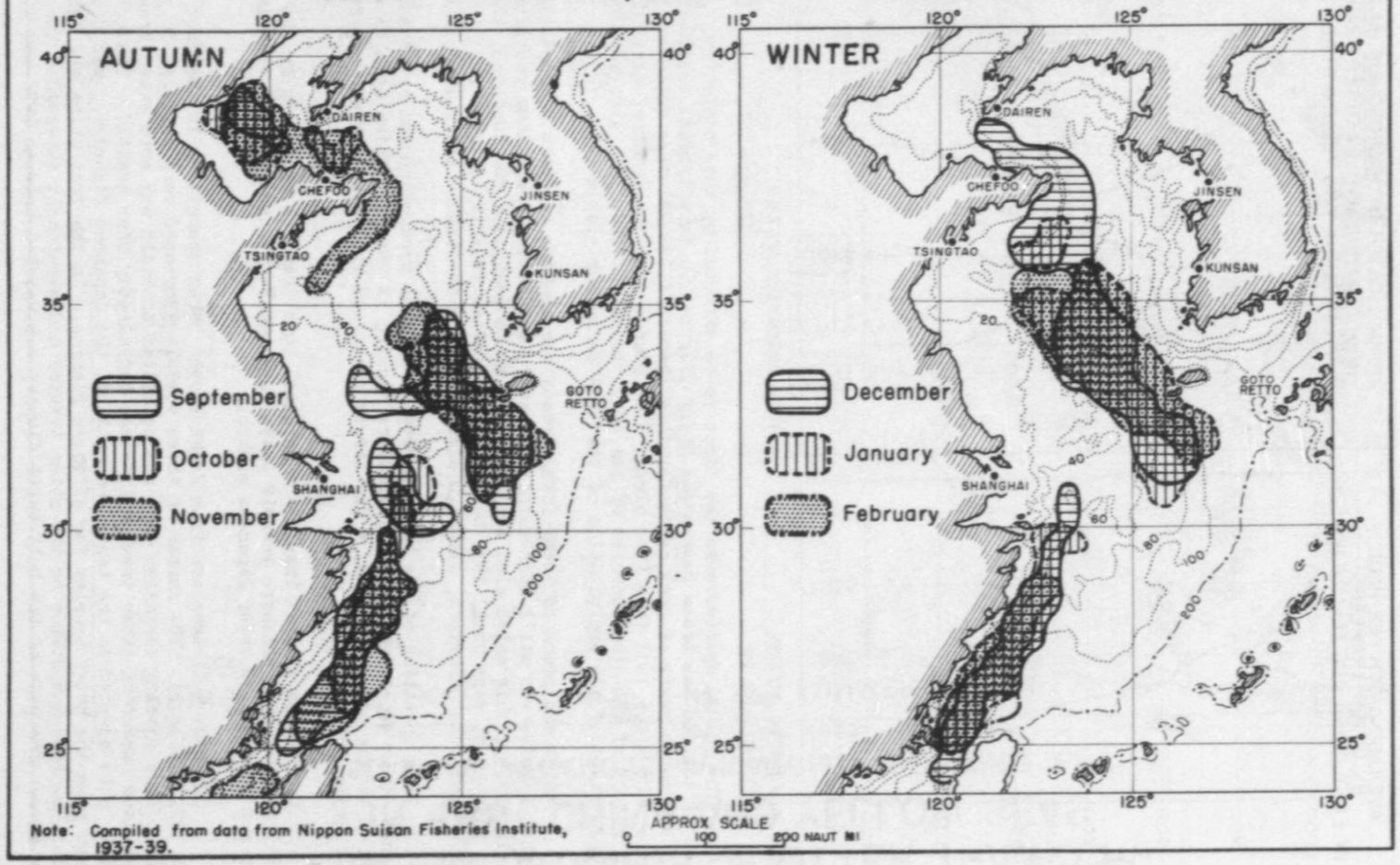


NATURAL RESOURCES SECTION

Figure 18

FISHING GROUNDS OF OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS (CONT'D)

SEASONAL VARIATIONS, JANUARY 1937-DECEMBER 1939



Note: Compiled from data from Nippon Suisan Fisheries Institute, 1937-39.

NATURAL RESOURCES SECTION

Figure 18 (Cont'd)

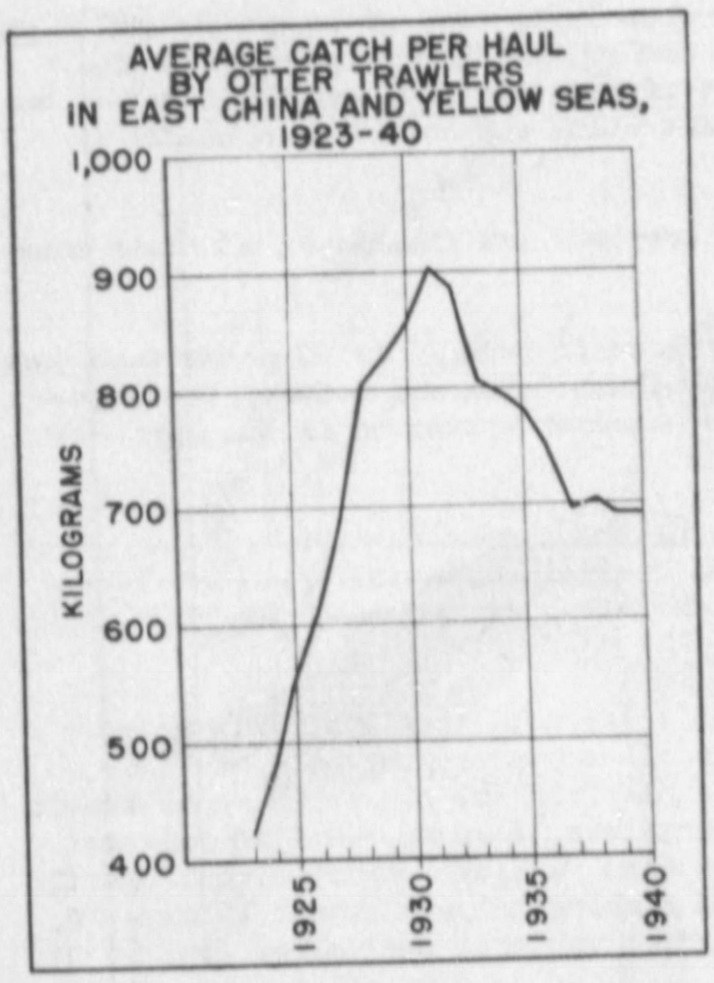


Figure 19

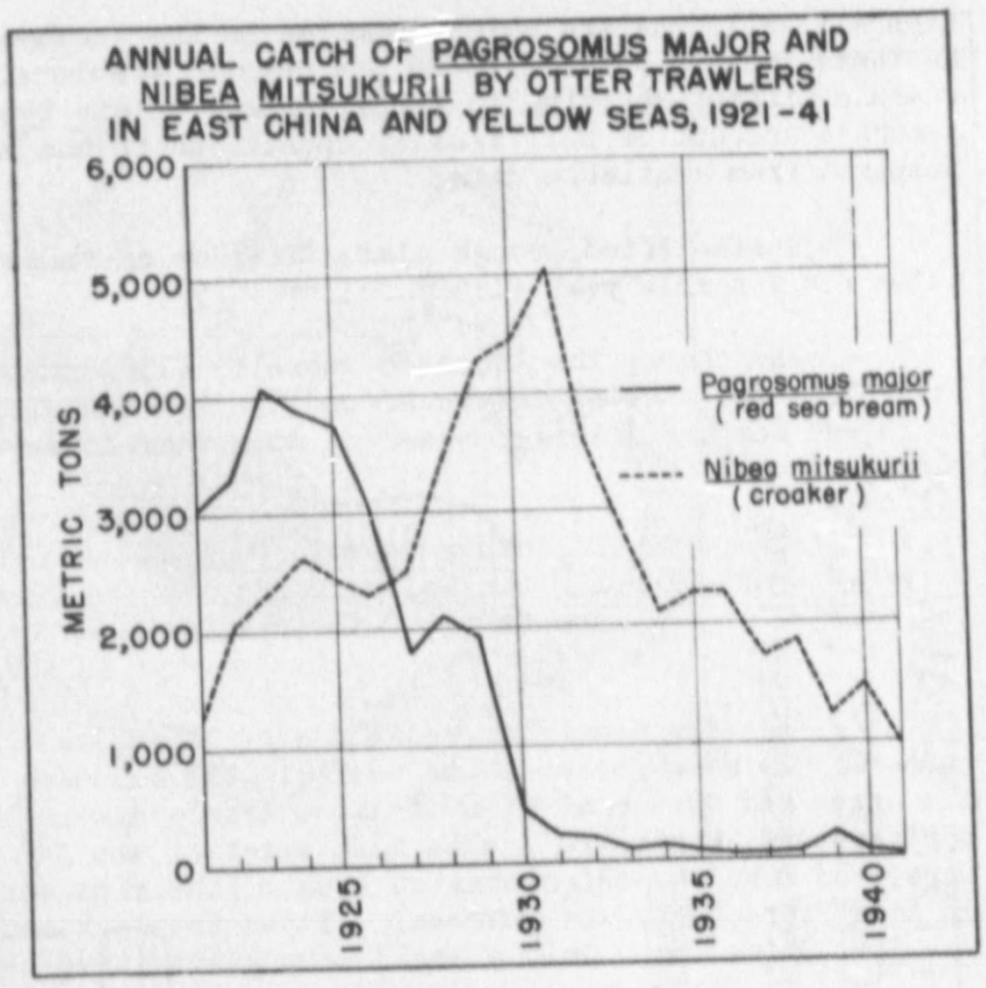


Figure 20

The valued species were the first to be affected by this depletion. The catch record of the red sea bream Pagrosomus major (Figure 20) is a typical example of overfishing. The three years of peak catch for this species (1923-25) were followed by a rapid decline, and after 1931 this fish almost disappeared from the catch of otter trawlers. The catch record of the other species of sea bream indicates that they also were overfished at an early stage of the exploitation of the East China Sea (Table 5).

While the stock of these fish already was showing evidence of depletion, the catch of other species was still increasing. However, as fishing operations continued with the same intensity, this catch also eventually began to decline. For instance, the catch of Nibea mitsukurii rose until 1931 but has since fallen steadily (Figure 20). A decrease of catch of the other croakers, although slower, became noticeable after 1937 (Table 6).

This upsetting of the balance between natural production and catch was due to the presence of an excessive number of trawlers fishing in the East China and Yellow seas. In addition to the otter trawlers, a far larger number of bull trawlers were operating on the same fishing grounds.

Operations of Bull Trawlers: Japanese bull trawlers operating in the East China and Yellow seas were offshore vessels based in Japan Proper and coastal vessels based in Korea and territories under Japanese control.

Offshore bull trawlers from Japan Proper began operations in the East China Sea about 1921 (Table 7). The number of these vessels increased very rapidly, in part owing to the fact that fishing companies were not permitted to build any more otter trawlers because the maximum number of otter trawler licenses had already been granted. The bull trawler, possibly more adapted to the taste and skill of the Japanese fishermen, was found more efficient than the otter trawler for offshore fishing. In the East China and Yellow seas, it became a serious competitor to the otter trawler and eventually superseded the latter in importance. The peak of the bull trawl fishery was reached between 1932 and 1937.

Few statistical data concerning bull trawlers are available. Existing statistics are not exact, and their meaning often is uncertain; the records group without discrimina-

tion all bull trawlers which operated in the license area lying west of longitude 130°E 18/. As these include both offshore and coastal trawlers, and as the fishing grounds of the vessels differ according to their tonnage, their type of construction, and their bases, an accurate account of bull trawler operations in the East China and Yellow seas cannot be prepared from available data.

A simplified, rough classification of these trawlers and the nature of their operation for a sample year (1939) follows: 19/

(a) Among the licensed vessels, (136) coastal craft from 25 to 50 gross tons were fishing in the coastal waters around the islands of southern Japan and between these islands and Korea. A large number of such vessels were based in Kyushu or in the Goto-retto (Goto Islands).

(b) Some (88) other vessels from 40 to 65 tons had a less definite status. They were mostly fishing off the Goto islands, in the Korea Strait, and around Quelpart island and carried on only one-fifth of their operations in the offshore waters of the East China Sea.

(c) The remaining vessels were the actual offshore bull trawlers. The greater number (352) were wooden ships built in the Japanese style and averaging 55 gross tons. The crews and owners of most of these trawlers were people from the old province of Awa in northeastern Shikoku 20/. The main bases of the Awa trawlers, however, were in Nagasaki, Saga, and Fukuoka prefectures on Kyushu (their harbors were Nagasaki, Karatsu, and Imari in Saga Prefecture, and Fukuoka). These trawlers made fishing trips of about 15 days in the East China Sea. Only a small proportion (five percent) entered the Yellow Sea.

A few other wooden bull trawlers (16), averaging 60 to 80 gross tons, originated from the old province of Izumo in southwestern Honshu. They were shaped like European vessels; unlike the Awa trawlers, they did most of their fishing in the central and eastern portions of the Yellow Sea and in the western part of the East China Sea.

Eighty-six steel bull trawlers of 75 gross tons or more belonged to large fishing companies which also operated otter trawlers. These large bull trawlers went on the same fishing grounds as the otter trawlers. Their principal bases were Shimonoseki and Tobata. During a year they averaged 19 fishing trips of 15 to 20 days.

(d) The bull trawlers based in China and Korea included 69 vessels in Korea, 115 in Dairen, Manchuria, 64 in Tsingtao, and 16 in Shanghai. (No bull trawler had been based in Shanghai before 1939.) These colonial bull trawlers were mostly small coastal craft. Their fishing grounds were located in the vicinity of their respective bases.

Catch by Bull Trawlers: The bull trawlers operating in the East China and Yellow seas took the same species of fish as did the otter trawlers. However they caught a larger proportion of "red fish" (sea breams, snappers, gurnards, etc) because of the fact that many of the bull trawlers were fishing in the eastern part of the East China Sea, where the proportion of these species was comparatively high. Japanese fishermen believe also that the bull trawl is more efficient than the otter trawl for the capture of these valued species.

Complete and accurate data concerning the amount of fish landed by the bull trawlers are not available except for the period following 1940, when trawling operations in the East China and Yellow seas had ceased to be normal on account of the international situation (Table 8). Thus the normal output of the bull trawl fishery in this area is not accurately known. The total amount of fish landed by the bull trawlers based in Japan Proper

18/ This license area includes the East China Sea, the Yellow Sea, and part of the Korea Strait.
19/ All figures given between parentheses are tentative.
20/ Most of the Awa trawlers were owned by individuals. A few Awa boats belonged to large companies such as Hayashikane Shoten Co, but they kept crews from Awa.

during 1932-37 is estimated to have been about 122,000 metric tons per year (Table B). The catch of bull trawlers from Korea and China during the same period is estimated at about 54,500 tons.

TABLE B. - ESTIMATED AVERAGE ANNUAL CATCH OF BULL TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1932-37

Base	Average Number of Vessels	Average Total Catch per Year (MT)
Japan	650	122,460
Korea	110	15,450
Manchuria	134	24,820
Tsingtao, China	64	14,210
TOTAL	958	176,940

SOURCE: Satouchi, 1937.

The fragmentary data available tend to show that the catch of certain species, especially the red sea bream Pagrosomus major, has declined gradually. This would corroborate the indications of a depletion of the resources in the East China and Yellow seas, as has been found in the catch record of the otter trawlers operating in those areas.

3. Trawling in Vicinity of Formosa, in East and South China Seas

The operations of the Japanese trawlers based in Formosa ranged from the mouth of the Yangtze River to the island of Hainan. The limits of this area, which overlapped on a large portion of the East China Sea but also included the Strait of Formosa and part of the South China Sea, were latitude 30°N and longitude 110°E. Within these limits, the fishing grounds of the Formosan trawlers in the East China Sea were the same as those of the trawlers from Japan Proper. In the South China Sea, they were located on the continental shelf bordering the coast of south China, between the territorial waters and the 200-meter depth line which runs parallel to the shore at a distance of about 120 miles.

Operations of Otter Trawlers: The fishing grounds in the vicinity of Formosa were exploited not only by the trawlers based in that island but also by a certain number of otter trawlers coming from Japan Proper. Most of the latter vessels were large Diesel trawlers which, because they had freezing equipment, could make long fishing cruises far from their bases. Normally they did not cross latitude 25°N 21/, but a few of them, holding licenses for the South China Sea, did occasionally fish south of this line between Formosa and the offing of Amoy. No otter trawler actually operated in the South China Sea.

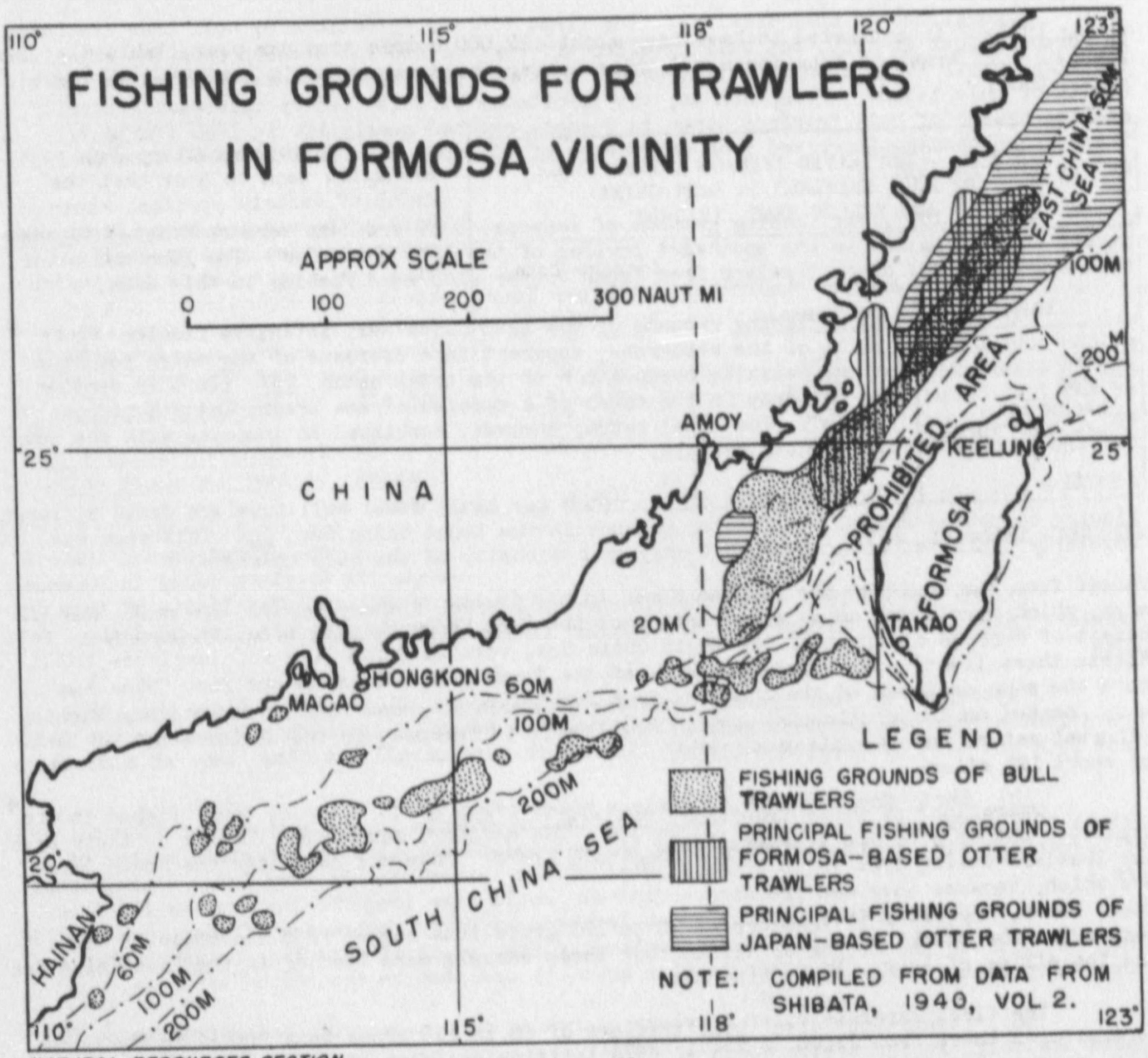
The first Japanese otter trawlers operating on a commercial scale from bases in Formosa came there from Japan in 1927. During the first seasons, there were only four vessels, ranging from 215 to 250 gross tons. In 1930, three more vessels were added to this fleet, but as too many trawlers already were fishing in the East China Sea, these three were not permitted to operate north of latitude 25°N. They confined their trawling operations to the southern half of the Strait of Formosa.

This situation was modified after the Sino-Japanese war began. In 1937, the Formosan otter trawler fleet included eight ships of 215 to 320 gross tons 22/. Its fishing grounds were located, as before 1930, between latitudes 24° and 28°N, the most important being centered on latitude 27°N, longitude 121°30'E (Figure 21).

The Formosan otter trawlers spent an average of 15 days on their fishing cruises without returning to their bases. They usually chose the summer months, which were least productive, for refitting and repairs, and only part of the trawling fleet was on the fishing grounds in summer. Altogether, the eight trawlers made approximately 100 fishing cruises per year.

21/ These trawlers were licensed for the East China and Yellow seas. The southern limit of the East China Sea area was latitude 25°N.

22/ This does not include the trawlers fishing in the Gulf of Tonkin, which transferred their bases to Formosa in 1937.



NATURAL RESOURCES SECTION

Figure 21

All otter trawlers were based in Takao, except one which was based in Keelung. Their catch was landed in either of these harbors. Part of this catch was sold fresh in Formosa, and the surplus was sent to Japan on refrigerated ships. The total catch of Formosan otter trawlers amounted to 5,900 metric tons in 1938 (Table C). The composition of the catch was similar to that of the otter trawlers based in Japan and fishing in the East China Sea (Table A).

TABLE C. - CATCH BY OTTER TRAWLERS IN VICINITY OF FORMOSA a/, 1935-38

Year b/	Trawlers Based in Formosa: Number of Vessels	Trawlers Based in Formosa: Catch (MT)	Catch of Trawlers Based in Japan c/
1935	6	2,170	8,260
1936	6	2,740	6,970
1937	8	4,470	11,370
1938	8	5,900	9,050

a/ In the East China Sea south of 30°N and in the Strait of Formosa

b/ Data later than 1938 are not available.

c/ Catch of trawlers from Japan is included in Table 3 except for the small amount of fish caught south of latitude 25°N.

SOURCE: Shibata, 1940, vol 2.

Operations of Bull Trawlers: The first fishing operations by bull trawlers based in Formosa began in 1919, but bull trawling off Formosa did not develop from the experimental stage until 1924, when 18 bull trawlers of about 50 gross tons came to fish in the vicinity of this island. From then on, the importance of this fishery increased gradually, and the number of bull trawlers based in Formosa reached nearly 100 in 1930 (Table 7). Their gross tonnage increased from an average of 50 gross tons in 1924 to 60 tons in 1935 and 70 tons in 1938.

Until 1933, the fishing grounds of Formosan bull trawlers were restricted to the Strait of Formosa and to the southwest portion of the East China Sea. The Formosan otter trawlers and large otter trawlers from Japan Proper also were fishing in this area.

As in the other fishing grounds of the East China Sea, intensive fishing operations caused a depletion of the resources, apparent in a decrease of the catch per haul and in a variation of the relative composition of the total catch. 23/ (In this section of the East China Sea, the drop in the catch of a species of sea bream, Taius tumifrons, was especially noticeable.) The total catch, however, continued to increase with the number and tonnage of the fishing vessels.

Because of this decrease of the catch per haul, steel bull trawlers owned by large fishing companies sought new fishing grounds in the South China Sea. 24/ This area was regularly exploited after 1933, but only by a minority of the bull trawlers.

At the end of 1938, when the Formosa bull trawl fishery reached its peak, the 122 trawlers based on this island were distributed on the fishing grounds approximately as follows:

(a) Three or four coastal trawlers of about 50 gross tons confined their fishing operations within the southern half of the Strait of Formosa, in the sector south of latitude 25°N and east of longitude 118°E.

(b) Forty-four vessels of various sizes (from 45 to 90 gross tons) fished in the Strait of Formosa and in the East China Sea. The northern and western limits of their area of operations were latitude 30°N and longitude 118°E. They did not enter the South China Sea.

(c) Fifty bull trawlers of 70 to 100 gross tons ranged from the mouth of the Yangtze River to the offing of Hainan, but these vessels were fishing in the East China Sea more often than in the South China Sea.

(d) Twenty-four steel bull trawlers of 80 to 110 gross tons fished in the South China Sea only, in the sector south of 25°N latitide and east of longitude 110°E.

The fishing trips of the bull trawlers of Formosa lasted approximately 10 to 12 days. These vessels usually made only one fishing cruise in each of the summer months but more than two in winter months, or a total of 20 to 24 trips per year. Their bases were Keelung and Takao; the catch was landed in these harbors and sold or exported in the same manner as for the otter trawlers. Some of the vessels fishing in the South China Sea were permitted, in addition, to land part of their catch in Macao.

The total output of the trawlers based in Formosa in 1938 amounted to more than 33,000 metric tons of fish, of which about 27,300 tons were caught by the bull trawlers (Table D.) Available statistical data do not permit a breakdown of this catch between the various fishing grounds exploited by the trawlers. However, indications are that only a small proportion of the catch was taken in the South China Sea.

23/ Discussion in section on catch of Japan-based otter trawlers
24/ Hayashikane Shoten Co (now Taiyo Gyogyo Co) was the principal owner of bull trawlers fishing in the South China Sea. This company operated two refrigerator ships which took the catch of the bull trawlers directly to Japan.

TABLE D. - CATCH BY BULL TRAWLERS BASED IN FORMOSA, 1931-38 a/	
Year	Catch (MT)
1931	9,820
1932	8,510
1933	12,810
1934	15,490
1935	22,900
1936	25,250
1937	25,730
1938	27,260

a/ In East and South China seas. The license area is limited to the north by latitude 30°N and to the west by longitude 110°E. No data are available after 1938.

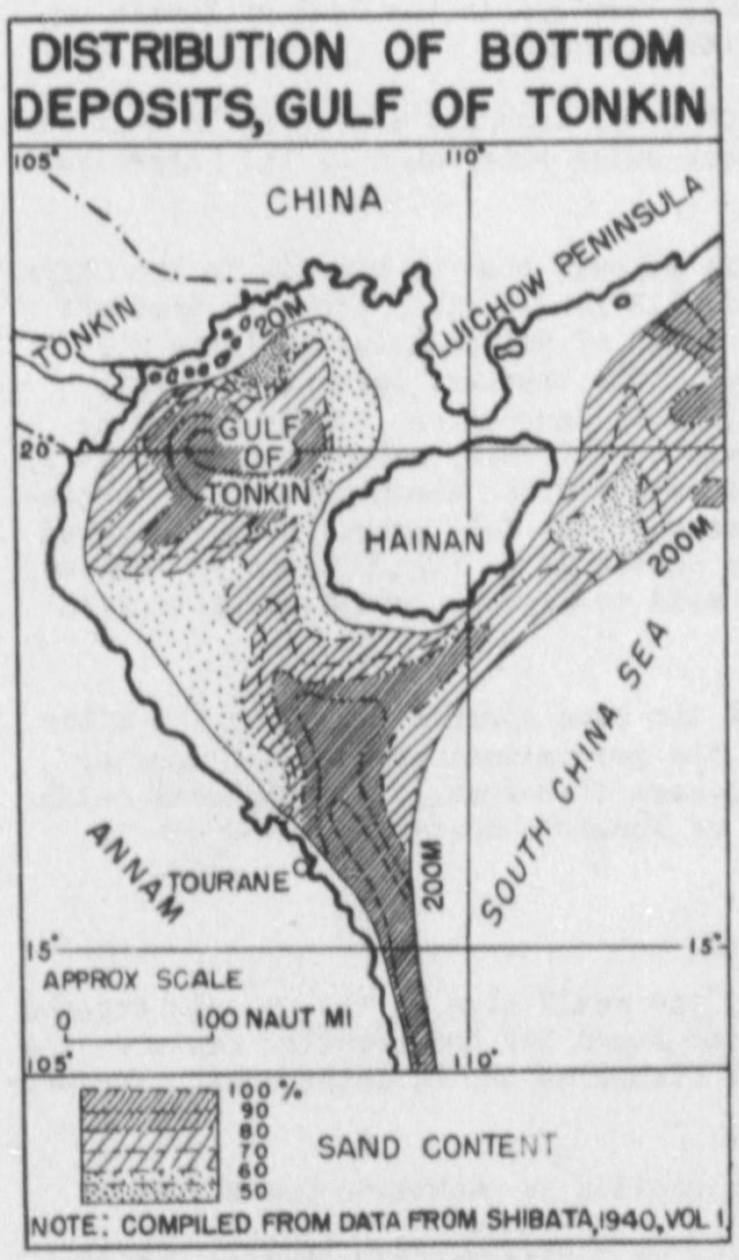
SOURCE: Shibata, 1940, vol 2.

4. Trawling in the Gulf of Tonkin

The Gulf of Tonkin, geographically a part of the South China Sea, is a sea area of approximately 17,000 square nautical miles. Open toward the southeast, the gulf is bounded on the east by the Luichow Peninsula and Hainan Island, on the north by the coast of south China, and on the west by the coasts of Tonkin and Annam, French Indo-China.

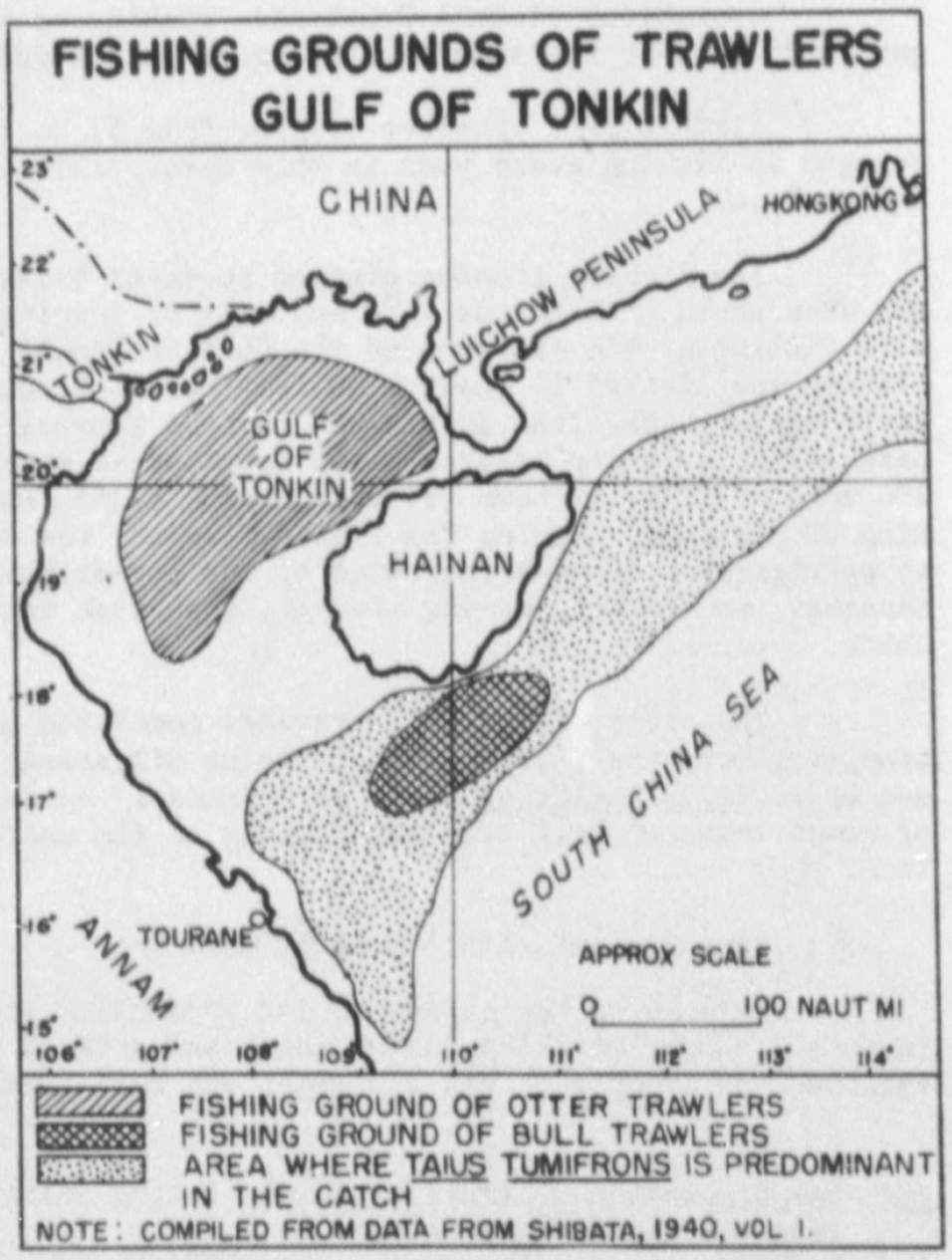
The climate of the gulf is affected by the climatic conditions of the South China Sea and subject to the influence of the monsoons. The general circulation of waters is influenced by the warm currents of the South China Sea; close to the coasts this influence decreases.

At its deepest point, the Gulf of Tonkin is less than 200 meters deep. Its gradual slopes, its bottom of sand and mud, and its fish resources render this area suitable for trawling (Figure 22).



NATURAL RESOURCES SECTION

Figure 22



NATURAL RESOURCES SECTION

Figure 23

Operations of Otter Trawlers: The Gulf of Tonkin was the principal fishing ground of a few Japanese trawlers which were licensed to operate in the South China Sea, south of latitude 21°N. Exploitation of this area began with one otter trawler in 1928 and four in 1929. The maximum number of licenses granted for operation in this fishing area was attained in 1935 with 20 otter trawlers having an average tonnage between 400 and 500 gross tons. Eleven of these vessels operated from Hongkong, and the nine others were based in Japan. After the outbreak of the Sino-Japanese war, the trawlers from Hongkong transferred their bases to Formosa, but they were not allowed to land their catch for sale on that island. The trawlers based in Hongkong were owned by the Horai Co which merged afterwards with the Kyodo Gyogyo Co. Most of the other ships were owned by the latter company.

None of these ships fished in the Gulf of Tonkin only. About 12 vessels occasionally operated elsewhere in the western portion of the South China Sea (Table 8). Three other ships operated in the Gulf of Tonkin in winter (September to April) and in the Bering Sea in summer. 25/ The remaining ships fished in the Gulf in summer and in the Strait of Formosa in winter.

The otter trawlers, when fishing in the Gulf of Tonkin, restricted their operations to the inner part of this gulf. The center of their fishing grounds was northwest of Hainan island (Figure 23). Their principal catch was a sea bream known as "chidai"; this designation applies to several closely related species among which Evynnis japonicus is the most common. This fish, highly valued by the Japanese, accounted for one-third to two-thirds of their catch (Table 9). Other important species found in the China Sea also were caught in the Gulf of Tonkin by the otter trawlers.

Operations of Bull Trawlers: Fishing by bull trawlers in the Gulf of Tonkin began in 1933 under the same conditions as in the South China Sea.

Sixteen bull trawlers ranging from 57 to 100 gross tons and averaging 74 tons were engaged in fishing every year in this area. All these ships were owned by the Hayashikane Shoten Co.

The fishing license granted to these vessels allowed them to operate in the China Sea area north of latitude 15°N and west of longitude 118°E. In fact, the bull trawlers were fishing at the entrance of the Gulf of Tonkin, south of Hainan island (Figure 23). Fishing was limited to the period from May to October. The trawlers left Shimonoseki, their winter base, late in May and reached Tourane (French Indo-China), their operating base, after a 12-day voyage. They operated an average of 140 days, catching approximately 280 tons of fish per team (average during 1938), and returned to Shimonoseki at the beginning of November. During the fishing season, the catch of the bull trawlers was conveyed by refrigerator cargo ships owned by the Hayashikane Shoten Co to fish markets in Formosa, Shanghai, and Japan. During the war, the catch was sold to Japanese armies operating in China.

The catch of the bull trawlers consisted of the same species caught by the otter trawlers, but, the fishing grounds being different, the predominant species was another sea bream, Taius tumifrons, known as "renkodai" to Japanese fishermen. In 1938, total catch of seven teams of bull trawlers fishing in the Gulf of Tonkin amounted to 1,980 metric tons. 26/

5. Danish Seine Trawling in Japan Sea

Because of the nature of its production and the small size of the vessels engaged in this fishery, trawling in the northeast area of the Japan Sea had peculiar features and was far less important than the otter and bull trawl fisheries in the China seas. The pro-

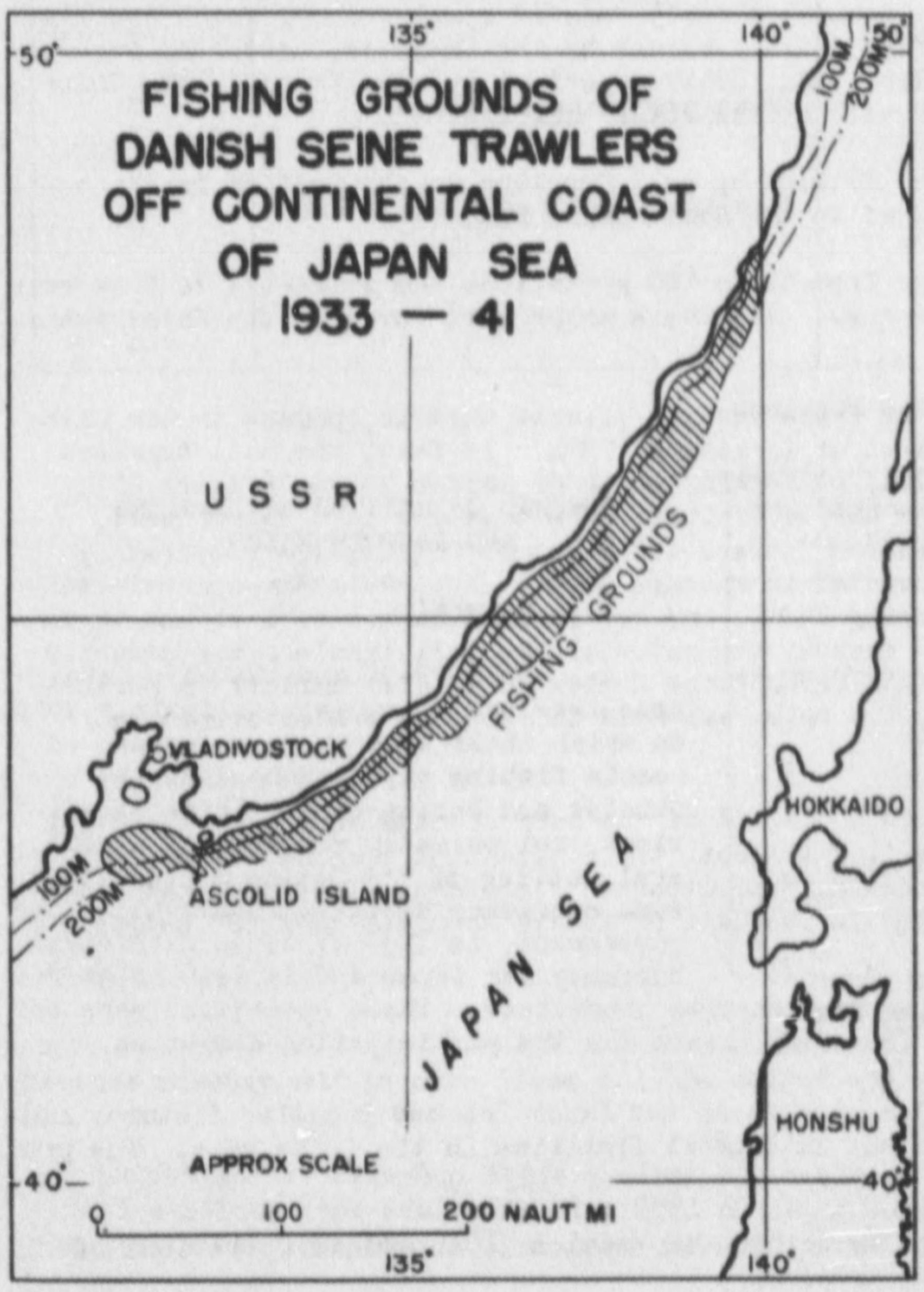
25/ See discussion of trawling in the Bering Sea in section on "Combined Operations of Trawlers and Factory Ships".

26/ Eight teams of bull trawlers operated in the Gulf of Tonkin in 1938, but one of the vessels was lost during the return voyage, and the catch of its team was not included in the statistics.

duction of the Danish seine fishery in the northern part of the Japan Sea consisted of cold-water species which are less valued on the Japanese market than the fish of warmer seas such as the red sea breams.

The trawlers engaged in this fishery were unsuitable for long-range operations. The Danish seine is one of the rather primitive fishing gears widely used on the continental shelf bordering the coasts of Japan. Because of its narrowness, this coastal area cannot accommodate a large number of fishing boats. Whenever the number grows too large, the catch on the overcrowded fishing grounds drops. Such a situation occurred in 1930 off the west coasts of Hokkaido and northern Honshu. The prefectural governments responsible for the control of coastal fisheries in these areas sent research vessels across the Japan Sea in the hope of finding better fishing grounds where the surplus Danish seine trawlers could operate.

The ultimate result of this research was the exploitation by Danish seine trawlers of fishing grounds in the northwest portion of the Japan Sea. The new fishing area, approximately 120 miles wide, extended along the coast of the Maritime Province of USSR from longitude 140°E to the offing of Ascolid Island. The best area was in the vicinity of that island (Figure 24).



NATURAL RESOURCES SECTION

Figure 24

The Danish seine trawlers operated in this fishing area from 1933 to 1941. In the fall of 1941, after war had begun between USSR and Germany, the Russians laid mines in the fishing ground area. Trawling was discontinued, and the trawlers went back to their former coastal fishing grounds off Hokkaido.

The Danish seine trawlers which went on these offshore operations were wooden boats of 30 to 40 gross tons with a crew of eight men. The trawlers were equipped with 60 to 100 horsepower hot-bulb engines.

Operations had begun in 1933 with only five boats, but every year new Danish seine trawlers came on the offshore fishing grounds. They numbered 38 in 1941. In their first year of operations, the trawlers averaged only 23 fishing trips. In 1937, which was the peak year of production, they made a total of more than 260 cruises on their fishing grounds.

The bulk of the catch (about 80 percent) consisted of various species of flatfish, but the catch also included codfish (about 10 percent) and other cold-water species. The most important species of flatfish in the catch are listed in Table E. In 1933 the total amount of fish caught on the Japan Sea offshore fishing grounds

was less than 300 metric tons, but in 1937 the total catch exceeded 5,000 metric tons (Table F).

TABLE E. - SPECIES OF FLATFISH CAUGHT BY DANISH SEINE TRAWLERS OFF CONTINENTAL COAST OF JAPAN SEA a/

Japanese Name	Scientific Name	Percent of Catch of Flatfish
Asabagarei 淺場鰈	Lepidopsetta mochigarei Snyder	42
Babagarei 婆々鰈	Microstomus stellerii Schmidt	27
Migarei ミカレイ	Cynopsetta dubia Schmidt	14
Chigogarei チゴガレイ	Protopsetta herzensteini	7
Magarei 眞鰈	Limanda angutirostris Kitahara	6
Others		4

a/ Off the coast of the USSR Maritime Province

TABLE F. - CATCH OF DANISH SEINE TRAWLERS OFF CONTINENTAL COAST OF JAPAN SEA, 1933-40

Year	Catch (MT)
1933	290
1934	970
1935	2,180
1936	3,920
1937	5,140
1938	4,710
1939	1,640
1940	3,300

COMBINED OPERATIONS OF TRAWLERS AND FACTORY SHIPS

1. General

In 1933-37 and 1940-43, Japanese trawlers accompanied a factory ship, on which their catch was processed, on remote fishing expeditions into the Okhotsk and Bering seas. These expeditions, not normally a part of the general setting of the Japanese fisheries, were emergency measures sponsored by the government, in 1933-37 to earn foreign currency for Japan and in 1940-43 to relieve the acute food shortage resulting from wartime conditions. These operations were not commercially successful and involved financial losses for the participating companies.

2. Trawling in Bering Sea

Experimental expeditions of trawlers and factory ships operated in the Bering Sea in 1929 and 1931. Commercial operations began in 1933. The trawlers accompanied a fish meal factory ship from 1933 to 1937. The mother ship used in 1940 and 1941 was a refrigerator ship which froze the catch of its trawlers.

Operations with Fish Meal Factory Ship: The combined fleet which operated in the Bering Sea in 1933 and 1934 consisted of a 6,000-ton factory ship and five otter trawlers. From 1935 to 1937, the factory ship was a vessel of 8,000 gross tons which was accompanied by five otter and eight bull trawlers (Table G).

TABLE G. - COMPOSITION OF TRAWLER AND FACTORY SHIP FLEETS

Year	Fishing Ground	Shipowner	Mother Ship			Otter Trawlers	Bull Trawlers	Danish Seine Trawlers
			Name	Tonnage	Principal Product			
1933	Bering Sea	Shinko Suisan Co	Kasado Maru	6,003	Fish meal	5	0	0
1934	Bering Sea	Nippon Suisan Co	Kasado Maru	6,003	Fish meal	5	0	0
1935	Bering Sea	Nippon Suisan Co	Taihoku Maru	8,250	Fish meal	3	8	0
1936	Bering Sea	Nippon Suisan Co	Taihoku Maru	8,250	Fish meal	5	0	0
1937	Bering Sea	Nippon Suisan Co	Taihoku Maru	8,250	Fish meal	3	8	0
1940	Bering Sea	Nippon Suisan Co	Kosei Maru	8,240	Frozen fish	1	8	0
1941	Bering Sea	Nippon Suisan Co	Kosei Maru	8,240	Frozen fish	4	8	0
1942	Sea of Okhotsk	Nippon Suisan Co	Kasado Maru	6,003	Salted fish	4	0	0
		Nippon Suisan Co	Ryokai Maru	4,680	Salted fish	4	0	0
		Nippon Suisan Co	Kosei Maru	8,240	Frozen fish	1	4	0
		Hayashikane Co	Banshu Maru No 7	5,490	Frozen fish	0	6	0
1943	Sea of Okhotsk	Nippon Suisan Co	Kasado Maru	6,003	Salted fish	0	0	9
		Nippon Suisan Co	Ryokai Maru	4,680	Salted fish	0	0	9
		Nippon Suisan Co	Toten Maru	3,820	Salted fish	0	0	7
		Hayashikane Co	Banshu Maru No 7	5,490	Frozen fish	0	6	0

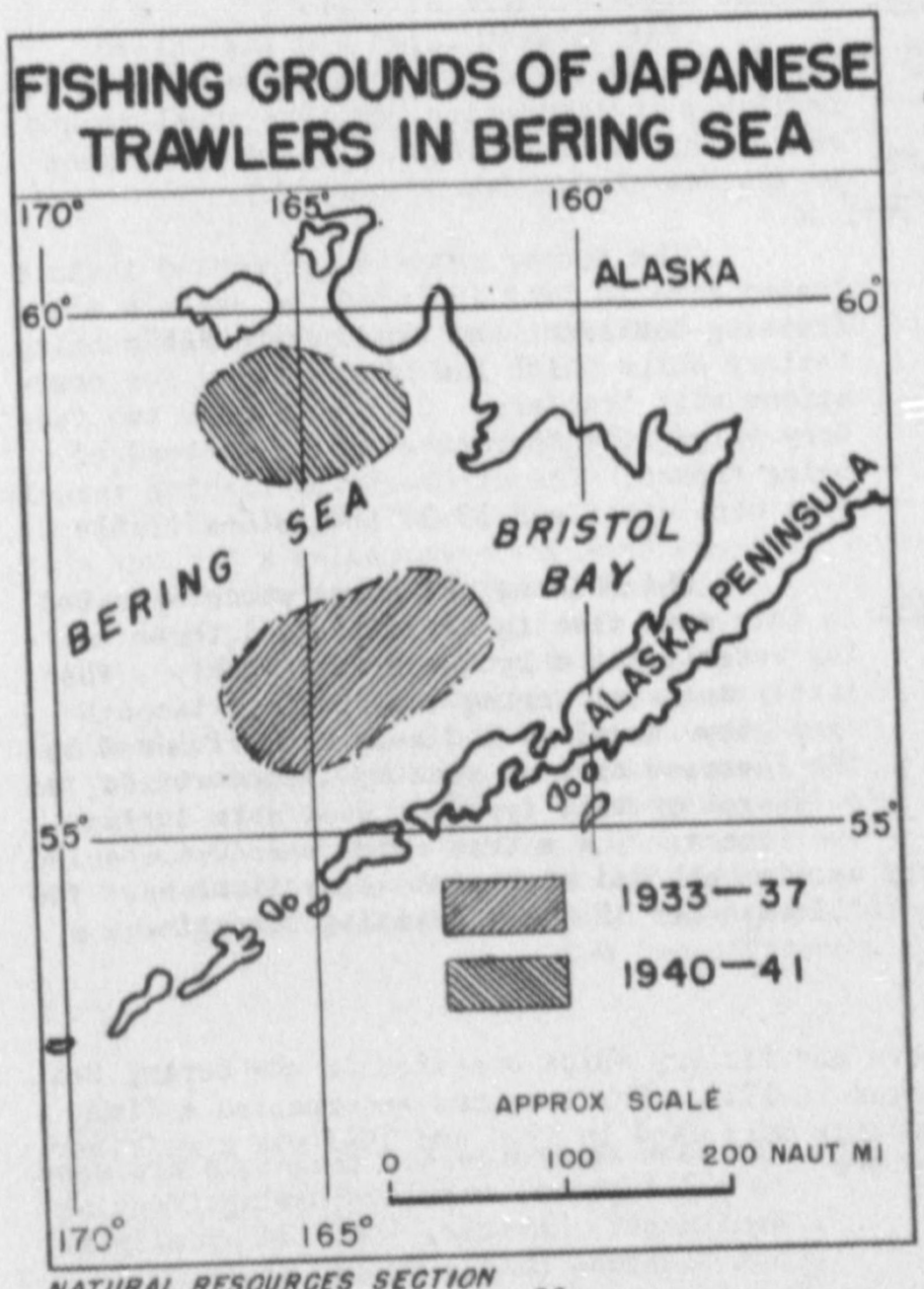


Figure 25

The fishing grounds were located in Bristol Bay, Alaska, and centered around a point at latitude 56°30'N and longitude 165°W, over bottoms about 150 meters deep (Figure 25). The trawlers fished within five miles of their mother ship. Their trawls had detachable cod ends which were separated from the nets after each haul and transferred to the mother ship with the fish caught in them.

The bulk of the catch consisted of Alaskan pollack. This fish was processed into fish meal on board the mother ship. Processing included washing in warm sea water, cooking, pressing, and drying. The livers were processed for vitamin oil. Other miscellaneous fish were salted on board the mother ship. The finished products were brought to Japan, and the salted fish was consumed locally. The fish meal and liver oil were re-exported to Europe, the most important customer being Germany.

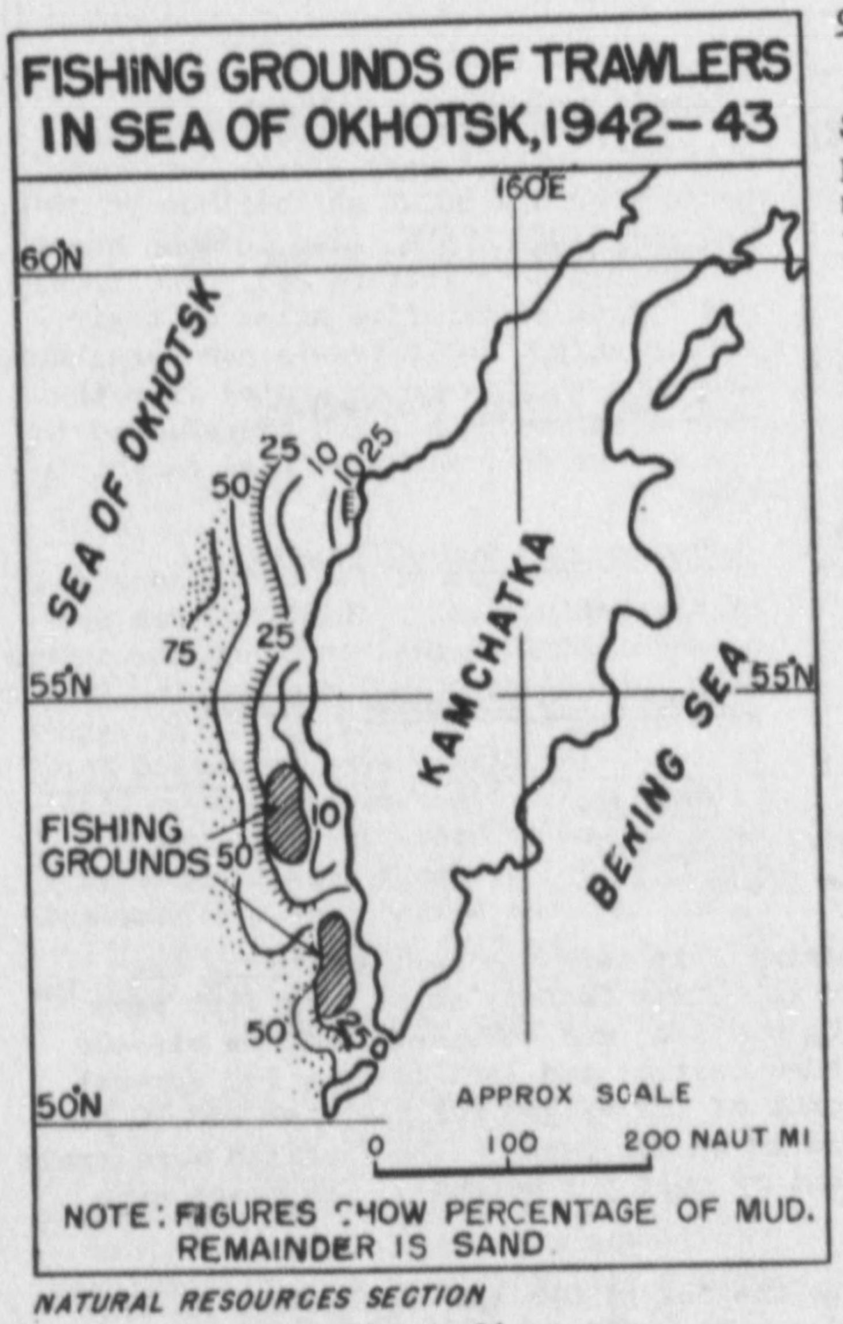
The company which undertook this fishing expedition in 1933, the Shinko Suisan Co, was amalgamated in the following year with the Nippon Suisan Co. This company conducted the operations until 1937, when they were discontinued because of the fall of the market for fish meal.

Operations by Mother Ship with Freezing Equipment: The mother ship used in the expeditions of 1940 and 1941 in the Bering Sea was a vessel of about 8,000 gross tons with a 5,000 horsepower turbine engine. The freezing equipment consisted of two steam engines of 200 horsepower, carbon dioxide compressors, and chambers for quick freezing. It operated in 1940 with one otter and eight bull trawlers, and in 1941 with four otter and eight bull trawlers.

Their fishing grounds were located within the area extending approximately from latitude 58° to 60°N and from longitude 163° to 167°W (Figure 25). Fishing operations lasted only during early summer.

The methods of operation were the same as in 1933-37, but the catch was frozen on board the mother ship instead of being processed for fish meal. The fish were sorted by species, beheaded or cut in fillets, washed, and packed in metal trays with a capacity of about 20 kilograms of fish. The trays were then conveyed to the freezing rooms, consisting of rows of shelves inside which cold brine was circulating. The trays were placed on the shelves and kept there for approximately four hours. The temperature in the freezing rooms was kept between -20° and -25°C. The frozen fish cakes were washed in fresh water (glazing), wrapped in paper, and stored in refrigerated holds.27/

The total frozen products processed during each of the two expeditions amounted to 4,400 metric tons. In addition, small quantities of salted cod and cod liver oil were produced.



NATURAL RESOURCES SECTION

Figure 26

3. Wartime Trawling Operations in Sea of Okhotsk

War between Japan and the United States precluding further Japanese fishing expeditions in the Bering Sea, the trawlers and mother ship in 1942 shifted their operations to the Sea of Okhotsk (Figure 26).

The mother ships which worked in this latter area in 1942 included two vessels with freezing equipment and two former crab canning factory ships which had been altered for operations with trawlers. On board these two factory ships, the fish were salted instead of being frozen. The accompanying fishing vessels were nine otter and 10 bull trawlers (Table G).

The four mother ships which operated in this same area in 1943 included three salting vessels but only one freezing ship. The latter was sunk during the fishing season. Many otter trawlers had been requisitioned by the Japanese navy or sunk by Allied action, so no vessel of this type was available during the season. The mother ships were accompanied by six bull and 25 Danish seine trawlers. The fishing gear of these vessels did not have a removable cod end.

27/ The same apparatus and technique are used on all Japanese trawlers having freezing equipment. However, the fish usually is not beheaded but is frozen whole.

The trawlers fished south of latitude 55°N on the continental shelf bordering the west coast of Kamchatka. They chose bottoms of mud mixed with fine sand where flatfish were distributed densely in summer (Figure 26). The catch consisted mainly of flatfish (Table H) but also included cod (about five percent of the total catch).

TABLE H. - SPECIES OF FISH CAUGHT BY TRAWLERS IN SEA OF OKHOTSK

English Name	Japanese Name	Scientific Name
Flatfish	Rosukegarei a/ 露助鰈	Limanda aspera (Pallas)
	Umagarei b/ 馬鰈	Hippoglossoides elassodon
	Shumushugarei b/ 占守鰈	Lepidopsetta bilineata (Ayres)
	Tsunogarei c/ 角鰈	Platessa quadrituberculata (Pallas)
	Hanagarei c/ 花鰈	Limanda proboscidea Gilbert
	Karafutogarei 樺太鰈	Limanda sakalinensis Hubbs
Cods and pollack	Komai コマイ	Eleginus novaga (Kolveuter)
	Madara 眞鱈	Gadus macrocephalus Tilesius
	Sukesodara 助宗鱈	Theragra chalcogramma (Pallas)

a/ Name used by fishermen is "koganegarei" (golden flounder).
b/ Name used by fishermen is "shirogarei" (white flounder).
c/ Name used by fishermen is "kigarei" (yellow flounder).

Methods of processing on board the freezing ship were the same as during the 1940-41 expeditions in the Bering Sea. On board the other factory ships, the fish were cured in salt. After they were washed, sorted by species, and beheaded, and the viscera were removed, the fish were mixed with salt in huge baskets and left to cure for several days. The proportions of salt used were 25 percent of the weight for flatfish and 30 percent for cod. After curing, the fish were packed in wooden cases. The flatfish were again sprinkled with salt in the cases (about 10 percent of salt per weight). The cases were stored in well-ventilated holds.

The total finished products processed in the Sea of Okhotsk expeditions in 1942 amounted to 5,800 metric tons of frozen fish and nearly 9,000 tons of salted fish. In 1943,

the production amounted to only 8,000 tons of salted fish. The cargo of the freezing ship was lost when it was sunk on the fishing grounds.

JAPANESE TRAWLING UNDER FOREIGN FLAGS

1. General

As the catch of trawlers in the best areas of the China seas was decreasing because of overfishing, the Japanese, in order to maintain their fish production, sought everywhere for fishing grounds as yet unexploited where their trawlers could operate and take the species valued best in their country.

Such fishing grounds were found near the coasts of Argentina and Mexico. As they were too remote to be exploited by trawlers based in Japanese territory, Japanese fishing companies established branch companies in Argentina and Mexico and operated their vessels under the flags of these countries.

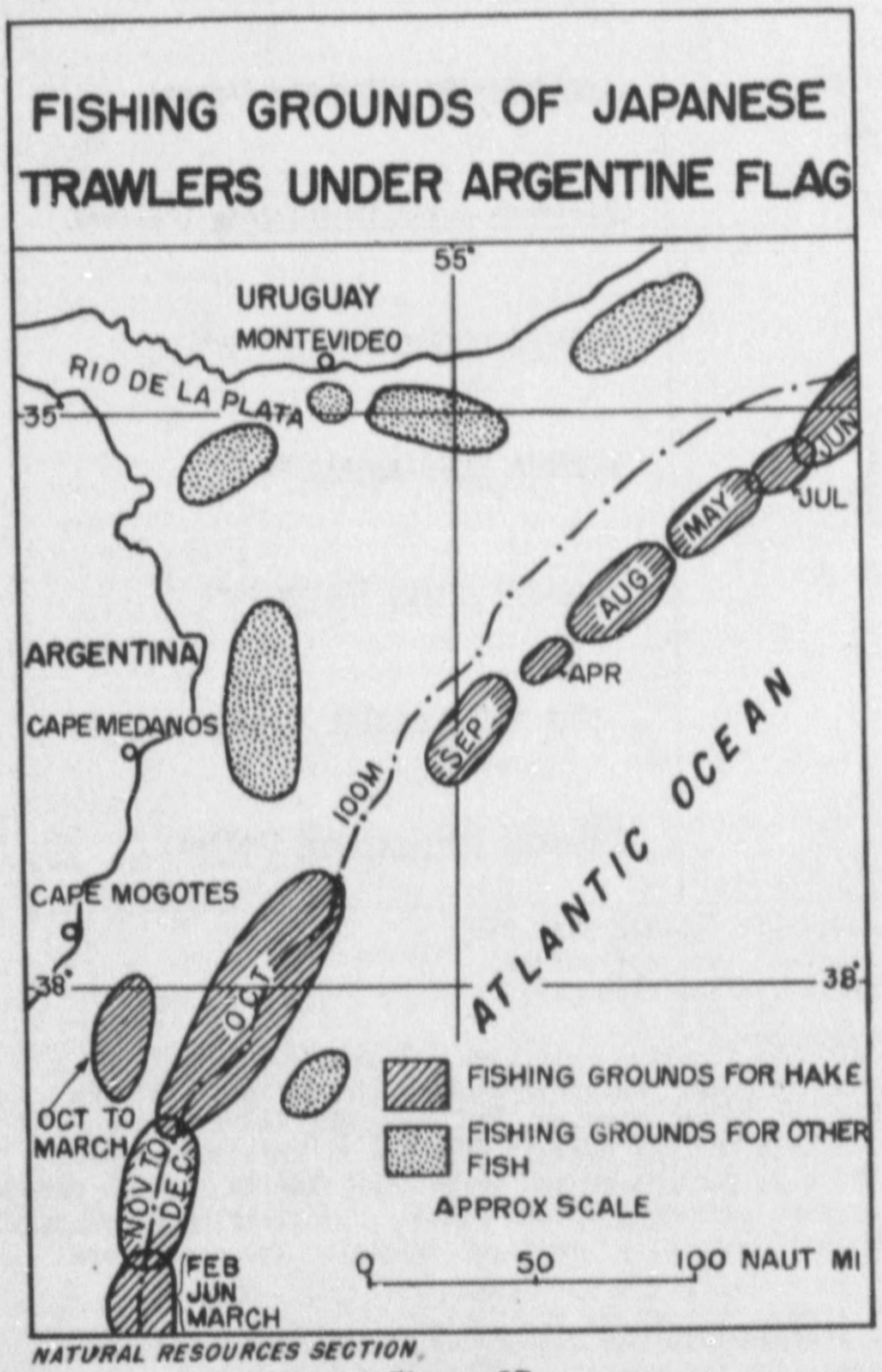


Figure 27

2. Operations of Japanese Trawlers in Argentina

In 1937, the Kyodo Gyogyo Co (Nippon Suisan Co after 1937) established in Buenos Aires a branch company called Compania Argentina Commercial e Industrial de Pesquerias. Officials and employees of this firm included Argentine and Japanese nationals. The capital originally invested by the Kyodo Gyogyo Co was increased in 1941 to 1,700,000 pesos. The objects of the branch company were to conduct an import and export business in marine products and to conduct trawling operations.

Two trawlers of the Kyodo Gyogyo Co were sold in 1936-37 to the Compania Argentina. Both ships flew the Argentine flag, but their crews were Japanese. These trawlers, Presidente Roca (ex-Kushiro Maru) and Presidente Metre (ex-Himeji Maru), were vessels of 413 and 473 gross tons, respectively, with 600-horsepower Diesel engines. Both had refrigerating equipment and made three or four fishing trips of seven to 10 days every month.

The fishing grounds were located in the offing of the bay of La Plata (Figure 27). The catch amounted to 4,300 metric tons in 1938, 5,530 tons in 1939, and 5,125 tons in 1940. The bulk of the catch consisted of a spe-

cies of hake known on the Argentine market as "merluzza". Other species in the catch included croakers, squids, and prawns. The profits of this enterprise amounted in 1940 to ¥268,000.

Since 1941, on account of the war, all ties have been severed between the Japanese company and its former branch company in Argentina.

3. Operations of Japanese Trawlers in Mexico

The two principal Japanese trawling companies, the Kyodo Gyogyo Co (Nippon Suisan Co) and Hayashikane Shoten Co, between 1937 and 1941 sent trawlers to Mexico to operate from bases in that country. Fishing grounds off the Mexican coast had been prospected by otter trawlers of the Kyodo Gyogyo Co in 1935 and 1936. Actual fishing operations were begun by both companies in 1938 after conclusion of agreements with the Mexican fisheries unions.

The fleet of the Nippon Suisan Co operating in Mexico included four large otter trawlers and two smaller vessels which were former bull trawlers converted into otter trawlers. The Hayashikane Shoten Co fleet included only five converted bull trawlers until 1939 and six vessels of that type from 1939 to 1941.

One of the large trawlers was a 665 gross ton ship; the others were ships of 400 tons. All had refrigerating equipment. Their fishing gear was an otter trawl of 122 feet headrope.

The smaller vessels were former bull trawlers of 75 to 90 gross tons without freezing apparatus. They fished with otter trawls of 80 feet headrope. 28/ The crews of these smaller vessels were in part Mexican.

Most of these vessels operated on the west coast of Mexico, principally in the Gulf of California (Figure 28). The trawlers in this area fished in shallow waters (5 to 15 meters) in sight of the shore. However, they made long cruises, exceeding one month in the case of the larger vessels. The trawlers owned by the Nippon Suisan Co were based in Guaymas and Mazatlan, those of the Hayashikane Shoten Co in Topolobampo.

Figure 28

Two of the large trawlers of the Nippon Suisan Co fished on the east coast of Mexico. Operations in this area were not successful because the bottoms were too rough (rocks and coral reefs).

The principal catch of the Japanese trawlers in Mexico was prawns, which are highly valued by the Japanese. The prawns were frozen, packed in wooden cases of about 20 kilograms capacity, and transported to Japan by refrigerator ships belonging to the fishing companies. The Nippon Suisan Co

28/ This net, however, was landed on the port side as in bull trawl operations.

used a vessel of 1,000 gross tons; the Hayashikane Shoten Co used a ship of 390 tons. A portion of the catch was sold on the American market in order to cover operational expenses. In 1939, the total catch amounted to 3,346 metric tons of prawn and seven tons of miscellaneous fish; 1,450 tons of prawns were sold in America.

RECONNAISSANCE EXPEDITIONS BY JAPANESE TRAWLERS

1. General

Each extension of the Japanese trawling industry to new fishing grounds was preceded by reconnaissance expeditions of trawlers sent by the Japanese Government or important fishing companies to explore areas not yet exploited by modern fishing vessels.

The object of these expeditions was primarily to survey the resources of the area visited and to study the nature of the bottoms and of the oceanographical conditions. Eventually, if indications were that a portion of the future catch could not be sold in Japan, possible market for the surplus fish were investigated.

Such expeditions went in 1928 to the South China Sea, in 1930 to the northeast Japan Sea near the coast of the Maritime Province of USSR, to the Bering Sea, and to the Mexican waters, and in 1935 to Argentina. All these expeditions were followed by actual trawling operations on a commercial scale in the waters explored.

Other reconnaissance expeditions did not ultimately lead to exploitation of the areas investigated. For example, expeditions were made between 1935 and 1938 in the Gulf of Siam, in the Bay of Bengal, in the Arabian Sea, and off the coast of Australia. A few of the fishing grounds tested in these areas were found suitable for trawling, and regular fishing operations probably would have been started there if the war and the defeat of Japan had not prevented a further extension of the Japanese trawling industry to new fishing areas.

NATURAL RESOURCES SECTION

Figure 29

2. Major Reconnaissance Expeditions

a. Expedition to Coast of Australia

From May 1935 to May 1936, a reconnaissance of the north and west coasts of Australia was made by the Shinkyo Maru, an otter trawler owned by the Kyodo Gyogyo Co. The area explored extended from the Gulf of Carpentaria to Fremantle. Experimental trawling was done in the Gulf of Carpentaria, the offing of Cape Londonderry, the area between Bedout and Barrow islands off Cape Thouin, Sharks Bay, and the offing of Fremantle (Figure 29).

The areas north of latitude 19°S were found poor in fish, but rather good catches of various species of sea breams and snappers were made on bottoms 50 meters deep between Bedout Island and Port Walcott, on bottoms 90 to 130 meters deep off Cape Thouin, and off Barrow Island.

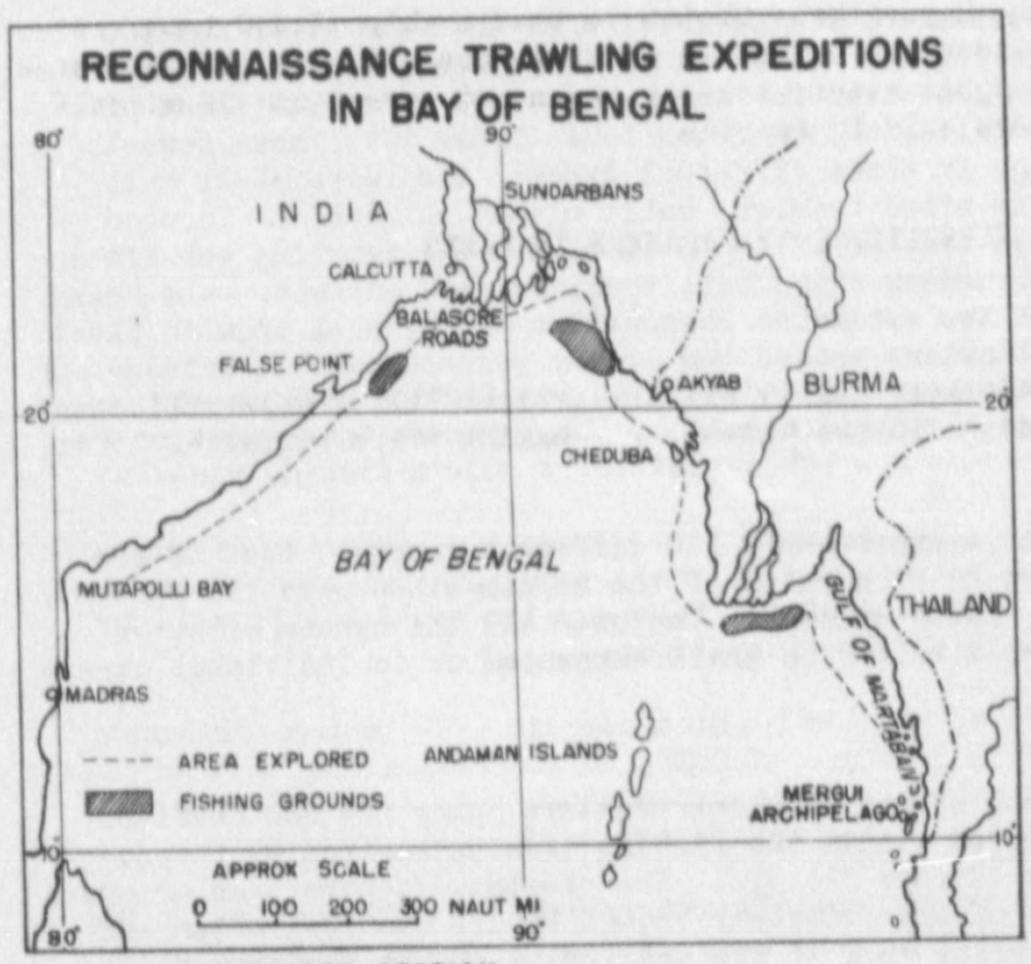


Figure 30

The 640 tons of frozen fish processed during the expedition were sold in Singapore through a Chinese agency.

b. Expeditions in Bay of Bengal

Between November 1936 and March 1938, the same vessel explored the Bay of Bengal in the hope of discovering new fishing grounds for sea breams and prawns. Two reconnaissance expeditions were made in the area.

The Bay of Bengal area visited by the first expedition was the continental shelf of the coast of Burma, from Mergui Archipelago to the Gulf of Martaban. No fishing ground for sea breams was discovered, but a certain amount of fish known to the Chinese as "gohoo" (Polynemus) was caught in the vicinity of the delta of the Irrawaddy River, near the Krishna shoal. This fish, which is valued on the Chinese market, was sold in Singapore. The total amount of fish processed during the expedition was about 30 tons.

During its second reconnaissance in the Bay of Bengal, the Shinkyo Maru explored the coasts of Burma and India from Cheduba Island to Mutapolli Bay (Figure 30). A good fishing ground for prawn was found on the coast of Orissa, India, near latitude 20°N (south of False Point). Fifty-eight metric tons of frozen fish were processed during the expedition and sold in Calcutta and Rangoon.

JAPANESE TRAWLING AFTER THE SURRENDER

1. Reconstruction of Trawling Fleet

When Japan surrendered to the Allied Powers, the greater number of the offshore trawlers had been destroyed during World War II hostilities and fishing was confined to the coastal area. However, the Japanese soon resumed offshore operations in the portion of the East China Sea which is included within the fishing area authorized by the Supreme Commander for the Allied Powers, and the reconstruction of the trawling fleet is now completed.

Otter Trawlers: Since 1946, 41 otter trawlers have been built. These include 26 motor vessels, seven of which have a gross tonnage between 530 and 560. Although 59 licenses for otter trawlers have been issued since the Surrender, the statistics of the Ministry of Agriculture and Forestry for 1949 indicate that the present otter trawler fleet consists of 58 vessels, having an aggregate gross tonnage of 19,400 tons (Table 10). Thus, although the present otter trawler fleet includes fewer vessels than the prewar fleet, the average tonnage of the otter trawlers is larger now than before the war (approximately 330 tons in 1949 against 275 tons estimated for 1937).

These trawlers are based in Shimonoseki, Tobata, and Nagasaki. All belong to large fishing companies. Except that their fishing grounds are now restricted to the southeastern part of the East China Sea, they operate in the same ways as in the prewar period.

Bull Trawlers: Since the Surrender, the keels of more than 430 steel and 500 wooden vessels designed for bull trawling have been laid in Japanese shipyards. However, some of these vessels have since been converted for other purposes. The 1949 fleet of bull trawlers included 987 vessels totaling 68,300 gross tons (Table 10) These vessels can be classified according to tonnage in three different types: the large steel bull trawler of 90 tons or more; the medium-sized trawler, built either in steel or in wood, of 70 to 85 tons; and the small wooden trawler of 45 to 60 tons. The existing vessels include approximately 170 large and 270 medium-sized bull trawlers, the other vessels being of the small type. A comparison with the estimated composition of the bull trawler fleet in 1939 shows that the present bull trawlers exceed the prewar vessels both in tonnage and in number. Because of their larger tonnage, nearly all the present bull trawlers licensed for operation in the East China Sea are offshore vessels 29/ making trips averaging 15 to 20 days on their fishing grounds.

These bull trawlers belong to approximately 170 different owners. Most of the large ships (86 percent) and an important proportion of the medium-sized ones (55 percent) are owned by large fishing companies, among which are included all the owners of otter trawlers 30/. Most of the small vessels belong to small companies or to individual owners.

2. Fishing Grounds and Catch

Among the prewar fishing areas of the offshore trawlers, only the southeastern portion of the East China Sea is included within the fishing area authorized by the Supreme Commander for the Allied Powers (Figure 31) 31/. The present offshore trawler operations are thus restricted to an area of approximately 75,000 square nautical miles, or less than 40 percent of the prewar fishing area of the East China and Yellow seas.

Since the reconstruction of the Japanese trawling fleet, this relatively small area yields a catch which compares favorably with the prewar catch of offshore trawlers based in Japan Proper and operating in the former fishing areas of the East China and Yellow seas. In 1948, the otter trawlers caught more than 27,000 metric tons of fish (Table 11), and the bull trawlers more than 176,000 tons (Table 12). The catch per haul averaged 0.88 for the otter trawl, and 0.71 for the bull trawl.

As the present number of otter trawlers is smaller, their total catch does not reach the prewar figures, but the catch per haul has reached a level which had not been attained by Japanese trawlers since 1932. The total catch of bull trawlers, as well as their number, exceeds that of the bull trawlers based in Japan before the war. As data concerning the latter are incomplete, the average catch per haul of the bull trawl for the prewar and the present periods cannot be compared, but the catch per vessel has increased.

This rise in the returns of trawling operations is in part due to the recent increase in the tonnage of bull and otter trawlers. However, it is also probable that the fish resources of the East China Sea, once depleted through overfishing, have partially recovered during the time when trawling operations were restricted or interrupted by the war. Studies have been undertaken to ascertain the existence and to determine the extent of this recovery. 32/ As the data presently available cover only the authorized area, no definite conclusions can be reached at this stage except for a few species.

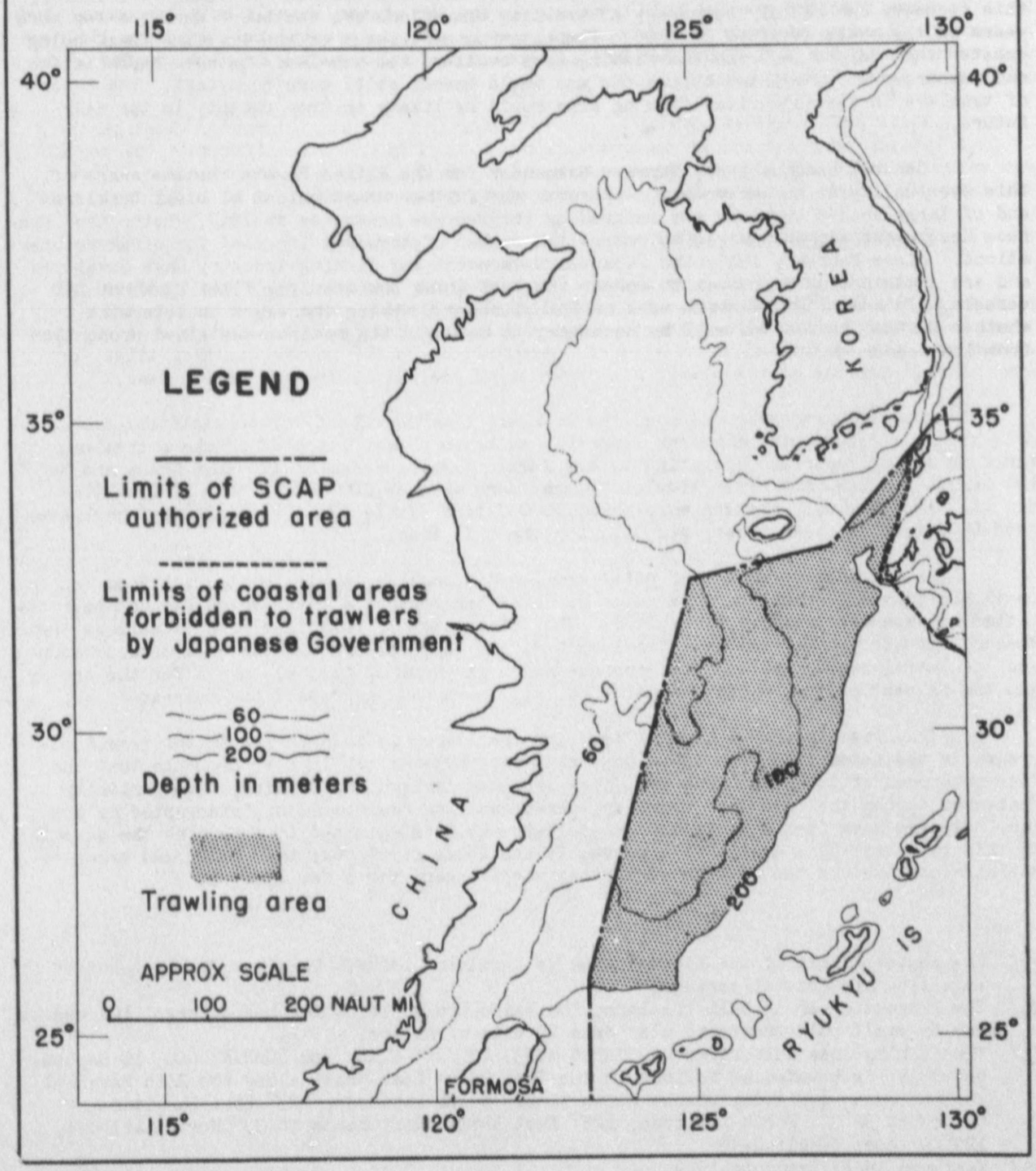
29/ The eastern limit of the license area is Longitude 130°E. Trawlers fishing east of this line are coastal vessels.

30/ The largest owner of bull trawlers, the Taiyo Gyogyo Co, which has 4 large, 102 medium, and 65 small bull trawlers, also owns 25 otter trawlers.

31/ The fishing area authorized by SCAPIN 1033, 22 June 1946, and SCAPIN 2046, 19 September 1949, is bounded as follows in the East China Sea: "west along the 24th Parallel to 123° East Longitude; thence north to 26° North Latitude, 123° East Longitude; thence to 32°30' North Latitude, 125° East Longitude; thence to 33° North Latitude, 127°40' East Longitude".

32/ Kasahara 1948; Yamamoto 1949.

OFFSHORE TRAWLING
IN
SCAP-AUTHORIZED AREA



NATURAL RESOURCES SECTION

Figure 31

An analysis of the present catch of trawlers shows that, with the exception of the prawn Peneaus orientalis, all the important species formerly caught in the East China and Yellow seas area also are taken in the present area of operations. However, some differences in the relative composition of the catch are evident (Tables 4 and 13). In 1946, the catch of sea breams was noticeably more important than in most prewar years; Taius tumifrons, a species of sea bream which had disappeared gradually from the catch of otter trawlers after 1930 (Table 5), is again taken in rather important amounts (Table 14).

If a few species actually have recovered from the effects of prewar overfishing, this recovery can be only temporary if trawling operations are continued during a few more years on the scale attained in 1948. The catching efficiency of the trawling fleet being greater than before 1941 and the fishing area smaller, the unbalance between exploitation and resources which existed before the war would become still more important. The catch of trawlers in the authorized fishing area would be likely to drop rapidly in the near future.

General Headquarters, Supreme Commander for the Allied Powers, became aware of this eventuality at an early date. Approval for further construction of steel trawlers and of large wooden trawlers was refused by the Supreme Commander in 1947. Later the Japanese Government was encouraged to reduce the number of trawlers licensed for offshore operations. Since February 1949, the Japanese Government and fishing industry have developed and are implementing a program to reduce the East China Sea trawling fleet by about 350 vessels. In addition, research work on this fishery is being increased to determine whether further reductions will be necessary to maintain the maximum sustained production from its resources.

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GLOSSARY

1. Glossary of Japanese Technical Terms

a. Most of the technical terms used by Japanese offshore trawl fishermen are phonetic transcriptions in the Japanese syllabary (kana) of the English terms. However, a few terms are used with a special meaning or are purely Japanese. The principal Japanese technical terms are listed:

Romaji	Kana or Kanji	English
ami	網	net
gyogyo	漁業	fishing
gyosen	漁船	fishing vessel
kisen	汽船	steamer
suisan	水産	marine products
tororu (trawl)	トロール	otter trawl
isei kisensokobikiami	以西機船底曳網	"western trawlers": bull and Danish seine trawlers operating west of 130°E
issobiki sokobikiami, issobiki kisensokobiki	一艘曳底曳網 一艘曳機船底曳	Danish seine, Danish seine trawler
kisensokobikiami, sokobikiami	機船底曳網 底曳網	bull trawl or Danish seine (terms used in official documents such as licenses and statistical reports)
kisensokobikiami gyosen, kisensokobiki gyosen	機船底曳網漁船 機船底曳漁船	bull trawler or Danish seine trawler (official)
kisentororu, kisentororu gyosen	汽船トロール 汽船トロール漁船	otter trawl, otter trawler

Romaji	Kana or Kanji	English
nisobiki sokobikiami, nisobiki kisensokobiki	二艘曳底曳網 二艘曳機船底曳	bull trawl, bull trawler
teguri, teguriami	手繰　手繰網	bull trawl or Danish seine (terms used by fishermen)
beri (belly)	ベリー	lower belly of trawl
me	目	mesh
sode	袖	wing of trawl
tegi	手水	spreader of Danish seine or bull trawl
tenjo	天井	upper belly of trawl
tsuna	綱	rope (hemp or Manila)
waiya (wire)	ワイヤー	wire rope

2. Units of Measurement

a. Metric to English

Metric		English
1 metric ton	=	1.102 short ton
1 kilogram	=	2.205 pounds
1 gram	=	0.035 ounce
1 kilometer	=	0.621 mile

Metric		English
1 meter	=	3.281 feet
1 centimeter	=	0.394 inch
1 millimeter	=	0.039 inch
1° centigrade x 9/5 32	=	1° Fahrenheit

b. Japanese to English

Japanese		Metric
1 shaku	=	0.9942 foot
1 sun	=	1.193 inches

TABLE 1.-JAPANESE OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1908-44 a/

Year	Based in Japan b/	Year	Based in Japan b/	Based in Formosa c/	Based in Shanghai d/
1908	1	1927	70	4	
1909	9	1928	67	4	
		1929	69	4	
1910	17				
1911	68	1930	70	4	
1912	137	1931	70	4	
1913	139	1932	68	4	
1914	131	1933	70	4	
		1934	70	4	
1915	129				
1916	56	1935	70	4	
1917	7	1936	70	4	
1918	6	1937	70	8	
1919	10	1938	47	8	
		1939	59	8	3
1920	48				
1921	57	1940	58	8	3
1922	67	1941	26	8 e/	3
1923	70	1942	16	8 e/	3
1924	70	1943	14	8 e/	3
		1944	7	8 e/	3
1925	70				
1926	69				

a/ For operations after 1944 see Table 11.
b/ Number of licensed vessels except 1938-43, number of vessels actually operating.
c/ Number licensed by the Formosan Government for operations between latitude 25° and 30°N. First license was issued in 1914, but commercial operation probably did not begin until 1927.
d/ No Japanese otter trawlers were based in Shanghai before 1939.
e/ No operation although licenses were issued
SOURCE: See Bibliography, Yamamoto, 1949 (Compiled from Fisheries Agency data).

TABLE 2.-CHARACTERISTICS AND SPECIFICATIONS OF SOME LARGE JAPANESE TRAWLERS

Item	Unit	Bull Trawler 88-Ton Class	Otter Trawlers 200-Ton Class	300-Ton Class	500-Ton Class
Tonnage					
Gross	Tons	88.60	210.00	314.00	538.59
Net	Tons	ND	82.00	122.00	351.85
Dimensions					
Length	Meters	27.40	35.97	38.10	50.70
	Feet	40.51	118.70	125.73	167.31
Beam	Meters	5.20	6.80	6.93	8.20
	Feet	17.00	22.44	22.86	27.06
Depth	Meters	2.70	3.89	3.96	4.50
	Feet	8.90	12.83	13.06	14.85
Hold capacity	Cubic feet	3,228.00 a/	3,796.00 b/	6,075.00 c/	12,239.98 d/
Engine					
Steam e/	Horsepower (maximum)	NA	690	500	NA
Diesel	Horsepower (maximum)	200	NA	NA	750
Speed					
Maximum	Knots	10.90	11.00	12.00	12.30
Cruising	Knots	8.00	8.50	8.50	9.50
Wireless range (approximate)					
Medium wave	Miles	250	250	250	500
Short wave	Miles	NA	1,500	1,500	1,500
Winch					
Steam	Horsepower	NA	40	40	NA
Electric	Horsepower	NA	NA	NA	45-50
Fishing gear					
Headrope length	Feet	130-280	130	130-145	145
Complement	Men	14-15	20	21	33

a/ About 1,500 fish boxes of 30 kilograms capacity and 40 tons of crushed ice.
b/ About 2,130 fish boxes of 40 kilograms capacity, ice packed.
c/ About 2,840 fish boxes of 40 kilograms capacity, ice packed.
d/ About 4,970 fish boxes of 40 kilograms capacity, for freezing.
e/ Triple expansion reciprocating type
NA: Not applicable
ND: No data available
SOURCE: Nippon Suisan Co and Taiyo Gyogyo Co

TABLE 3.-CATCH BY OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1922-41

Year	Total Catch (MT)	Total Number of Hauls	Average Catch per Haul (kg)
1922	34,294	77,904	437
1923	37,443	81,774	420
1924	37,647	78,048	480
1925	39,498	71,664	551
1926	45,559	76,768	607
1927	50,256	73,056	690
1928	58,226	72,480	802
1929	62,246	74,800	828
1930	60,970	71,300	855
1931	55,829	61,813	903
1932	53,856	60,925	885
1933	43,999	54,727	802
1934	45,515	57,127	795
1935	42,667	54,600	780
1936	42,430	56,700	750
1937	39,717	57,000	693
1938	32,175	45,936	701
1939	30,550	43,845	690
1940	30,051	43,600	690
1941	21,045	ND	ND

ND: No data available
SOURCE: Fisheries Agency, Ministry of Agriculture and Forestry.

TABLE 4.-COMPOSITION OF CATCH BY OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS, SELECTED YEARS, 1921-41 (percent of total catch)

Species	1921	1924	1927	1930	1933	1936	1939	1941
Sea breams								
Pagrosomus major	11	10	4	1	a/	a/	a/	a/
Evynnis japonicus	7	2	2	1	1			1
Taius tumifrons	19	7	1	a/	a/	a/	a/	a/
Croakers								
Nibea mitsukurii	4	7	5	7	6	5	4	4
Others	17	23	34	31	34	41	39	33
Gurnards								
Chelidonichthys kumu	1	4	4	2	1	1	1	a/
Lepidotrigla microptera	a/	5	3	2	6	7	2	2
Prawns								
Peneaus orientalis	a/	a/	a/	1	3	1	a/	a/
Flatfish	4	6	9	11	12	8	6	4
Sharks	9	8	9	9	6	5	4	4
Rays	6	7	8	8	7	6	5	6
Others	22	21	21	27	23	25	39	46

a/ Less than one percent
SOURCE: Fisheries Agency, Ministry of Agriculture and Forestry.

TABLE 5.-CATCH OF SEA BREAMS BY OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1921-42

Year	Pagrosomus major		Evynnis japonicus		Taius tumifrons	
	Total Catch (MT)	Average Catch per Haul a/ (kg)	Total Catch (MT)	Average Catch per Haul a/ (kg)	Total Catch (MT)	Average Catch per Haul a/ (kg)
1921	3,077	ND	2,132	ND	5,510	ND
1922	3,316	39	1,211	16	4,954	64
1923	4,064	50	1,043	13	4,117	50
1924	3,890	49	666	9	2,476	32
1925	3,761	52	748	10	1,644	23
1926	2,999	40	1,310	18	1,584	21
1927	1,776	24	1,106	15	681	9
1928	2,139	30	914	13	174	2
1929	1,915	26	546	7	79	1
1930	463	6	362	5	42	b/
1931	276	4	113	2	22	b/
1932	210	3	98	2	3	b/
1933	102	2	222	4	1	b/
1934	126	2	123	2	1	b/
1935	84	2	426	9	1	b/
1936	52	1	84	2	c/	b/
1937	33	b/	59	1	c/	b/
1938	48	1	50	1	c/	b/
1939	215	5	9	b/	7	b/
1940	82	2	15	b/	c/	b/
1941	38	2	105	4	2	b/
1942	149	ND	33	ND	5	ND

a/ Average catch per haul is obtained by dividing total catch for each species by total number of hauls for all species in the entire fishing area.
b/ Less than one kilogram
c/ Less than one ton
ND: No data available
SOURCE: Fisheries Agency, Ministry of Agriculture and Forestry.

TABLE 6-CATCH OF CROAKERS BY OTTER TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1921-42

Year	Nibea mitsukurii		Other Croakers	
	Total Catch (MT)	Average Catch per Haul (kg)	Total Catch (MT)	Average Catch per Haul (kg)
1921	1,128	ND	5,016	ND
1922	2,060	26	7,076	91
1923	2,317	28	7,775	95
1924	2,606	33	8,613	110
1925	2,425	34	10,218	143
1926	2,283	31	14,660	196
1927	2,509	34	16,656	228
1928	3,506	48	21,374	295
1929	4,276	57	19,686	263
1930	4,428	62	18,738	263
1931	5,046	82	18,853	305
1932	3,549	58	21,036	345
1933	2,835	52	14,961	273
1934	2,115	37	18,810	329
1935	2,286	42	17,807	326
1936	2,254	40	17,625	311
1937	1,757	31	17,103	300
1938	1,855	40	12,112	264
1939	1,255	29	11,842	270
1940	1,450	33	11,550	265
1941	922	33	7,001	284
1942	321	ND	5,111	ND

ND: No data available
SOURCE: Fisheries Agency, Ministry of Agriculture and Forestry.

TABLE 7.-BULL TRAWLERS LICENSED FOR OPERATIONS WEST OF 130°E, 1920-44 a/

Year	Base					
	Japan Proper	Korea	Kwantung, Manchuria	Tsingtao, China	Shanghai, China	Formosa b/
1920	NA	NA	4	NA	NA	NA
1921	106	NA	4	NA	NA	NA
1922	c/	NA	c/	NA	NA	NA
1923	240	NA	8	NA	NA	18
1924	c/	NA	c/	NA	NA	18
1925	280	NA	10	NA	NA	58
1926	c/	NA	20	20	NA	70
1927	320	c/	c/	20	NA	76
1928	c/	c/	67	20	NA	76
1929	c/	c/	78	36	NA	96
1930	594	c/	81	c/	NA	108
1931	582	c/	90	c/	NA	96
1932	640	c/	90	c/	NA	96
1933	c/	c/	99	64	NA	94
1934	560	c/	126	64	NA	104
1935	609	c/	c/	64	NA	118
1936	694	c/	c/	64	NA	110
1937	688	69	136	c/	NA	100
1938	685	69	135	64	16	114
1939	678	69	135	64	16	114
1940	603 d/	69	c/	64	16	c/ d/
1941	603	69	150	64	16	c/ d/
1942	590 d/	69	150	64	16	c/ d/
1943	585 d/	69 d/	150 d/	c/ d/	16	c/ d/
1944	581 d/	69 d/	150 d/	c/ d/	16	c/ d/

a/ East China and Yellow seas
b/ Includes only the trawlers authorized to operate east of longitude 118°E. These trawlers did not fish north of latitude 30°N.
c/ Licenses were issued, but no data are available concerning their number.
d/ Only a few of the licensed vessels actually operated (see Table 8).
NA: Not applicable
SOURCE: Fisheries Agency (Bibl); Yamamoto, 1949.

TABLE 8.-WARTIME OPERATIONS OF BULL TRAWLERS IN EAST CHINA AND YELLOW SEAS, 1940-45

Year	Vessels in Operation per Month				Total Catch (MT)	Average Catch per Vessel a/
	Maximum		Minimum			
	Number	Month	Number	Month		
1940	552	Dec	129	Aug	108,370	262.5
1941	603	Jan	78	Aug	125,840	326.5
1942	423	Mar	46	Aug	95,690	344.5
1943	411	Jan	20	Sep	68,490	336.0
1944	169	Jan	20	Sep	27,260	336.5
1945	56	Mar	6	Aug	5,600	161.0

a/ Total of averages calculated for each month
SOURCE: Offshore Trawlers Fisheries Assn

TABLE 9.-CATCH OF OTTER TRAWLERS IN THE GULF OF TONKIN, 1931-38

Year	Number of Licensed Vessels a/	Total Catch (MT)	Number of Hauls	Average Catch per Haul (kg)	Percent of Evynnis japonicus in Catch	Percent of Operations in the Gulf	
						Hauls	Catch
1931	11	3,380	4,237	797	18	97	99
1932	11	2,940	4,216	697	41	100	100
1933	15	6,200	8,488	730	33	100	100
1934	14	6,228	7,449	836	34	100	100
1935	18	11,677	12,492	934	47	89	90
1936	20	11,021	11,298	975	35	96	96
1937	17	9,610	11,677	823	38	100	100
1938	15	6,448	5,035	1,281	67	100	100

a/ As of 1 January
SOURCE: Shibata 1940, vol 1.

TABLE 10.- OFFSHORE TRAWLERS LICENSED FOR OPERATIONS IN EAST CHINA SEA WITHIN SCAP-AUTHORIZED AREA, 1947-49 a/

Year b/	Construction	Otter Trawlers			Bull Trawlers c/		
		Number	Total Gross Tonnage	Total Horse-power	Number	Total Gross Tonnage	Total Horse-power
1947	Wood	NA	NA	NA	506	29,500	61,400
	Steel	56	18,600	28,800	406	32,200	72,400
	Total	56	18,600	28,800	912	61,700	133,800
1948	Wood	NA	NA	NA	567	33,800	68,800
	Steel	56	18,600	28,800	440	35,400	84,600
	Total	56	18,600	28,800	1,007	69,200	153,400
1949	Wood	NA	NA	NA	554	33,300	67,200
	Steel	58	19,400	29,900	433	35,000	84,600
	Total	58	19,400	29,900	987	68,300	151,800

a/ Trawlers in 1945-46 operated with licenses issued before the Surrender.
b/ As of 31 December
c/ Includes all bull trawlers licensed for operations west of longitude 130°E.
NA: Not applicable
SOURCE: Fisheries Agency, 1947, 1948, 1949 A.

TABLE 11.- CATCH BY OTTER TRAWLERS IN EAST CHINA SEA WITHIN SCAP-AUTHORIZED AREA, AUGUST 1945 - DECEMBER 1949

Year	Vessels in Operation		Total Catch (MT)	Total Number of Hauls	Average Catch per Haul (kg)
	August	December			
1945	NA	5	920	ND	ND
1946	8	24	8,100	9,900	820
1947	21	43	20,760	22,100	940
1948	4	50	27,830	31,800	880
1949	25	47	31,260	ND	ND

NA: Not applicable
ND: No data available
SOURCE: Japanese Offshore Trawlers Fisheries Assn

TABLE 12.- CATCH BY BULL TRAWLERS IN EAST CHINA SEA WITHIN SCAP-AUTHORIZED AREA, SEPTEMBER 1945- DECEMBER 1949

Year	Vessels in Operation				Total Catch (MT)	Average Catch per Vessel a/ (MT)	Total Number of Hauls	Average Catch per Haul (kg)
	Minimum		Maximum					
	Number	Month	Number	Month				
1945	2	Sep	20	Dec	810	67	ND	ND
1946	123	Jan	356	Dec	46,970	211	ND	ND
1947	156	Sep	611	Dec	134,290	330	157,900	850
1948	65	Aug	696	Dec	176,540	392	248,400	710
1949	284	Aug	895	May	218,680	277	ND	ND

a/ Total of averages calculated for each month.
ND: No data available
SOURCE: Japanese Offshore Trawlers Fisheries Assn

TABLE 13.- COMPOSITION OF CATCH BY OFFSHORE TRAWLERS WITHIN SCAP-AUTHORIZED AREA, 1946-48 (percent)

Species	1946	1947	1948
Otter trawlers			
Sea breams			
Pagrosomus major	3	3	1
Evynnis japonicus	1	a/	a/
Taius tumifrons	12	1	1
Croakers			
Nibea mitsukurii	2	6	7
Others	23	13	11
Gurnards			
Chelidonichthys kumu	a/	1	1
Lepidotrigla microptera	2	1	11
Ribbonfish			
Trichiurus haumela	a/	10	9
Conger			
Muraenesox cinereus	a/	1	3
Flatfish	2	3	5
Sharks	4	5	3
Rays	7	8	6
Others	43	48	42
TOTAL	100	100	100
Bull trawlers			
Sea breams	ND		
Pagrosomus major	ND	1	1
Evynnis japonicus	ND	1	1
Taius tumifrons	ND	16	9
Croakers			
Nibea mitsukurii	ND	1	2
Others	ND	5	6
Gurnards			
Chelidonichthys kumu	ND	1	2
Lepidotrigla microptera	ND	1	10
Ribbonfish			
Trichiurus haumela	ND	a/	1
Conger			
Muraenesox cinereus	ND	1	3
Flatfish	ND	4	4
Sharks	ND	6	5
Rays	ND	5	9
Others	ND	58	47
TOTAL	ND	100	100

a/ Less than one percent
ND: No data available
SOURCE: Japanese Offshore Trawlers Fisheries Assn

TABLE 14.-CATCH OF SEA BREAMS IN EAST CHINA SEA WITHIN SCAP-AUTHORIZED AREA, 1946-48

Year	Pagrosomus major		Evynnis japonicus		Taius tumifrons	
	Total Catch (MT)	Average per Haul a/ (kg)	Total Catch (MT)	Average per Haul a/ (kg)	Total Catch (MT)	Average per Haul a/ (kg)
Otter trawlers						
1946	270	27	93	9	976	98
1947	565	26	62	3	228	10
1948	168	5	61	2	377	12
Bull trawlers						
1947	1,631	10	1,321	8	20,962	133
1948	1,058	4	1,027	4	15,555	63

a/ Obtained by dividing amount of catch for each species by total number of hauls in the authorized area.
SOURCE: Japanese Offshore Trawlers Fisheries Assn

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