Report of Japan-U.S. Joint Survey on Selective Trawls in the Bering Sea in the Winter of 1983

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Report of Japan-U.S. Joint Survey on Selective Trawls in the Bering Sea in the Winter of 1984

Keiichiro Mori
(Japan Marine Fishery Resource Research Center)

1. Objectives of the Survey

To develop new trawl gears and new methods of fishing operation which has minimum incidental catch of prohibited species such as Pacific halibut (Hippoglossus stenolepis), chinook salmon (Onchorhynchus tshawytscha) and has enough fishing efficiency for target species such as pollock (Theragra chalcogramma), Greenland halibut (Reinhardtius hippoglossoides), etc.

2. Methods

1) General idea for the experiments

Two types of net were designed through modifications in the standard trawl commonly used for pollock fishing by commercial boats in the North Pacific. The catching efficiency for target species and the rate of incidental catches of prohibited species of these two types of net were examined through a comparison with

the original net in situ. In order to elucidate the effect of the modification, other factors such as towing speed, tow duration, and the tow location were kept as equal as possible in each set of ~~daily~~ experiments in which new gear and the original gear was used. Details of the experiment will be discussed later.

The original plan was that newly designed nets and original nets were to be towed simultaneously from respective research boat running side by side. One of the boats became incapacitated shortly before leaving the mother port, and the plan was revised to use just one boat.

2) Survey area

The experiments were carried out on the continental shelf and the continental slope in the area between 54°49' and 56°40' North Latitude and 166°27' and 168°46' West Longitude in the Bering Sea, mostly in the area called the Polaris Ground. The water depth of the survey area ranged from 55 to 400 m.

3) Survey period

The entire period of the trip was 53 days from November 6th to December 28th, 1983. Of this, 32 days, (from November 17th to December 18th), were spent surveying the area.

4) Research boat and personnel

Research boat: Yakushi Maru, No. 31; 349.87 GT, a stern trawler belonging to the Shiogama Port of Miyagi Prefecture.

Ship complement: 27 officers and crew including
Akira Hoshi, Master fisherman
Norio Hoshi, Captain,

Research personnel:

Keiichiro Mori; Japan Marine Fishery Resource Research Center

Calvin Blood; International Pacific Halibut Commission

Kazuo Hamamura; Japan Marine Fishery Resource Research Center

3. Details of the Experiments and the Results Obtained

1) Experiment of nets with hanging ropes

In this net, ground rope and fishing rope were linked with eight pieces of hanging ropes of 1.0 m in length in order to keep the fishing rope off the sea bottom during towing. This net and the standard net for pollock fishing, (from which the first net was modified), were towed 60 times alternately, and 30 sets of data were obtained.

The area covered, towing speed, and the tow time (90 minutes) were kept equal, throughout the entire experiment, as stated earlier. If there was some difference either in number or weight of a catch between the two types of gear, it was considered to have had stemmed from a difference in gear structure, or from the effect of the gear modification. The catches of both nets were compared on a graph with the catch of the standard net on the abscissa and the catch of the net with hanging ropes on the ordinate. In the graph, the 45° line indicates an equal value, or there was no difference between catches.

The number of Pacific halibut caught (Fig. 4-a) tended to be higher from the standard net, indicating that the presence of hanging ropes reduces the halibut catch. This corresponds to the fact that the difference in catches between the two types of net was not small

(Table 1). There was no remarkable difference in the size range and length mode in length frequency distributions between the two nets (Fig. 5), suggesting that there was no big difference in the rate of escapement through the hanging ropes due to the length of the fish.

The catch, in weight, of all flatfishes other than Pacific halibut (Fig. 4-b) was remarkably larger from the standard net, indicating the effect of the hanging ropes in reducing the catch of these fishes. A larger catch in the standard net was seen by the catch of sablefish (Fig. 4-c), and a similar tendency was seen by the catch of Pacific cod (Fig. 4-d), and by the catch of chinook salmon both in numbers and weight (Fig. 4-e). The catch of pollock in weight was much larger on the average from the standard net (Fig. 4-f), and the reason for this will be discussed later.

2) Experiment of trawl net with a baiting section of large mesh (2000 mm)

In this net, the baiting section of the standard net for pollock (Fig. 2) was replaced with 2000 mm mesh. The modified and the standard nets were towed 25 times each and the results were compared.

The catches of chinook salmon in number were much larger from the standard net than from the large mesh net in many cases (Fig. 7-a). Since the two nets had exactly the same structure except for the mesh size in the baiting section, it may be natural to think that this remarkable difference came from the fact that the fish once caught in the net escaped via the large-meshed baiting section. The catch of pollock, like chinook salmon, was also smaller from the large mesh net (Fig. 7-b). Although the difference was not so great as the first two cases, a similar tendency of smaller catches were observed in the large mesh net with Pacific cod (Fig. 7-c). The difference between the two nets was not clear with sablefish, Pacific halibut and other flatfishes (Fig. 7-d, e, and f).

Length frequency distribution of chinook salmon did not show much difference between the two types of net (Fig. 8). This seems to indicate that it was not just the fish of particular length that escaped from the large mesh section, but that fish escaped from it regardless of the length.

4. Discussion and Proposal for the Future Investigation

Although the decrease in the catch of Pacific halibut from the net with hanging ropes was not remarkable, the decrease in the catch of other flatfishes was great. This seems to have an important meaning. Since these fishes are similar in behavior and live on the sea bottom or in the mud of the sea bottom, the effect of hanging ropes should work for all these species. Because some of the flatfishes are important for the fishing industry, the net with hanging ropes can have little meaning if it reduces the fishing efficiency for flatfishes to a large extent. In this respect, there may be some difficulties in designing a trawl net which catches other flatfishes effectively without catching Pacific halibut.

The results of the experiment showed the net with hanging ropes was more effective in catching pollock than the standard net. A large catch of pollock is thought to happen by chance when a ship happens to encounter a large school of the fish. So, the amount of catch varies greatly from tow to tow even within one fishing ground. In order to determine the fishing efficiency of a net for pollock, two trawls should be towed simultaneously from two boats running in parallel. Otherwise, the reliability of the experiment is limited.

It was clearly shown that the use of a large mesh net in the baiting section had the effect of reducing the catch of chinook salmon, but at the same time, it had the effect of losing a substantial amount of pollock, which is an important species for the fishing industry.
A simple comparison of the catch of pollock between the modified and

the standard nets shows that the catch by the former is 42.4% of that of the latter (Table 1), meaning a 58% loss through the net. In order to design a trawl net which effectively retains pollock and allows chinook salmon to escape, the problem will be how to balance the two factors, and the loss of pollock should be minimal. To clarify this, an experiment using two boats at the same time is advisable as with the experiment of the net with hanging ropes.

Those fish species which were caught to a lesser degree in the net with hanging ropes are supposed to be caught in a net on or near the bottom of the sea. These are Pacific halibut, other flatfishes, sablefish, Pacific cod and chinook salmon. Of these species, chinook salmon and Pacific cod escaped from the large mesh net, but Pacific halibut and other flatfishes did not. It may be possible to presume that the latter two species proceed deeper into the net along the bottom after they enter, while the former two species swim upward in the net. For further modification of the net, more precise knowledge of fish behavior is needed to clarify how fish enter the net and their behavior after they are in the net.

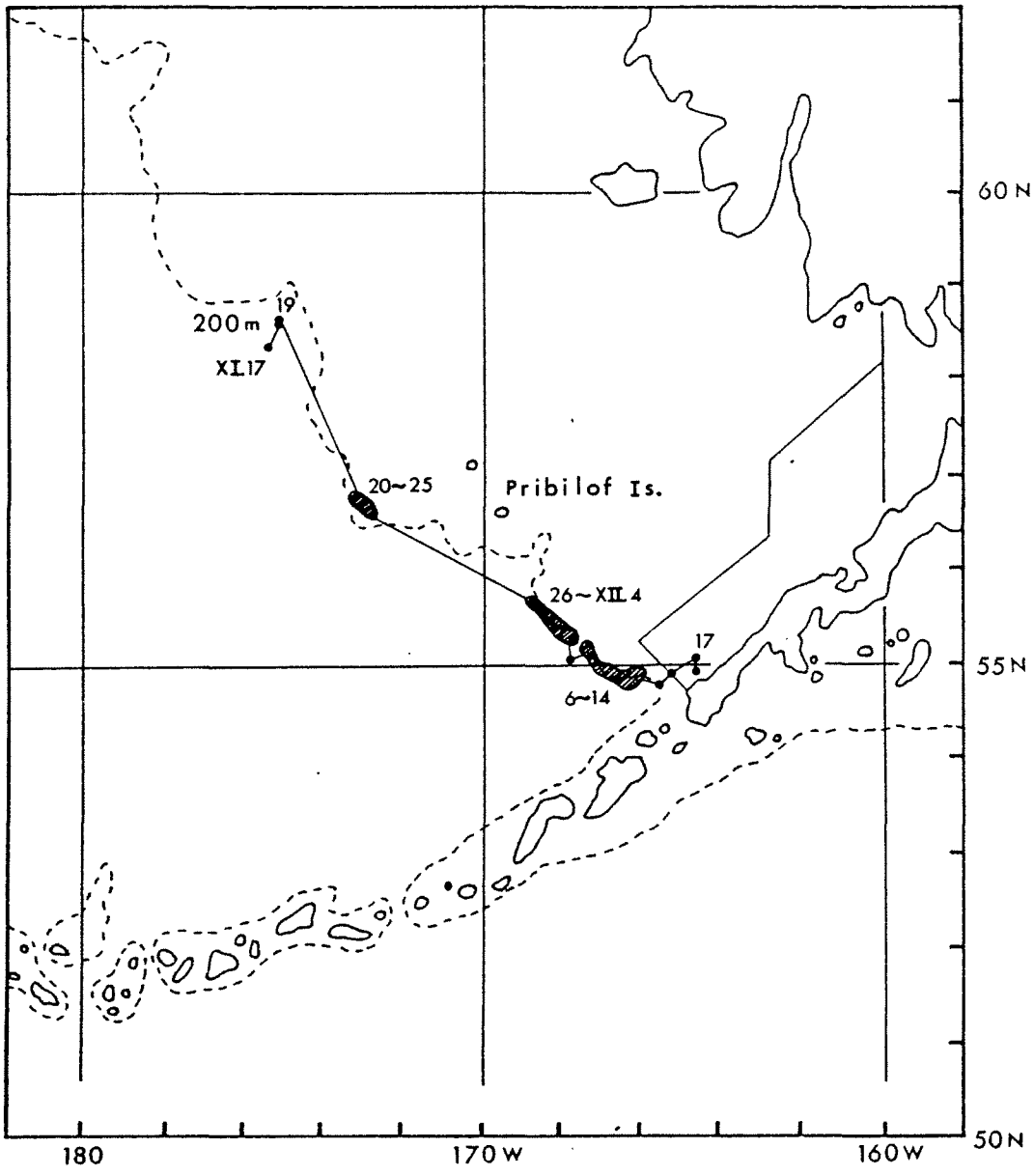


Fig.1 Noon positions (solid circles) and major survey areas (shaded) in the Bering Sea during the 1983 winter cruise.

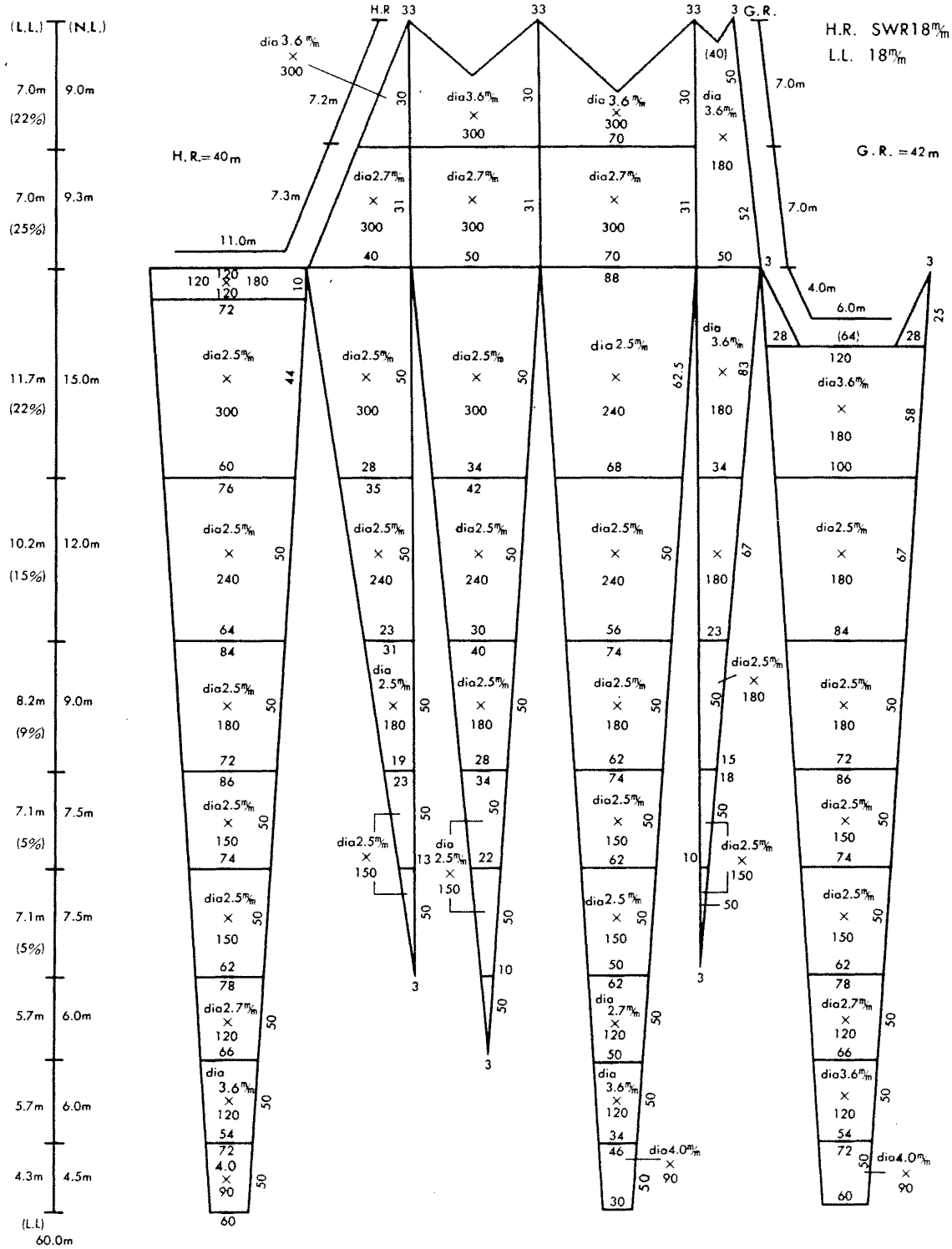


Fig.2 General design of a standard trawl used in pollock fishery in the North Pacific.

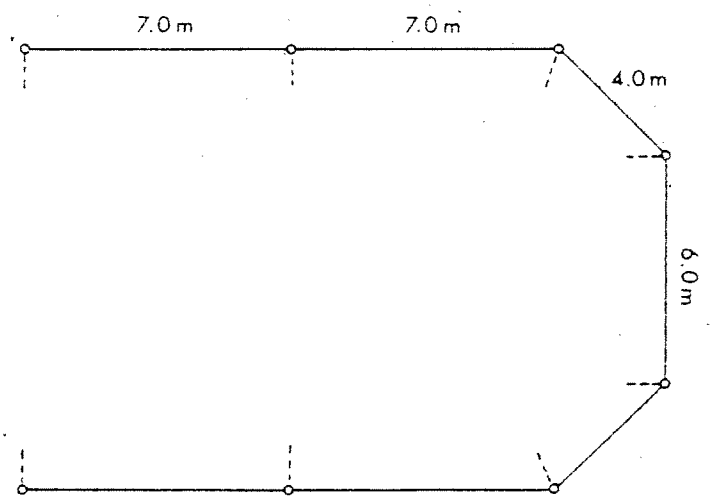
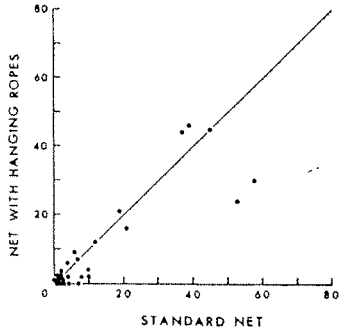
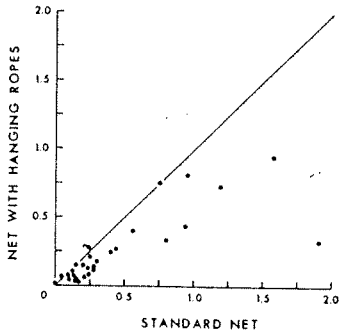


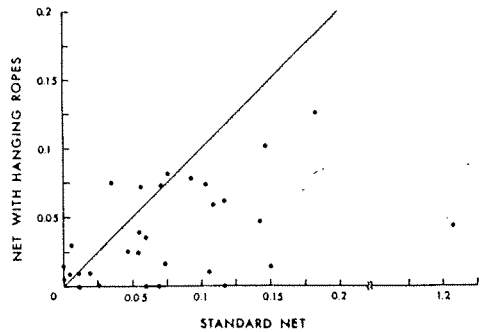
Fig.3 Arrangement of hanging ropes attached to the ground rope. The hanging ropes are 1.0 m each in length and were installed to lift the fishing rope up from the sea bottom at tow.



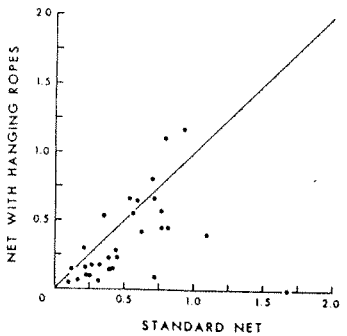
a. Numbers of Pacific halibut caught.



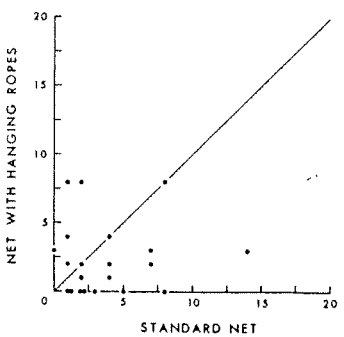
b. Weight of flatfishes other than Pacific halibut (tons).



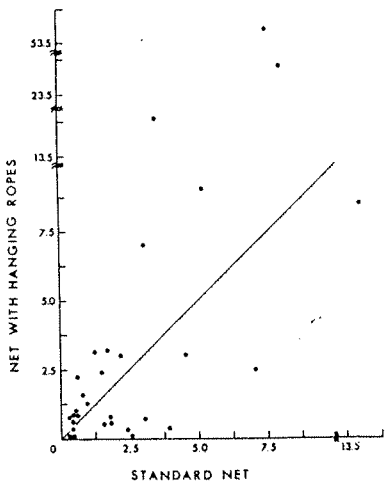
c. Weight of sablefish caught (tons).



d. Weight of Pacific cod caught (tons).



e. Numbers of chinook salmon caught.



f. Weight of pollock caught (tons).

Fig. 4 Comparison of the numbers and weights (in tons) of major fish species caught with the trawl equipped with hanging ropes (ordinates) and those caught with the standard trawl (abcissa). A, number of Pacific halibut; B, weight of flatfishes other than Pacific halibut; C, weight of sablefish; D, weight of Pacific cod; E, number of chinook salmon; F, weight of pollock.

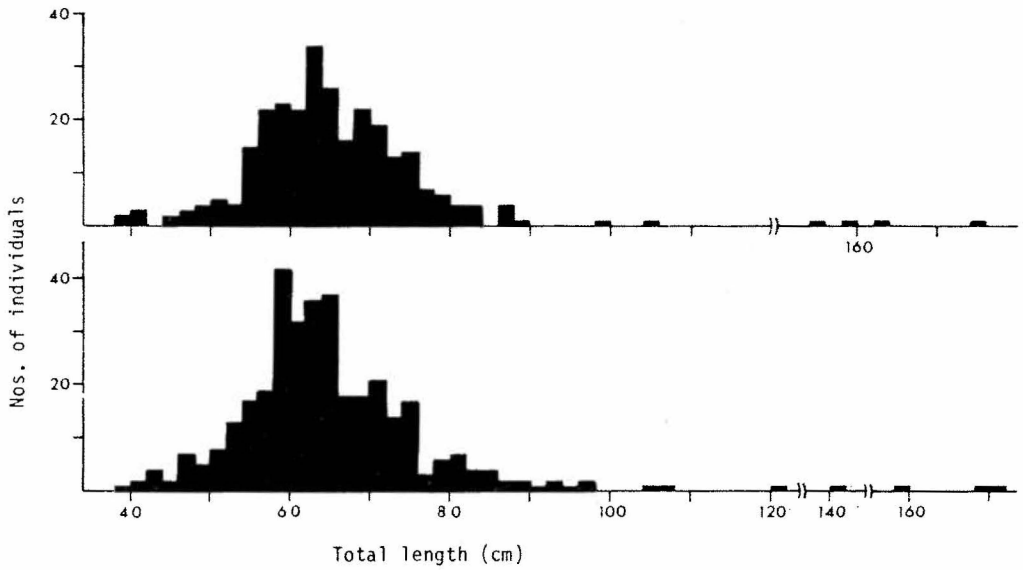


Fig. 5 Comparison of length frequency distributions of Pacific halibut caught with the trawl equipped with hanging ropes(upper case) and those caught with the standard trawl(lower case).

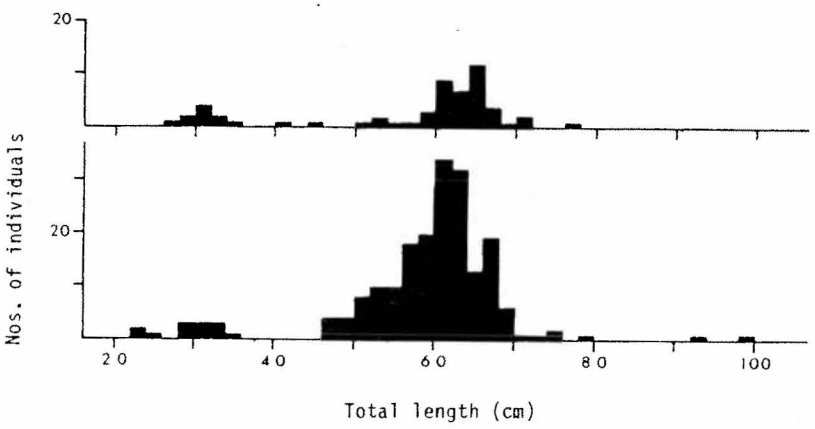


Fig. 8 Comparison of length frequency distributions of chinook salmon caught with the trawl equipped with 2000 mm mesh net in the baiting section(upper case) and those caught with the standard trawl(lower case).

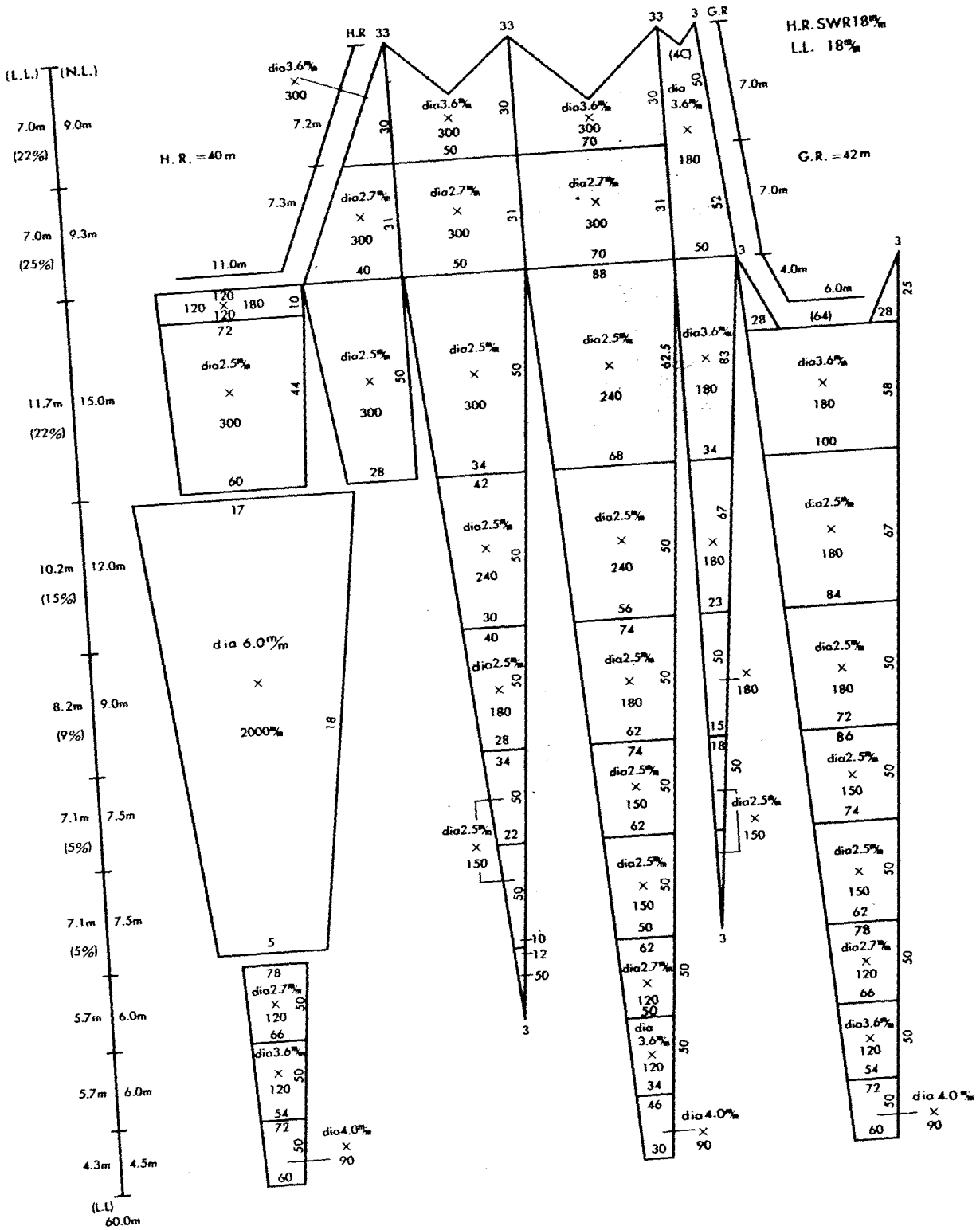
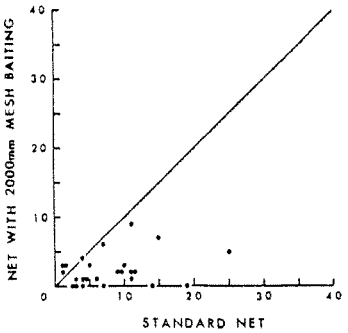
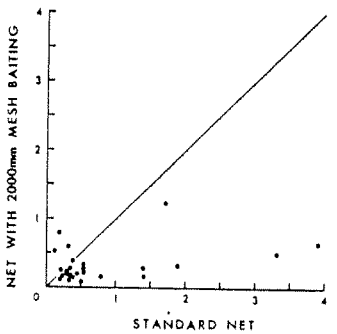


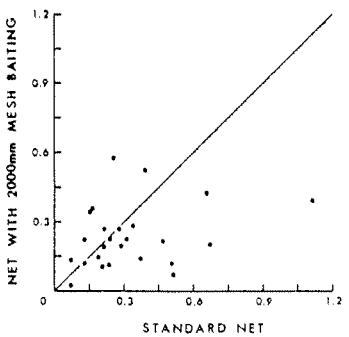
Fig.6 General design of the trawl with 2000 mm large mesh in the baiting section.



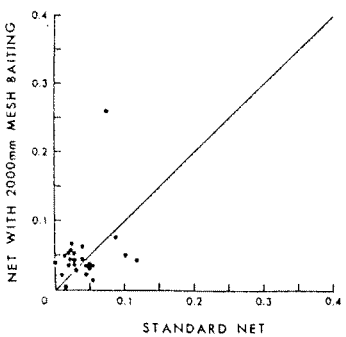
a. Numbers of chinook salmon caught.



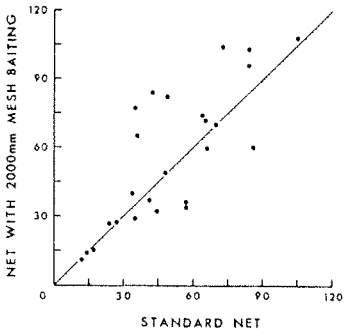
b. Weight of pollock caught (tons).



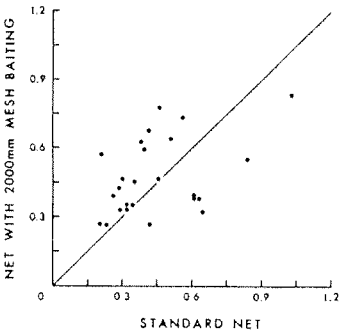
c. Weight of Pacific cod caught (tons).



d. Weight of sablefish caught (tons).



e. Numbers of Pacific halibut caught.



f. Weight of flatfishes caught other than Pacific halibut (tons).

Fig. 7 Comparison of the numbers and weights(in tons) of the fish caught with trawl equipped with 2000 mm large mesh baiting (ordinates) and those caught with standard trawl(abcissa). A, numbers of chinook salmon; B, weight of pollock; C, weight of Pacific cod; D, weight of sablefish; E, numbers of Pacific halibut; F, weight of flatfishes other than Pacific halibut.

Table 1. Numbers and weights of major fish species caught by the type of gear.

Type of gear	Trawl with hanging ropes	Standard trawl	Trawl with large mesh in the baiting	Standard trawl
Serial numbers of tow	1-59	2-63	67-115	64-111
Nos. of effective tows	30	30	25	25
Weight of pollock (kg)	148,364	82,573	8,595	20,282
Weight of sablefish (kg)	1,146	3,211	1,242	1,022
Nos. of halibut	279	355	1,411	1,272
Weight of halibut (kg)	1,127	1,400	5,739	5,842
Weight of flatfishes other than halibut (kg)	7,607	13,092	11,874	11,073
Nos. of chinook salmon	52	78	58	198
Weight of chinook salmon (kg)	147	245	152	579
Weight of Pacific cod (kg)	10,941	15,923	5,917	8,106
Nos. of tanner crabs	68	73	6,714	4,347

Numbers and weights are the sum of catches from 90 minute tows. The catch of the 19th tow which towed 30 minutes was multiplied by 3.