INVESTIGATION'S REPORT ON THE FISHERIES RESOURCES OF DEEP-SEAS SHRIMPS, PELAGIC FISHES AND SILVER HAKE AT THE NORTHERN SEA ZONE OF REPUBLIC OF PERU

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OVERSEAS TECHNICAL COOPERATION AGENCY

TOKYO, JAPAN

FOREWORD

The present one is a Report on a very interesting exploratory research trip carried out by the Russian vessel "CHATYR-DAG" along the northern Peruvian territorial waters. This document has been carefully prepared by Ing. Tadanobu Machii, who participated in the above mentioned trip, and contains data on some newly detected and potentially valuable species, particularly of shrimps, localized off the northern coast of Perú.

The continuation of this type of studies would be mist desirable and I am sure that Ing. Machii, a very capable and dedicated professional (appointed by O. T. C. A. from the Japanese Government, to assist the Department of Fisheries of the Universidad Nacional Agraria, in the area of fishing methods), will give us in the future more of this type of information to increase our rather scant data on this subject.

Hèctor R. Pimentel,
Head Department of Fisheries
Universidad Nacional Agraria

La Molina, March 31, 1972

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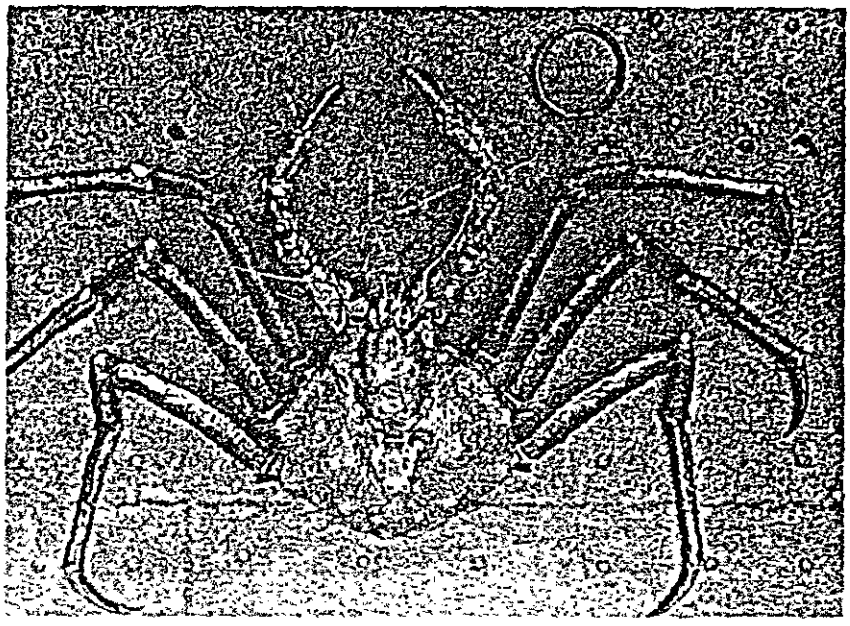
Paralomis sp.



Lithodes panamensis

INVESTIGATION'S REPORT ON THE FISHERIES RESOURCES OF DEEP-SEAS SHRIMPS, PELAGIC FISHES AND SILVER HAKE AT THE NORTHERN SEA ZONE OF REPUBLIC OF PERU

By
Tadanobu MACHII *

Abstract

The exploratory investigations of fisheries resources at the northern sea zone of Republic of Peru were realized by "CHATYR-DAG", fisheries exploratory ship of Soviet Union, from September 14 to October 23 1971.

The author had very good opportunity to get on board the ship from September 25 to October 4, 1971, in the 2nd. investigation's travel of above navigation's plan.

Out field of the investigation extended from the northern territorial Waters (lat. 3^{o} 23' 4 S.) to Punta Aguja (lat. 5^{o} 53' 2 S.).

We have confirmed the existence of deep-seas shrimps at the southern zone of Mancora Bank, having sea depth from 600 to 800 m.. Important species of it were Nematocarcinus sp. and Hymenopenaeus d.. The fishing ground is, in this moment, small and has very much rough bottom.

By the mid-water trawl, we encountered with the new pelagic fishes of Round herring (Etrumeus teres (D.), and Striped bonito (Sarda orientalis velox M. & H.), but it remains unexplained whether these are seasonal or temporal going south school from Ecuador region or no, also whether these always have a southern school boundary as far as northern sea zone of Peru or no.

As for Silver hake (Merluccius gayi peruanus G.), at the southern sea region from Cabo Blanco (lat. 4^{o} 16' 6 S.), the author found the existence of depth migration towards coastal shallow waters from deep-seas region or contrary direction following isobath migration along the continental shelf edge. That may be very locally and temporarily and relatively narrow school being influenced oceanographical conditions. In our investigation, it can be observed date at Paita bay and Sechura one in comparison with other investigation's date.

* The author work at Department of Fisheries, Peru Agrarian University, Lima-Peru being based on the Japanese Technical Cooperation Program for Peru

I. General

The first and third travels mainly carried out Silver hake resources investigation off "Lobos de Tierra" island (lat. 6° 27' S., long. 80° 52' W.) and off "Lobos de Afuera" one (lat. 6° 56' S., long. 80° 43' W.). The forth one was realized mainly oceanographical observation.

In the second navigation that the author could join in, main objects of this surveys were to explorate and investigate deep-seas shrimps resources at the southern region of Mancora Bank, pelagic fish ones around Mancora Bank and demersal fish ones along the northern coast from Punta Aguja.

Here, the author would like to submit the report of results obtained that put together from the piscatology point of view. Unfortunately, in our investigation, no oceanographical observations closed together with each fisheries operations have been done for the reason of mechanical brake trouble of winch.

As for deep-seas shrimps surveys, Dr. Del Solar [x 1)] says that in June 2, 1966, "ANTON BRUUN" caught various specimens of Heterocarpus b. at lat. 5° 01' S., long. 81° 25' W. with the sea depth from 200 to 311 m., also in December 16, 1968, "KAIYO-MARU" got one specimen of Hymenopenaeus d. at lat. 3° 48' 2 S., long. 81° 21' 5 W. with the sea depth of 518 m..

Under these established facts, Peruvian Sea Institute (I. MAR. PE.) carried out, on Dr. Del Solar advice, the exploratory investigation by "SNP-1", fisheries investigation ship, around at Mancora Bank and it's southern region with beam trawl in January, 1971 [x 1)]. And it got biologically valuable results.

Up to now, the author can scarcely find any investigation on pelagic fish resources in this region, but we can encoutner one investigation that in December 1969, Dr. J. Scharfe[x2)], chief of gear section of F. A. O., realized with peruvian scientists and the author [x3)] the experimental trials of mid-water trawl from the gear technology point of view. In this moment, fisheries scale is somewhat small, but coastal fisheries aimed at pelagic fish actually developping in this region by purse-seine, drift net and dart.....etc...

In Peru, it is said that Silver hake has a habitat on the continental shelf edge [x 4)], that it distributes to a northern region from Pisco (lat. 13° 40' S.) as a southern boundary, and that the more going north, the more large length we have. In fact, we can encounter the commercial fishing ground at the north of Salaverry (lat. 8° 13' 7 S.). And this sea region makes the favorable fishing ground of Silver hake in lat. 4° to 6° south which has a remarkable effect of upwelling.

From the investigation's data obtained by I.MAR.PE, the author is of the opinion that there may have a fishing ground center of Silver hake at around "Lobos de Tierra" island and "Lobos de Afuera" one. This opinion may have a reason that existences of upwelling and local oceanic front showing a predominance in this sea zone, and of topographical complex make primary physical factor of favorable fishing ground.

Under present condition, it is very difficult for me to get a definite conclusions that will suit to the investigated region from limited data, so the author confined oneself to synoptic observation only as a conclusion so as not to lead a misjudgement. In this report there may contain some erroneous observations, and may have errours in the attached data tables, in this case please point it out me. Also, the author would like to get general criticisms by fisheries scientists.

II. Results and Discussion

The fishing investigation ranged from lat. 3^{o} 27.5' to 5^{o} 24.0' S. and from long. 80^{o} 49.0' to 81^{o} 28.0' W.. The range of hauling net depth was from 450 to 1,100 m. in deep-seas shrimps and bottom trawl, from 15 to 182 m. in mid-water one and from 40 to 200 m. in coastal bottom one. Hauling net speed had the range from 2.4 to 4.5 knots in deep-seas shrimps and bottom trawl, from 2.9 to 4.8 knots in mid-water one and from 3.0 to 4.5 knots in coastal bottom one.

In our investigation, we caught a total of 144,530 kg. by operating 31 times, 2,060 minutes and 118.1 nautical miles. This catch could give as 2,105 kg. per 30 minutes or as 1,224 kg. per mile. To be concrete, the author is able to give approximate fishing intensities as follows using the units of kg./mile;

Deep-seas zone; deep-seas shrimps shows 22 and demersal fish 33.

Mancora Bank and around it; pelagic fish gives 1,200 and demersal one 100.

Coastal zone; pelagic fish denotes 280 and demersal one 2,700.

Species caught that could clearly classify were 62 ones in total, these were 51 fishes, 2 mollusks and 9 crustaceans. As for commercial aimed fishes and crustaceans that we could relatively regard as good catch in investigation sence, the author can adduce following species; Round herring (Etrumeus teres (D.))" Sardina japonesa", Chilean pilchard (Sardinops sagax sagax (J.)) "Sardina" and Mackerel (Pneumatophorus japonicus peruanus J. & H.) "Caballa" to pelagic fish, and Silver hake (Merluccius gayi peruanus G.) "Merluza" to demersal one, also Nematocarcinus sp. and Hymenopenaeus d. to deep-seas shrimps. Although we did not get good results, following fishes out of 62 species that we got will be important for fisheries exploitation in the future; these are Dog fish (Mustelus sp.) "Tollo", Sea bass (Alphestes multiguttatus f.H.) "Mero", Split-tail bass (Hemianthias peruanus (S.)) "Doncella", Drums (Polyclemus peruanus (S.)) "Coco", Drums (Cynoscion analis (J.)) "Ayanque", Drums (Sciaena deliciosa (T.)) "Lorna" and Drums (Larimus sp.) "Bereche" to demersal fish and Pacific jack (Trachurus symmetricus) "Jurel", Pacific bonito (Sarda sarda chilensis (C.)) "Bonito" and Striped bonito (Sarda orientalis velox M. & H.) "Bonito" to pelagic fish.

It is worth special mention that we got somewhat good catches of Round herring and deep-seas shrimps and a catch of Striped bonito for the first time in the fisheries investigation up to now.

Please refer to detailed data tables accompanied (Tables. 1-a, 1-b, 2-a, 2-b, 2-c and 2-d).

a. Deep-seas shrimps

This exploratory investigation had a object of supporting the I.MAR.PE's biological investigation results obtained to deep-seas shrimps [x 1)] by surveys with a full-sized fishing condition.

At the southern region from Mancora Bank, we caught a total of 2,400 kg. of deep-seas demersal fish by operating 10 times with 893 minutes and 44.2 nautical miles. Of the above catch, deep-seas shrimps occupied 948 kg., and out of the total shrimps catch, Nematocarcinus sp. and Hymenopenaeus d. holded 91%, that is the former took 51.5%, the latter 39.5%, but Heterocarpus 4.5%.

In the case of St. No. 5 that got the good catch, we obtained 44 kg. of Nematocarcinus sp., 21 kg. of Hymenopenaeus d. and 4 kg. of Benthesicymus sp. with the units of catch per mile.

Fig. 1-a to 1-e show the relation between catching depth of deep-seas shrimps and it's catch per mile. From these Figs., all species got a good catch at the sea depth from 600 to 800 m., and we could not have good catch's expectations more than about 800 m..* In this moment, our data obtained are too poor to come to a definite conclusion, but it may be said that in northern region of Peru deep-seas shrimps generally has a habitate deeper than chilean region.

From the biological point of view, the author has to write it in addition for references that other deep-seas shrimps, Pacifaena magna, caught 3 kg. at the depth from 750 to 800 m. at St. No. 5, also two species of deep seas crabs, Paralomis sp. and Lithodes panamensis caught each one specimen at the depth from 950 to 1,000 m. at St. No. 4.

b. Pelagic fishes

Investigation's field was on Mancora Bank and around it at the northern region of lat. 3^{o} 35' S. and offshore of Punta Sal (lat. 4^{o} 00' S.).

We caught a total of 61,280 kg of pelagic fish by operating 10 times of mid-water trawl with 685 minutes and 46.4 nautical miles. Of the pelagic fish catch, Round herring occupied 48 %, Chile an pilchard 27 % and Mackerel 16 %. These three species took for the most part of catch.

We got good catches of pelagic fish at the depth from 60 to 110 m., which is net position from face, inclining towards the S-E of Mancora Bank and the offshore of Punta Sal. But we could not get good catches on Mancora Bank, though there was an exception of St. No. 8.

Fig. 2 has been made in order to find school's inclination in each species, showing the relation between total pelagic fish catch and Round herring, Chilean pilchard and Mackerel one respectively, with units per one haul per mile. Then, the author wishes to discuss as follows on school's inclination on Mancora Bank, at the S-E of it and offshore of Punta Sal, using above mentioned units.

* It is said that in Nov. 1971, "CHALLUA JAPIC" caught abundantly its at the depth from 800 to 1,000 m. too.

On Mancora Bank; Total pelagic fish catch has the direct correlation to Mackerel one, but the inverse correlation to Round herring one. We had Mackerel caught together with Round herring by mid-water trawl, and Mackerel occupied a major part (from 80 to 90 %) of the total pelagic fish catch. However, St. No. 8 shows much the same school's inclination as following region.

The S-E of Mancora Bank and Offshore of Punta Sal; Total pelagic fish catch has the direct correlation to Round herring and Mackerel one, but has the inverse correlation to Chilean pilchard. It finds that we got Round herring caught being mixed with Chilean pilchard about the same proportion, herring caught being mixed with Mackerel about the ratio of two to one respectinely, or encountered Round herring only.

Fig. 3-a shows the weight-length relation of Round herring. The data have much variations, but we can roughly estimate the distribution of length having the range from 26 to 29 cm. of weight from 200 to 270 g..

Fig. 3-b shows the weight-length relation in case of Chilean pilchard, the length is distributed from 29 to 34 cm and the weight from 200 to 300 g. Here, we can generally understand that Chilean pilch ard has the more length's distribution but the less fatness than Round herring. Also, we can understand that the data obtained by "CHATYR-DAG" are large in length and poor in fatness compared with I.MAR.PE's data, which is distributed from 23 to 30 cm. in length and from 100 to 250 g. in weight, though sampling region and season are unknown.

Striped bonito was caught 2 times in the course of our pelagic fish investigation at the depth from 42 to 83 m. on Mancora Bank. This species is tropical bonito that can be found at the region from Mexico to Ecuador*, so this deffers from Pacific bonito (Sarda sarda chilensis (C.)) that is caught along the coast of Peru and Chile.

Fig. 3-c shows the weight- length relation of Striped bonito, which is distributed from 50 to 75 cm. in length and from 1,500 to 4,000 g. in weight. The author quoted the Pacific bonito's data from I.MAR.PE's literature in this Fig. for reference. It does not unqualifiedly compare with both data, but the fatness of Striped bonito may be something large than that of Pacific bonito.

The author has to add that we caught Pacific cutlass-fish (Trichiurus nitens G.) "Pez cinta" only in the catching weight of 5,500 kg. at the east boundary of Mancora Bank with the operation depth from 15 to 85 m..

* by the opinion of Mrs. Aurora Chirinos de Vildoso, fisheries biologist of I.MAR.PE.

From the biological point of view, also the author must point out the catching fact of Anchovy (Engraulis ringens J.) "Anchoveta" at the position of lat. 3° 47' S., long. 81° 28' W., probably caught in the course of hauling net up towards ship. It is said that the northern boundary of Anchovy's habitat in Peru is about lat. 7° S., but in our case, we had it caught much more north. This fact exceeds by far the record up to now, which was at lat. 5° 17' S., long. 81° 14' W. ("BETTINA" in March, 1965).

c. Silver hake

At the northern coast from lat. 6° S., we caught a total of 80,850 kg. of demersal fish by operating 11 times of bottom trawl with 482 minutes and 27.5 nautical miles. Out of the demersal fish catch, Silver hake occupied 79 % and Drums (Larimus sp.) "Bereche" about 7 %. Other demersal one was a very little.

Along the northern coast from Cabo Blanco, Drums' proportion a haul was the greater than Silver hake's one, but at the southern region of Cabo Blanco, specially at Paita and Sechura bays, Silver hake took for the most part of catch.

Above mentioned region that we realized the investigation is so important for Silver hake's resources that the author would like to discuss about an inclination of catch and of it's migration by means of comparing our data obtained with other ones that up to now - had got in this region.

The region from the northern territorial waters to Lobitos (lat 4° 27' S.).

Absolute catches of demersal fish a haul were poor. Silver hake's proportion a haul were nearly zero at the sea depth from 24 to 145 m. But the proportion was about 18 % at the depth from 145 to 205 m. and was about 96 % at the continental shelf edge (in this case that is from 225 to 274 m). Namely, we are able to understand that over 145 m. depth, absolute catch of Silver hake and the proportion a haul are on the increase in proportion to depth.

data; St. No. 13-15, 24, 29 in Sept - Oct. 1971 "CHATYR-DAG"
St. No. 12, 13 in Nov. 1968 "RONCAL"
St. No. 11-14 in Oct. 1968 "RONCAL"
St. No. 2-5, 7 in Dec. 1969 "SNP-1"

The region from Lobitos to Punta Aguja

As showing in Fig. 4, we can observe the correlation between Silver hake's catch and it's catching depth, that is, the more depth increase, the more favorable catch we get at the depth from 40 to 170 m.. Furthermore, Silver hake's proportion a haul is about 96 % (90-99 %) having nothing to do with the depth.

In our investigation, there has an example that we got a good catch (3,250 kg/mile) of Silver hake at the depth of 40 m. being close to coast. On the other hand, according to other ships' data, there have the examples of nearly zero catch of it within the same closing region. This may be explained that is due to the short time's or day's variations and seasonal or anual ones of marine environments bringing about migrations.

data; St. No. 30-36 in Oct. 1971 "CHATYR-DAG"
St. No. 14, 15 in Oct. 1968 "RONCAL"
St. No. 1, 2 in Dec. 1970 "SNP-1"

We are able to find the short time's variation of Silver hake's catching proportion a haul at the same closing region in Sechura bay. For example, in two cases with the same stations's starting day and time, the proportion was on the one hand about 3 % on the other 100 %. Also we can observe the short day's variation of it within the within the same closing region in Sechura bay. For instance, the proportion a haul had been about 28 % (less than 50 %) in Oct. 19 to 20, but was about 5 % (less than 8 %) in Oct. 31 to Nov. 2nd., similarly, it had been 100 % in Oct. 18, but in Oct. 31, it was about 6 % (less than 8 %) in the same station and depth of 77 m., being based on RONCAL's data in Oct.-Nov., 1968.

data; St. No. 7, 9-11, 18 in Oct. 1968 "RONCAL"
St. No. 7, 9, 10, 16, 17, 19-21 in Oct.-Nov. 1968 "RONCAL"

In case of closing to operation's starting time at the same depth, it has an inclination to great rate in south than in north. For example, it was about 80 % at Punta Aguja and was about 2 % offshore of Punta Capitala (lat. 5^{0} 08' 5 S.).

data; St. No. 5 in Dec. 1968 "KAIYO-MARU"
St. No. 6-2 in Dec. 1968 "KAIYO-MARU"

Fig. 5 shows what plotted Silver hake's proportion a hual with an interval of sub-zone regarding investigated region, and what plotted, at the same time, the datas obtained by other research ships for reference. There is no unqualified comparison among sub-areas with different depth, but from this Fig., it may roughly observe in Sept.-Oct., 1971 that Silver hake school went up more north to around offshore of Cabo Blanco than ordinary years.

From the mentioned things, the author would like to divide following two regions from the territorial water to lat. 6^{0} S..

zone 1 - The north from Cabo Blanco; this region has the oceanographical characteristics prevaling "El Niño Current" with the tropical water of high temperature and low salinity. So, within the continuntal shelf, Silver hake is very poor in absolute catch and in catching proportion a haul, but other demersal fishes of warm water abound in species. Around continental shelf edge existing optimum water condition for Silver hake, it shows good catch more depth than at the south of this region.

zone 2 - The south from Cabo Blanco; this region has the characteristics of repetitions going north or south of local oceanic front between El Niño Current and Peru Current, of the rise and fall of S-E wind bringing about upwelling and of the existance of points with the complex shoreline. For reason of the complex oceanographical conditions, we can encounter the greater catch of Silver hake, but generally does not get a steady catch of it like at the south of this region. Therefore, there may have much irregularities of Silver hake catch at the coast of this region by means of depth migration owing to oceanographical variations. This depth migration is very locally, temporarily and relatively narrow school towards the coast from deep seas or contrary direction. Further, isobath migration along the continental shelf edge exists together with the depth migration. These may clearly encounter at this region, and specially, the depth migrations were able to observe at the bay of Paita and of Sechura. Actually, Silver hake enter the fixed net installed at Paita bay by feeding and depth migrations in early morning.

III. Conclusion

At the south of Mancora Bank, we encountered deep-seas shrimps at the depth from 600 to 800 m. Abundant species of it are Nematocarcinus sp. and Hymenopenaeus d.. This fishing ground is, in this moment, small and has very much rough bottom.

We caught new species of pelagic fish, that is, Round herring and Striped bonito for the first time in these exploratory investigations. Unfortunately, it remains unexplained whether these species are seasonal or temparary going south school from Ecuador region or no, also whether these always have a southern boundary as far as a northern region of Peru or no.

On Mancora Bank and around it, we caught Round herring, Chilean pilchard and Mackerel at the depth range from 60 to 110 m.. On Mancora Bank, total pelagic fish catch has the direct correlation to Mackerel one, but the inverse correlation to Round herring one. At the S-E of Mancora Bank and offshore of Punta Sal, total pelagic fish catch has the direct correlation to Round herring and Mackerel one, but has the inverse correlation to Chilean pilchard.

At the northern coast from Cabo Blanco there had poor catch of Silver hake within the continental shelf, but had good catch of it at the continental shelf edge. At the southern coast from Cabo Blanco to lat. 6^{o} S. especially at Paita bay, we can observe the correlation between Silver hake catch and it's catching depth, increasing the catch accompanied with enlarging the sea depth within the range from 40 to 170 m..

At Paita and Sechura bays we may find the existance of depth migration of Silver hake towards shallow water from deep-seas region (or contrary direction), that is very locally and relatively narrow school and is affected very much by oceanographical conditions. Also, in our investigation (Sept.-Oct., 1971), it may observe that Silver hake school, as isobath migration, went up more north than ordinary year, really went up north to around offshore of Cabo Blanco.

IV. Recomendations

Detailed vertical oceanographical observations up to fishing gears position that are close together fishing operations are so important to make a study of fisheries hydrography that we have at any cost to give consideration to realize these observations.

In the case of pelagic fisheries resources at the northern region of Peru, these are oceanographically related very much to fishing conditions in Ecuador region, so we have to make common studies of fisheries hydrographical characteristics with Ecuador.

It is very difficult thing for us to make resarches in fisheries dynamics without cooperation of statistical catching data from commercial fishing boats operating actually in sea. Therefore, we have to consolidate a close cooperation system for the furture.

A cknowledgement

I would like to express my deep sence of gratitude for following authorities provided me the opportunity of going on board the ship, who are Dr. J. Sanchez, director of Technical Direction of I.MAR.PE., Dr. R. Jordan, chief of Marine Investigation Division of I.MAR.PE., and Ing. J. Ducato, director of Department of Fisheries of Peru Agrarian University.

I offer cordial thanks for Dr. E. Del Solar, scientific advisor of I.MAR.PE. and consulting commission member of Ministry of Fisheries of Peru, who has given me kind instructions on deep-seas shrimps. Also, I thanks from my heart to the 2nd. investigation members who persevered in our efforts for collecting the scientific data on board.

On the ship, the author much indebted to following U.S.S.R. scientist members for their kind assistances and for offering me all of their facilities, who are Mr. K. Vladimir, chief of investigation team, Mr. G. Vladimir, captain of the ship and Mr. P. Anatoly, fishing master.

Finally, the author would like to thanks to Ing. K. Kawagoe and Ing. Y. Yamamura, technical advisors of Ministry of Fisheries of Peru, whom the author has asked for general criticisms and for general criticisms and for reading through my manuscript.

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T A B L E

F I G U R E

	Species names	Catch (Kg)	%
Deep-seas shrimps:	Nematocarcinus sp.	488	51.5
	Hymenopenaeus d.	374	39.5
	Heterocarpus b.	43	4.5
	Benthesicymus sp.	28	3.0
	Others	15	1.0
Sub-total		948	100.
Pelagic fishes:	Round herring	29,136	47.5
	Chilean pilchard	16,650	27.1
	Mackerel	9,485	15.5
	Pacific cutlass-fish	5,500	9.0
	Others	555	0.9
Sub total		61,326	100.
Demersal fishes:	Silver hake	64,945	79.0
	Drums (Larimus sp.)	5,525	6.7
	Searobin	2,060	2.5
	Dogfish	1,910	2.3
	Cusk-eel	1,410	1.7
	Sea bass	1,040	1.3
	Others	5,366	6.5
Sub-total		82,256	100.
Total		144,530 Kg	

Table 1-a ; Main species catch statistics in general

	Species names	Deep - seas zone		Bank of Mancora		Coastal zone		Total
		S. T	B. T	M-W.T	B.T	M-W.T	B.T	
Deep-seas shrimps	Nematocarcinus sp.	446 Kg	42 Kg					488 Kg
	Hymenopenaeus d.	243	131					374
	Heterocarpus b.	28	15					43
	Benthesicymus sp.	16	12					28
	Other deep-seas shrimps	10	5					15
	Sub-total	743	205					948
Pelagic fishes	Round herring			25,535	1	3,600		29,136
	Chilean pilchard			13,050		3,600		16,650
	Mackerel			8,625	60	800		9,485
	Pacific cutlass-fish			5,500				5,500
	Other pelagie fishes			555				555
	Sub-total			53,265	61	8,000		61,326
Demersal fishes	Silver hake	180	160		2,805		61,800	64,945
	Drums (Larimus sp.)				120		5,405	5,525
	Searobin						2,060	2,060
	Cusk-eel				120		1,290	1,410
	Dogfish		95	10	600		1,205	1,910
	Split-tail bass				1,020			1,020
	Rockfish	52	230					282
	Other demersal fishes	465	270	5	374		3,990	5,104
	Sub-total	697	755	15	5,039		75,750	82,256
	Total	1,440	960	53280	5,100	8,000	75,750	144,530

* Remarks S T ... Shrimp trawl net B.T ... Bottom trawl net , M-W T ... Mid-water trawl

Table 1-b ; Main species catch statistics depending on operation zone and type

Sea zone	Trawl net	Operation times	Duration (min.)	Distance (mile)	Sea dpth (m)	Total catch (Kg.)	Deep seas shrimps			Pelagic fishes			Demersal fishes		
							Kg.	Kg/30min.	Kg/mile	Kg.	Kg/30min.	Kg/mile	Kg	Kg/30min.	Kg/mile
Deep-seas zone	S.T	5	395	20.1	600-1000	1,440	743	56.4	37.0				697	52.9	34.7
	B.T	5	498	24.1	450-1100	960	205	12.3	8.5				775	45.5	31.3
	Sub-tot.	10	893	44.2		2,400	948						1,452		
Bank of Mancora	M-W.T	9	594	40.3	(15- 182)	53,280				53,265	2,690	1,322	15	0.8	0.4
	B.T	2	95	5.1	120- 135	5,100				61	19.3	12.0	5,039	1,591	988
	Sub-total	11	689	45.4		58,380				53,326			5,054		
Coastal zone	M-W.T	1	91	6.1	(65- 80)	8,000				8,000	2,637	1,311			
	B.T	9	387	22.4	40-200	75,750							75,750	5,872	3,382
	Sub total	10	478	28.5		83,750				8,000			75,750		
	Total	31	2,060	118.1		144,530	948			61,326			82,256		

Remark ( ): Net's position from sea-surface

Table 2-a ; Catch inclination in general

Trawl Net	St. Nº	Position		Sea Depth (m)	Catch (Kg/mile)				
		Lat. (S)	Long. (W)		Total	Deep-seas Shrimps	Silver hake	Dogfish	Others
S.T	3	3.57.0	81.20.5	600 - 750	161	5.8	37.8	-	117
	4	3.46.5	81.11.3	950 - 1000	4.7	1.9	-	-	2.8
	5	3.45.0	81.21.7	750 - 800	82.1	70.0	-	-	12.1
	6	3.45.8	81.21.8	660 - 700	66.7	53.9	5.3	-	7.5
	* 7	"	"	720	77.0	30.8	15.4	-	30.8
B.T	16	-	-	600 - 700	129	53.9	46.4	8.9	19.3
	17	3.30.0	81.06.0	450 - 620	-	-	-	-	-
	* 26	3.52.0	81.26.0	700 - 1000	26.0	0.5	3.9	5.2	16.4
	* 27	3.47.0	81.28.0	800 - 1070	38.0	3.8	-	-	34.2
	28	4.00.0	81.18.0	960 - 1100	30.4	6.1	-	9.1	15.2

Remarks In the Others of St. Nº 16, including Splittail bass 20 Kg. (7.1 Kg/mile)

* ..... Net Accidents

Table 2-b ; Catch inclination's data table of deep-seas shrimps and demersal fishes

Sea zone	Trawl net	St. Nº	Position		Net position from sea-surface (m.)	Catch (Kg/mile)				
			Lat. (S)	Long. (W)		Total	Round herring	Chilean pilchard	Mackerel	Others
Bank of Mancora	M-W.T	8	3.34.0	81.12.0	62	3,235.	2,941	265	-	29.4
		* 9	3.33.5	81.11.0	-	100	83.3	-	-	16.7
		10	3.34.4	81.03.0	15 - 85	661	-	-	2.4	659.
		12	3.27.5	81.05.6	33 - 182	2,584	1,165	1,165	243	10.7
		19	3.33.0	81.08.0	80 - 90	283	47.2	-	226	9.4
		20	3.31.9	81.10.0	-	322	32.3	-	290	-
		21	3.30.0	80.58.0	105	5,223	3,333	167	1667	55.6
		22	3.33.0	81.16.0	42 - 83	412	11.8	-	368	32.4
		* 23	"	81.23.6	-	11.2	5.6	-	5.6	-
Coastal zone	M-W.T	11	3.55.0	81.03.0	65 - 80	1,311	590	590	131	-

Remarks: In the Others of St. Nº 10, including Pacific cutlass-fish 5,500 Kg (655 Kg/mile).
" St. Nº 9, including Striped bonito 10 Kg (8.3 ")
St. Nº 22, including Striped bonito 210 Kg (30.9 ")
*..... Net Accidents

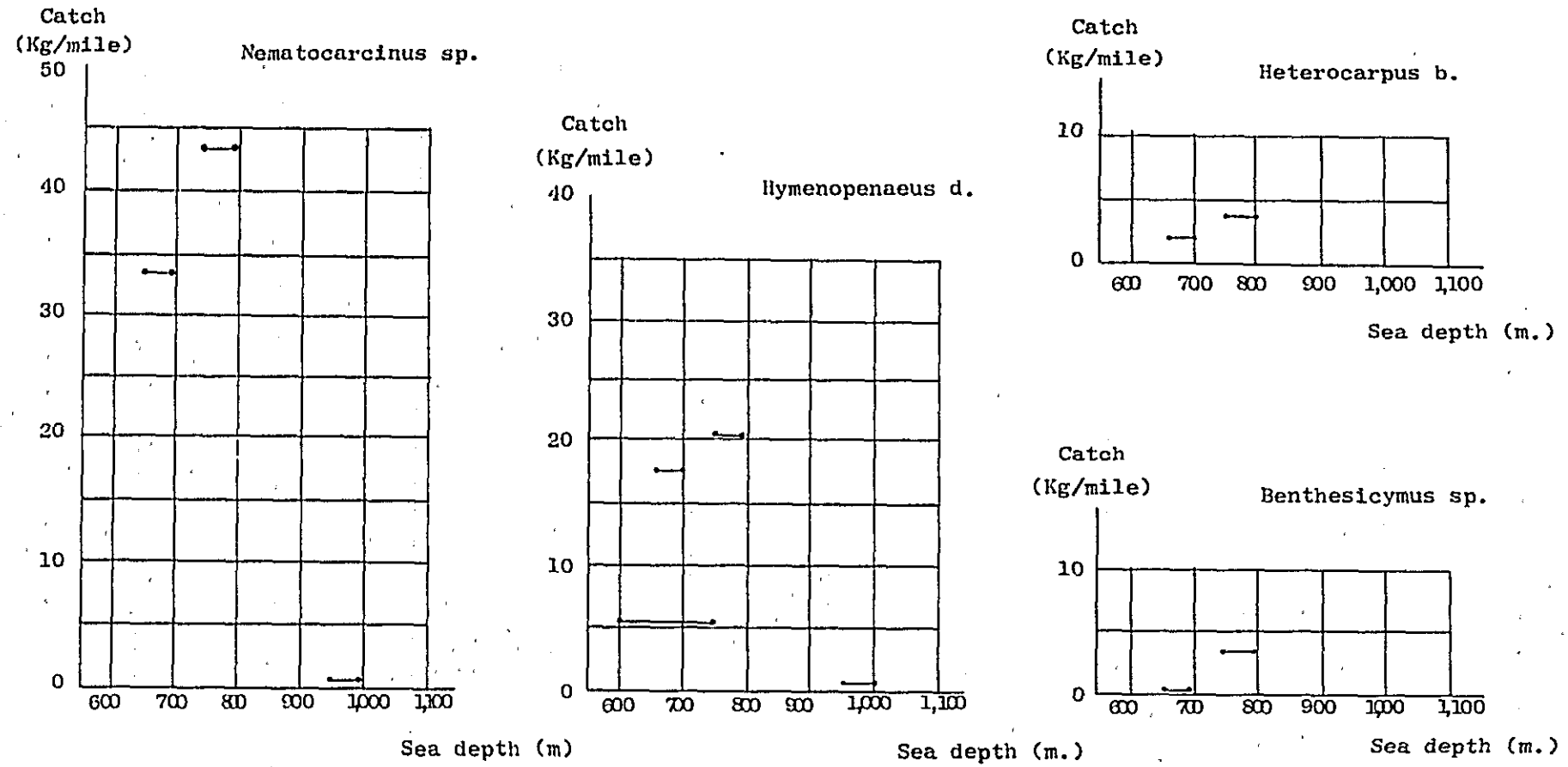
Table 2-c ; Catch inclination's data table of pelagic fishes

Sea zone	Trawl net	St. Nº	Position Lat. (S)	Position Long. (W)	Sea depth (m)	Catch (Kg./mile) Total	Silver hake	Drums (Larimus sp.)	Searobin	Cusk-eel	Dogfish	Sea bass	Split-tail bass	Others
Bank of Mancora	B.T	* 18	3.37.2	81.07.0	120	556	2.8	-	-	-	-	5.6	500	47.2
		25	3.35.5	81.03.0	135	1,242	848.	36.4	-	36.4	182.	-	36.4	103.
Coastal zone	B.T	1	5.19.0	81.20.2	145 - 150	1,250	1,167	-	-	-	-	-	-	83.3
		* 2	5.24.0	81.19.0	200	6,613	6,129	-	-	129	96.8	-	-	258
		13	3.43.2	80.50.2	105	2,061	45.5	1,061	606	-	36.4	212.	-	100
		14	3.47.0	80.58.0	46	283	-	-	4.3	-	21.7	21.7	4.3	230.
		* 15	3.30.0	80.49.0	150 - 170	1,251	188	500	-	87.5	125	-	-	351.
		24	3.46.0	80.53.0	145 - 150	619	119	357	11.9	19.0	35.7	23.8	23.8	28.6
		29	4.17.0	81.24.0	71	1,500	1,450	1.3	--	10.0	8.8	5.0	-	25.0
		30	4.58.0	81.21.0	160	20,000	19,200	-	-	400.	300	-	-	100
		31	5.02.5	81.12.5	40 - 48	3,350	3,000	-	-	50.0	-	-	-	300
Coastal zone (References)	B.T	07	5.37.	81.02.	50 - 70	1,842	1,066	-	-	376	-	-	-	690
		08	5.32.	81.02.	50	11,538	9231	-	-	-	-	-	-	2,308.
		32	4.53.	81.12	40	3,333	3,250	-	-	33.3	33.3	-	-	16.7
		33	4.48.5	81.26.	150	13,333	13,167	-	-	66.7	83.3	-	-	16.7
		34	4.45.	81.29.	150 - 170	16,667	16333	-	-	-	-	167	-	167.
		35	4.51.2	81.22.5	140 - 150	7,500	7438	-	-	-	50.0	-	-	12.5
		36	4.43.	"	80	5,769	5500	-	-	-	-	38.5	-	231.

Remarks In the Others of St. Nº 18, including Mackerel 60 Kg. (33.3 Kg/mile)
" St. Nº 07, " Drums 360 Kg. (94.7 Kg./ mile) and Blackruffs 270 Kg. (71.1 Kg/mile)
" St. Nº 36, " Blackruffs 500 Kg (192 Kg/mile)

* ..... Net Accidents

Table 2-d ; Catch inclination's data table of demersal fishes



CHATYR-DAG, Sep. & Oct., 1971, On the Mancora Bank and it's south, Shrimp trawl

Fig. 1: Relation between deep-seas shrimp's catch and it's catched depth

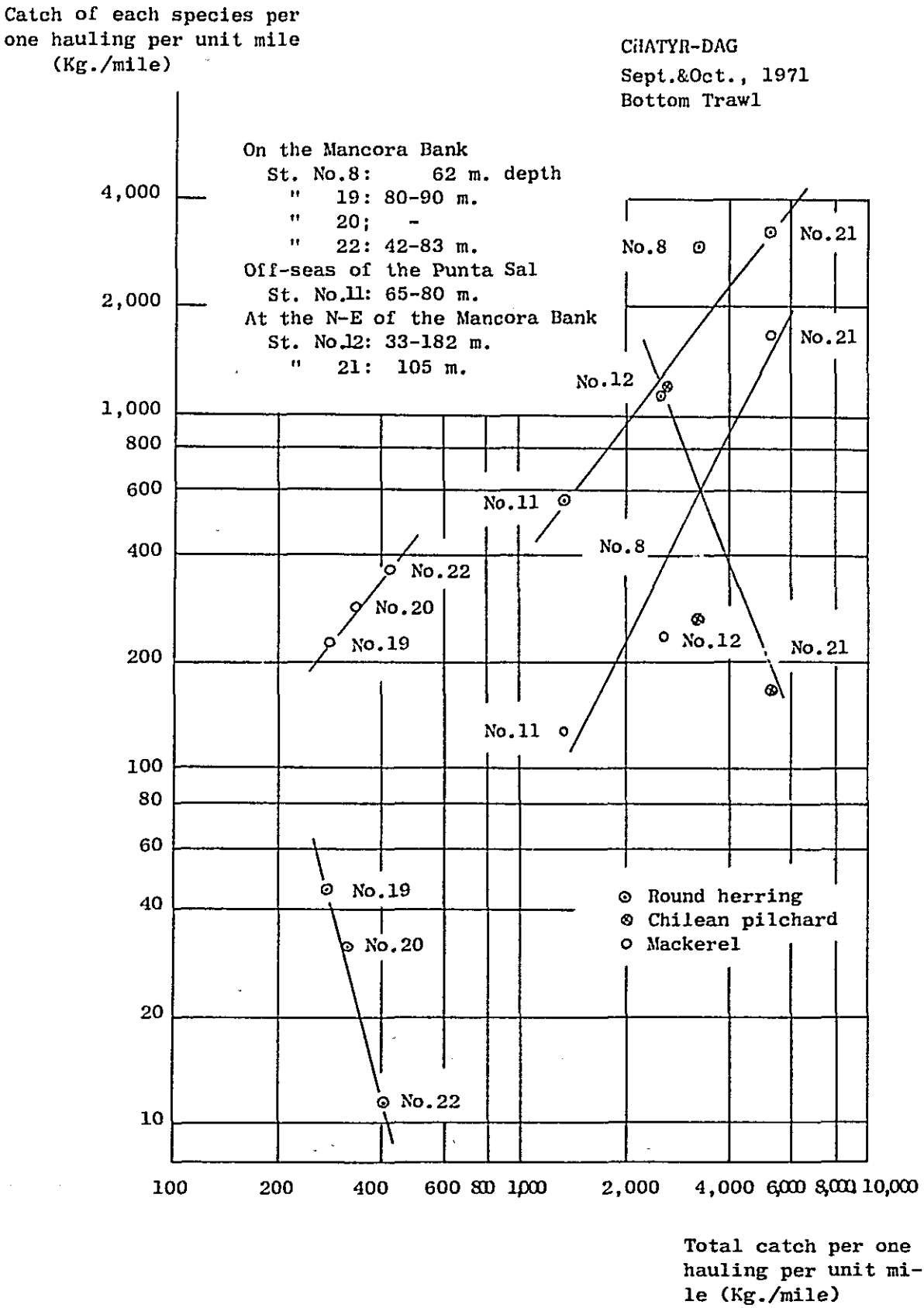
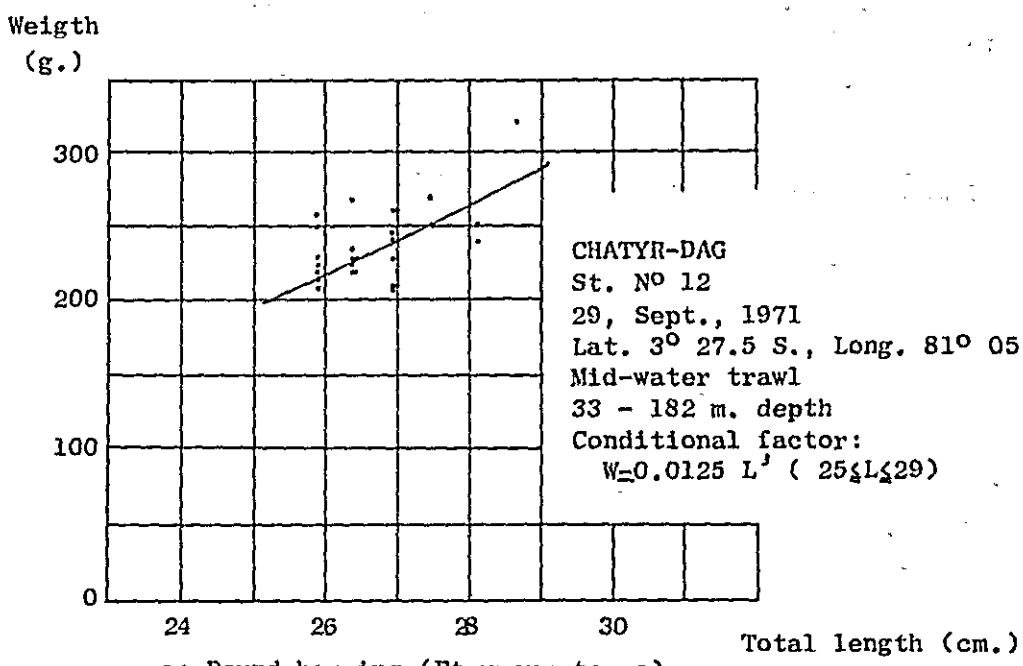
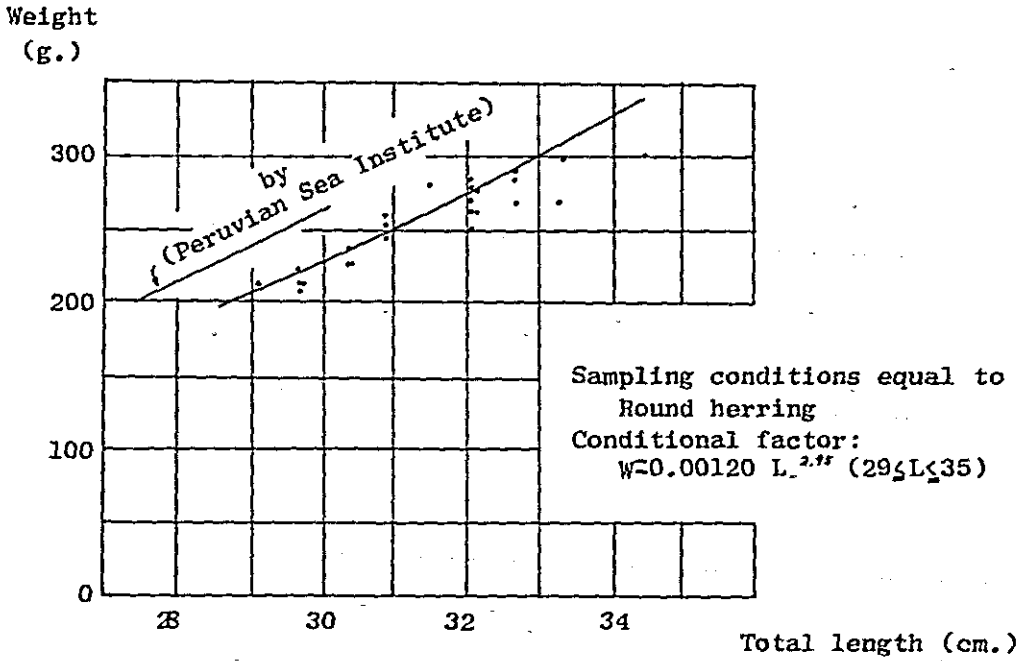


Fig. 2: Relation between total catch per one hauling per unit mile and catch of Round herring, Chilean pilchard and Mackerel per one hauling per unit mile.

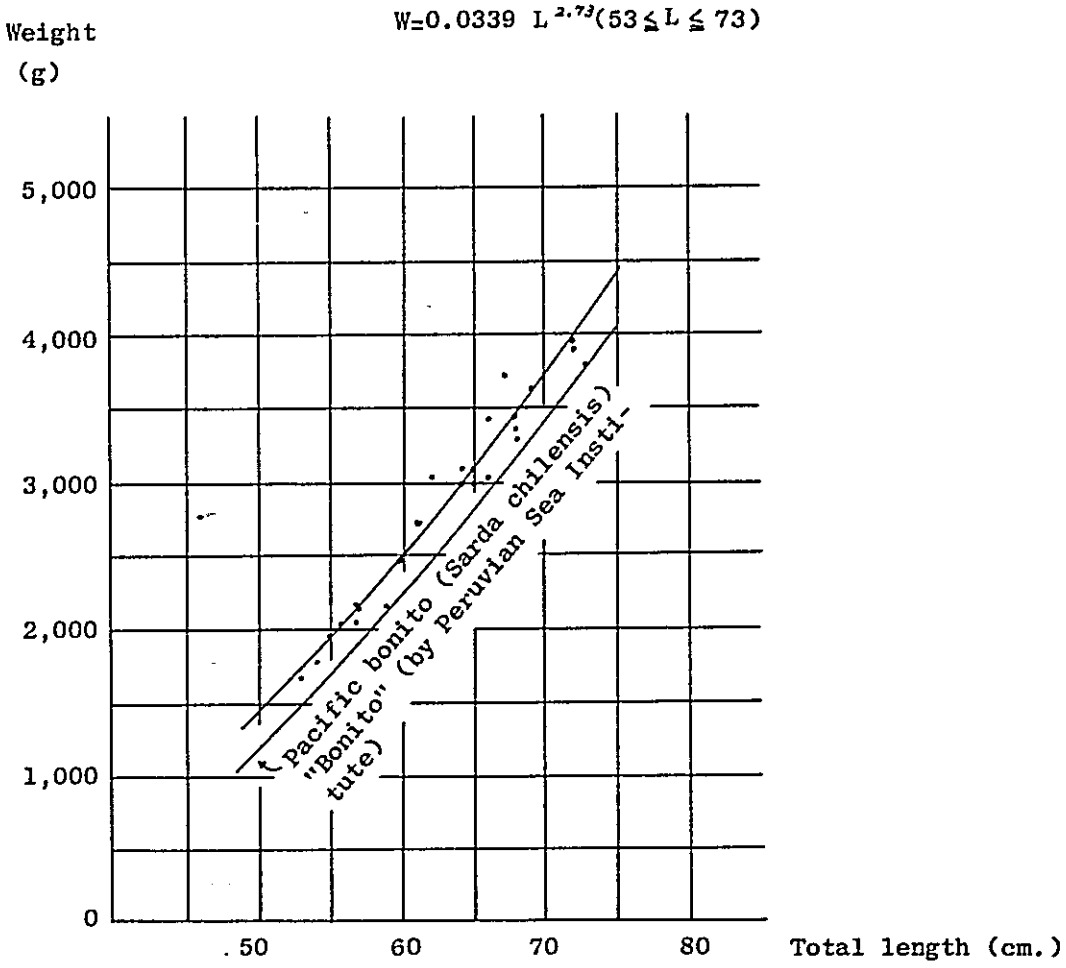


a: Round herring (Etrumeus teres)
"Sardina japonesa"



b: Chilean pilchard (Sardinops s. sagax)
"Sardina"

CHATYR-DAG
St. Nº 22
1 st. Oct., 1971
Lat. 3° 33.0 S., Long. 81° 16.0 W.
Mid-water Trawl
42 - 83 m. depth
Conditional factor:
$W=0.0339\ L^{2.73}(53 \leqq L \leqq 73)$



c: Striped bonito (Sarda orientalis velox) "Bonito"

Figs. 3: Relation between total length of fish and it's weight

(contain Fig. a to c.)

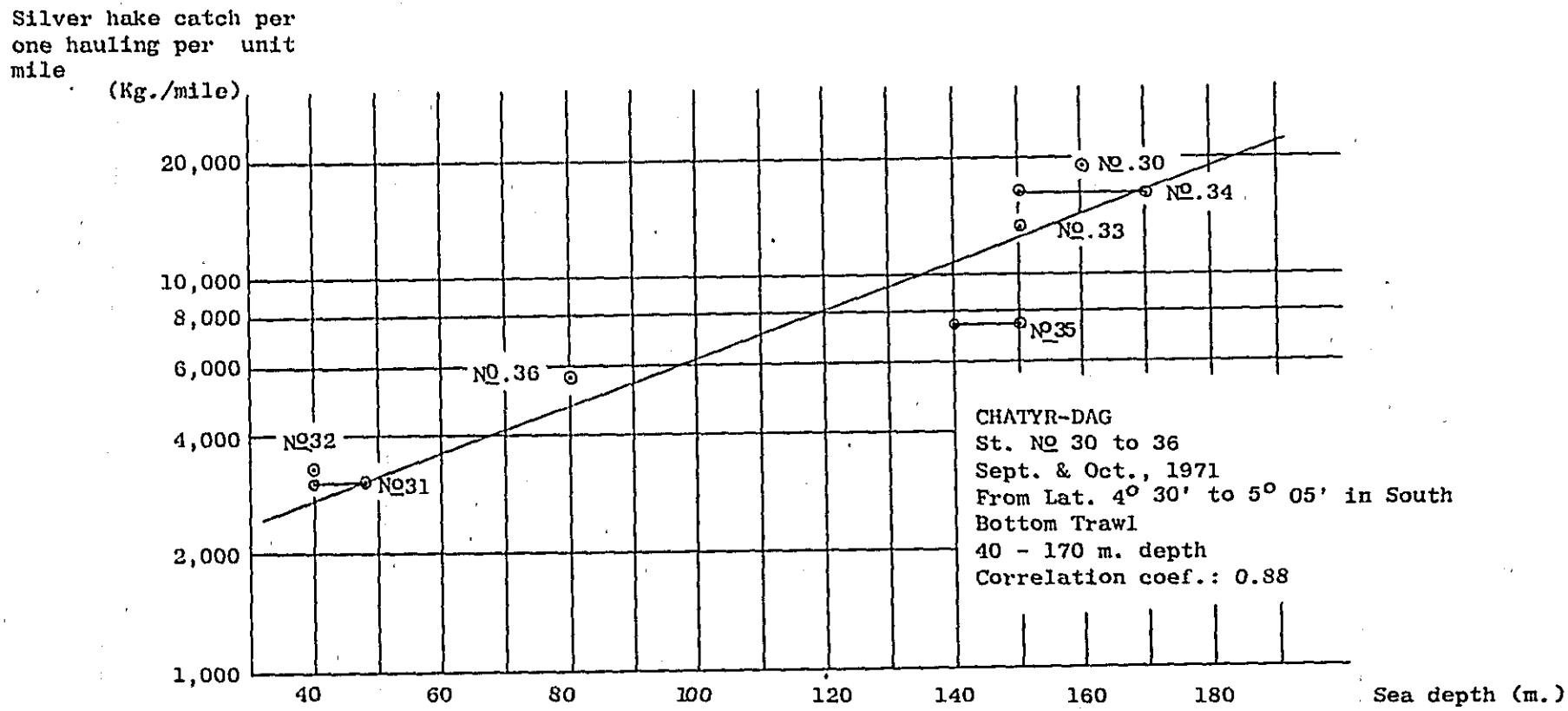


Fig. 4: Relation between Silver hake catch and it's catched depth

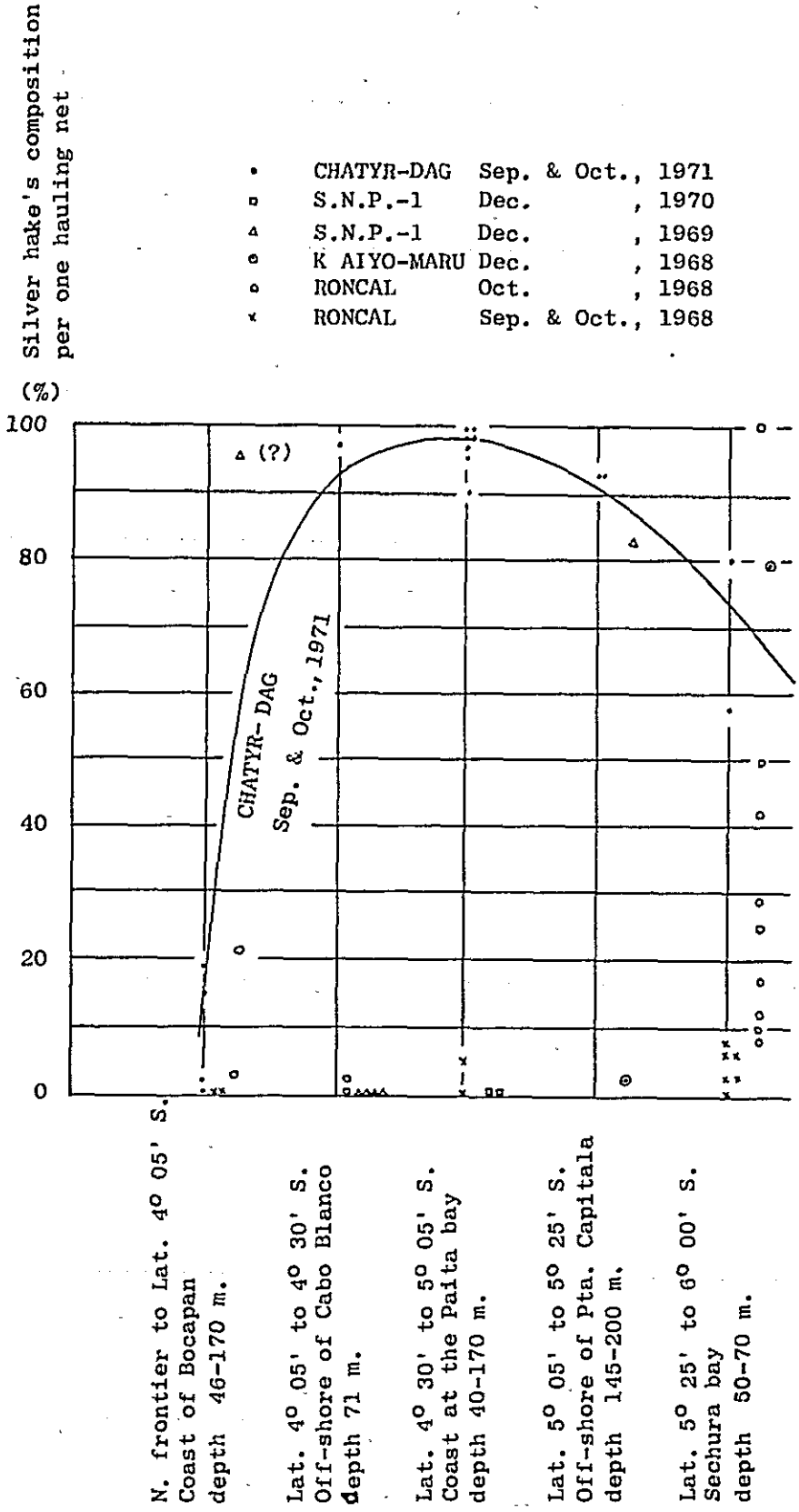


Fig. 5: Relation between Silver hake's composition per one hauling net and it's catched sea zone

A P P E N D I X

Appendix 1; Navigation schedule of "CHATYR-DAG"

1st. navigation;	from Sept. 14 to 24, 1971.
	Callao to Punta Aguja.
2nd. navigation;	from Sept. 25 to Oct. 4.
	Punta Aguja to Northern territorial
	water line.
3rd. navigation;	from Oct.4 to 15.
	Punta Aguja to Callao.
4th. navigation;	from Oct.15 to 23.
	Callao to San Juan.

Appendix 2; Fisheries scientist list of second navigation

1) U.S.S.R. scientist members

Karol Vladimir	Chief of fisheries investigation
Grechanov Vladimir	Captain.
Anisinov Yuri	Assistance of Captain.
Marin Guennady	Fish technology.
Shirokov Boris	Fisheries biology
Grunin Wyacheslav	Fishing methods (fish pump)
Prijodko Anatoly	Fishing gears
Tsalikov Taymuraz	Fisheries biology
Buriachenko Anatoly	Fisheries instruments (fish finder)

2) Peruvian scientist members

a) Ministry of Fisheries

Enrique del Solar	Chief of fisheries investigation
Jaime Palacios	General fisheries

b) Peruvian Sea Institute

Manuel Samame	Fisheries biology
Juan Velez	Fisheries biology

Aurola Chirinos de Vildoso	Fisheries biology
Norma Chirichigno	Ichthyology
Wilfred Urquizo	Oceanography
Roger Quiroz	Fishing gear and methods

c) Depertment of Fisheries, Peru Agrarian University

Overseas Technical Cooperation Agency, Japan

Tadanobu Machii	Fishing gear technology

Appendix 3; Particulars of "CHATYR-DAG"

a) Hull

Starn trawl factory ship	
Length (o.a.)	82.00 m.
Length (b.p.p.)	73.00 m.
Breadth (moulded)	13.60 m.
Depth (")	9.55 m.
Draft (")	5.00 m.
Gross tonnage	3,346 t.
Net tonnage	2,213 t.
Displacement	3,124 m^3.
Hold capacity	
Frozen fish	470-480 t.
Fish meal	96 t.
Fish oil	6 t.
Freezing capacity	60 t./day
Fuel oil	595 t.
Fresh water	123 t.
Service speed	12-15 knot.
Radius of action	20,160 nautical miles.
No. of crew	70.

b) Power

Main power	S.F.L. diesel power with super-charger x. 2
rated output	1,160 p.s. X 375 r.p.m. each
Auxiliary power	Diesel power X 4
rated output	200 p.s. X 450 r.p.m. each
Generator	330 kw. X 2, 250 kw. X 2
Propeller	4 bladed aerofoil, single Right turn, controlable pitch.
diameter	3.2 m.
revolution	175 r.p.m.

c) Winch

Trawl winch	Hydraulic X 2
power	6.3 t. X 100 m./min.
pressure	170 kg./ min.
warp	26 mm. X 2,200 m. each drums
Auxiliary winch	Hydraulic X 2
power	5 t. X 60 m./ min.
wire rope	26 mm. X 70 m. each drums
Auxiliary winch	Electric X 2
power	5 t.
Winch for net-sonde	Electric X 1
power	0.5 t. X 120 m./ min.
captire code	12 mm. X 1,800 m.

d) Fish pump gear

Air compressor	180 m^3 / h.
max. pressure	12 kg./ cm.
Absurving tube	15 cm. X 100 m.
Right power	110 V. X 750 W. X 2/ unit

c) Fish detectors

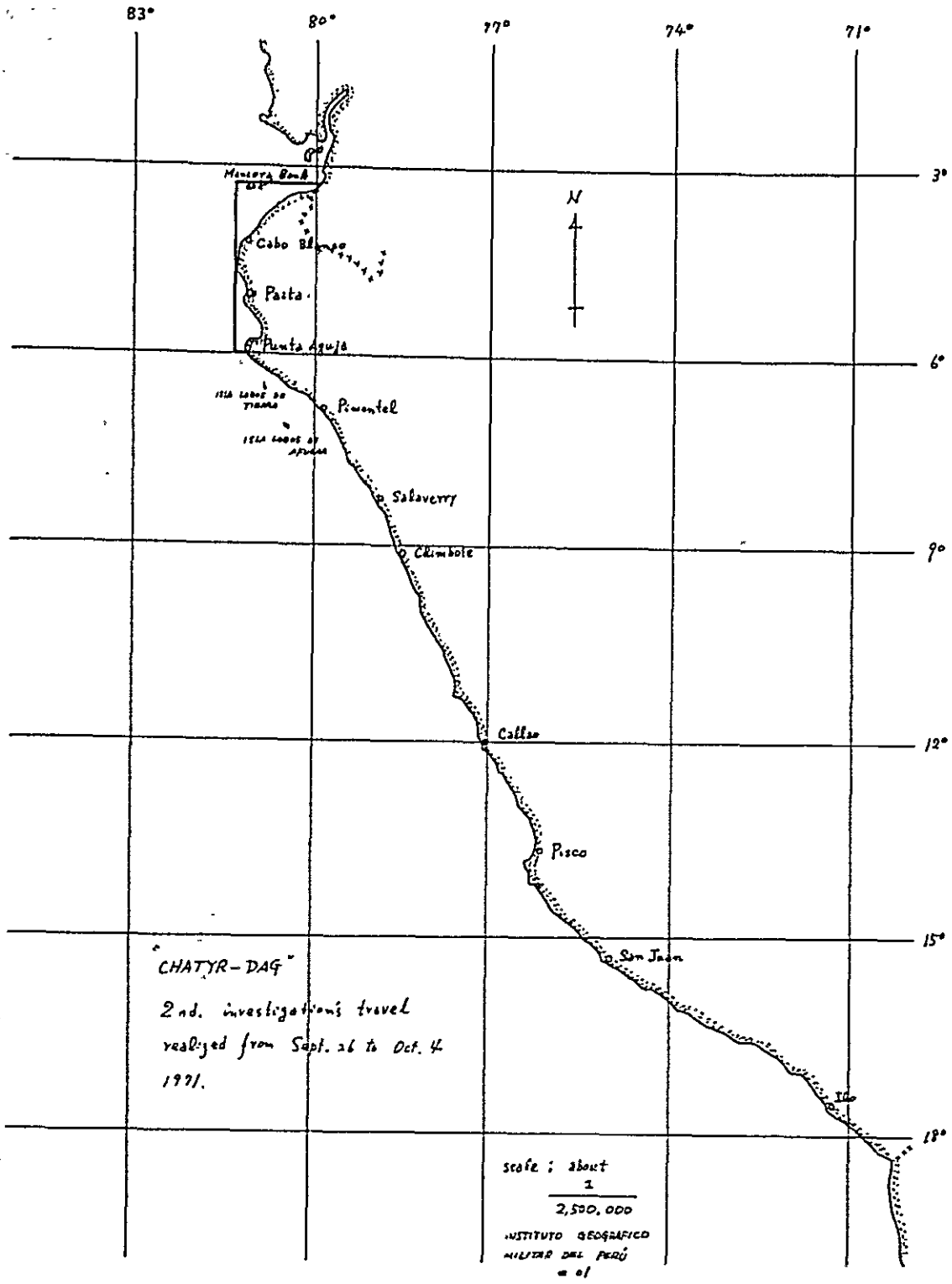
Sonar	R.F.T. sonar with oscillo-scope
	20 KC. X 4 channel
depth range	250, 500, 750, 1,000 m.
swing	vertical; 90 ^{o}
	horizontal; 360 ^{o}

in the case of using as Fish finder (vertical)

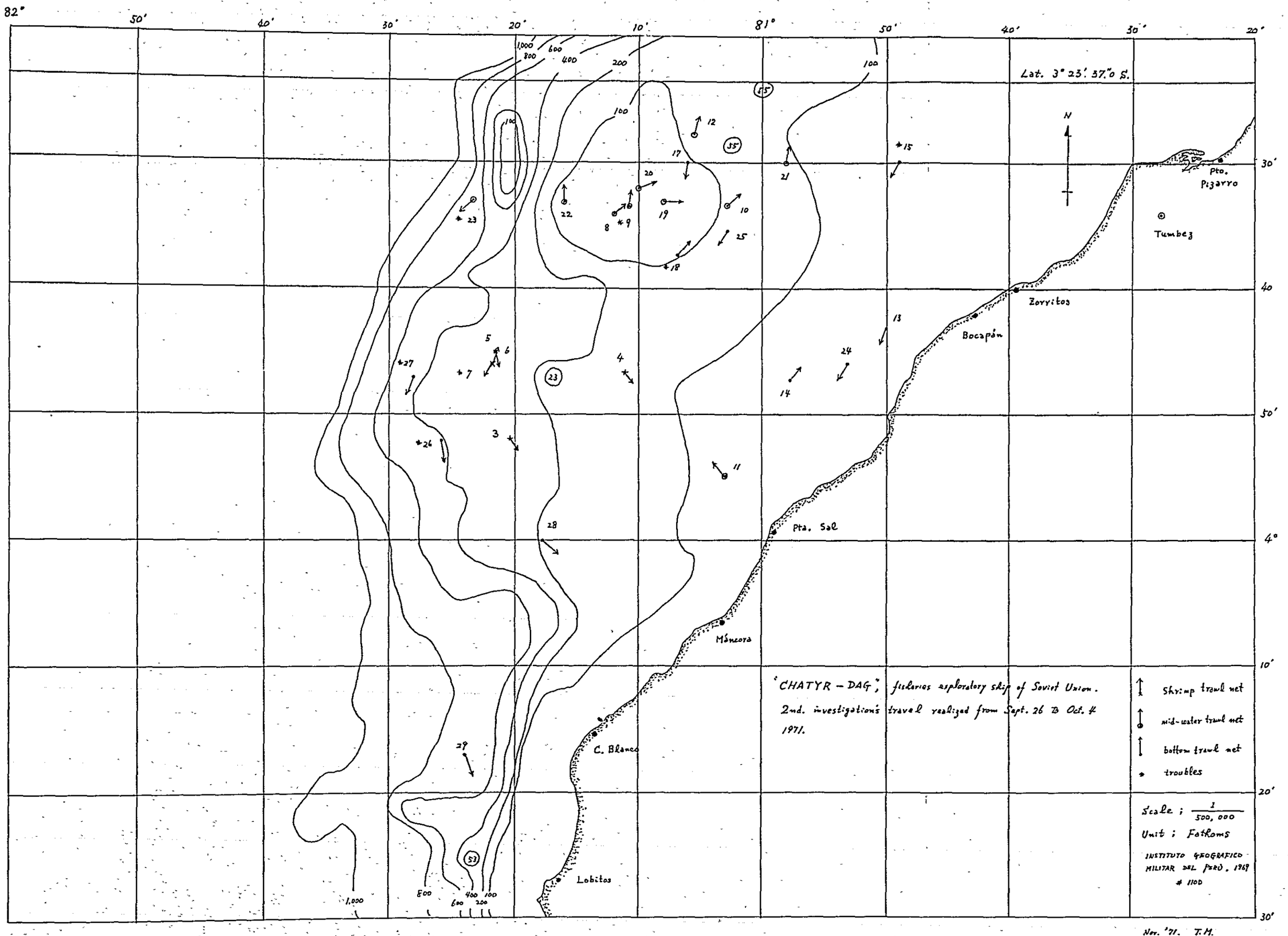
4 channel, 200, 400, 800, 1,600 m.

Fish finder	R.F.T. finder with oscllo-scope
	30 KC. X 4 channel
depth range	100, 200, 400, 800 m.

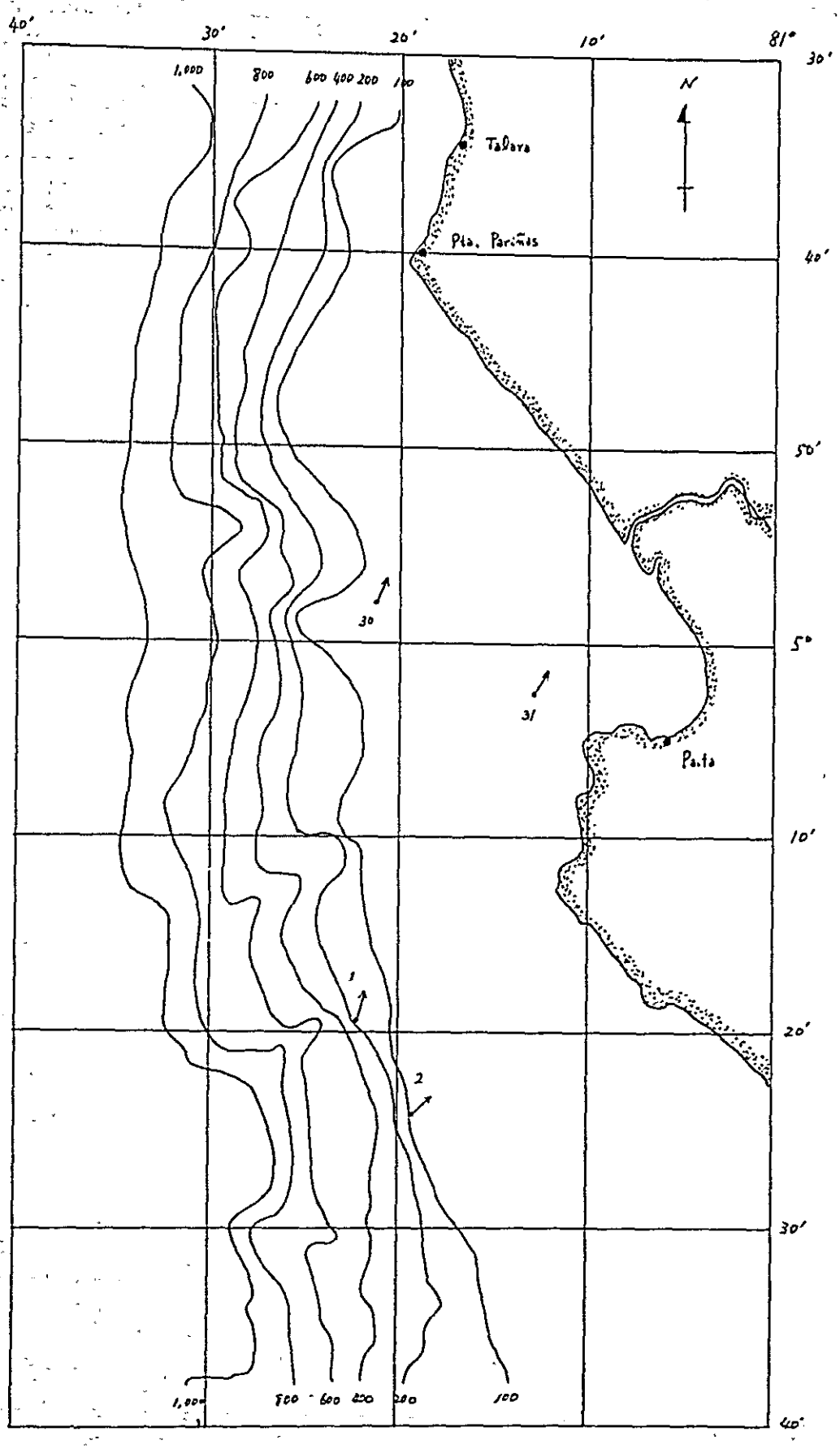
being able to use as Net sonde at 100 m. range



Appendix 4 ; General chart of operated sea zone



Appendix 5-a ; Detail chart of operated stations



Appendix 5-b ; Detail chart of operated stations

Nº	CATCHED SPECIES NAMES			SEA ZONE	DEEP SEA ZONE										BANK OF MANCORA										COASTAL ZONE									
				TRAWL NET	S.T					B.T					M-W.T							B-T		M-W T	B.T								
				ST. Nº	3	4	5	6	7	16	17	26	27	28	8	9	10	12	19	20	21	22	23	18	25	11	1	2	13	14	15	24	29	30	31
	SCIENTIFIC NAMES	ENGLISH NAMES	SPANISH NAMES	NET POS (m)	(30) 80		20) 70		20	80	90	80	90	90	62	-	57	95	87	-	116	68	-	130	140	72	150	300	340	45	260	150	70	160	45
1	Heterodontus quoyi (F.)	Bullhead shark	Perro gato															X								X								
2	Alopias vulpinus (B.)	Thresher shark	Peje zorro															X																
o 3	Mustelus sp. aff. dorsalis G.	Dogfish	Tollo fino							X		X	X	X			X							X			X	X	X	X	X	X	X	
4	Sphyrna zygaena (L.)	Hammerhead	Pez martillo															X																
5	Squatina armata (P.)	Angel shark	Angelote									X												X				X	X	X				
6	Rhinobatos planiceps G.	Guitarfish	Guitarra																									X	X			X		
7	Psammobatis caudispina H.	Skates	Raya con púas																							X		X	X	X				
8	Raja sp.	Big skate	Raya bruja							X		X	X	X			X							X				X	X	X	X			
9	Urotrygon peruanus H.	Stipe ray	Raya con espina																							X								
10	Gymnura afuerae H.	Butterfly ray	Raya mariposa																															
11	Myliobatis peruvianus G.	Whip ray	Raya águila																									X						
12	Torpedo sp.	Torpedo	Torpedo									X														X		X	X					
13	Hydrolagus sp.	Ghost shark	Quimera			X																												
14	Muraena albigutta H.	Morays	Morena																					X				X				X		
15	Ophichthus pacifici (G.)	Snake-eel	Anguila común							X		X												X							X			
o 16	Sardinops sagax sagax (J.)	Chilean pilchard	Sardina												X		X	X	X	X	X				X			X						
o 17	Etrumeus teres (D.)	Round herring	Sardina japonesa							X					X	X	X	X	X	X	X	X	X	X	X									
o 18	Engraulis ringens J.	Anchovy	Anchoveta										X																					X
19	Anchoa nasus (K.&S.)	Anchovy	Anchoveta blanca							X																	X		X	X				
20	Argentina sp. aff. sialis G.	Pacific argentine	Pez plata																												X			
21	Synodus scituliceps J.&G.	Lizardfish	Pez lagarto																									X	X	X				
o 22	Merluccius gayi peruanus G.	Silver hake	Merluza		X			X	X	X		X												X	X		X	X	X		X	X	X	X
23	Genypterus chilensis (G.)	Cusk-eel	Congrio rosado																						X					X	X	X	X	X	
24	G. maculatus (T.)	Cusk-eel	Congrio negro									X															X	X	X	X	X			X
25	Brotula clarkae H.	Brótulas	Brótula																						X					X	X	X			
26	Nematonurus sp. aff. altipinnis G.	Rat-tail	Ratón		X	X																												
27	Scorpaena histrico J.	Rockfish	Diablico		X	X		X				X	X	X										X				X		X	X			
o 28	Alphestes multiguttatus f.H.	Sea bass	Mero																										X					
29	Peristedion sp. aff. barbiger (G.)	Armored	Caballito moro							X				X										X						X	X			
30	Prionotus stephanophrys L.	Searobin	Falso volador																										X	X		X		
o 31	Hemianthias peruanus (S.)	Splittail bass	Doncella							X														X	X				X	X	X	X		
32	Hemilutjanus macrophthalmos (T.)	Sea bass	Ojo de uva																												X			
33	Paralabrax humeralis (V.)	Sea bass	Cabrilla																					X			X		X	X		X	X	
34	Diplectrum sp.	Sand perch	Camotillo																											X		X		
35	Caulolatilus p. princeps (J.)	Ocean whitefish	Peje blanco																					X					X	X	X			
o 36	Trachurus symmetricus	Pacific jack	Jurel																			X												
37	Calamus brachysomus (L.)	Pacific porgy	Sargo																										X	X				

Appendix 6-a ; list of scientific, english and spanish names of catched species in each haul

	Nº	CATCHED SPECIES NAMES			SEA ZONE	DEEP SEA ZONE										BANK OF MANCORA											COASTAL ZONE									
					TRAWL NET	S.T					B.T					M-W.T								B.T		M-W T	B.T								
					ST. Nº	3	4	5	6	7	16	17	26	27	28	8	9	10	12	19	20	21	22	23	18	25	11	1	2	13	14	15	24	29	30	31
		SCIENTIFIC NAMES	ENGLISH NAMES	SPANISH NAMES	NET POS/m	60	80	80	70	70	350	370	910	90	100	62	-	57	95	87	-	105	68	-	20	140	72	150	100	140	45	160	10	70	160	45
	38	Menticirrhus paitensis H.	Kingfish	Mismis									X																						
o	39	Polyclemus peruanus (S.)	Drums	Coco																								X		X	X	X				X
o	40	Cynoscion analis (J.)	Drums	Ayanque																								X		X	X	X		X		
o	41	Sciaena deliciosa (T.)	Drums	Lorna																										X						
o	42	Larimus acclivis J.&B. ?	Drums	Boracho																					X					X	X	X	X	X		
	43	Scartichthys gigas (S.)	Blenny	Borracho																											X					
	44	Trichiurus nitens C.	Pacific cutlass fish	Pez cinta														X										X								
o	45	Pneumatophorus japonicus peruanus J.&H.	Pacific Mackerel	Caballa												X		X	X	X	X	X	X	X	X		X						X			
o	46	Sarda sarda chilensis (C.)	Pacific bonito	Bonito																								X								
o	47	S. orientalis velox M.&H.	Striped bonito	Bonito													X						X													
o	48	Xiphias gladius L.	Swordfish	Pez espada															X																	
o	49	Seriolella violacea G.	Blackruffe	Cojinoba																														X		X
	50	Stromateus palometa J.&H.	Pacific pampano	Palometa																														X		
	51	Fam. Bothidae	Flounders	Lenguados									X		X										X			X		X	X	X	X			
	52	Octopus sp.	Deepsea octopus	Pulpo de fondo		X																														
	53	Loligo sp.	Squid	Calamar							X																									X
	54	Paralomis granulosa	Deepsea crabs	Centolla			X																													
	55	Lithodes panamensis	Deepsea crabs				X																													
	56	Euphylax dovii S.	Crabs																									X								
o	57	Nematocarcinus sp.	Deepsea shrimp	Langostino rojo			X	X	X	X	X		X	Y																						
o	58	Hymenopenaeus diomedeae (F.)	Deepsea shrimp	Gamba roja		X	X	X	X	X	X		X	X	X																					
o	59	Heterocarpus bicarius	Deepsea shrimp	Camarón nailon				X	X	X	X		X																							
	60	Benthesicymus sp.	Deepsea shrimp	Camarón rojo				X	X		X																									
	61	Munida sp.	Galatheid crabs	Munida			X																													
	62	Pasifaena magna	Deepsea shrimps	Camarón rojo				X																												
		Others				X	X	X	X	X		X	X	X													X	X	X	X	X	X	X	X	X	X

Remarks o : Important species

Appendix 6-b ; List of scientific, english and spanish names of catched species in each haul

Appendix 7 ; Detail catch statistics in each haul

DEEP SEA ZONE

1) SHRIMP TRAWL NET

Nº 3:

Hymenopenaeus diomedeae (F.)	:	18
Merluccius gayi peruanus G.	:	120
Scorpaena histrico J.	:	30
Nematonurus sp.	:	15
Octopus sp.		10
Others	:	307
		500 Kg.

Nº 4:

Hymenopenaeus diomedeae (F.)	:	4
Nematocarcinus sp.	:	3
Paralomis granulosa	:	3
Hidrolagus sp.	:	3
Nematonurus sp.	:	3
Scorpaena histrico J.	:	2
Others	:	2
		20

Nº 5:

Nematocarcinus sp.	:	170
Hymenopenaeus diomedeae (F.)	:	81
Benthesicymus sp.	:	14
Heterocarpus bicarius	:	5
Others	:	50
		320

Nº 6:

Nematocarcinus sp.	:	253
Hymenopenaeus diomedeae (F.)	:	133
Heterocarpus bicarius	:	16
Benthesicymus sp.	:	2
Merluccius gayi peruanus G.	:	40
Scorpaena histrico J.	:	20
Others	:	36
		500

Nº 7: *

Nematocarcinus sp.	:	20
Hymenopenaeus diomedeae (F.)	:	13
Heterocapus bicarius		7
Merluccius gayi peruanus G.	:	20
Others	:	40
		100 Kg.

2) BOTTOM TRAWL NET

Nº 16:

Hymenopenaeus diomedeae (F.)	:	81
Nematocarcinus sp.	:	42
Heterocarpus bicarius	:	14
Benthesicymus sp.	:	12
Merluccius gayi peruanus G.	:	130
Mustelus sp.	:	25
Hemianthias peruanus (S.)	:	20
Ord. Rajiformes	:	20
Ord. Anguilliformes	:	5
Others	:	11
		360 Kg.

Nº 17:

	0

Nº 26: *

Hymenopenaeus diomedeae (F.)	:	2
Heterocarpus bicarius	:	1
Mustelus sp.	:	40
Merluccius gayi peruanus G.	:	30
Menticirrhus paitensis H.	:	10
Scorpaena histrico J.	:	10
Others	:	107
		200

Nº 27: *

Hymenopenaeus diomedeae (F.)	:	28
Scorpaena histrico J.	:	220
Others	:	52
		300

Nº 28:

Hymenopenaeus diomedeae (F.)	:	20
Mustelus sp. / Fam. Bochidae / Ord. Rajiformes	:	60
Others	:	20
		100 Kg.

BANK OF MANCORA

1) MID-WATER TRAWL NET

Nº 8:

Etrumeus teres (D.)	:	10,000
Sardinops s. sagax (J.)	:	900
Others		100
		11,000 Kg

Nº 9: *

Etrumeus teres (D.)	:	100
Sarda orientalis velox	:	10
Others	:	10
		120

Nº 10:

Trichiurus nitens G.	:	5,500
Pneumatophorus japonicus peruanus J. &H.	:	20
Mustelus sp.		10
Ord. Rajiformes	:	5
Others	:	15
		5,550

Nº 12:

Etrumeus teres (D.)	:	12,000
Sarda s. sagax (J.)	:	12,000
Pneumatophorus japonicus peruanus J. &H.	:	2,500
Xiphias gladius L.	:	30
Sphyrna zigaena (L.)	:	40
Alopias vulpinus (B.)	:	30
Others	:	--
		26,600

Nº 19:

Pneumatophorus japonicus peruanus J. &H.	:	1,200
Etrumeus teres (D.)	:	250
Others	:	50
		1,500

Nº 20:

Pneumatophorus japonicus peruanus J. &H.	:	900
Etrumeus teres (D.)	:	100
Others	:	-
		1,000

Nº 21:

Etrumeus teres (D.)	:	3,000
Pneumatophorus japonicus peruanus J. &H.	:	1,500
Sardinops s. sagax (J.)	:	150
Others	:	50
		4,700

Nº 22:

Pneumatophorus japonicus peruanus J. &H.	:	2,500
Sarda orientalis velox	:	210
Etrumeus teres (D.)	:	80
Others	:	10
		2,800

Nº 23: *

Pneumatophorus japonicus peruanus J. &H.	:	5
Etrumeus teres (D.)	:	5
Others	:	-
		10Kg.

COASTAL ZONE

2). BOTTOM TRAWL NET

1). MID-WATER TRAWL NET

Nº 18: *

Hemianthias peruanus (S.)	:	900
Pneumatophorus japonicus peruanus J. &H.	:	60
Caulolatilus p. princeps (J.)	:	20
Paralabrax humeralis (V.)	:	10
Merluccius gayi peruanus G.	:	5
Scorpaena histrico J.	:	2
Etrumeus teres (D.)	:	1
Muraena albigutta H.	:	1
Others	:	1
		1,000 Kg.

Nº 25:

Merluccius gayi peruanus G.	:	2,800
Mustelus sp.	:	600
Brotula clarkae H.	:	120
Genypterus sp.	:	120
Hemianthias peruanus (S.)	:	120
Larimus sp.	:	120
Squatina armata (P.)	:	80
Fam. Bochidae	:	40
Others	:	100
		4,100

Nº 11:

Etrumeus teres (D.)	:	3,600
Sardinops s. sagax (J.)	:	3,600
Pneumatophorus japonicus peruanus J. &H.	:	800
Others	:	-
		8,000 Kg

2). BOTTOM TRAWL NET

Nº 1:

Merluccius gayi peruanus G.	:	1,400
Others	:	100
		1,500 Kg

Nº 2: *

Merluccius gayi peruanus G.	:	19,000
Genypterus sp.		
Mustelus sp.	:	1,000
Scorpaena histrico J.		
Others	:	500
		20,500

Nº 13:

Larimus sp.	:	3,500
Prionotus stephanophrys L.	:	2,000
Paralabrax humeralis (V.)	:	700
Merluccius gayi peruanus G.	:	150
Mustelus sp.	:	120
Fam. Bochidae	:	100
Muraena albigutta H.	:	10
Others	:	220
		6,800

Nº 14:

Scartichthys gigas (S.)	:	200
Polyclemus peruanus (S.)	:	150
Paralabrax humeralis (V.)	:	50
Mustelus sp.	:	50
Cynoscion analis (J.)	:	40
Squatina armata (P.)	:	30
Brotula clarkae H.	:	30
Caulolatilus p. princeps (J.)	:	20
Diplectrum sp.	:	15
Raja sp.	:	15
Hemianthias peruanus (S.)	:	10
Prionotus stephanophrys L.	:	10
Others	:	30
		650

Nº 15: *

Larimus sp.	:	400
Merluccius gayi peruanus G.	:	150
Squatina armata (P.)	:	120
Mustelus sp.	:	100
Genypterus sp.	:	70
Cynoscion analis (J.)	:	50
Scorpaena histrico J.	:	25
Hemilutjanus macrophthalmos (T.)	:	5
Others	:	80
		1,000

Nº 24:

Larimus sp.	:	1,500
Merluccius gayi peruanus G.	:	500
Mustelus sp.	:	150
Hemianthias peruanus (S.)	:	100
Paralabrax humeralis (V.)	:	100
Genypterus sp.	:	80
Prionotus stephanophrys L.	:	50
Brotula clarkae H.	:	20
Raja sp.	:	20
Scorpaena histrico J.	:	15
Peristedion sp.	:	10
Fam. Bochidae	:	5
Others	:	50
		2,600 Kg.

Nº 29:

Merluccius gayi peruanus G.	:	5,800
Ord. Rajiformes	:	45
Genypterus sp.	:	40
Mustelus sp.	:	35
Paralabrax humeralis (V.)	:	20
Rhinobatos planiceps G.	:	10
Muraena albigutta. H.	:	10
Seriolella violacea G.	:	10
Larimus sp.	:	5
Stromateus palometa J.&H.	:	5
Others	:	20
		6,000 Kg.

Nº 30:

Merluccius gayi peruanus G.	:	28,800
Genypters sp.	:	600
Mustelus sp.	:	450
Others	:	150
		30,000

Nº 31:

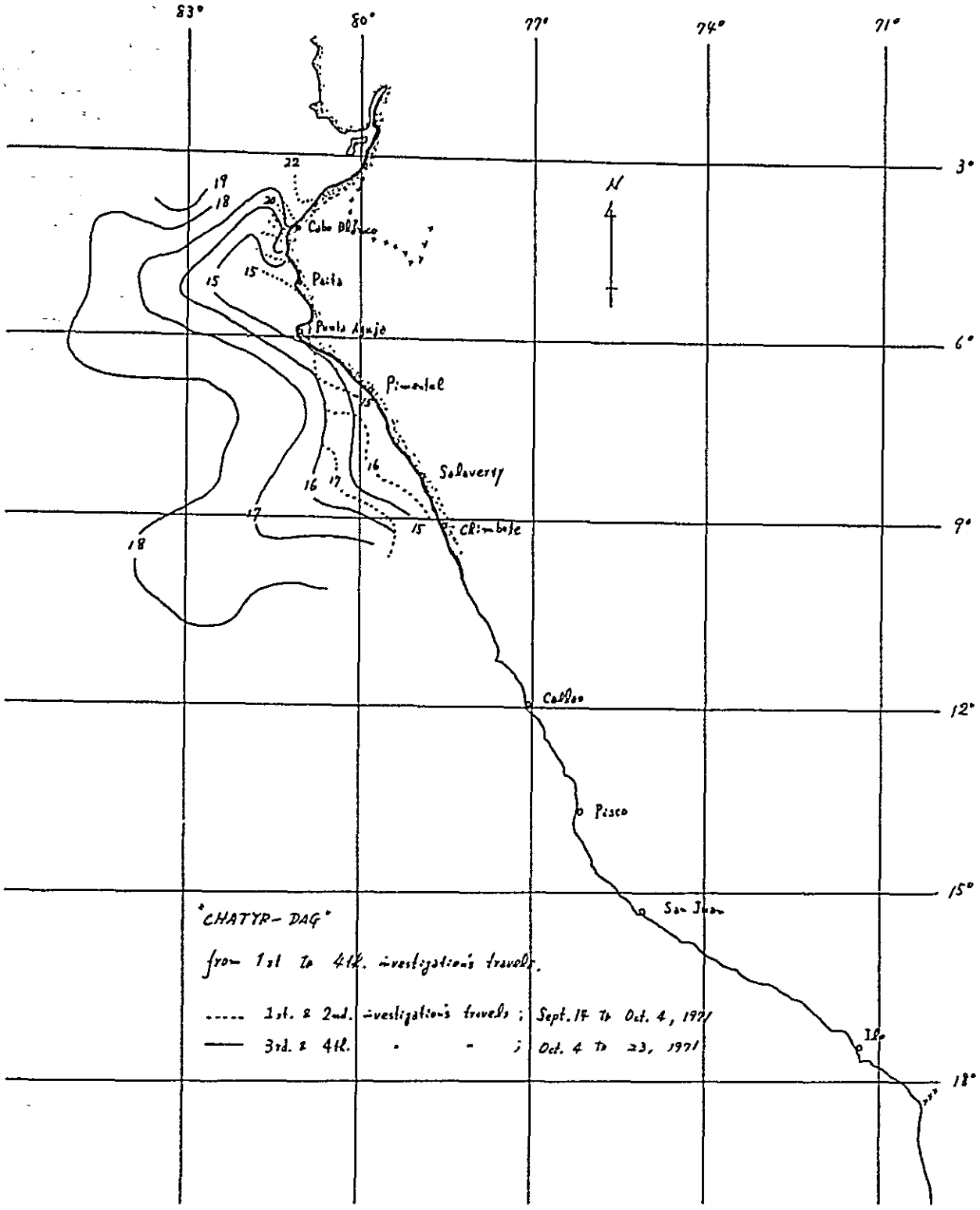
Merluccius gayi peruanus G.	:	6,000
Polyclemus peruanus (S.)	:	400
Genypterus sp.	:	100
Others	:	200
		6,700 Kg.

* : Operational or net's accident

St. №	Trawl Type	Date 1971	Local time	Position			Hauling			Sea depth (m)	Net's position from sea-surface (m)	Net height (m)	Catch (kg)	Sea-surface temp (^{o}C)	Sea condition	Wind Direction
				Lat. (S)	long. (W)	Duration (min.)	Distances (miles)	Speed (knots)	Direction (^{o})							
1	B.T	26.9	13.25	5.10.0	8120.2	20	1.2	3.7	160	145-150			1,500	16.0	1	S
* 2	"	"	11.45	5.24.0	8119.0	50	3.1	3.7	155	200			20,300	"	2	"
3	S.T	27.9	9.55	3.57.0	8120.5	55	3.1	3.0-3.7	145	600-750			300	22.0	1	"
4	"	"	12.45	3.46.5	8111.3	85	4.3	2.8-3.2	140	950-1000			20	"	"	SW
5	"	"	17.30	3.45.0	8121.7	80	3.9	2.7-3.1	165	750-800			320	"	"	"
6	"	"	20.45	3.45.8	8121.8	150	7.5	2.7-3.2	20	660-770			500	21.0	"	"
* 7	"	28.9	0.55	"	"	25	1.3	3.0	210	720			100	22.0	"	"
8	M-W.T	"	14.05	3.31.0	8112.0	50	3.4	4.0-4.1	50	100-220	62	20-25	11,000	21.0	"	"
* 9	"	"	17.55	3.33.5	8111.0	15	1.2	4.8	10	250-300	-	20	120	21.5	"	"
10	"	"	21.05	3.34.4	8103.0	110	8.4	4.5-4.8	50	110-260	15 - 85	18-22	5,350	21.0	"	"
11	"	29.9	8.15	3.55.0	8103.0	91	8.1	3.7-4.2	320	100-110	65 - 80	19-20	8,000	20.0	"	"
12	"	"	11.15	3.27.5	8105.6	140	10.3	4.2-4.6	15	104-220	33-182	19-20	26,600	21.5	"	"
13	B.T	"	20.35	3.43.2	8050.2	60	3.3	3.1-3.4	200	105			6,800	21.0	"	"
14	"	29/30.9	23.40	3.47.0	8058.0	35	2.3	3.5-4.5	40	46			650	"	0	"
* 15	"	30.9	1.15	3.30.0	8049.0	15	0.8	3.0	210	150-170			1,000	"	0	"
16	"	"	8.10	-	-	60	2.8	2.4-3.1	75	600-700			360	"	2	"
17	"	"	10.30	3.30.0	8106.0	52	2.4	2.5-3.0	100	450-620			0	"	1	"
* 18	"	"	16.10	3.37.2	8107.0	30	1.8	3.5	40	120			1,000	21.5	"	"
19	M-W.T	"	18.55	3.33.0	8108.0	102	5.3	2.9-4.1	90	122-140	80- 90	20-21	1,500	21.0	"	"
20	"	"	22.17	3.31.9	8110.0	40	3.1	4.6	70	240	-	20	1,000	"	0	"
21	"	1.10	7.50	3.30.0	8058.0	15	0.9	3.5	10	130	105	19	4,700	25.5	1	"
22	"	"	9.45	3.33.0	8116.0	107	6.8	3.7-4.0	0	100-120	42- 83	17-20	2,800	25.0	"	"
* 23	"	"	13.15	"	8123.6	15	0.9	3.5	230	-	-	-	10	24.0	"	"
24	B.T	2.10	0.35	3.46.0	8053.0	83	4.2	3.0-3.5	210	145-150			2,600	19.0	"	"
25	"	"	3.35	3.35.5	8103.0	65	3.3	3.0	215	135			4,100	20.0	"	"
* 26	"	"	7.25	3.52.0	8126.0	160	7.7	2.5-3.2	170	700-1000			200	"	2	SSW
* 27	"	"	13.00	3.47.0	8128.0	158	7.9	2.5-4.5	200	800-1070			300	21.0	3	"
28	"	3.10	1.15	4.00.0	8118.0	63	3.3	2.8-3.0	130	960-1100			100	18.0	2	S
29	"	"	8.42	4.17.0	8124.0	"	4.0	3.8	160	71			6,000	17.0	0	"
30	"	"	10.52	4.58.0	8121.0	26	1.5	3.4	170	160			30,000	"	1	"
31	"	"	15.20	5.02.5	8112.5	35	2.0	"	0	40- 48			6,700	-	"	-

Remarks * St. № 2: The inferior part of right wing of net is broken
7: Right trawl winch does not work smoothly
9: Hauld up the net for encounter the bottom peak
15: Hauld up the net by the accident of right trawl winch
18: The inferior part of left wing is broken
23: Hauld up the net by the NET SONDE accident
26: Suffered the operation's accident of twisting net and otter boards.
27: The part of belly is broken

Appendix 8 ; Trawl fishing records



Appendix 9 ; Horizontal distribution of sea surface water temperature

Data Sheet

NAME OF GEAR : Deep-seas shrimp trawl
TYPE : Otter trawl
COUNTRY : Soviet Union
LOCALITY :
REFERENCE

Main species caught: Deep-seas shrimps
Fishing conditions : All conditions

Vessels : Factory trawler
L.O.A : 82 m
Gross tonnage : 3,346 t
Horse power : 1,160 ps x 2
Crew : 70

WEBBING	A	B	A_1	B_1	A'	B'	A_1'	B_1'	C	C'	D	E ⌀	E_1 ⌀
Material	Nylon	→	→	→	→	→	→	→	→	→	→	→	→
Type of knot	⊠	→	→	→	→	→	→	→	→	→	→	→	→
Preservation	R	→	→	→	→	→	→	→	→	→	→	→	→
Colour													
Twine size	ϕ3	→	→	→	→	→	→	→	→	→	10.7/9	→	→
Breaking strength kg													
Stretched mesh mm	100	→	→	→	70	→	→	→	100	70	28	→	→
Upper edge	10	→	→	→	2	→	→	→	160	29	454	171	→
Lower edge	10	→	60	→	2	→	→	→	110	29	171	→	→
Depth	40	→	100	→	57	→	143	→	50	2	354	36	685
Hanging ratio $\frac{m}{out}$	all b	→	5P6b / 4P5b	→	all b	→	5P6b	→	1P2b	all P	3P4b	all P	→
Take up	A : A' =	7 : 10		$A_1 : A_1'$ =	7 : 10		C : C' =	4 : 3		C : D =	1 : 4		
Self edge			*	$\frac{d}{AA_1C}$ =	$\frac{d}{BB_1C}$ =	$\frac{32.4}{30}$	1.08	$\frac{d_1}{DE}$ =	$\frac{10.2}{10.9}$ =	0.93	$\frac{d_2}{E_1}$ =	$\frac{19.2}{19.2}$ =	1.00
Hanging	$\frac{a_1}{A'A_1'}$ =	$\frac{b_1}{B'B_1'}$ =	$\frac{30}{30}$	$\frac{a}{A'A_1'}$ =	$\frac{b}{B'B_1'}$ =	$\frac{24}{30}$	$\frac{c_1}{C_1'}$ =	$\frac{c}{C'}$ =	$\frac{2}{2}$ =	$\frac{C'}{C}$ =	$\frac{C_1}{C}$ =	$\frac{c}{C}$ =	$\frac{2}{4}$
			1.00			0.80			1.00				0.50

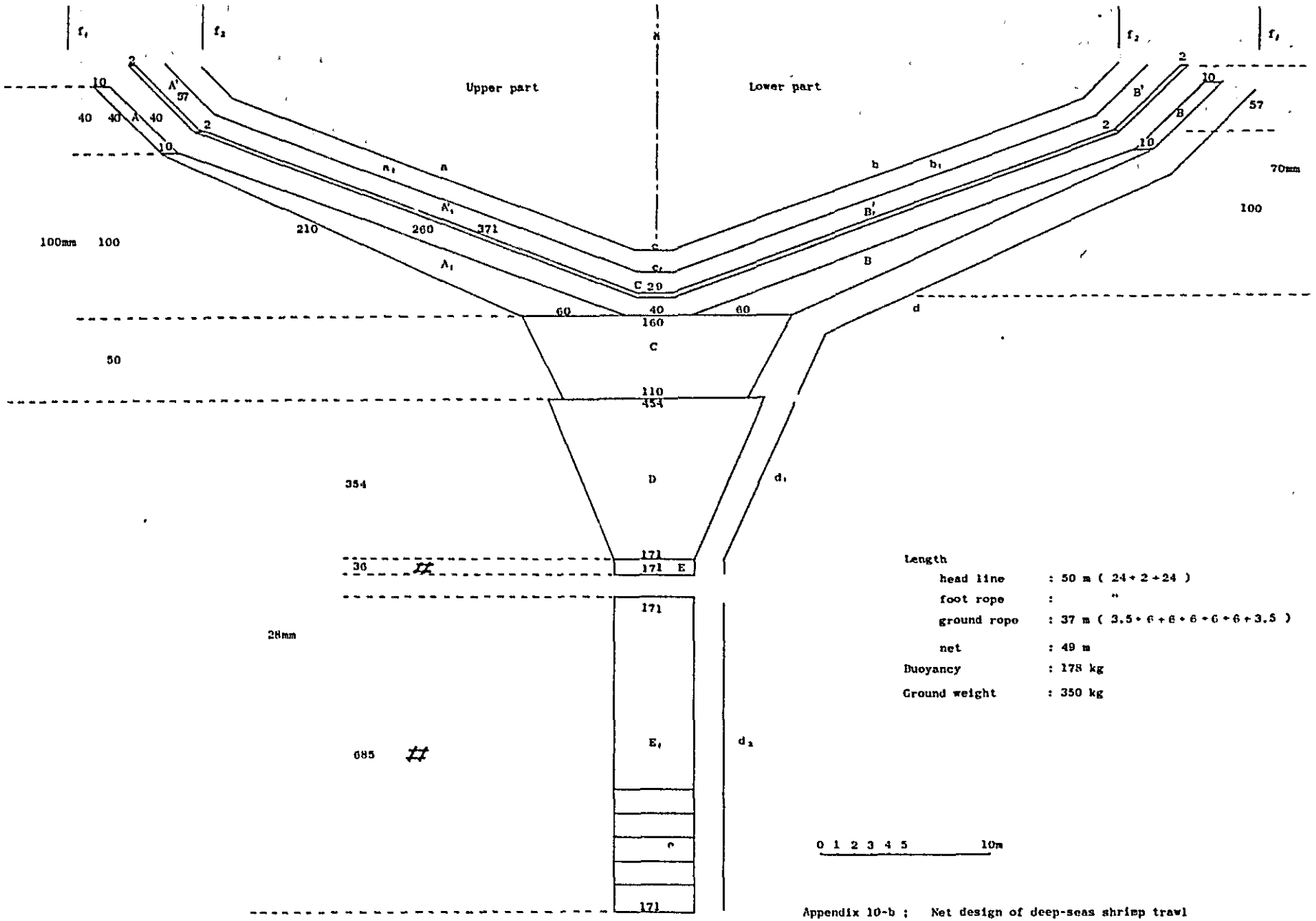
LINES, ROPES	a	b	a_1	b_1	c	c_1	d	d_1	d_2	e	f-f_1-f_2	g	h
Material	Comb.	→	Nylon	→	Comb.	Nylon	Comb.	→	Nylon	Man.	Comb.	SWR	→
Preservation	O	→	→	→	→	→	→	→	→	→	→	Gal	→
Circumference													
Diameter mm	22	→	17	→	22	17	22	→	30	12		18	22
Breaking strength kg	5,400 ~ 7,400	→	6,000	→	5,400 ~ 7,400	6,000	5,400 ~ 7,400	→	16,300	1,000		15,000	23,300
Construction	3 Z	→	Braided cord	→	3 Z	Braided cord	3 Z	→	→	→	→	6×19 Z	→
Lay													
Length m	24	→	30	→	2	→	32.4	10.2	19.2	24	8.0 each	8.5	50

FLOATS, SINKERS	Floats on lead line	Floats on cod-end	Bobbins	Leads	Leads	Hanging chain	Chain	SWR	→	Dan leno	Butterfly	Otter boards
Number	81	25	15	18	30	→	2	→	1	2	→	→
Material	Steel	→	Iron	Rubber	Iron	→	→			Iron	→	Wood Iron
Shape	Spher.	→	→	Disc	Cylinder							Oval
Diameter mm	200	→	300					22	→	500		
Length mm							35 m	6 m	18 m			5.5 m²
Static buoyancy kg	2.2	→										
Weight in air kg										2~3	±20	1,555
Weight submerged kg										1~2		

Buoyancy 178 kg 55 Sinker weight 350 kg

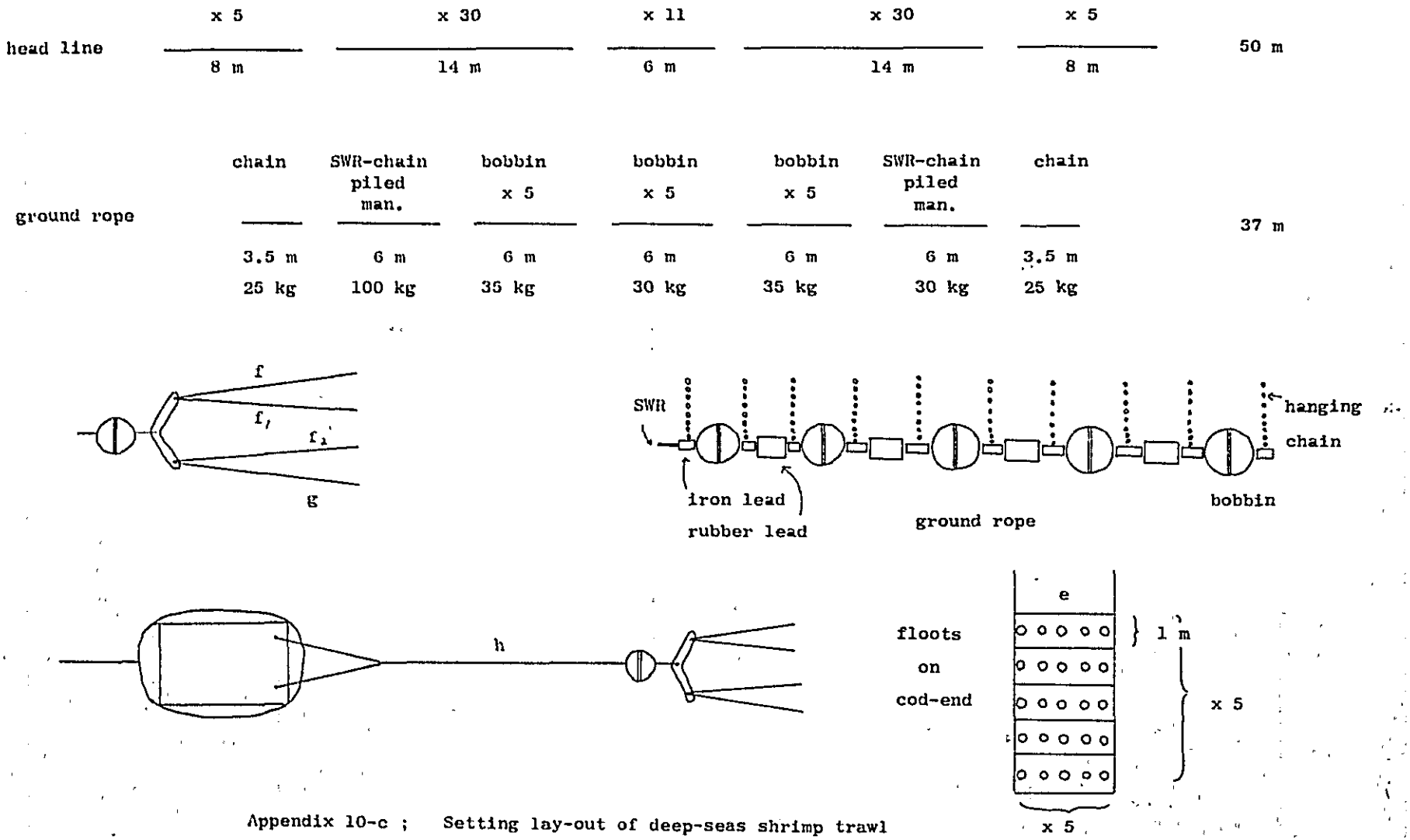
* Unknown twine size, but according to Soviet units being used as ϕ3 and 10.7/9

Appendix 10-a ; Data sheet of deep-seas shrimp trawl net



Appendix 10-b ; Net design of deep-seas shrimp trawl

Mar. '72 T.H



Appendix 10-c ; Setting lay-out of deep-seas shrimp trawl

Data Sheet

NAME OF GEAR : Pelagic trawl Main species caught : Pelagic fishes Vessels : Factory trawler
TYPE : One boat Midwater trawl L.o.A : 82 m
COUNTRY : Soviet Union Fishing conditions : Gross tonnage : 3,346 t
LOCALITY : Horse power : 1,160 ps × 2
REFERENCE : Crew : 70

WEBBING	A	A′	A_1	A_1'	B	B_1	C	C_1	D	D_1	E	E_1	F	F_1
Material	Nylon	—	—	—	—	—	—	—	—	—	—	—	—	—
Type of knot	⊠	—	—	—	—	—	—	—	—	—	—	—	—	—
Preservation	R	—	—	—	—	—	—	—	—	—	—	—	—	—
Colour		—	—	—	—	—	—	—	—	—	—	—	—	—
Twine size	93.4 × φ3	—	—	—	—	—	—	—	—	→	934 × 24	—	—	—
Breaking strength kg														
Stretched mesh mm	1,200	—	—	—	—	—	800	→	400	→	200	→	160	→
Upper edge	8	23	8	19	103	76	105	75	138	102	224	170	198	157
Lower edge	23	30	19	24	70	50	69	51	112	85	158	126	158	124
Depth	18	9	18	9	26	→	27	→	20	→	50	→	40	→
Baling rule in / out	1P 11b / 2P 1b		1P 13b / 1P 2b		1P2b	→	1P4b	2P3b	1P3b	2P3b	1P4b	2P3b	1P2b	→
Take up	B:C =	$B_1:C_1$ =	2:3	C:D =	$C_1:D_1$ =	1:2	D:E =	$D_1:E_1$ =	1:2	E:F =	$E_1:F_1$ =	4:5	F:G =	$F_1:G_1$ = 3:4
Self edge	1 ✻	—	—	—	—	→								
Hanging	$\frac{b}{A}$ =	$\frac{f}{A_1}$ =	$\frac{240}{216}$	$\frac{b_1}{A}$ =	$\frac{f_1}{A_1}$ =	$\frac{25.2}{21.6}$	$\frac{c}{x}$ =	$\frac{105}{19.2}$	$\frac{c_1}{x}$ =	$\frac{11.0}{19.2}$	$\frac{g}{y}$ =	$\frac{105}{22.8}$	$\frac{g_1}{y}$ =	$\frac{11.0}{22.8}$
			1.11			1.17		0.55		0.57		0.46		0.48

LINES, ROPES	a	b	c	d	e	f	g	h	a_1	b_1	c_1	d_1	e_1	f_1
Material	Comb	—	—	—	—	—	—	→	Nylon	—	—	—	—	—
Preservation	0	—	—	—	—	—	—	—	—	—	—	—	—	—
Circumference														
Diameter mm	22	—	—	—	—	—	—	→	12	—	—	—	—	—
Breaking strength kg	5,400 ~ 7,400	—	—	—	—	—	—	→	2,950	—	—	—	—	—
Construction	3Z	—	—	—	—	—	—	—	—	—	—	—	—	—
Lay														
Length m	45	24.0	10.5	8.6	45	24.0	10.5	2.2		25.2	11.0	9.0		25.2

FLOATS, SINKERS	Floats on head line	Floats on cod-end	Sinker			Weight	Otter boards	
Number	120	25	1	2	→	3×2	2	
Material	Steel	→	chain		→	Iron	Wood / Iron	
Sharpe.	Spher.	→						
Diameter mm	200	→						
Length mm							5.2 m²	
Static buoyancy kg	2.2	→						
Weight in air kg			75~80	25~30	10~15	900 × 2	700	
Weight submerged kg								

Buoyancy 264 kg 55

× Unknown twine size, but according to Soviet units being used as 93.4 × φ3 and 93.4 × 24

Appendix 11-a_1 ; Data sheet of pelagic trawl net

Data Sheet

NAME OF GEAR : Pelagic trawl
TYPE :
COUNTRY :
LOCALITY :
REFERENCE :

Main species caught :
Fishing conditions :

Vessels :
L.O.A. :
Gross tonnage :
Horse power :
Crew :

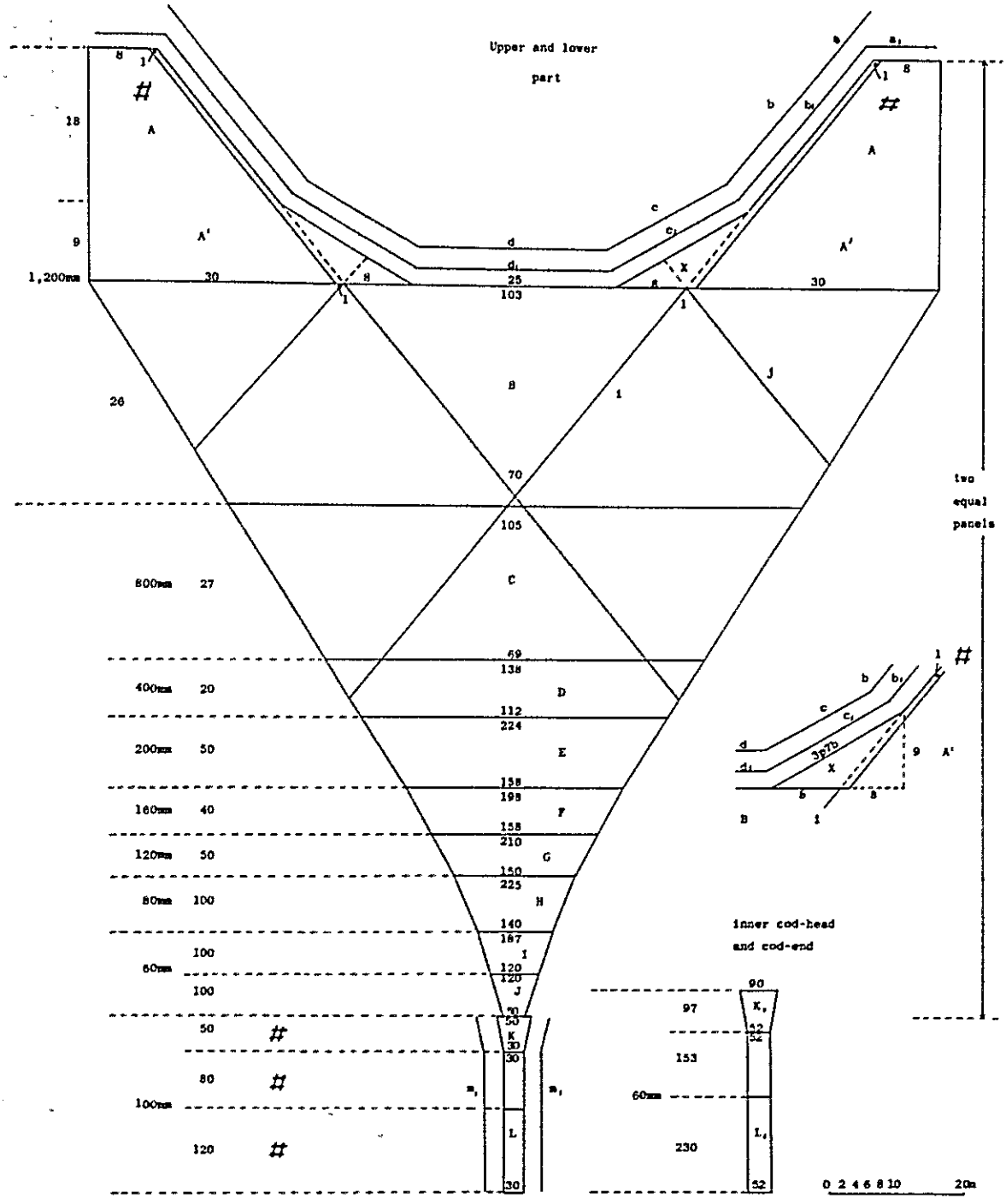
WEBBING	G	G_1	H	H_1	I	I_1	J	J_1	K ϕ	L ϕ	K_1	L_1		
Material	Nylon	→	→	→	→	→	→	→	→	→	→	→		
Type of knot	⊗	→	→	→	→	→	→	→	→	→	→	→		
Preservation	R	→	→	→	→	→	→	→	→	→	→	→		
Colour														
Twine size	924 × 24	→	→	→	→	→	→	→	93.4 × φ3	→	→	→		
Breaking strength kg														
Stretched mesh mm	120	→	80	→	60	→	→	→	100	→	60	→		
Upper edge	210	165	225	188	187	112	120	72	50	30	90	52		
Lower edge	150	125	140	92	120	72	50	54	30	30	52	52		
Depth	50	→	100	→	→	→	→	→	50	200	97	383		
Hanging ratio	1P3b	3P4b	2P3b	→	1P1b	2P1b	1P1b	6P1b	2P1b	all P	2P1b	all P		
Take up	G:H =	$G_1:H_1$ =	2:3	H:J =	3:4	$H_1:J_1$ =	5:6	I:J =	$I_1:J_1$ =	1:1				
Selvedge														
Hanging	$\frac{d}{B}$ =	$\frac{86}{30}$ = 0.29	$\frac{d_1}{B}$ =	$\frac{9.0}{30}$ = 0.30	$\frac{k}{B_1}$ =	$\frac{2.2}{10.8}$ = 0.20	$\frac{k_1}{B_1}$ =	$\frac{2.4}{10.9}$ = 0.22						

LINES, ROPES	g_1	l_1	i	j	β	l	m	m_1	m_2					
Material	Nylon	→	Comb.	→	→	→	→	→	Nylon					
Preservation	D	→	→	→	→	→	→	→	→					
Circumference														
Diameter mm	12	→	22	→	→	→	→	→	40					
Breaking strength kg	2,950	→	5,400 7,400	→	→	→	→	→	27,800					
Construction	32	→	→	→	→	→	→	→	→					
Lay														
Length m	11.0	2.4	76	31	54	24	150	45	25					

FLOATS, SINKERS				
Number				
Material				
Shape				
Diameter mm				
Length mm				
Static buoyancy kg				
Weight in air kg				
Weight submerged kg				

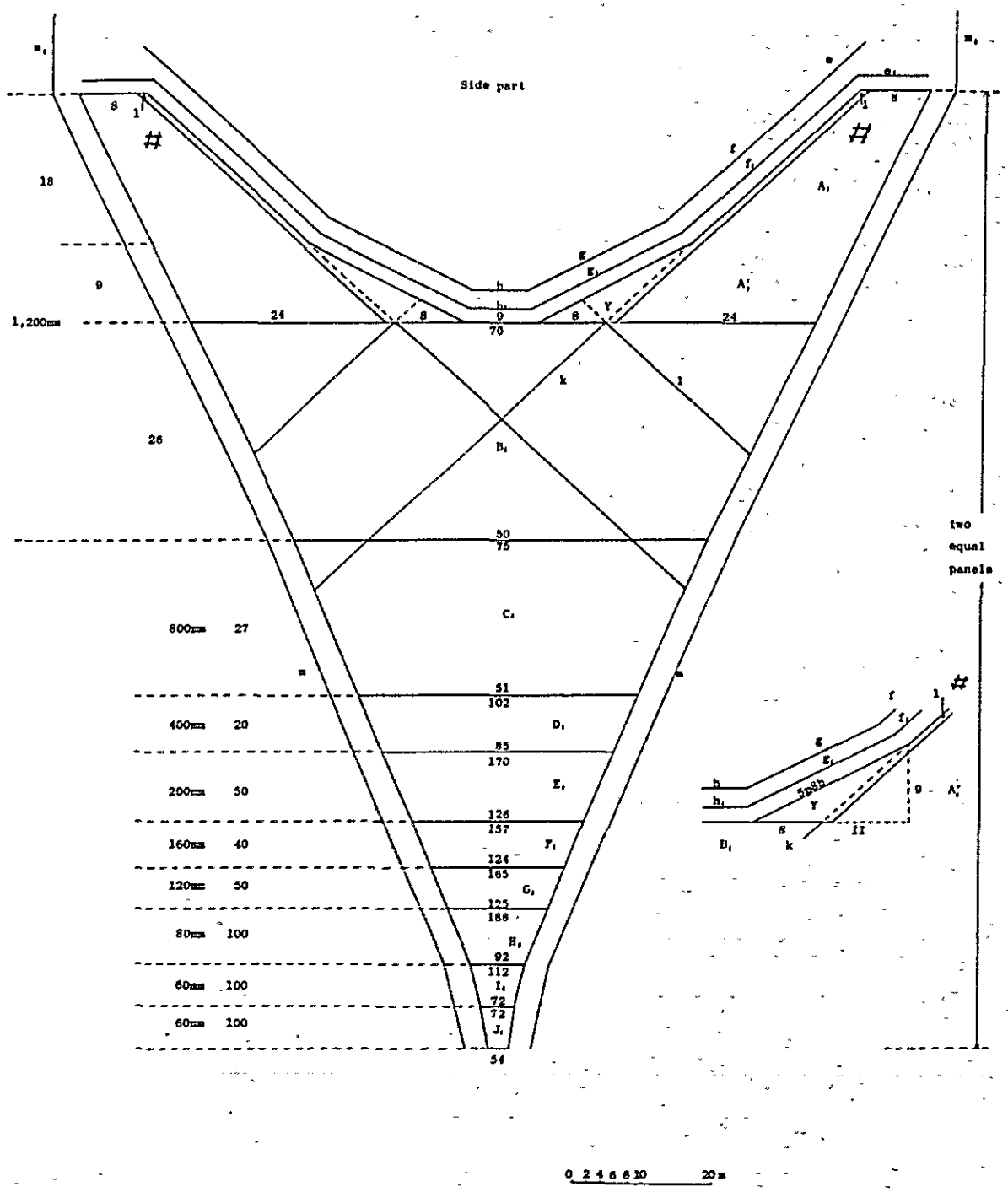
Head line and Foot rope : 77.6 m each
Side line : 71.2 m
Total length of net : 162 m
Total buoyancy : 264 kg
Total sinker weight : 145 ~ 170 kg

Appendix 11-a_2 ; Data sheet of pelagic trawl net

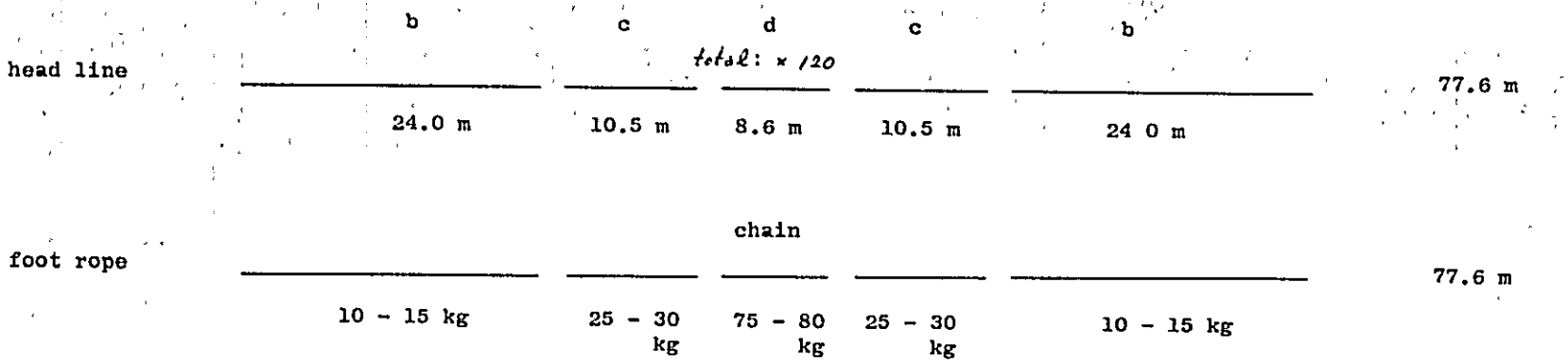


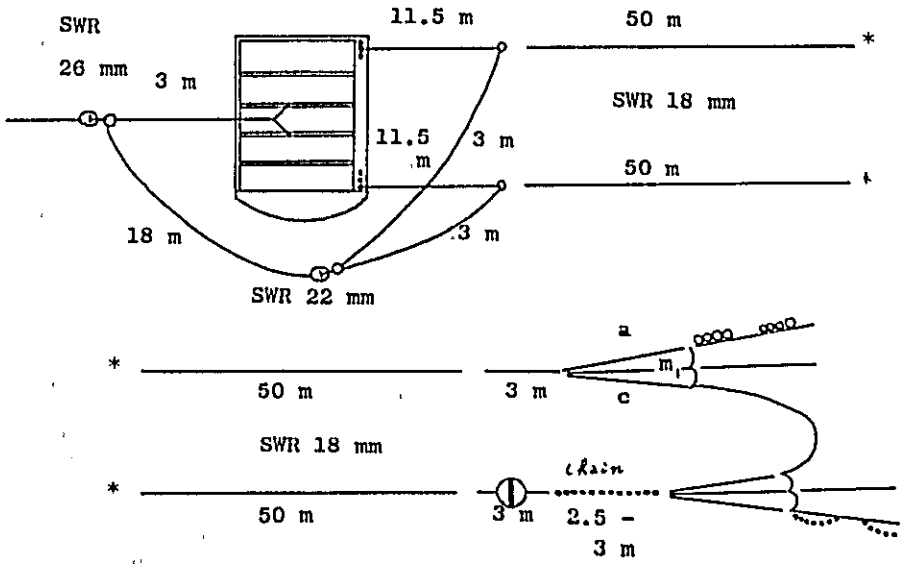
Appendix 11-b, ; Net design of pelagic trawl (upper & lower part)

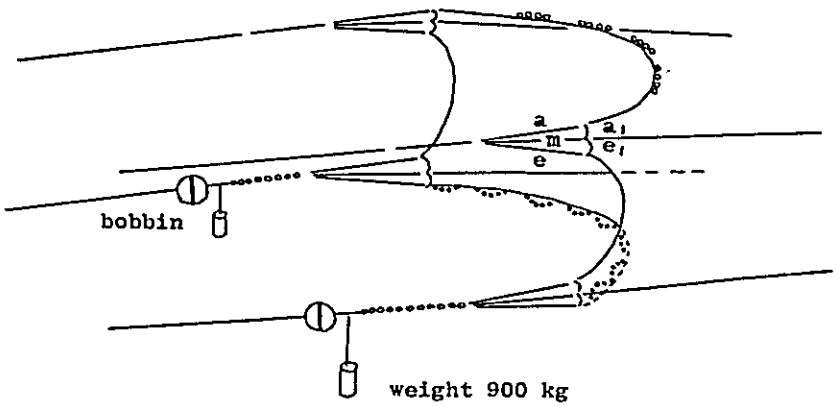
Mar. '72 TM



Appendix 11-b$_3$: Net design of pelagic trawl (side part)







Appendix 11-c ; Setting lay-out of pelagic trawl

Data Sheet

NAME OF GEAR : Bottom trawl
TYPE : Otter trawl
COUNTRY : Soviet Union
LOCALITY
REFERENCE :

Main species caught : Demersal fishes
Fishing conditions :

Vessels : Factory trawler
L.O.A. : 82 m
Gross tonnage : 3,346 t
Horse power : 1,160 ps × 2
Year : 70

WEBBING	A	A_1	A_2	B	B_1	C	D	E	F	G	H ϕ	H_1 ϕ	I ϕ	H_2
Material	Nylon	———												
Type of knot	⊠	———												
Preservation	R	———												
Colour														
* Twine size	ϕ3	———					→	10.7/24			→	ϕ3	———	
Breaking strength Kg														
Stretched mesh mm	200	———					→	160	120	90	60	100	→	60
Upper edge	12	→	89	12	55	252	218	250	267	286	110	80	40	212
Lower edge	19	41	105	55	→	174	187	200	191	190	80	40	40	80
Depth	14	→	35	49	38	→	14	25	35	50	30	60	160	165
Bobbin rate in/out	2x28b / 2x28b	2x28b / 2x28b	2x28b / 1P28b	1P28b / 1P28b	2x28b / 2x28b	28 b	———			→	1P28b	1P18b	2x28P	3P14b
Take up					$B_1:D$ =	C : D =	4 : 5	D : E =	3 : 4	E : F =	3 : 4	F : G =	2 : 3	
Self edge														
Hanging	a_1 / A_1A_2 = 10.8 / 9.8 = 1.10		a / A_1A_2 = 10 / 9.8 = 1.02		c_1 / C = 84 / 84 = 1.00		c / c = 5 / 84 = 0.60		b_1 / BB_1 = 20 / 174 = 1.15		b / BB_1 = 19 / 174 = 1.09		d_1 / D = 13 / 13.2 = 0.99	

LINES, ROPES	a	b	c	d	a_1	b_1	c_1	d_1	e	e_1	e_2	e_3	f	f_1
Material	Comb.	———		→	Nylon	———		→	Comb.	———		→		Nylon
Preservation	o	———												
Circumference														
Diameter mm	26	———		→	12	———		→	15	———		→	22	35
Breaking strength kg	7,500 ~ 8,700	———		→	2,950	———		→	3,500	———		→	5,400 ~ 7,400	21,700
Construction	3Z	———												
Lay														
Length m	10	19	5	6	10.8	20	8.4	13					344	5.5

FLOATS, SINKERS	Floats to headline	Floats on cod-end	Bobbins	→	Leads	→	Hang'g chain	Chain	SWR	Danleno	Butterfly	Other boards
Number	125	25	10	5	12	30	→	2	1	2	→	→
Material	Steel	→	Iron	→	Rubber	Iron	→	→		Iron	→	Wood Iron
Shape	Spher.	→	→	→	Disc	Cylinder				Spher.		Oval
Diameter mm	200	→	400	500					22	500		
Length mm								9.4m	18m			5.5m
Static buoyancy kg	2.2	→										
Weight in air kg										2~3	± 20	1,555
Weight submerged kg										1~2		

Buoyancy 275 kg 55 — Sinker weight about 300 – 400 kg

* Unknown twine size, but according to Soviet unit being used as ϕ3 and 10.7/24

Appendix 12-a_1; Data sheet of bottom trawl

Data Sheet

NAME OF GEAR : Bottom trawl
TYPE :
COUNTRY :
LOCALITY :
REFERENCE :

Main species caught :

Fishing conditions :

Vessels :
L.O.A :
Gross tonnage :
Horse power :
Crew :

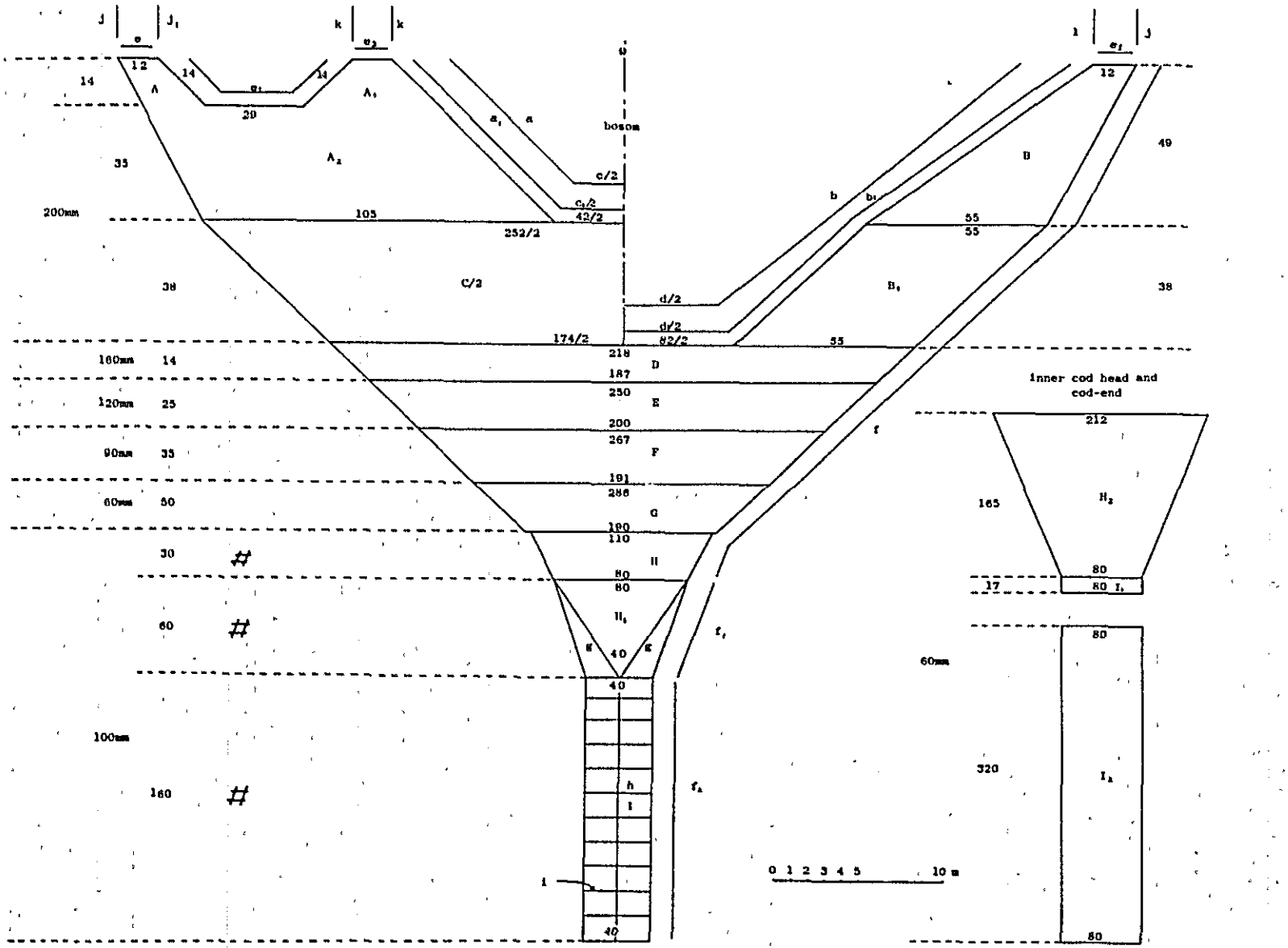
WEBBING	I_1	I_2												
Material	Nylon	→												
Type of knot	⊠	→												
Preservation	R	→												
Colour														
* Twine size	→	→												
Breaking strength kg														
Stretched mesh mm	60	→												
Upper edge	80	→												
Lower edge	80	→												
Depth	17	320												
Baling rate	all P	→												
Take up	G:H =	7:4	G:H_2 = 8:9											
Self edge														
Hanging	$\frac{d}{D}$ =	$\frac{6}{13.2}$ = 0.46	$\frac{f}{AA_2CDEFGH}$ =	$\frac{f}{BB_1DEFGH}$ =		$\frac{34.4}{31.8}$ = 1.08	$\frac{f_1}{H_1}$ =	$\frac{8}{H_1}$ =	$\frac{g_1}{H_1}$ =	$\frac{5.5}{5.9}$ = 0.93	$\frac{f_2}{I}$ =	$\frac{k}{I}$ =	$\frac{16.0}{16.0}$ = 1.00	

LINES, ROPES	f_2	g	g_1	k	i	d	d_1	k	k_1	l				
Material	Nylon	→	→	→	Man.	Comb.	→	→	→	SWR				
Preservation	O	→	→	→	→	→	→	→	→	Gal.				
Circum ference														
Diameter mm	35	25	→	35	12	15	→	→	→	18				
Breaking strength kg	21,700	11,000	→	21,700	1,000	3,500	→	→	→	15,000				
Construction	3Z	→	→	→	→	→	→	→	→	6x19 Z				
Lay														
Length m	16	5.5	→	16	2.0	2.5	→	3.0	→	4.8				

FLOATS, SINKERS				
Number				
Material				
Shape				
Diameter mm				
Length mm				
Static buoyancy kg				
Weight in air kg				
Weight submerged kg				

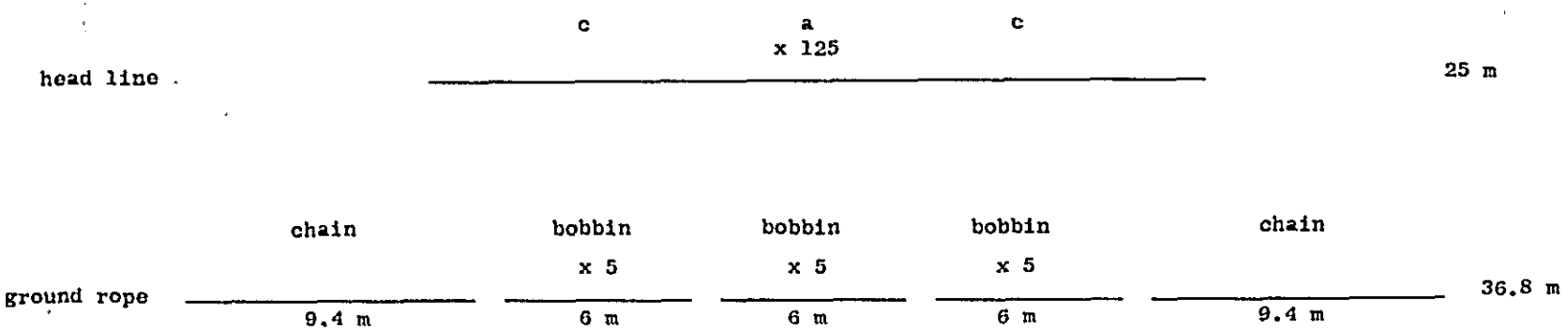
Head line : 25m (10 + 5 + 10)
Foot rope : 44m (19 + 6 + 19)
Ground rope : 36.8m (9.4 + 6 + 6 + 6 + 9.4)
Total length of net : 54m
Total buoyancy : 275 kg
Total sinker weight : about 300 ~ 400 kg

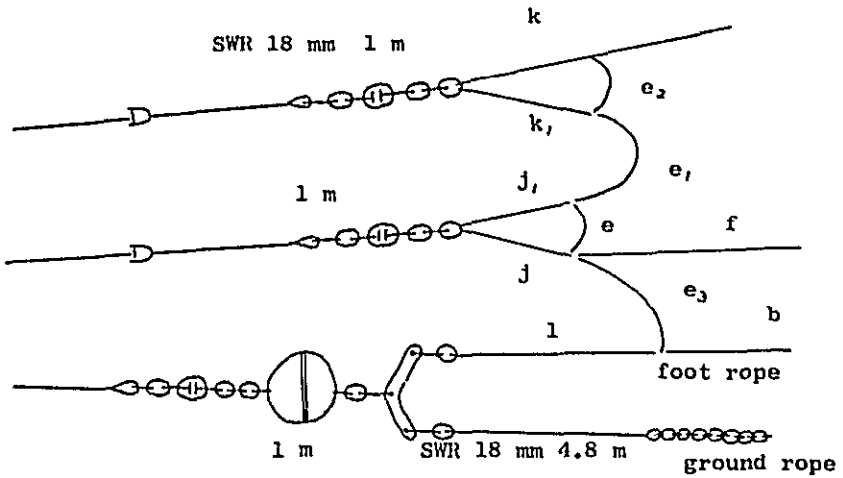
Appendix 12-a_1; Data sheet of bottom trawl

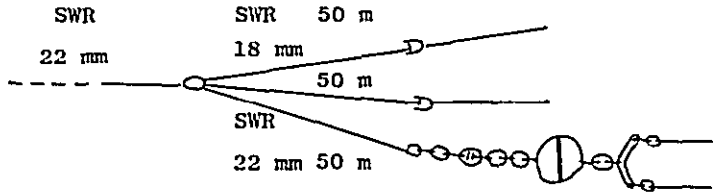


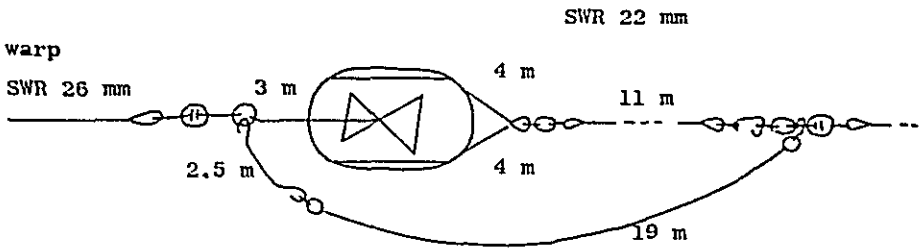
Appendix 12-b : Net design of bottom trawl

Mar. '72. TH









Appendix 12-c ; Setting lay-out of bottom trawl