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# ON THE ABILITY OF OTTER TRAWLS TO CATCH PELAGIC FISH IN MANILA BAY

By

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## ABSTRACT

This paper describes the results of some experimental trawl fishing undertaken on a series of cruises in Manila Bay, Luzon, Philippines in 1970. Two commercial medium-sized trawlers were employed using four kinds of trawl nets, namely, two German trawl nets A and B, a Norwegian star net, and a locally-made Norwegian net. The fishing observations and the statistical data gathered were concentrated on the catching ability (catch-per-unit-of-effort) of the nets and on the catch composition of each haul. The efficiencies of the four types of nets were shown by the fact that for all nets, more than 50% of the catch was composed of pelagic fish, mostly chub mackerels, anchovies, and hairtails. The German trawl net A proved the most efficient. It was noted, however, that from 1957 through 1962, the catches of the trawlers were made up mostly of two demersal fish species, the sap-sap (*Leiognathus* sp.) and kalaso (*Saurida* sp.). There was a considerable decrease in the landings of these two species during the period under review and this was a clear indication of the change toward pelagic fish noted in the catch composition of the trawlers in Manila Bay. A reduction in the catch per unit of effort (catch rate per hour) was observed up to 1966. In 1970, the increase in the catch rate per hour could be explained by the development of better nets (German trawl nets) and the use of more powerful engines.

## INTRODUCTION

Before World War II, Japanese beam trawlers numbering from 40 to 50 units were already operating the so-called "utase" in Manila Bay (Umali, 1932). Very little fishing was done during the Japanese occupation and otter trawl fishing was introduced in Manila Bay some

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time in 1947. In 1950, the first study was made by Warfel and Manacop under the Philippine Fishery Programme of the U.S. Fish and Wildlife Service on the otter trawl exploration in Philippine waters.

Nine tows at the Manila Bay approach in 1947 gave an average catch of 44 kg. per hour. An average of 33.6 kg. of marketable fish was taken per hour inside Manila Bay. This consisted of slipmouth (*sap-sap*), hairtail (*espada*), medium-sized snappers, shrimps, and squids.

Manacop (1955) reviewed the development of commercial trawling in the country especially of the otter trawl fishery in Manila Bay as of 1953, and the improvements which were made in the fishery from the use of beam trawl to the otter trawl together with a corresponding increase in the catches from 34 kg/hr (beam trawl) to 45.8 kg/hr. It appears that the *sap-sap*, *Leiognathus*, formed the bulk of the catches of the trawl. By 1950, the otter trawl replaced the beam trawl in Manila Bay. Considering that the gear was introduced only in 1947 in Manila Bay, the transition was quite rapid.

As early as 1953, however, Manacop (*op. cit.*) realized the danger of the expansion of the trawl gear coupled with the limited trawling grounds of the country, and set forth remedial measures.

At that time, Manila Bay then, as now, was the most important trawling ground of the country. Trawling experiments done in 1950 showed that *sap-sap* (*Leiognathus*) and kalaso (*Saurida*) predominated the catch.

In fact, *Leiognathus bindus*, *L. splendens*, *L. equulus*, *Gazza minuta* and *Saurida* spp. formed the most important fish in the great variety of fish catches of this gear.

Ronquillo *et al.* (1960), in a preliminary report covering the first three-year period of the marine fisheries biological research program from 1957 through 1959, found that there was a slight increase in the number of fishing vessels operating in Manila Bay during the period reviewed with a resulting decrease in the total average catch. Sorting of the fish catch based primarily on the commercial method was used, classifying the catches into *boya* (first class fish), shrimp, squid, slipmouth, lizard fish and a miscellaneous group. The *boya* formed the highest percentage ranging from 22% to 41%, probably indicating a higher concentration of the larger fish in the deeper water preparatory to their spawning migration outside the bay.

It was also shown that there had been a decrease in the average catch per hour drag from 16.16 kg in 1957 to 12.15 kg in 1959. This may be attributed to the increase in the number of units that operated in the bay from 1957 to 1959, and this already was a sign of overfishing in the area.

It was believed that the Manila Bay trawl fishery had, at that time, reached its maximum development and this led to some changes of fishing gear for catching pelagic fish in and outside Manila Bay, namely, the bagnet, *basnigan* with light and the introduction of twin engines in larger trawlers to enable them to catch more pelagic species in the bay.

Caces-Borja *et al.* (1968) reported the results of studies on the commercial otter trawl fishery of Manila Bay from 1960 to 1962. The fleet increased in number from 50 in 1957 to 81 in 1962 and the average catch rate per hour of effort which showed a stationary trend from 1957 to 1959, fluctuated annually from 15.72 kg in 1960 to 16.33 kg in 1962. The catch composition showed that the percentage of first and second class fishes (*boya* and *halo*) were much higher than all the other groups, and that the quantity did not follow clear-cut seasonal changes from year to year.

An average of 50 trawlers then operating in Manila Bay in 1956-59, gave an average catch per boat of nine tons a month, or a total catch of about 6,000 tons a year (Ronquillo *et al.*, *op. cit.*).

This increased to 11,000 tons in 1962 and 19,000 tons in 1968 although in 1970 this was reduced to about 16,000 tons (Fig. 1). This rapid increase may be explained by the fact that with the use of two Grey Marine engines, more pelagic fish were caught by the net. Furthermore, there was also an increase of fishing units operating in the bay.

As of 1970, there were about 295 otter trawlers which were based in the Manila Bay area. This was a heterogeneous group of fishing vessels with sizes ranging from 3 to 170 gross tons. While about one half of these vessels fish in Manila Bay, the other half were large and fitted to fish outside Manila Bay, in deeper waters. At any one time, about 25 units were fishing in the bay for a period of four to five days each trip, fishing in areas seven fathoms or deeper.

## 2. MATERIALS AND METHOD

In 1970, an opportunity arose for the Philippine Fisheries Commission to evaluate the catches of commercial trawlers using the newly

introduced German nets in Manila Bay, 10 years after a detailed study on the commercial catches was made by Ronquillo *et al.*, (*op. cit.*).

This was due to the technical assistance given by the Philippine Fisheries Commission (PFC) to the commercial trawlers with its procurement of German trawl nets. These had been previously introduced in other parts of the country. They had also been found successful in other countries of Southeast Asia, i.e., Thailand and Malaysia, through the technical assistance of the Federal Republic of Germany to these countries.

A series of trial cruises for experimental fishing were undertaken in Manila Bay in December 1970, using four kinds of comparable trawl nets on board two commercial medium-sized trawlers owned by a firm in Navotas, Rizal.

These fishing vessels were from 40 to 44 gross tons weight and were provided with twin 225 hp marine engines which gave greater trawling speed, allowing the trawl nets to catch more pelagic fish. This development of providing two engines in trawlers, which started in 1958 in Manila Bay, categorically showed the effectiveness of this innovation.

The four nets used in these trial cruises were two German trawls, a Norwegian star net, and a locally-made Norwegian net.

The locally-made Norwegian net was made of kuralon. It was used in four daylight trials from 180 to 210 minutes duration.

The German net A is the German trawl of 294 x 160 mm. mesh, which is made of nylon. It was used in four trials in daylight from two to three hours duration.

The German net B is the 418 x 160 mm. mesh net also of nylon material. This was used in 10 trials in daylight and at night from 120 to 225 minutes duration, for three days.

The Norwegian star trawl was also of kuralon material. It made three trials in daylight from 60 to 105 minutes duration. However, it could not be rigged to fish effectively during the experiment.

Fishing observations were made and statistical data were gathered on the catching ability of the nets and on the catch composition of each haul. Statistical treatment of the data was done to get the catch per unit of effort and the percentage of the most important fish species in the catch. These data were taken for purposes of comparison with previous studies made in the bay.

### 3. RESULTS AND DISCUSSIONS

From a comparison made of the efficiency of the four trawl nets it was noted that when the German nets were used, a greater trawling speed was attained at 3 to 3.2 knots per hour as the nets appeared to be lighter to pull because of their larger meshes and material (nylon). Nevertheless, more anchovies were caught which were not gilled (in the meshes) showing the effectivity of these trawl nets.

#### *Catching ability of the different nets*

The four nets were evaluated as to their catching ability (catch per unit effort) and ability to catch pelagic fish (chub mackerel, anchovies, and hairtails).

Using the locally-made Norwegian trawl net for four trial drags during daylight (60 to 165 minutes duration) gave a total catch of 564 kg and an average catch of 31.1 kg per hour of which more than 50% were chub mackerel (*basabasa*) and 6% were *hairtails* (*espada*). About 58% of the catch were pelagic fish, the rest were good kinds of bottom-living fish (Table I).

Table II shows the result of using German net A, during daylight for four trial hauls (two to three hours duration) which gave a total catch of 1,206.5 kg and an average catch of 94 kg per hour. About 65% consisted of first class pelagic fish, the rest were bottom-living fish, while 1/5 were trash fish.

Table III shows the result of three trial drags using a Norwegian star trawl during daylight from 60 to 105 minutes duration. The total catch was 225.5 kg with an average catch per hour of 25.5 kg/hour. More than 60% of the catch were pelagic fish, the rest were trash fish.

Table IV shows that results of ten trial hauls for three days using the German trawl net B, from 120 to 220 minutes duration day and night, gave a total catch of 3,909.5 kg and an average catch of 108 kg per hour. More than 50% of the catch were pelagic fish and about 30% were trash fish.

#### *Catch composition of the different nets*

The trawl catches usually consisted of a great variety of fish, but these were normally separated according to the commercial way of sorting, i.e., *hoya*, *halo*, *sap-sap*, *kalaso*, *hipon* and trash fish as discussed by Tiews and Caces-Borja (1965). Tables I to IV also showed

TABLE I. Catch and Percentage Composition of Locally-made (Norwegian) Trawl Net.

Fish Group	Weight of catch in kilograms				Total Catch Kg	Percentage
	Haul 1	Haul 2	Haul 3	Haul 4		
Chub mackerel	98	70	126	-	294	52.14
Anchovy	-	-	-	-	-	-
Hairtail	-	35	-	-	35	6.38
Shrimp	-	-	-	7	7	1.24
Hoya (Pomfret, Spanish mackerel)	-	14	-	-	14	2.28
Halo (mixed fish)	35	19	28	35	117	20.74
Trash fish	-	70	26	-	96	17.02
<b>Total</b>					<b>564</b>	<b>100.00</b>
<b>Total fishing time - 14.3 hours</b>						

Total catch of saleable fish — 502.25 kg  
 Total fishing time — 14.3 hours  
 Average catch — 35.1 kg/hr  
 Percentage of pelagic fish — 60.80%

TABLE II. Catch and Percentage Composition of 294 x 160 mm mesh German A Trawl Net.

Fish Group	Weight of catch in kilograms				Total Catch Kg	Percentage
	Haul 1	Haul 2	Haul 3	Haul 4		
Chub mackerel	112	77	77	98	364	30.16
Anchovy	21	52.5	119	14	206.5	17.1
Hairtail	35	49	114	14	212	17.54
Hoya	-	28	7	28	63	5.21
Halo	-	21	35	42	98	8.1
Trash fish	70	105	70	20	265	21.9
<b>Total</b>					<b>1,206.5</b>	<b>100.00</b>
<b>Total fishing time - 10.16 hours</b>						

Total catch of saleable fish — 955.5 kg  
 Total Fishing time — 10.16 hours  
 Average catch — 94. kg/hr  
 Percentage of pelagic fish — 64.8%

TABLE III Catch and Percentage Composition of Norwegian Star Trawl  
560 x 60 mm mesh

Fish Group	Weight of catch in kilograms			Total Catch Kg	Percentage
	Haul 1	Haul 2	Haul 3		
Anchovy	7	14	21	42	16.44
Hairtail	-	-	14	14	5.47
Herring	7	21	10.5	38.5	15.07
Crevalle	-	-	56	56	21.92
Trash fish	-	70	35	105	41.1
Total				255.5	100.00

Total catch of saleable fish

— 150.5 kg

Total fishing time

— 4.25 hours

Average catch

— 25.53 kg/hr

Percentage of pelagic fish

— 36.98%

TABLE IV Catch and Percentage Composition of German B Trawl Net

Fish group	Weight of catch in kilograms										Total Catch Kg	Percent- age	
	Haul 1	Haul 2	Haul 3	Haul 4	Haul 5	Haul 6	Haul 7	Haul 8	Haul 9	Haul 10			
Chub													
mackerel	35	56	45.5	35	38.5	14	56	-	17.5	35	332.5	8.5	
Anchovy	10.5	105	210	217	105	182	280	94.5	52.5	24.5	1,176.5	30.09	
Hairtail	10.5	14	91.0	24.5	7	84	98	21.0	18.5	175	552	14.13	
Shrimps	7	3.5	3.5	-	-	-	-	3.5	3.5	-	21	0.54	
Squids	-	3.5	3.5	-	-	3.5	-	-	3.5	-	14	0.36	
Hoya	-	-	-	-	-	-	-	-	-	-	-	-	
Halo	49	49	14	21	14	14	7	49	35	77	329	8.42	
Mulletts	-	-	7	-	-	-	-	3.5	-	-	10.5	0.26	
Crabs	3.5	-	-	-	-	-	-	-	7	-	10.5	0.26	
Trash													
fish	210	210	14	70	17.5	87.5	105	105	105	70	1,120	28.39	
Total											3,909	100.00	
Total fishing time	- 25.83												

Total catch of saleable fish

— 2,779 kg

Total fishing time

— 25.83 hours

Average catch

— 107.6 kg/hr

Percentage of pelagic fish

— 53.89%

the comparable amounts and percentages of the most important catches which were mostly pelagic fish. These were:

- (1) *Rastrelliger*, commonly known as chub mackerel, *hasa-hasa* — The Norwegian net appeared to be effective in catching chub mackerel (52.13%) compared to the German net A (30%) and the German net B (8.51%).
- (2) *Stolephorus*, commonly known as anchovies, *dilis* — The German net B was very effective for catching anchovies (30.09%) followed by the German net A type (17.10%).
- (3) *Trichiurus*, commonly known as hairtail, *espada* — The German net A was more effective in catching hairtail (17.54%) than the German net B (14.13%) and the Norwegian net (6.20%).
- (4) *Trash fish* — The German net B caught more trash fish (28.30%) followed by German net A (21.90%). The Norwegian net caught 17.02%.

The Norwegian star net was not included in this evaluation because it was not properly rigged and could not be made to fish efficiently during the experiment.

Figure 2 shows the comparable catches in percent of the four kinds of nets. It was noted in all cases that the predominant catches were pelagic fish, in all cases forming more than 50% of the catch and at times almost 75% of the total. However, great differences in the catches of the different trawl nets were noted among the pelagic fish. The trash fish was also included to show the percentage of the waste fish taken by the trawls which go to the fish meal industry. There were, however, very poor catches of *sap-sap* and *kalaso* probably due to larger meshes of the nets (16 cm.) allowing these small fish to escape. As previously seen, from 1957 to 1962 the catches of the trawlers were mostly *sap-sap* and *kalaso*.

The data of Ronquillo *et al.* (*op. cit.*) showed that for the period 1957-59, *sap-sap* was the mainstay of the trawl fishery of Manila Bay although 1960-62, Caces-Borja *et al.* (*op. cit.*) showed that there was a considerable decrease of the *sap-sap* catch from 12% in 1960 to 4.5% in 1962.

The *kalaso* catches formed from 29% to 10% of the catches in 1957-59 depending upon the season. These decreased further in the 1960-62 period from 10.3% to 2.4% (the average for 1961 and 1962 respectively).

The absence of the above groups as predominant groups of the catches in the present data indicates the great change now occurring in the catch composition of the trawlers in Manila Bay, i.e., they were catching more pelagic fish.

The groups of *boya* and *halo* were made up of fish which were predominantly bottom-living and although some pelagic species may be included, they were negligible.

Table V is a comparison of the important catch data of the four nets showing the better efficiency of the German trawl nets. This experiment led to the general modification of the trawl gear and increased catches in Manila Bay recently, (1970-71), following the trend started in Bacolod, Negros Occidental, where the German trawl was introduced earlier. The Manila Bay trawlers appeared to be more conservative in this regard.

#### *Catch per unit of effort*

The average catch rate per hour (the measure for catch per unit of effort) has been determined roughly for the otter trawl fishery in Manila Bay since its introduction in 1949.

The average catch rate has been reduced to one half (12.15 kg/hr) in 1959, eight years after (1949) and fluctuated a little until 1966. This reduction (a drop of 50%) corresponds roughly to the maximum equilibrium yield and as the decrease exceeds 50%, it indicates that the stock is overfished in a biological sense, i.e., it is yielding less than it could despite the large fishing effort (Kvaran, 1971).

However, with the new development of improved nets and the increasing power of fishing vessels, there appeared to be an increase in the catch per unit of effort (as obtained in 1970-1971) from the catches in Manila Bay of both the commercial and PFC research vessels. The high average catches obtained by both types of German trawls indicate the effectiveness of these well-designed trawls for Southeast Asia as has also been found in other countries (Table VI). It is apparent also from the catch composition, that this increase has been brought about by the effectiveness of the net to catch pelagic fish which prefer to stay for some time near the sea bottom. This ability to catch pelagic fish has been found also to be true in the Visayan Sea and elsewhere in the country with the use of the German trawl (Sarmiento, per. comm.).



TABLE V. Comparing the catches and efficiency of the four trawl gear used in the December 1970 Comparable Cruises.

Types of nets	Saleable catch		Total fishing Time (Hrs)	Average catch Per hour (kg)	Anchovy		Trash fish		Hasa-hasa	
	Kg	%			%	%	%	%		
Norwegian (local net)	502.25		14.3	35.1	0	17.0	52.13			
German net A	955.5		10.16	94.1	17.0	21.9	30.06			
German net B	2,779		25.83	105.6	30.09	28.39	8.51			
Star trawl (large Norwegian net) rigging not completed	150.5		4.25	25.53	16.4	41.1	0			

TABLE VI. Catch per unit effort (catch rate per hour) of otter trawler in Manila Bay (1949-1971).

Year	Catch rate per hour (kgs)
Before World War II	No record
1947	33.6
1948-49	45.8
1957	16.16
1958	13.32
1959	12.15
1960	15.72
1961	13.57
1962	16.33
1966	14.00 (approximate)
1970	
G. net A	94.1
G. net B	105.6
Norwegian star trawl	25.53
Norwegian (local)	35.1
Japanese trawl	48.78
1971	
Japanese trawl	37.39

## CONCLUSION AND RECOMMENDATIONS

*Conclusion*

Several changes in the trawl fishery of Manila Bay were noted. First, the catches of the German and Norwegian nets were predominantly pelagic fish which are temporary visitors and are continuously recruited into the bay. This change in the catch is beneficial to the trawl fishery as it relieves the pressure upon the demersal fish of the bay. Second, the efficiency of the German trawl nets over the Norwegian-type local nets was made very clear. Not only more pelagic fish caught but even small pelagic fish such as *dilis* were caught without being gilled, hence they become available to the trawl fishery. The good points as noted on the use of the nets in other Southeast Asian countries were verified and were found applicable to Manila Bay conditions. Third, the large mesh size (16 cm.) of the net apparently prevents the catching of small bottom-living fish (*sap-sap* and *kalaso*) as very few of them were caught, although they predominate in the catch of conventional trawl nets.

Since very few fish breed in Manila Bay, there appears to be little danger of destroying the breeding population, as the recruitment of the fish into the bay does not depend entirely upon the fish that migrate out to breed.

Although Manila Bay is in a way biologically overfished, the catch per unit of effort indicates that the trawl fishery is more or less stabilized because of the very high rate of recruitment of young fish into the bay. With the recent innovations leading to more pelagic fish catches, the catch per unit of effort has been increased six times.

*Recommendations*

Based on the findings of the recent trawling experiments in Manila Bay, it can be noted that total prohibition of otter trawlers in Manila Bay would be baseless especially with the innovations whereby the trawlers catch more pelagic fish. Hence, it is recommended that regulated trawling be allowed in the bay. This has to be taken in view of the socio-economic problem of competition between the sustenance fishermen and the otter trawlers.

The baby trawls (one to two men banca-type trawlers) should be encouraged to evolve into larger crafts or medium-sized trawlers ( $\pm$  3-G.T. bancas) which has just been introduced and are capable

of fishing in deeper waters (7-15 fathoms) by phasing out the small trawlers through government loans to allow the purchase of larger vessels and engines (20-25 hp). The medium-sized trawlers appears to be the ideal gear for Manila Bay, as it is manned by four to five men and is operated only during daytime.

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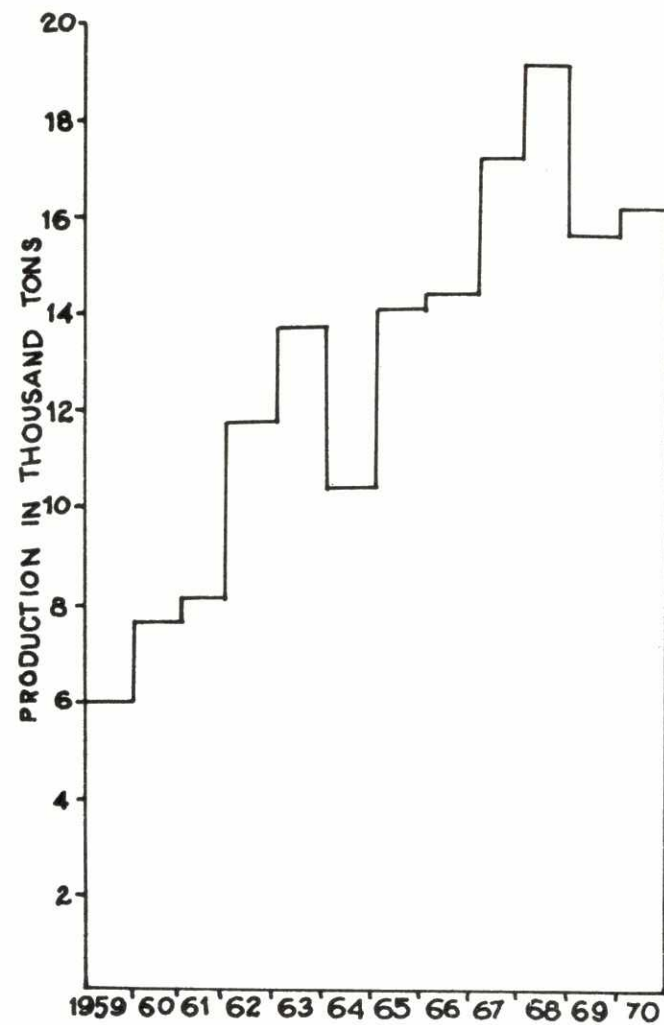
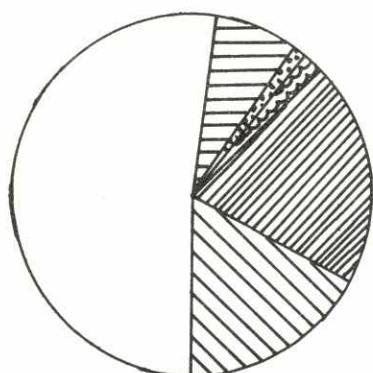
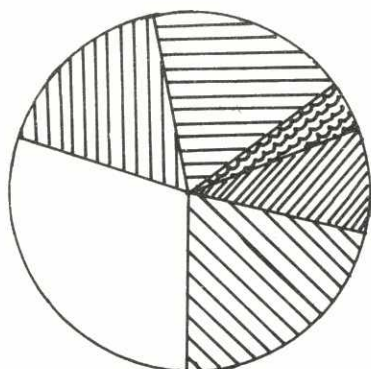


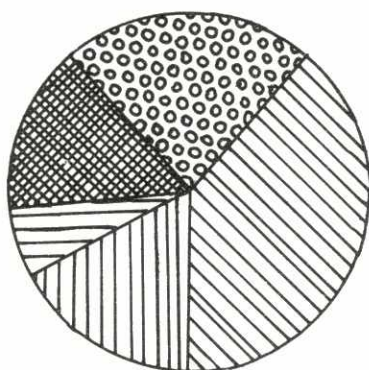
FIG. 1. Otter trawl production of Manila Bay.



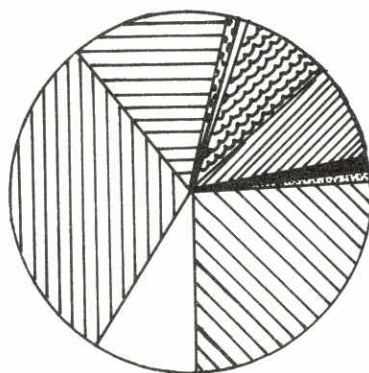
LOCAL NORWEGIAN TRAWL



GERMAN TRAWL A



NORWEGIAN STAR TRAWL



GERMAN TRAWL B

## LEGEND

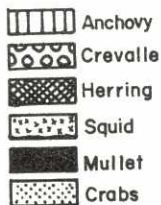


FIG. 2. Catch composition from experimental fishing of four kinds of commercial otter trawls, 1970.