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ByCatch Activities in Brazil

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ABSTRACT

Along the 4,590 nautical miles of Brazil's coast line, all the fisheries resources are under or over exploited, especially in shallow water (up to 100m). The administration of these resources is conducted by controlling the fleet size and closing the fisheries during seasons according to the species.

It is well known that new technology innovations can only be conducted towards selectivity and energy efficiency. With the reduction of shrimp and fish stocks, it is necessary to trawl more hours to obtain the same catch yields, but this effort only increases the by-catch of juvenile fish that are very representative in the landings.

The increase of the national demographic density, specially in the coastal areas, imposes a great pressure on the fisheries resources. Every year more young fishermen start their life at sea and the market demands for fish increases. The world is nearly into the 21st century and our fisheries are entirely dependent on juvenile fish.

Until the late 1980's the assessment of fish stocks was based on catch and effort from landings by the commercial fleet without considering the discards still at sea. Now special attention is given to by-catch problems in all trawling fisheries.

In 1986, the total national by-catch was estimated at 414.883 tons only from the shrimp fisheries. Of this total, 68%, or 281,066 tons, was wasted. Recent studies have shown that this catch is composed of over 147 species of which 50% are juvenile commercial fin-fish.

The biggest problems occur in the south, where shrimp fishermen use small trawls with small meshes in coastal areas. Also, a new fishery for *Artemesia* by the double-rig fleet using small meshes in areas with great concentration of juvenile-fish, has increased the by-catch discards and threatens these resources.

Fin-fish trawling in the South of Brazil is also a major activity and is responsible for great quantities of by-catch. The 130 pair-trawlers operate near the coast using small meshes in cod-end, 60mm, and discard 50% of their catch. A research program carried out on board this fleet demonstrates that by-catch discards of only one pair-trawler is about 1,701,123 juvenile commercial fish per year. These numbers are only for the four major species. If we take into account that the fleet catches 87 different species and 38% are discarded, the total by-catch represents billions of juvenile fish.

To reduce the by-catch rates, three research programs are being conducted.

In the Amazon shrimp fisheries a boat was used to collect the good commercial fish and evaluate the composition of this catch directly from the fleet during fishing operations.

In the South experiments are being made with new shrimp trawl designs and escape panels to reduce the juvenile catches and retain fish of commercial size. The observations are being conducted directly on board the fishing fleet to evaluate the acceptance of professional crews towards these innovations. Complicated and expensive nets will not be accepted by traditional fishermen.

In the pair and stern trawling fisheries the square mesh cod-ends and panels are being tested.

Special attention has also been given to the evaluation of turtle and mammal by-catch in the Brazilian fisheries.

INTRODUCTION

Along the coast line, Brazil has two main large scale trawling regions. The first is in the North and the second in the South. The third developing area is located on the Northeast coast. In the Northern region, 187 steel double-rig trawlers, 23 meters long equipped with 450 to 800 HP motors, catch 5.800 tons of pink shrimp per year. All these vessels are equipped with refrigerated holds. This fleet operates two four-seam trawls, 18 meters head line, made of polyamide netting 210/48, 50mm meshes in the belly and 44mm in the codend.

In the Amazon region, by-catch from the commercial shrimp fleet is composed of 147 species of which 76% are juvenile fish of commercial value, but 98% are discarded. The fishing companies have no interest in the fish because of the long periods at sea, 45 days, and the lack of storing space in shrimp holds. Total by-catch waste in 1990, was 21.066 tons and landings 20.645 tons.

The Northeast coast of Brazil is characterized by a typical tropical climate, warm waters and coral sea bed. The major fishing activity is lobster trapping and line fishing.

Trawling activities are located only on muddy bottoms, near river outlets. The principal shrimp fishery is situated on the mouth of the River Sao Francisco, where 410 small trawlers ranging from 8 to 16 meters, equipped with inboard diesel engines 60 to 180 HP, operate very near the coast in shallow waters, up to 20m. The most popular trawl net is a 16m two seam net made of nylon 210/16 or polyethylene 30/06 with 36mm meshes in the body and 28mm in the codend. This fleet catches an average of 1.541 tons of sea bob (*Xiphopenaeus kroyeri*), and white shrimp (*Penaeus schimitti*).

In the Northeast region the shrimp by-catch is a very important economic resource. The fish by-catch is nearly totally consumed by the local markets, sold fresh or salted dry. Only poisonous species are discarded. The main reason for the low waste is due to the daily fishing trips and the social-economic problems of this area. The fish by-catch total landings in 1990, was 2.175 tons. The waste is estimated at 215 tons.

The Southern regions are the major fishing grounds of Brazil. The trawling operations occur from Lat. 18 30' S to Lat. 30 30'S, covering an area of 17.100 square miles. In this region, trawling activities are directed to shrimp and bottom fish.

The shrimp fishery is very important and is divided into three classes. The first is characterized by a fleet of 257 double-rig trawlers of 19 to 23m which fish pink shrimp (*Penaeus brasiliensis*), and (*Penaeus paulensis*). These boats are equipped with engines of 180 to 270 HP and trawl two flat nets made of braided polyethylene netting 50mm meshes size.

The second fleet consists of 556 medium size, 11m to 16m long, double-rig trawlers powered by 90 to 160 HP motors, that operate small two seam trawls with 36mm meshes. These boats work near the coast catching sea-bob and white shrimp.

The last shrimp fleet has nearly 4300 boats that are operated by artisanal fishermen. These vessels are small open dories equipped with central diesel engines of 09 to 36 HP that trawl two seam nets with 24mm mesh size. This fishery is very coastal, not exceeding 20m in depth.

Fish by-catch in the southern shrimp fisheries of Brazil, represents a very high average ratio of 1:15 that can increase to 1:44 according to the season of the year. Of the total by-catch, only 12% is landed and over 258.579 tons are discarded back to sea. In 1986, Conolly (1986), showed that 35% of the catch was used for human consumption and that fish by-catch is an important economic support for covering operational costs. The increase of rejection from 65% to 88% is due to the reduction of fish stocks that are seriously in danger as a consequence of trawling activities with no selectivity.

The by-catch in the sea-bob fisheries is very significant. The small open shrimpers and the medium trawlers, operate very close to the beaches with very small meshes, 24mm. The nets have a low vertical opening so they only catch small juvenile fish that are all discarded.

Also, a new fishery for argentine shrimp (*Artemesia longinaris*), and (*Pleoticus muelleri*), has been developed by the shrimp double-rig fleet using small meshes near estuary areas with great concentration of juvenile-fish, thereby increasing the by-catch discards and threatening these resources. This fishery increased from 74 tons in 1986, to nearly 2000 tons in 1989. Ruffino (1991), showed that 47 species of fish are caught as by-catch, but 4 species represent more than 50% of the discards. The shrimp : by-catch relation was 1:12.7 in 1980, and decreased to 1:0.05 in 1990, as a consequence of the discards of large quantities of undersize juvenile fish, near the Patos Lagoon estuary, Ruffino (1991).

Demersal Fish.

In the Southern Region, trawling for bottom fish is a very important activity. The principal fishing method is "pair-trawling," double-rig and stern-trawlers. The 230 boats' average size is 23 meters powered by 270- 450 HP motors. They fish close to the coast up

to 150 meters deep, using two-seam wing-trawls, with meshes averaging from 200mm to 90 in the bunt, but undersize meshes such as 60mm double-twine are used by illegal fishermen.

Fin-fish trawling in the South of Brazil is responsible for great quantities of by-catch. Discards of only one pair-trawler are about 1,701,123 juvenile commercial fish per year. These numbers are only for the four major species. If we take into account that the fleet catches 87 different species and 38% are discarded, the total by-catch represents billions of juvenile fish. A total of 230 trawlers land 31.500 tons per year and discard 12.600 tons at sea.

In the last 10 years, one more factor has also contributed to the increase of discarded fish; the reduction of shrimp and fish stocks. Now it is necessary to trawl longer to obtain the same catch yields, but this effort only increases the by-catch of juvenile fish that are very representative in the landings.

Estimated by-catch and discards in the Brazilian fisheries in 1990. Source: IBAMA/CEPENE/CEPSUL *

Region	Total ByCatch	ByCatch Landings	ByCatch Waste	Discard Ratio
North	21,066	421	20,645	98%
Northeast	2,390	2,175	215	9%
South shrimp	293,840	35,261	258,579	88%
South fish	44,100	31,500	12,600	40%
Total	361,396	69,357	292,039	

Turtle By-Catches

Turtles are present in all the Brazilian coastal areas especially the species, (*Chelonia mydas*), (*Caretta caretta*) and (*Dermochelys coriacea*). They are caught accidentally by trawlers, static traps and gill-nets.

In the Northern shrimp fisheries one turtle is caught for every 2000 hours of trawling, IBAMA (1991), and are released by fishermen. This catch-rate is very low, because the boats operate 30 to 40 miles from the coast in deeper waters.

In the northeast region, outside the mouth of the River Sao Francisco, about 200 turtles per year are caught by the sea-bob trawling fleet. For the last 3 years the TAMAR Project has created observation bases to teach fishermen how to revive the turtles caught in the trawls. This work has brought excellent results and nearly all turtles are saved in this region. The project has 19 bases to protect turtle nests in the main beaches and 5 revival bases where these animals are caught by fishermen.

In the southeast shrimp region turtle catches are even smaller. It is necessary to trawl over 4000 hours to catch one turtle. Fishermen do not eat these animals because of local traditions.

Bigger accidental catches occur in Curral Traps (type of set-net made of wood), in the Northeast. Approximately 300 turtles are caught, some are eaten by the local fishermen. Also, in the southern region more turtles are caught in small artisanal gill nets that are set near islands and rocky bottoms.

MATERIALS AND METHODS

Since 1985, the Southeast Fisheries Research Center, CEPSUL/IBAMA, is working on the development of selective trawl nets and testing new technologies on board commercial fishing boats.

Considering the three different by-catch situations due to social-economic aspects of the Brazilian regions, the research programmes were directed to the following:

a - Develop selective nets to reduce by-catch in the Northern shrimp fleet and for the artisanal sea bob fishery in the south where fish catches have no economic importance.

b - Develop selective nets for the southern industrial fleet that permits the escape of juvenile fish, catching only shrimp and commercial size species.

c - Introduce the square mesh and other selective methods in the pair and stern trawler fleet.

All these experiments were and are being carried out on board the commercial fleet.

SHORT NETS.

To reduce the total fish by-catch, especially for the Northern region, trials were done changing the shape of the traditional nets.

In fish trawl design, especially in mid-water trawls, it is well known that the net needs a long body and tunnel, with a low tapering. This is needed to trap the fish during haulback. Wardle (1986), and Watson (1988), showed in underwater observations that fish swim always in the same direction of the trawl and that they try to swim out of the net when speed is reduced.

In shrimp fisheries, the tapering of nets in the belly are 1N 2B or 1N 4B. This means that big nets tend to have longer bellies and consequently they increase fish by-catch yields. Normally, smaller trawls or twin gear systems catch more shrimp and less fish than traditional big trawls.

Based on these theories, experiments were done with short tapered nets, All Bar cut in the belly. This tapering reduced the nets belly length in 8.85 meters. The long net total length was 20.1m and the short net 11.25m. To evaluate the differences in by-catch, these nets were tested on a commercial vessel, 18m length and 180 HP, using twin trawls system. On the Starboard side two 9.5m trawls with a taper of 1n 2B and on the Port side two short

9.5m "AB cut" nets. The experiments were done during 2940 trawling hours in commercial fishing conditions. See fig. 1 and 2.

Selective Panels.

The first test for selecting by-catch in Brazil was done by Conolly (1986), in the Southern Region using square mesh netting in the upper section of the tunnel just in front of the codend. To avoid shrimp escapes through this area, a funnel (Valdermarsen 1986), was fixed ahead of the square mesh to drive all the catch in to the codend. Fish with a more active behavior would react and escape through the open meshes. This test demonstrated that the funnel was not efficient because it got clogged by big fish such as rays, sharks and weeds. See fig. 3

The second experiment with this same type escape section was developed on board the commercial fleet, using the square meshes (50mm bar length), but the funnel was modified. A simple panel of netting was joined to the beginning of the square meshes and stretched down like a tongue. See fig. 4. This modified the original conical entrance of the funnel to a wide oval entrance near the lower netting.

During the tests a second tongue was introduced just at the end of the square mesh panel and the beginning of the codend. See fig. 5

Selective Codends For Stern and Pair-Trawlers

A project to modernize the fin-fish bottom trawling in the south of Brazil is under way. The main objective is to introduce square mesh codends, sections and other methods on the commercial fleet to reduce juvenile by-catch.

The work is based on testing and transferring the results of experiments with codend designs developed by the DAFS Marine Laboratory, Scotland, and other research institutions, to the local trawling fleet.

RESULTS.

The experiments with short shrimp trawls achieved promising results. The total by-catch was reduced in 17%, and shrimp catches increased in 5%. See fig. 6 and 7.

- This demonstrates that the trawls do not need long bellies or extension codends.
- Once the shrimp passes the ground rope, they jump and become passive, Watson (1988).
- During haulback 15% of the small by-catch and 24% of the big commercial fish swim out or avoid the short trawl.
- Shrimp do not escape.
- Shorter nets offer less resistance, consequently there is a gain in horizontal spread and more shrimp are caught.
- Less netting is used, the nets become easier to handle and cheaper.
- Better acceptance by crews and boat owners.
- There is a limitation to short nets; they need a minimum length equal to the distance from the deck to the end of the boom.
- The short belly and the AB cut makes the meshes open more.

The experiments with escape sections reduced the by-catch in 48% with two tongues and 23% with one tongue, in comparison with the conventional trawls. The loss of shrimp was 27%, but these numbers are too high to be accepted by the fishermen. The tongue solved the problems with clogging that had occurred with funnels at the first tests. See fig.8.

The lack of underwater observation during the trials with escape panels makes the work much more difficult to estimate where the shrimp are escaping or how the fish react.

CONCLUSIONS.

Considering the total national waste of 292.039 tons of fish per year, the by-catch must be regarded as a major problem and a threat to fish stocks. The small artisanal double-rig trawlers have a very important social-economic activity, but the inshore trawling with small meshes is putting in risk the whole ecosystem of the region.

The development of selective trawls for tropical shrimps, fished in shallow waters, mostly up to 40 meters, has shown that it is a very difficult matter, because of the behavior of over 147 different species closely mixed with the shrimp. The videos on under water observations produced by National Marine Fisheries Service, USA, are very important for Brazil, because of the similarity of the penaeid shrimp fisheries.

The results with separating panels need further research to avoid shrimp escapes and to develop simple and practical methods for the commercial fleet. Expensive and complicated nets will not be accepted by traditional fishermen.

The short tapered nets were considered a major progress in reducing by-catch without losing shrimps. The reduction of 17% of the total fish catches and 24% in commercial size species, represents an average survival of 3 tons of fish per trip or some thousands of juvenile fish. This principle is being introduced to the commercial fleet with very good acceptance because no further modifications are needed.

The reduction of by-catch in the fin-fish pair and stern trawler fleet, depends only on the transfer of selective codends such as square meshes directly to board the commercial boats. The results available from experiments developed by the Marine Laboratory, UK, gives excellent support for this work.

Turtle by-catch is not significant in the Brazilian shrimp fisheries; the effects of accidental catches in the North-east region by the coastal sea-bob trawlers are being minimized by the TAMAR Project, that is teaching fishermen how to save nearly drowned turtles.

By-catch selectivity or avoidance are very complex matters. The development of new fishing gear will only be possible with direct under water observation and the exchange of international experiences.

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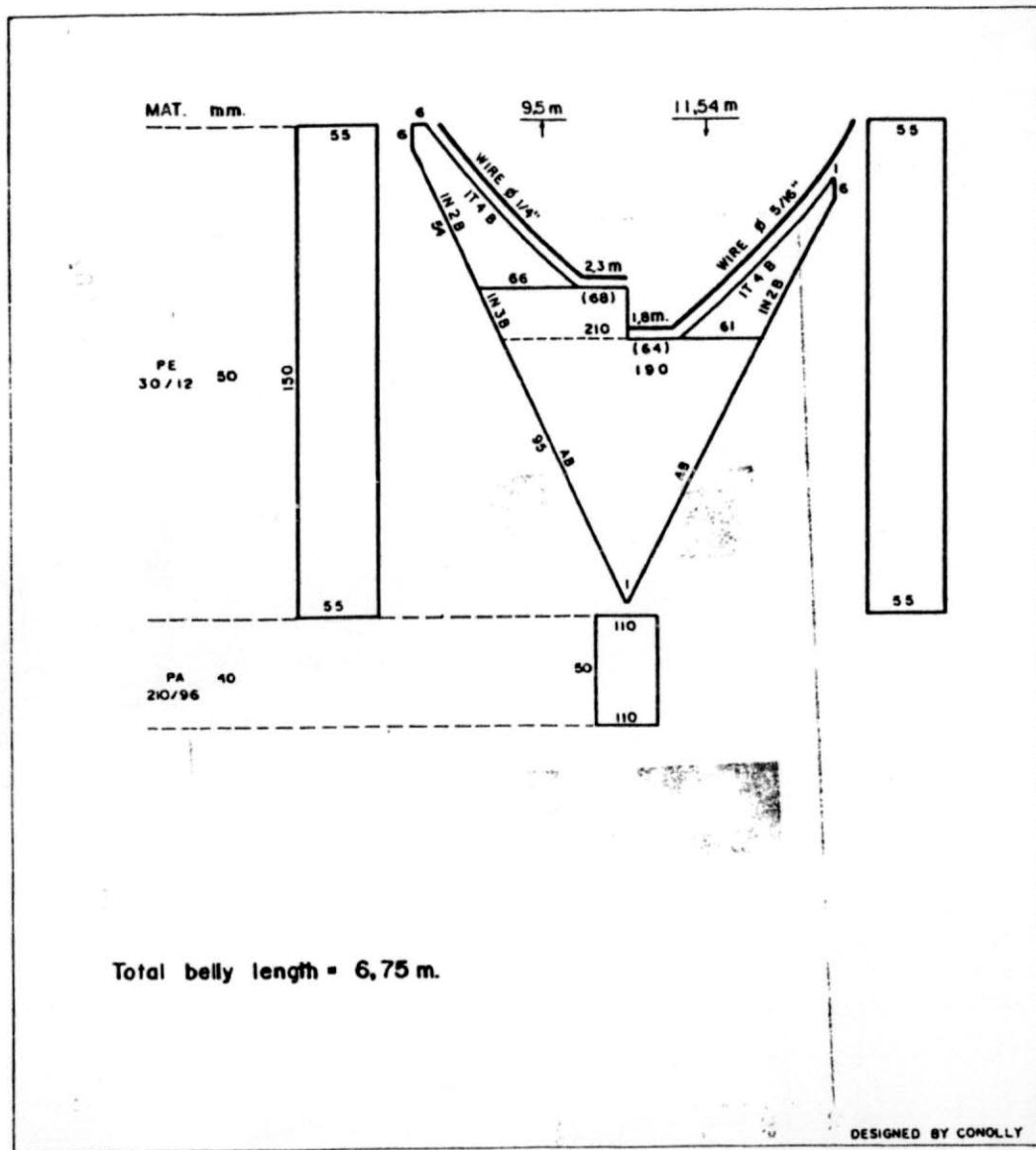


FIG.-1 Design of the short tapered shrimp trawl used in the experiments. Twin trawl system.

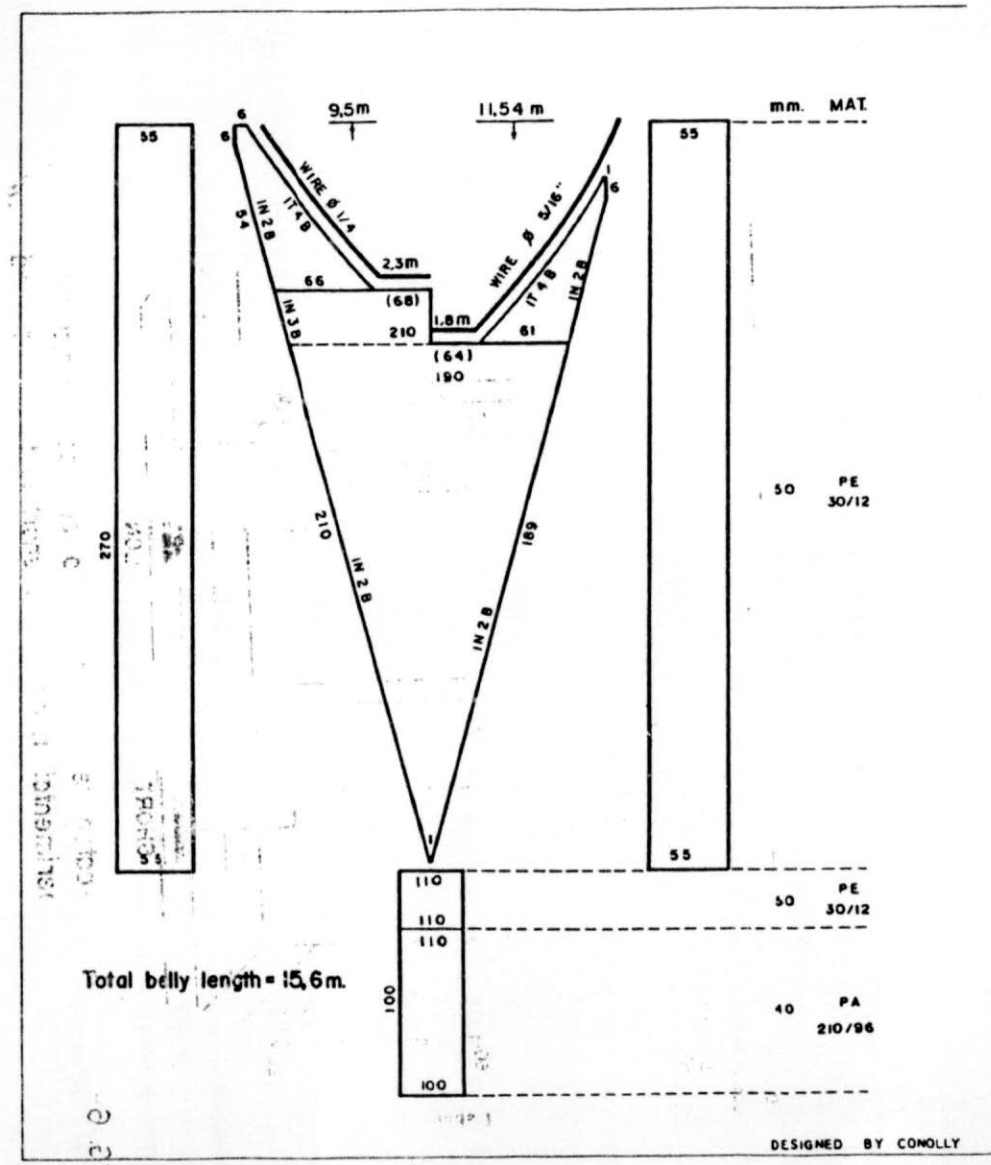


FIG.-2 Design of the traditional long tapered net used in the experiments. Twin trawl system.

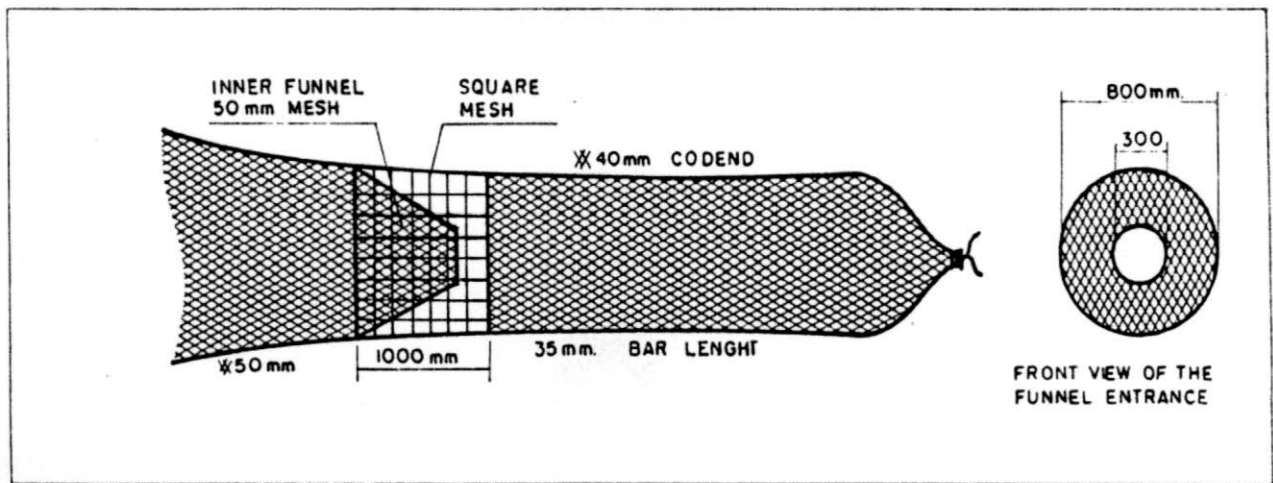


FIG. 3 First escape section used in 1986

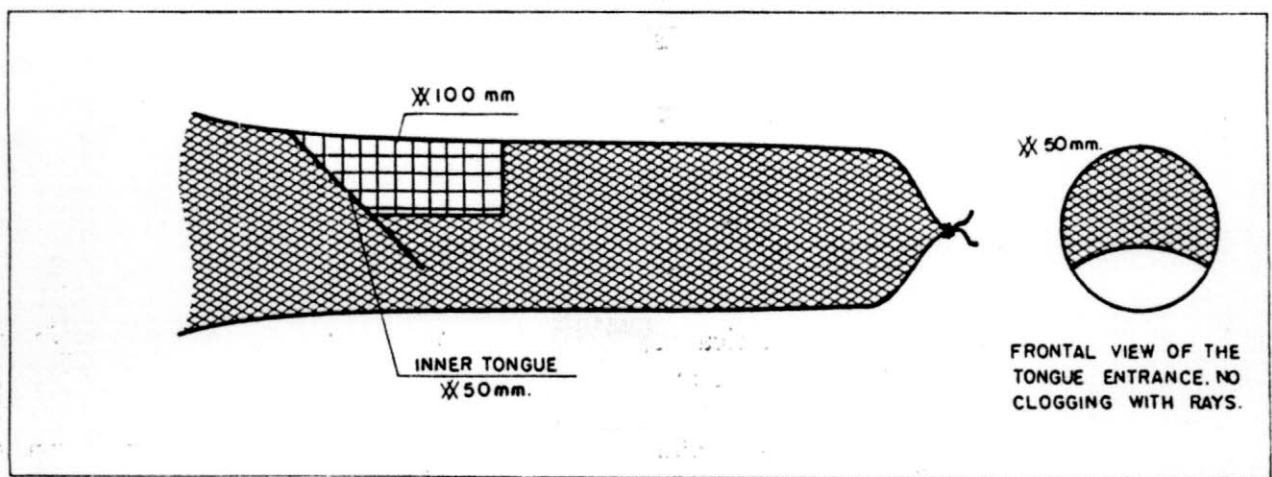


FIG. 4 Escape section with one tongue

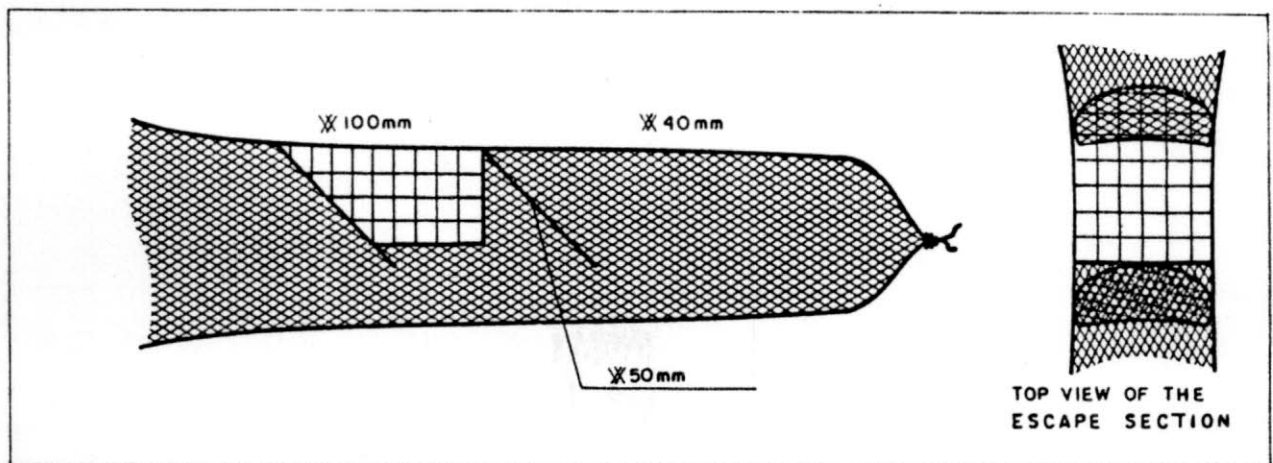


FIG. 5 Escape section with two tongues. The second tongue improved selectivity and increased the squid catches.

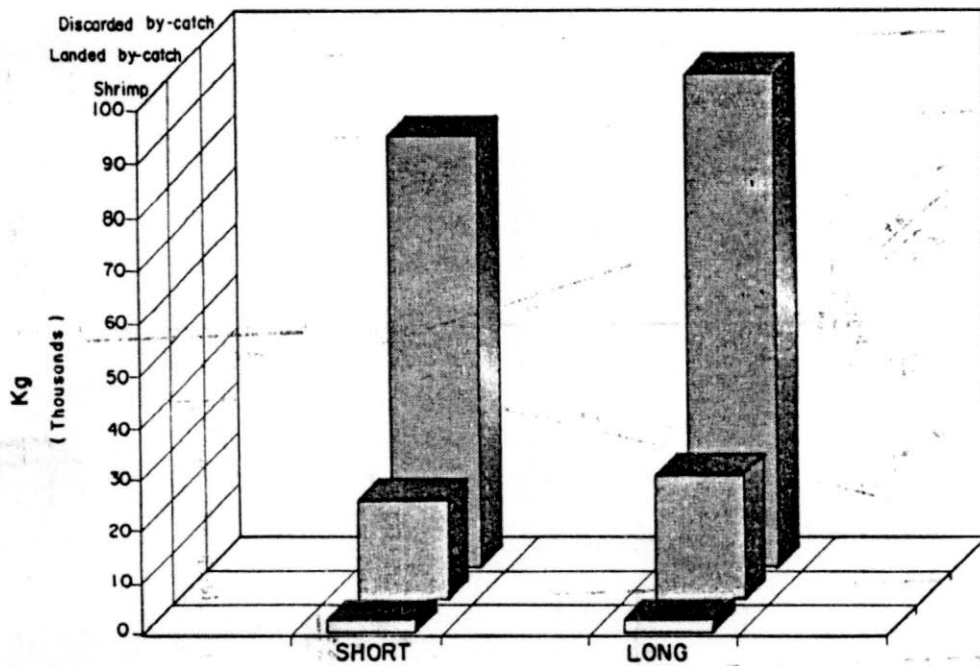


FIG. 6- Discarded by-catch related to shrimp and commercial size fish caught in experimental fishing with short and long tapered trawls.

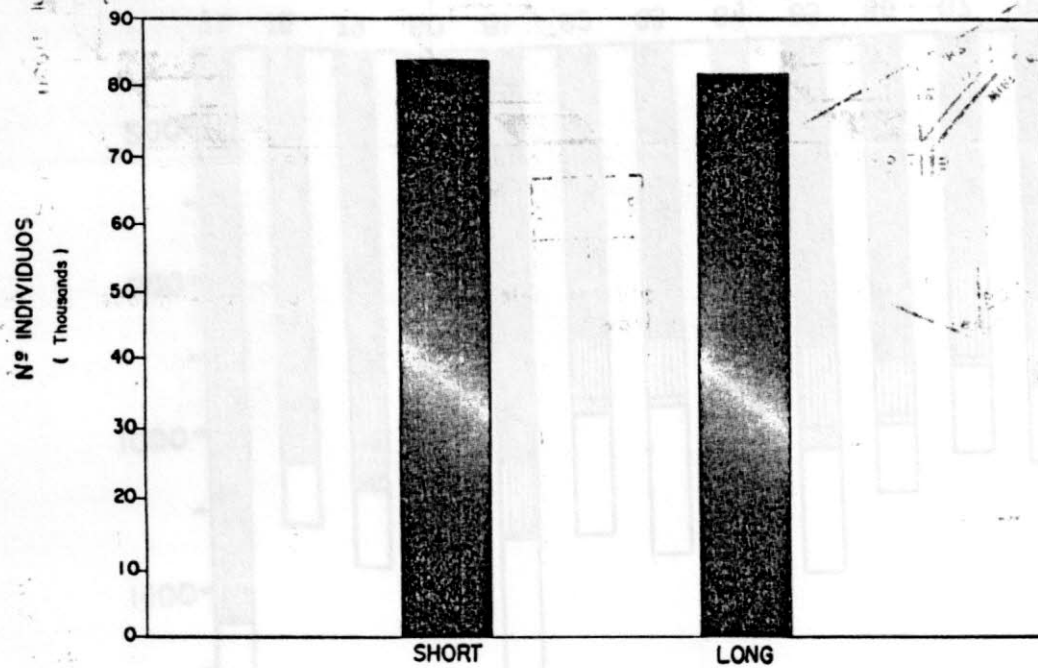


FIG. 7 - Number of shrimps caught with short tapered nets and long traditional trawls.

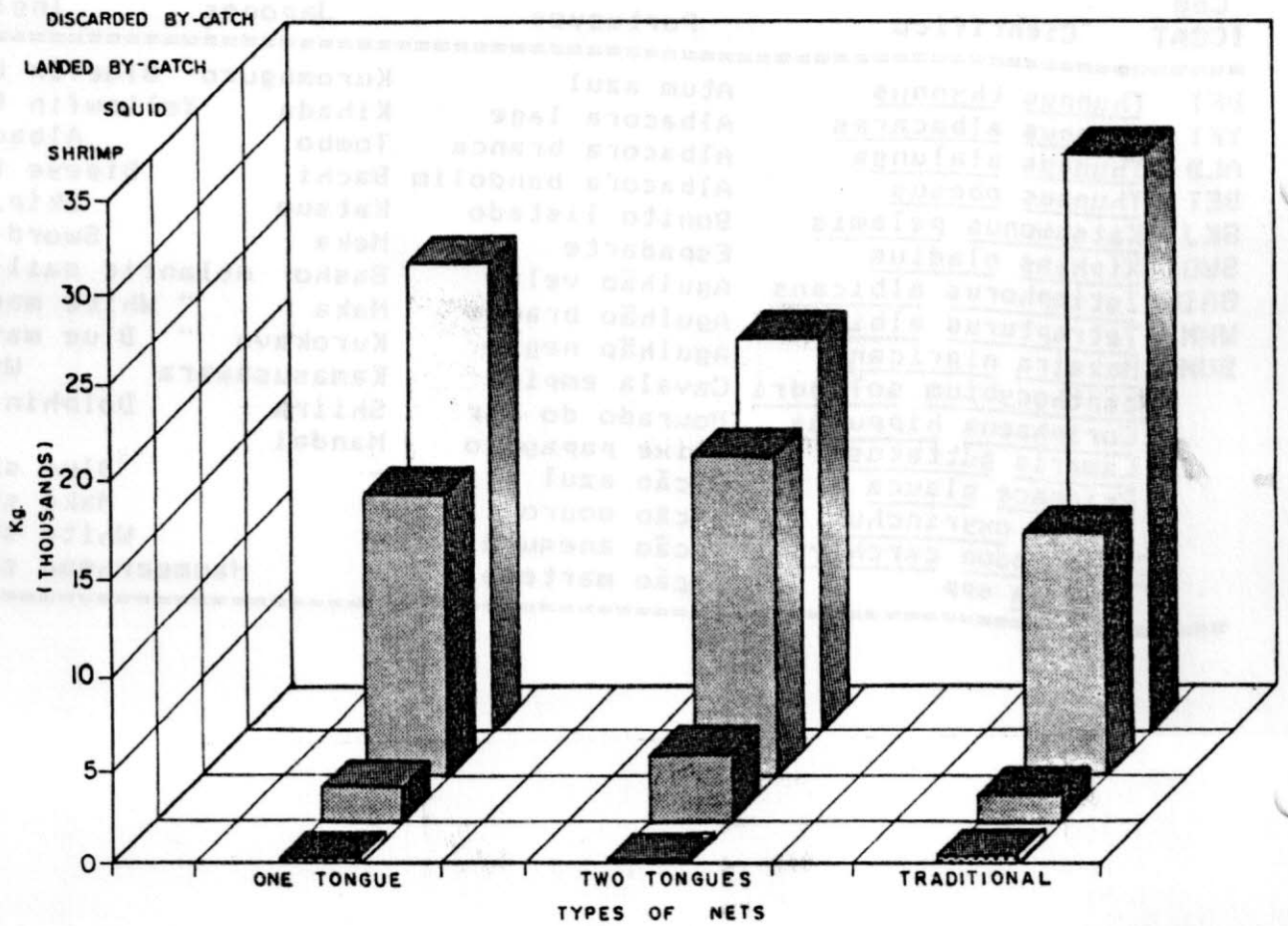


FIG. 8 Discarded fish by-catch of diferent selective escape panels with one and two tongues, related to traditional trawls.