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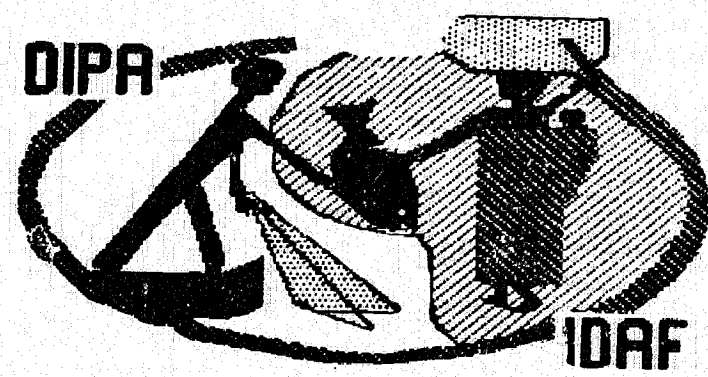
PURSE SEINE AND ENCIRCLING NET FISHING OPERATIONS IN SENEGAL, GUINEA, SIERRA LEONE, GHANA AND BENIN



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July 1991

PURSE SEINE AND ENCIRCLING NET FISHING OPERATIONS IN SENEGAL, GUINEA, SIERRA LEONE, GHANA AND BENIN

R.J. Beare and P. Tanimomo

Programme de Développement Intégré des Pêches Artisanales en Afrique de l'Ouest - DIPA

Programme for Integrated Development of Artisanal Fisheries in West Africa -IDAF

GCP/RAF/192/DEN.

With financial assistance from Denmark and in collaboration with the Republic of Benin, the Fisheries Department of FAO is implementing in West Africa a programme of small scale fisheries development, commonly called the IDAF Project. This programme is based upon an integrated approach involving production, processing and marketing of fish, and related activities; it also involves an active participation of the target fishing communities.

This report is a working paper and the conclusions and recommendations are those considered appropriate at the time of preparation. The working papers have not necessarily been cleared for publication by the government(s) concerned nor by FAO. They may be modified in the light of further knowledge gained at subsequent stages of the Project and issued later in other series.

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The consultation was undertaken in April, 1991.

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1. FOREWARD

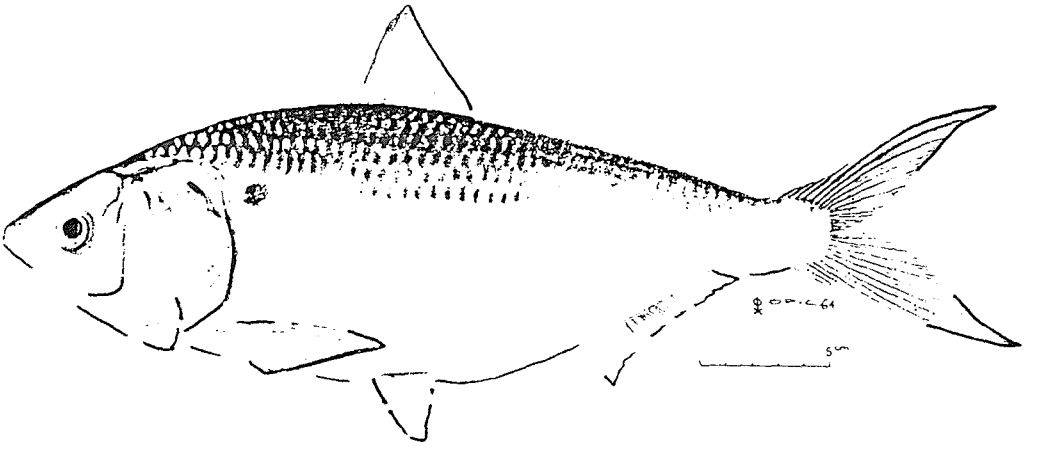
The terms of reference for the examination of purse seine operations by the artisanal canoe fleets in Senegal, Guinea, Sierra Leone, Ghana and Benin afforded a timely opportunity to examine the background to the development of the purse seine fisheries of these countries as well as an opportunity to to draw together other closely related studies and observations on fishing gear, canoes and methods of operation from a variety of West African sources.

Because the use of the purse seine by the artisanal canoe fleets of West Africa has evolved from both indigenous as well as external influences and the continued viability of such operations depends on so many different factors it was considered appropriate to incorporate such studies as the investigations carried out by the FAO Shenge Project SIL/ 82/ 015 into the cost and earnings of Ghana Plank canoes, Ring net and fuel efficiency investigations carried out by the Kambia Fisheries Development Project (Mac Allister Elliott 1985-1987). It was also considered relevant to incorporate research from the Centre de Recherche Halieutique de Boussoura in Guinea into purse seines in Côte d'Ivoire as well as the variety of canoe and fishing gear studies carried out by the IDAF Regional project GCP/RAF/192/DEN in Benin and the Fisheries Research and Utilization Branch of the Ghanaian Ministry of Agriculture. All the studies mentioned and many more besides provide additional insights into the past , present and future of artisanal purse seine operations.

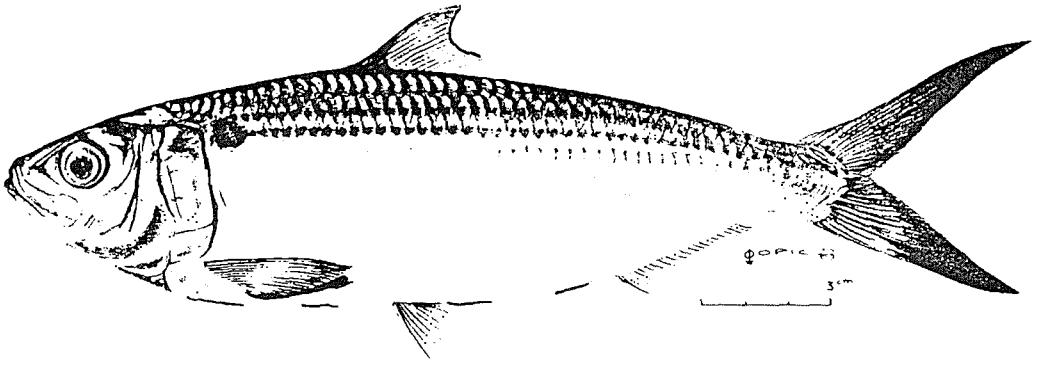
Drawing these threads together in the short time available proved to be a difficult exercise and in some areas such as the cost and earnings of purse seine operations the time allowed was insufficient for statistically valid comparisons to be made. Rather the information gathered should be regarded as indicative of the underlying cost and earnings of purse seine operations in the different countries concerned and care should be exercised with extrapolation. Likewise the dearth of reliable and recent statistical information on the size, composition and catch effort of the artisanal fleets while not surprising again makes comparisons and the identification of trends that affect fishing techniques and viability that much more difficult. It should also be kept in mind that many of the countries concerned are undergoing severe structural readjustment problems and that resulting currency and commodity fluctuations can invalidate data almost overnight.

This report seeks to describe the purse seining canoes, gear and methods of operation which have evolved and spread from the major purse seining traditions of Senegal and ghana. It also looks at the encircling gill net fisheries of Sierra Leone and Guinea which represent the interface between the Senegalese and Ghanaian purse seining traditions. For this and other reasons involving the pursing of the encircling net it was considered essential to include a more than cursory description of the operation of the encircling net fisheries of Sierra Leone and Guinea.

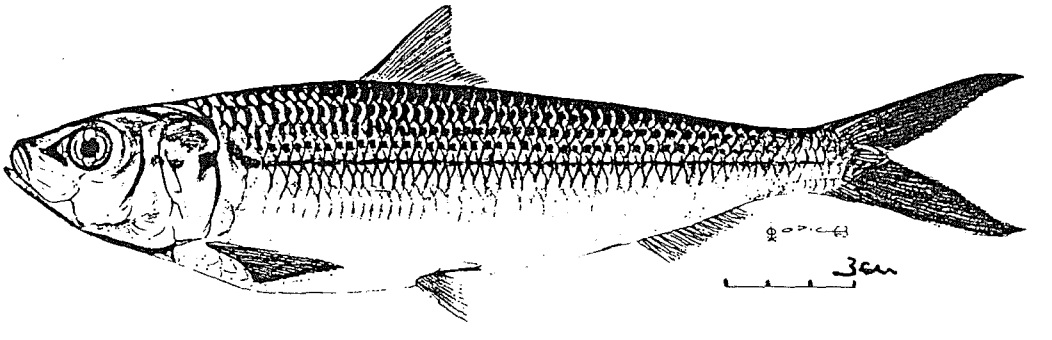
MAIN COMMERCIAL TARGETS OF THE PURSE SEINE AND ENCIRCLING NET FISHERIES.



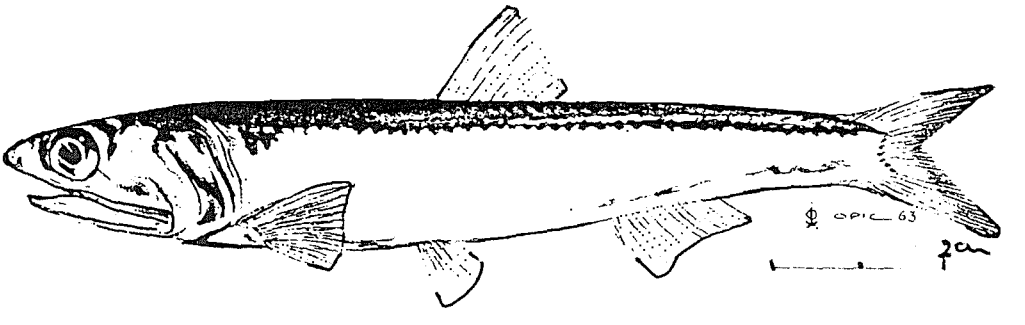
Ethmalosa fimbriata (Bowdich, 1825)



Sardinella maderensis (Lowe, 1841)



Sardinella aurita Valenciennes, 1847



Engraulis encrasicolus (Linnaeus, 1758)

FIG 1

2. GENERAL INTRODUCTION

The artisanal canoe fisheries of the maritime states of West Africa play a major role in the supply of protein to both urban and rural communities contributing towards more than 80% of the total landings. The greatest part of these landings are represented by pelagic species that are caught by various types of encircling nets of which the purse seines are one of the most important.

Purse seines are designed and constructed to catch pelagic fish such as Sardinella aurita, Sardinella maderensis and Ethmallosa fimbriata (see Fig 1). However, these target fish are also efficiently exploited by another type of encircling net, which unlike in Senegal and Ghana, are the dominant forms of capture among artisanal fishermen in Guinea and Sierra Leone. The reason for including these other encircling nets is that the manner in which they are used makes them, if conditions are favourable, operate with the same effect as a purse seine. Not through closing the bottom with a purse line, but through contact with the seabed.

The use of purse seine nets is a relatively recent phenomenon in West Africa and is generally accepted to have evolved seperately and spread from the two most technically inovative fisheries of West Africa, Senegal and Ghana.

In Senegal the purse seine was the result of a deliberate attempt from external sources to improve the efficiency of the large Pirogues. Up to this point the larger pirogues used the encircling gill net as the main type of gear for catching pelagics.

On the other hand the artisanal canoe fishermen of Ghana appear to have adapted their own encircling nets to the pursing principal through the influence of the industial fleet which was increasingly using purse nets to exploit offshore pelagic resources in the early 1960's.

After the adoption of the purse seine method by the artisanal canoe fishermen its spread along the coast of West Africa was assisted by the migratory nature of the artisanal fishermen who took their new technique with them from Senegal to the north and from Ghana to both east and west. Purse seine nets of similar pattern to the Ghanaian model are in use as far to the east as the Cameroons and in the past were to be found in operation as far to the west as Sierra Leone.

At present the purse seine method is predominantly in use in Ghana and Senegal while in countries such as Guinea its use has been banned and in Sierra Leone it is actively discouraged.

3 SUMMARY OF FINDINGS.

1. The statistics and research into the specific effects of purse seines and the trend towards smaller mesh sizes are inadequate for determining their effect on fish stocks and legislative requirements.

2. The increased use of purse seines has been accompanied by larger canoes to carry longer, deeper and heavier nets with smaller mesh. This trend has accompanied the targetting of juvenile fish as well as smaller species such as the anchovy.

3. Little technical progress has been made towards....
   a. improved crew safety.
   b. improved reserve bouyancy and stability.
   c. more fuel efficient canoe propulsion.
   d. adoption of inboard well mounted outboard engines.
   e. improved engine maintenance and handling practices to improve safety and engine life and minimise fish escape.
   f. marketing the large catches from purse seine canoes.Including onboard use of ice and onshore refrigeration.
   g. Improved navigation ,knotwork and splicing.
   h. reducing pressure on the use of the wawa tree in canoe construction/finding alternatives to existing canoes.
   i. testing the effectiveness of the purse seine against other techniques such as the encircling reggae net.

4. Current methods of gear and boat hauling appear appropriate to the need to provide work and to the social organization of the fishing communities. The purse seine fishermen do not appear to need the mechanization of hauling procedures-- crews are available, willing and able to haul purse nets and beach canoes.

5. The purse seine method is not a necessity to the exploitation of pelagics in either Sierra Leone or in Guinea due to shallow water and the technique of pursing the encircling net with seabed contact.

6. Although current information indicates that purse seining and encircling net operations are viable in all the countries visited the total package of canoe engine and net depends on increasingly expensive imported and in many cases, subsidized inputs. Any significant rise in the price of inputs or elimination of subsidies would decrease the viability of this method of fishing.

4. RECOMMENDATIONS.

4.1. CONSERVATION.

a. Assist in the identification of the effects of the use of the purse seine by artisanal fishermen on small and immature fish stocks with the overall aim of advising all West African fisheries departments on mesh size regulation and policy towards purse seines in the various fisheries concerned. Specifically assist the Ghanaian Research Bureau in this matter where concern has already been expressed.

b. Disperse fishing effort through encouragement of more fuel efficient engines which afford greater fishing range.

e. Encourage improved monitoring of purse seining and encircling net operations to identify the magnitude and effects of the decrease in mesh size and increased use of this method of fishing.

4.2. TECHNICAL.

a. Devise improved methods of crew safety in large canoes including the employment of locally found balsa type woods (very light and bouyant) such as musanga circropioides (umbrella tree). This same wood could be used to improve bouyancy in some instances.

b. Demonstrate and introduce artisanal fishermen to the use of diesel outboard engines especially to the large purse seining and encircling net canoes to improve viability.

c. Improve mechanic training and facilities in artisanal fishing communities to improve operational reliability and safety of outboards as well as increasing engine life.

d. Initiate projects which assist in the improved marketing of fresh fish to inland markets.

e. Initiate training in appropriate navigation, knots splices and stability among the captains of large canoes.

f. Test the relative effectiveness and costs of the purse seine in comparison with the encircling reggae net. Test and demonstrate the internal outboard engine well to reduce vibration, noise and cavitation to improve engine performance among Ghanaian fishing canoes.

g. finding appropriate replacements for the dugout canoes and pirogues should remain an important aim among aid agencies and organizations.

4.3. GENERAL.

a. New entrants to the use of purse seines and the purse seine fishery should not be encouraged.

b. The monitoring of the effects of the encircling net fisheries need to be encouraged just as much as the monitoring of the purse seine fisheries.

5. DEFINITIONS.

There appears to be some confusion in the literature on West African fishing gear concerning the definitionms of particular types of encircling nets. This confusion is understandable given the large number of people from other fishing areas and traditions who have from time to time added to this descriptive work.

To avoid confusion in this report concerning the use of various terms to describe encircling nets it was decided to avoid the term "ring" net which to some describes the action of ringing the fish while to others it denotes a particular type of encircling gear similar to the purse seine.

All the types of gear described in this report are generically of the encircling type. The artisanal purse seine being of the type which has rings on the bottom through which runs a continuous rope called the purse line. The action of hauling the purse rope from one or both ends closes off the bottom of the net by drawing the net together under the fish and prevents their escape.

In Senegal there does not appear to be a problem with the definition of the purse seine as it follows a single basic type which again appears to follow quite faithfully the design which was originally introduced in the late sixties. This had small mesh and a bunt (an area of relatively smaller and stronger mesh) for the final concentration of fish at or very close to one end of the net.

However, in Ghana there is a more complex situation because of the divergent nature of the sources of origin of the technique and the increasing need to catch a more diverse selection of fish. In this respect it is proposed to follow the currently used official Ghanaian definitions of the three most commonly used forms of purse seine, the Watsa (see fig 20),the poli/ sieve (see fig 21) and finally, the only intermediate net to be described, the watsa/poli (see fig 22) which is basically a watsa net with mesh sizes above 25mm and a bunt of 10mm. Between these three basic types there are many variations which appear to be based on expediency as well as the dictates of conscious design.

5.1 The Watsa purse seine net.(see fig 20).

The Ghanaian watsa purse net is a surrounding net which originally evolved from a net which did not have a pursing mechanism. This net was constructed with 50 - 60 mm mesh netting for catching pelagics such as the little tunny (Euthynus alleteratus) and other species of a similar size. With the adaptation of this net to smaller mesh netting, rings and the purse line, it lost its original characteristic and is currently used in the capture of an expanded range of small pelagic fish. These include Sardinella (see fig 1), the european anchovy (Engraulis encrasicolus), chub mackerel (Scomber japonicus)etc. The size of the net varies but is generally in the region of 400 to 600 metres in length and 35 to 50 metres deep. The net has a minimum mesh size of 25 mm in the bunt while the rest of the net

is constructed of a variety of meshes up to about 50mm in size. It is operated in deeper water than the poli/sieve by a crew varying from 18 to 25 men from an outboard engined dugout canoe (see fig 19a).

5.2 The Poli/ Seive purse seine net.

This purse seine net (see fig 21) is referred to as a sieve because of the fineness of the mesh used in its construction. It is generally about 450 - 540 metres in length and 35 - 40 metres in depth. It is constructed of small meshes, with around 10 mm in the bunt while the rest of the net has mesh which is under 25mm. The legal limit is 25 mm. The bunt, as in the watsa, can be situated either in the middle or towards one end. The poli/sieve purse is in extensive use for the capture of european anchovy (Engraulis encrasicolus) and for juvenile Sardinella and small fish like grunt (Brachydeuterus auritus).

5.3 The Watsa/Poli purse seine net.

The other Ghanaian version of the purse seine (see fig 22) is intermediate between the watsa and the poli/sieve purse seine. This net is called the Watsa/ poli net, that is a net which is essentially a watsa but has a bunt with very small 10 mm mesh. The rest of the net has meshes which are above 25 mm in size. This combination of netting enables the net to be used in the fishery for the very small pelagics such as the anchovy and therefore increases the versatility of the watsa net and makes it possible to exploit fish during all seasons.

The essential point with regard to the three different types of Ghanaian purse seine is that their versatility has been increased through the addition of small mesh netting, the watsa/poli to catch the anchovy as an alternative to larger pelagics while the poli/sieve was devised to catch anchovy.

5.4 Encircling Gill net and Reggae net.

In this report the term encircling net will refer to the nets used mainly in Sierrra Leone and Guinea, but also used elsewhere. These nets surround the target fish but do not have rings secured to the leadline. Neither do they have a purse rope whose function is to close off, or purse , the bottom of the net.

There are two main types of encircling nets which are hauled in a manner which in shallow water perform like a purse seine. First there is the encircling gill net which generally has mesh sizes in the range 45 - 65 mm and a length of between 400 to 1,000 metres which is used to surround and gill the fish. The main commercial targets for this net are the adult Bonga (Ethmalosa fimbriata,see fig 1) while its juvenile form awefu is more likely to be the target of the encircling reggae net.

The reggae net has a smaller mesh size of around 40 mm,is of similar length to, and is deployed to catch a wider size range of fish than the encircling gill net. It also has the distinct function of guiding more fish to the final stages of hauling without gilling them although juvenile bonga are occassionally gilled . This is particularly true if the fish are large or medium bonga, the most important commercial target for such nets. A final definition of these encircling nets reflects similar trends to the purse in the adoption by some fishermen of a "bunt" of smaller reggae sized mesh in their encircling gill net. This type of gear is known as"filet mixte"in Guinea where this mixing of net is following an identical trend in Sierra Leone.

6 PURSE SEINING IN SENEGAL.

According to quarterly statistics issued by the Direction des Peches the marine artisanal fisheries of Senegal produce more than 80 % of the national catch. Using essentially planked pirogues the artisanal fishermen deploy a wide variety of fishing gear of which purse seines are the most important.

IMPORTANCE OF THE METHOD.

6.1 PELAGIC FISH PRODUCTION

The total fish production landed by purse seines cannot be given since the method for collecting the statistics were changed in 1986 since when purse seine and beach seine statistics were taken together and since 1987 there have been no statistics available. However, approximately 90 % of the pelagic species landed by the different nets are mainly gaught by purse seines it is therefore possible to estimate the size of the catch attributable to the purse seining method. For this reason only the principal target fish for purse seines have been selected to provide an indication of the level of production which is a result of purse seining activities.

These target fish (see Fig 1) are Sardinella maderensis, Ethmalosa fimbriata, and mackerel from the regions of Dakaar, Thies, Saint-Louis, Ziquinchor, Kaolack and Louga.

	1984	1985	1986	1987	1988	1989
Sardinella	-	86907.9	102,013.9	138,543.7	140,074.3	153,949.3
Ethmalosa	-	6865.5	8,073.6	8,035.8	10,160.1	15,063.4
Mackerel	-	7039.2	14443.8	17725.6	9124.7	9379.8
Total	96469.6	100812.6	124531.3	164305.1	159359.1	178392.5

Table 1: Pelagic fish production in tons. Regions of Dakar, Thiès, St. Louis, Ziguinchor, Fatick, Kaolack and Louga.

Source : Fisheries Department, Dakar

These statistics indicate a constant increase in fish landings from 1984 to 1989 from the purse seine method. Unfortunately there are no more recent statistics available but it is reasonable to suppose that this increasing trend has continued to the present and that there has been a continued increase in the numbers of purse seines.

6.2. Number of purse seines

As already mentioned the number of purse seine nets in operation is impossible to distinguish which is doubly unfortunate from the point of view of the need to monitor this potentially damaging form of fishing and the fact that the statistics on its use stop at a time in 1986 when the method was becoming a significant contributor to the national catch. See table below.

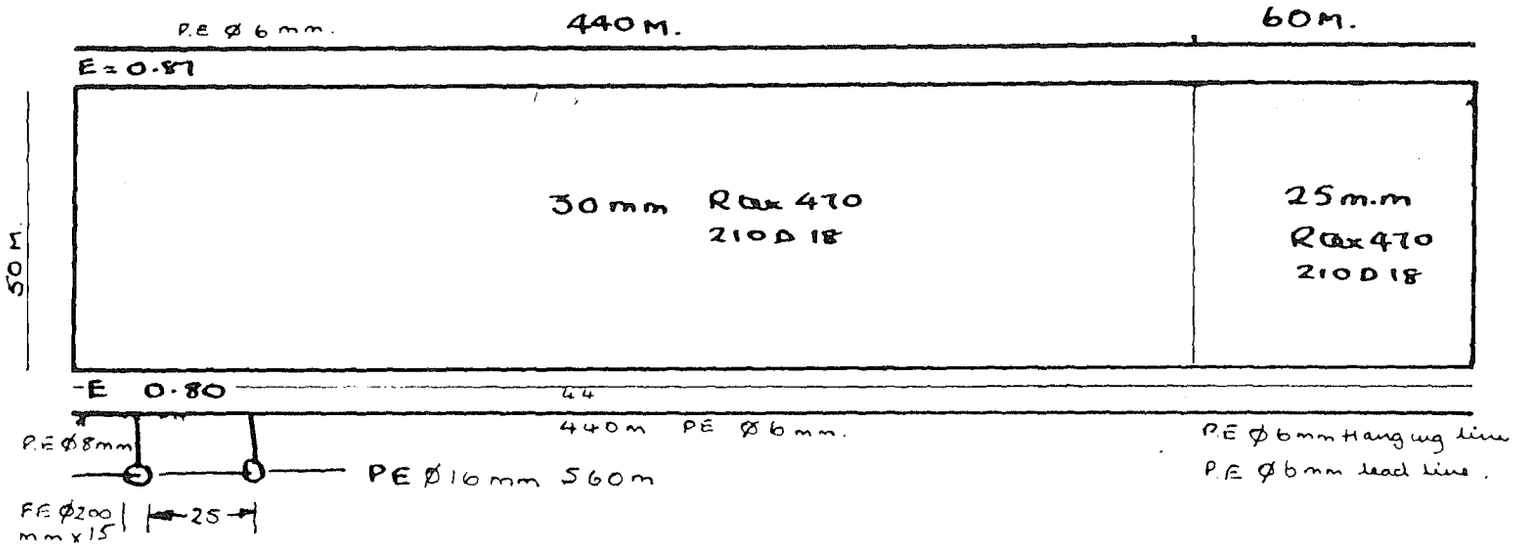
	1984	1985	1986	1987	1988	1989
Dakar	83	79	153*	-	-	-
Thiès	174	180	211*	-	-	-
St. Louis	67	58	62*	-	-	-
Ziguinchor	-	2	64*	-	-	-
Fatick	23	33	63*	-	-	-
Kaolack	-	-	21*	-	-	-
Louga	-	2	1	-	-	-
Total	347	354	575*	-	-	-

Table 2 : Number of purse seines from 1984 to 1986

* : The number includes that of beach seines

Table 2. confirms that the nuber of purse seines increased slowly from 1984 onwards. according to local advice the number of beach seines in use was also growing and becoming an important factor in the fish production of the Senegalese fishery.

PURSE-SEINE - DAKAR SENEGAL.



NOTES.

1. PARTICULAR TARGET OF THIS NET WAS SARDINELLA.
2. MESH TWINES HEAVIER THAN IN GHANA.
3. LATERAL BUNT USED TO CONCENTRATE FISH.
4. FLOATLINE ONLY.

FIG 2.

6.3 BACKGROUND TO THE INTRODUCTION OF PURSE SEINING.

The first trials and demonstrations of a purse seine were carried out in the "Baie de Goree" in may 1969 to introduce purse seining to the marine artisanal fisheries of Senegal. Despite the small size of the pirogue used in the demonstrations (8 m) the results were encouraging with landings of five tons of big sardinella in three hauls. These trials which were carried out by G. Grasset (FAO fishing gear expert) with several Senegalese fishermen were continued until 1972 in the fishing centres of M'Bour and Joal.

Further trials were conducted with Senegalese type pirogues of 12 metres length and 2 metres width powered by 20 hp petrol outboard engines. The crews of 8 - 9 fishermen were selected from among the most experienced fishermen in the encircling gill net fishery which, at that time, was the most common fishing method for catching pelagic fish before the introduction of purse seines.

The net used in the trials had single 24 mm stretched mesh throughout its 150 metre length and 40 metres depth. The twines used were 6,660 m/kg (r-tex155 or 210D 6)in the lateral bunt and 10,000 m/kg (r-tex 100 or 210D 4) in the body of the net. Rings were fitted to the leadline of the net every 15 metres and leads at the rate of 2kg every metre. The basic design of the net used during these trials is still closely followed by the purse seining pirogues to this day.

These trials also established the basic arrangements for stowing and shooting the purse seine from the pirogue. Hence setting the pattern of operations still in current use. To set the purse seine the net is arranged in the middle of the pirogue with the lead line laid foreward (see fig 4) athwartship and the floatline across the pirogue towards the stern. The purse rings attached to the leadline are stacked on a pole on the portside through which the purse line is attached to the first wing end to be shot into the water. The other end of the purse line is led forward to the bow from where it is coiled and guided during shooting operations (see fig 5).

When a shoal of fish is sighted the pirogue is manoevred into a suitable position, if competitors allow, and the first wing end plus purse line and marker bouy are cast into the water.The net is then shot from the port side and the fish surrounded. Pursing starts immediately by hauling the purse line and only stops when the rings of the net are brought alonside and the net closed or pursed. Hauling the net and leads then begins in earnest and the fish guided into the lateral bunt where the catch is brailed into the pirogue.

In may 1972 the last trials of the seine were completed and the technique considered sufficiently developed for adoption by the local artisanal fleet (see Tab 3 for details of seine development). The decision was then taken to allocate a few nets to Senegalese fishermen for use in commercial fishing operations.

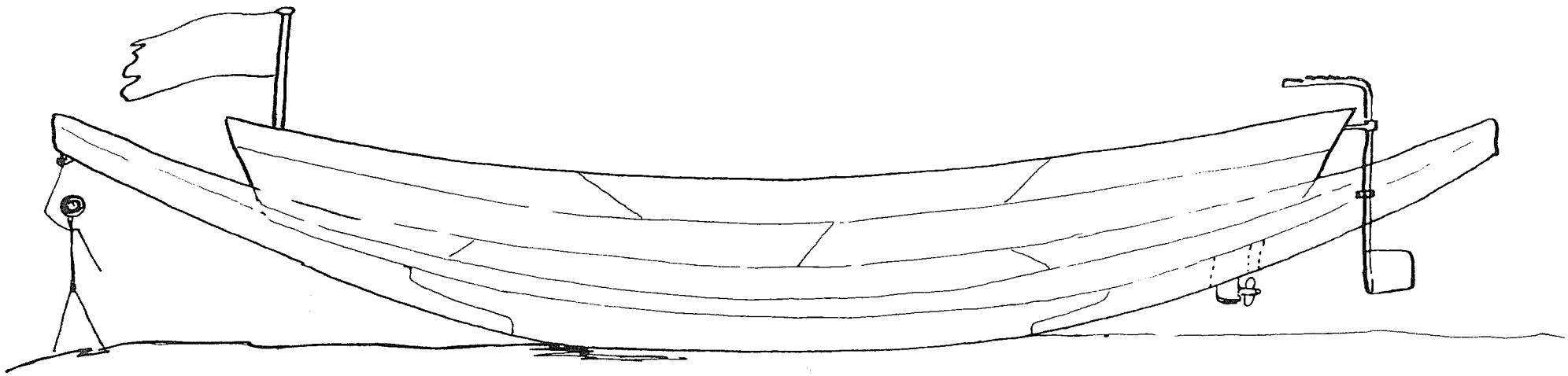
During the trials the original net design evolved as shown in Tab 3. Unfortunately the hanging ratio of the original net was not available and although the length of the net is shown there are no comments on the reasons for the relatively short length in relation to the depth of the net. Current practice is for the fishermen to employ nets of approximately the same depth but much longer. In some cases reaching 500 or more metres.

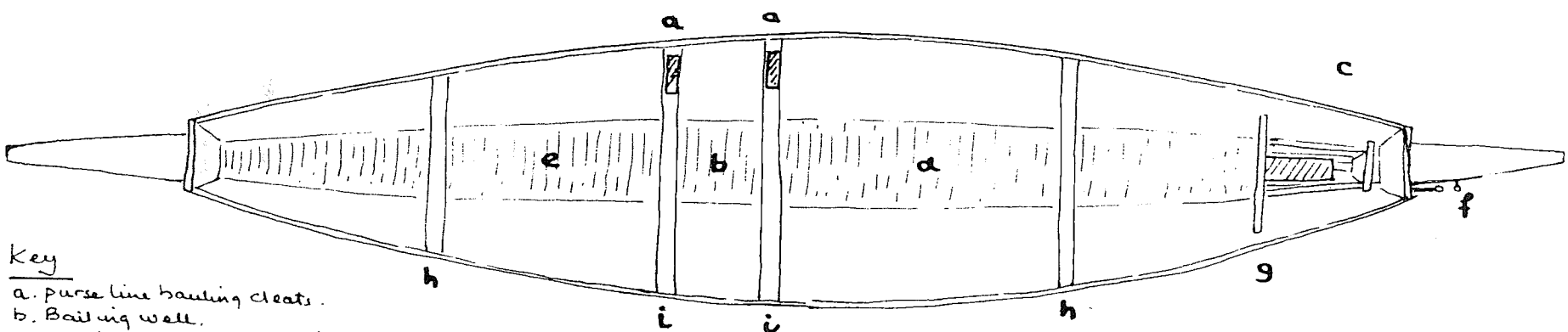
EVOLUTION OF THE PURSE SEINE IN SENEGAL. (EXPERIMENTAL).

Purse seine	First introduced 1969	Improvement 1970	Improvement 1972	
E_1 (Float line)	-	-	-	-
E_2 (leadline)	-	-	-	-
Length	150 m	200 m	200 m	220 m
Depth	40 m	25 m	28 m	40 m
Bunt	24 m/m 6660 m/kg	-	28 m/m 3330 m/kg	20 m/m 4440 m/kg
Body	24 m/m 10.000 m/kg	36 m/m	28 m/m 6660 m/kg	20 m/m 4440 m/kg
Leadline	2 kg/m	500 g/m	500 g/m	300 g/m
Floatline	-	-	12 Fl/m	10 Fl/m
Ring	1 rg/15 m	-	-	1 rg/10 m Ø 10 cm

Tab 3.

PIROGUE DAKAR SENEGAL.
EXAMPLE SKETCHED IN DAKAR





Key

a. purse line hauling cleats.
b. Bailing well.
c. engine well with splash box.
d. Net bin.
e. fish hold.
f. rudder
g. Engine bearing bulkhead.
h. Thwarts.
i. Bulkheads.

FIG3.

6.4 CURRENT PURSE SEINING CANOES, NETS AND METHODS.

Since the introduction of the purse seine in the late sixties and early seventies the most important trend has been the increase in the size of canoes and the length of nets deployed in this type of fishing. This trend has, however, been accompanied by a reduction in mesh size although the style of net and the method of use has changed little from the pattern introduced by Grasset.

THE BOAT.

The Senegalese Pirogue has evolved from the dugout canoe and has a solid beam of wood some 40 - 50 cm thick as a keel upon which side planks have been fitted to increase both the size and carrying capacity of the canoe (see fig 3). These side planks are linked together by transverse thwarts, cross beams and occassionally bulkheads which give the hull strength. Strips of heavy canvas are nailed lengthwise over tarred caulking to stop leakage while at the stern of the canoe an outboard engine mounting bracket is situated amidships over a well cut directly through the keel. The length of canoe used in the purse fishery has increased since the mid eighties to an average of some 18-20 metres but there are some canoes of this type which now occassionally reach 24-26 metres in length. Example measured at Dakaar Fig 3 proved to be 24 metres in length.

THE ARTISANAL PURSE SEINE NET.

Since the introduction of the purse seine method the length of the gear has markedly increased. How long the net is depends on the size of the canoe and the purse of the owner. The average length of net appears to be in the region of 400 metres and up to 50-60 metres in depth. There is no single model of construction and the fishermen use what is available and matches the amount the fisherman can afford to spend.

The two most important factors to consider in relation to the evolving purse seine method are the mesh size and the position of the bunt. In 1980 the FAO Catologue on Fishing Gear Designs shows three different types of seine with 28 mm, 30mm, and 80 mm uniform mesh size. During the consultants visit almost all the purse nets were of 30 mm stretched mesh size in the body of the net and 25 mm in the bunt. The bunt of the net was invariably at or very close to one wing end (see fig 2).

THE OPERATION OF THE PURSE SEINE (DAY AND NIGHT)

The fishing operation is divided into three main stages; the searching for the shoals of fish, surrounding the fish and finally hauling and relaying the net (see figs 4-7).

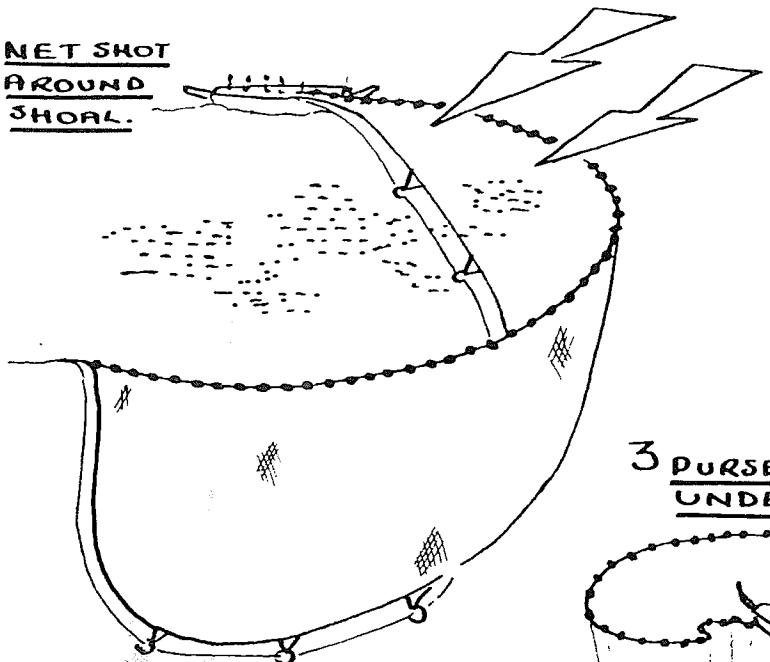
1. Searching for the fish.

When a school of fish is detected on the surface its swimming speed and direction is assessed before setting the net in relation to the prevailing wind and tide. The captain of the pirogue needing to position the canoe, after shooting the gear, in such a way that it is pushed away from the circle formed by the net. This is not always possible especially when fishing among a large and very competitive fleet who will not hesitate to cut in front of the captain who is trying to make up his mind what to do.

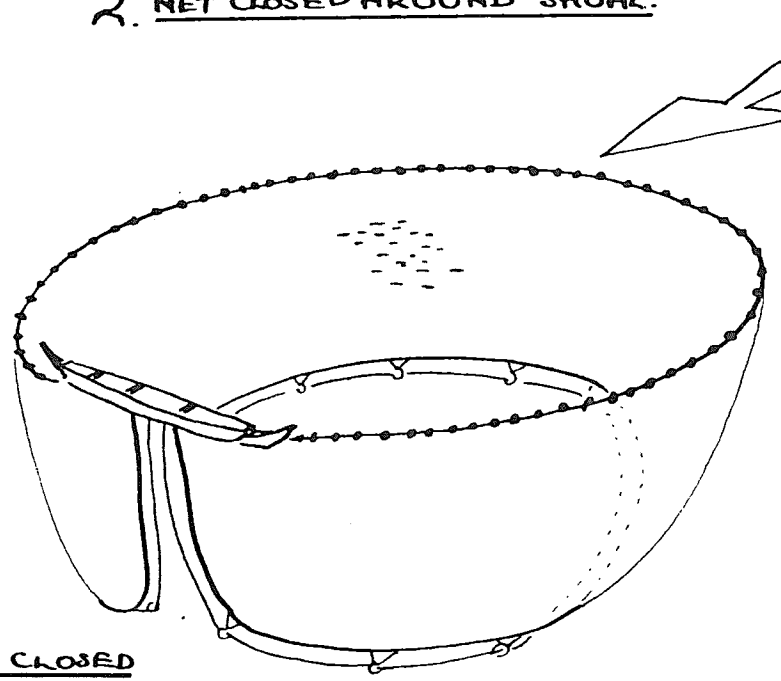
SENEGAL.

PURSE SEINE SHOOTING AND HAULING PROCEDURE.

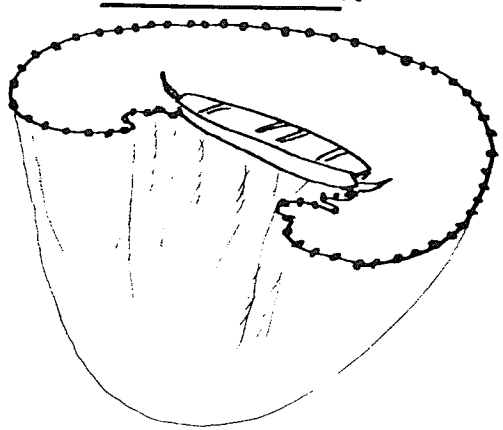
1 NET SHOT AROUND SHOAL.



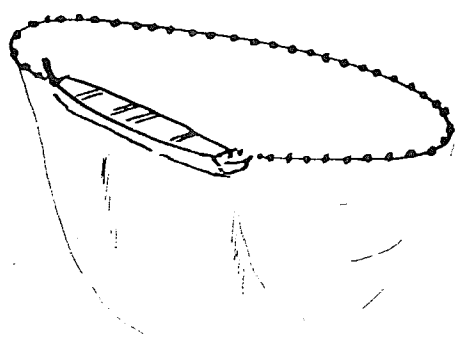
2. NET CLOSED AROUND SHOAL.



3 PURSE LINE CLOSED UNDER FISH.



4. NET HAULED INBOARD.



5. FISH BRAILED INBOARD

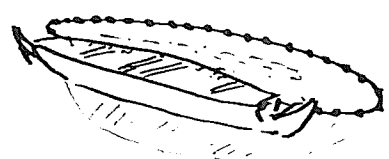


FIG 4.

2. SURROUNDING THE FISH.

The first step in setting the purse around the shoal of fish is that the first wing end and marker bouy is thrown into the sea with the purse line attached. As the net is shooting over the side of the canoe the purse line is fed into the rings which are stacked on a small stick in the sequence in which they are to be shot (see fig 5). This purse line is attached to the other wing end of the net so a line runs forward to the coil in the bow together with another line which is tied to the second wingend bouy. This overide line is occassionally used when the net is not long enough to entirely close the circle around the shoal (see fig 4). As soon as the first bouy is picked up and the net secured to the pirogue this line is hauled in as fast as possible to bring the other wing end to the pirogue.

3. HAULING.

Hauling the purse line starts as soon as the two wing ends of the net are secured to the pirogue. Unusually for such an operation the pirogue is deliberately heeled over to the port side (the hauling side) as far as possible without allowing water to enter the pirogue (see fig 6). This procedure creates a working platform upon which the crew can stand and get a full purchase on the purse ropes and netting during the whole hauling operation. What makes this method possible is the v-shape of the pirogue hull and the flat sides of the hull which are unencumbered by a deck.Note also the potential danger of this procedure.

During the hauling operation it was observed that the hauling rate of the purse line on the wing end furthest away from the bunt was a lot faster than the end closest to the bunt. This procedure continued throughout the whole operation until the rings were all inboard. It should be mentioned that the concentration of the rings ie. closing of the purse. was accompanied by a distinct rise in the crews attention to the trim of the vessel as the full weight of rings and net was transferred to the beam of the pirogue and especially as the rings were hauled from seabed to gunwale.

Notice also how the purse line"stoppers",crew and cleats on the starboard gunwale, opposite to the hauling side, could contribute very quickly and easily to a capsize (see fig 6). During the whole hauling operation it was observed,however,that the crew adjusted themselves automatically and in unison to the various upsetting influences of the hauling operation. This is a factor (automatic load redistribution) which current stability rules do not take into consideration and which could very well be the subject of further research.

Once the purse line and rings and leadline are inboard the floatline is hauled in the same manner until the fish are guided into the bunt end of the net. This period is also critical to the stability of the pirogue when the full weight of the catch is transferred to the bunt end of the net. This is especially dangerous if the fish have no swim bladders and drop as deadweight as soon as their forward movement is stopped.

As the fish are concentrated in the bunt they are either hauled into the canoe in one go or if the catch is large the fish are brought inboard in smaller bights of net or brailed (see fig). Relaying the net is shown in fig 7.

1.

SHOOTING THE PURSE SEINE ~ SENEGAL.

DETAILS

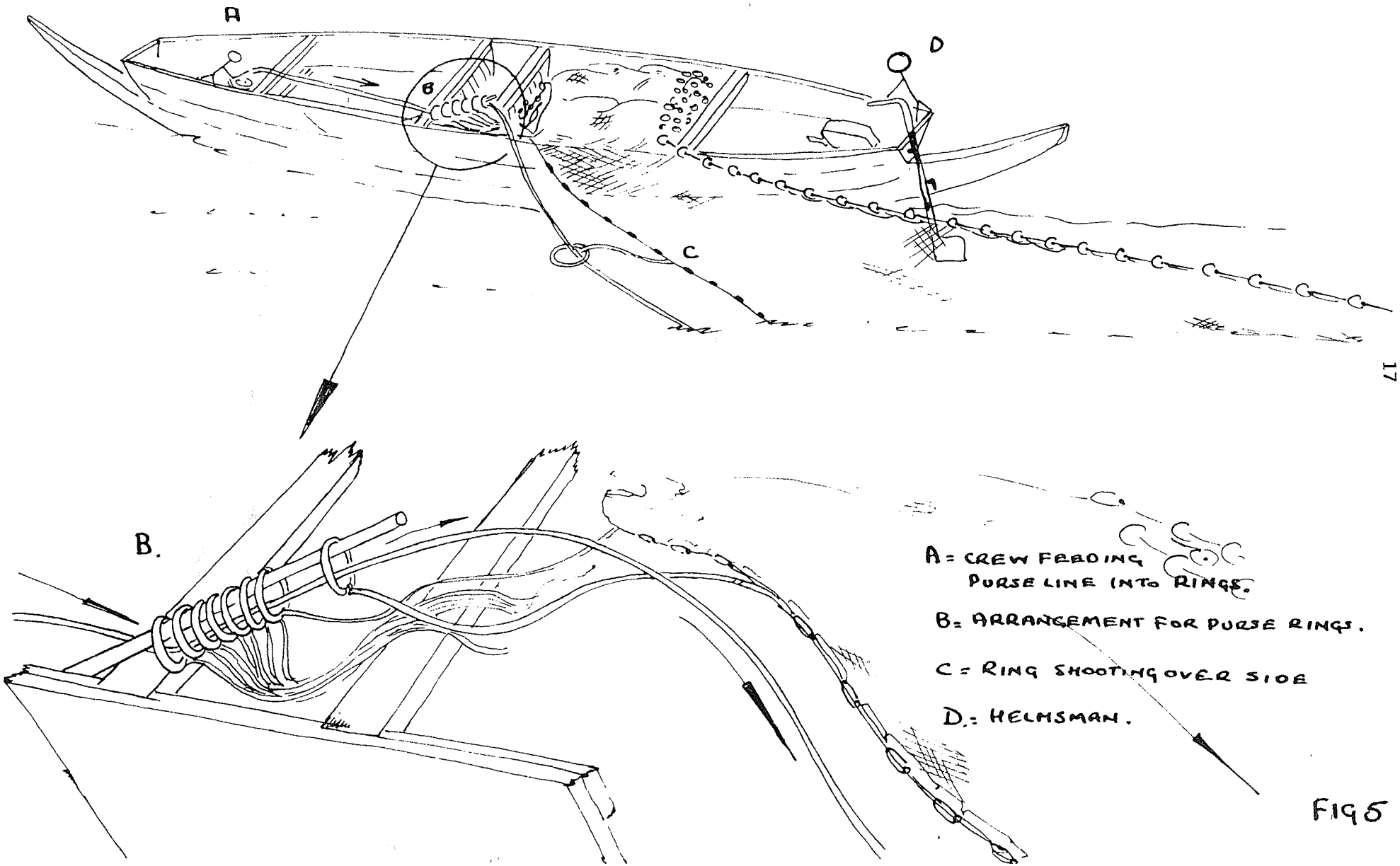
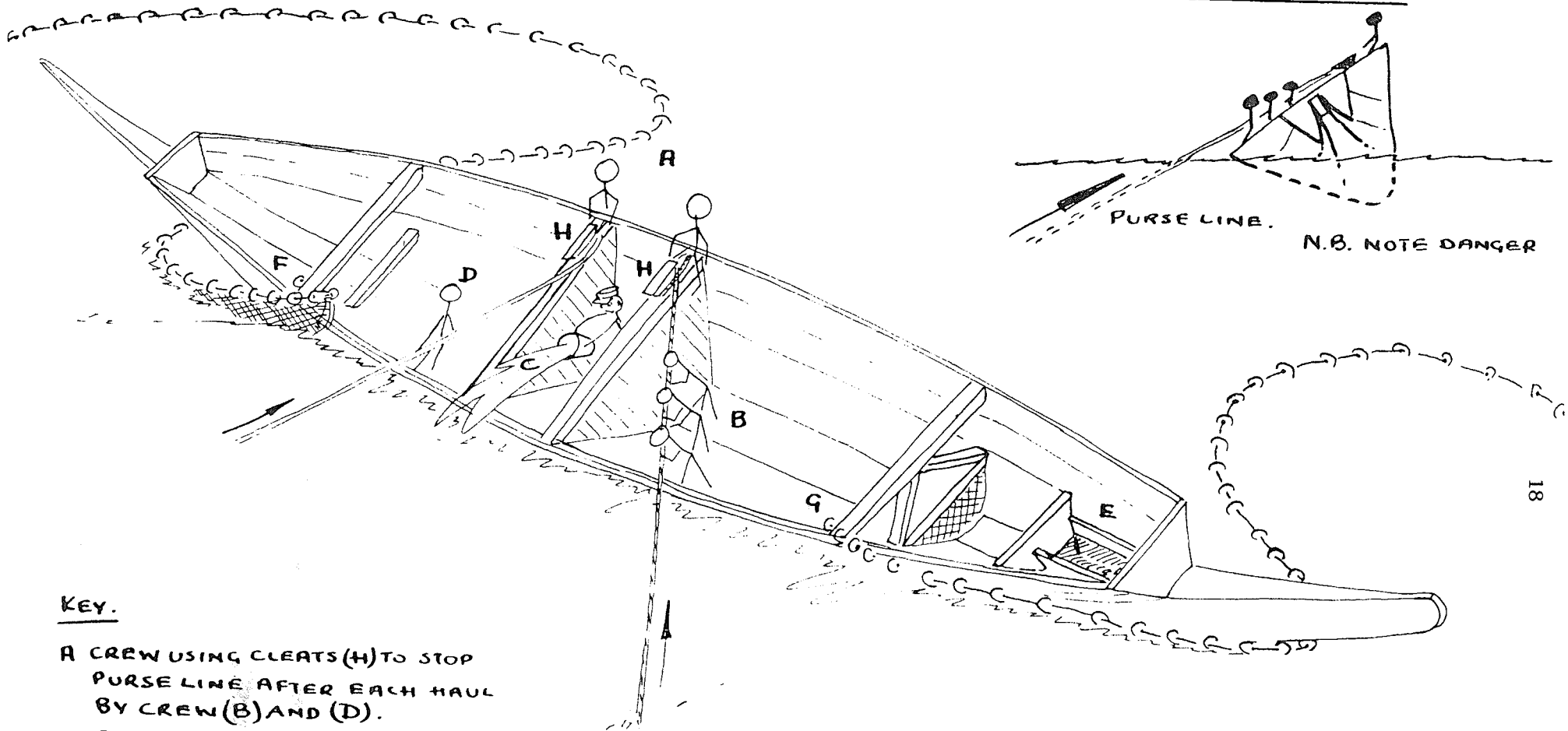


FIG 5

2.

HAULING THE PURSE LINE ~ SENEGAL.

DETAILS



PIROGUE HEELED ONTO ITS SIDE TO FACILITATE EASIER HAULING.

N.B. NOTE DANGER

KEY.

A CREW USING CLEATS (H) TO STOP PURSE LINE AFTER EACH HAUL BY CREW (B) AND (D).

C. BAILER ~ CONTINUOUS OPERATION.

E. ENGINE WELL (CENTRAL POSITION).

F. BUNT END SECURED TO THWART.

G. HAULING END SECURED TO THWART.

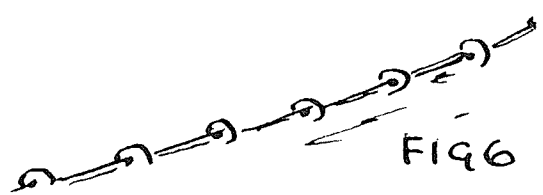
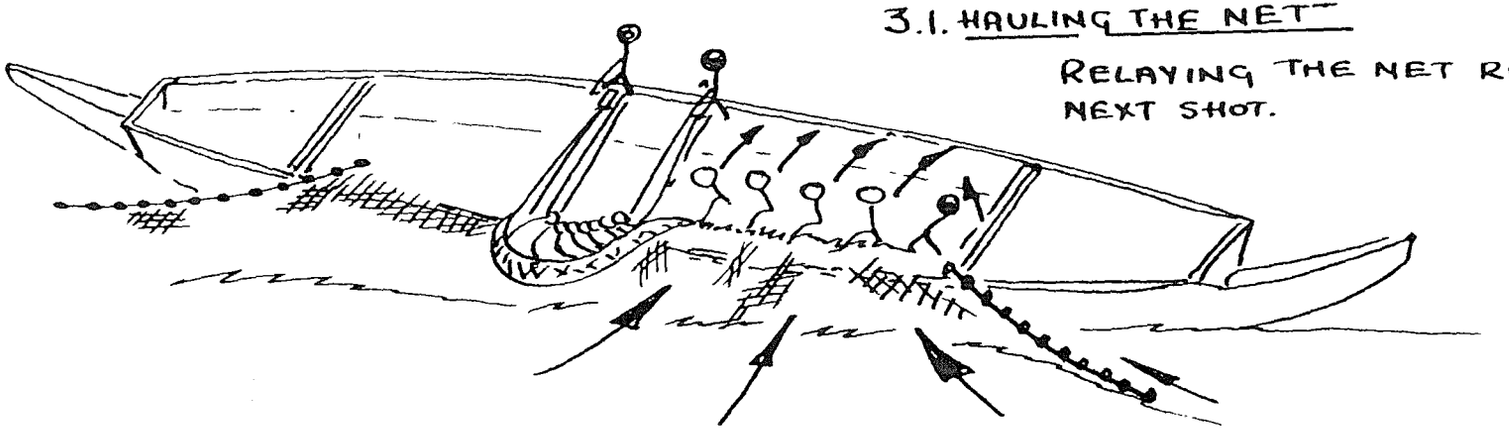


FIG6

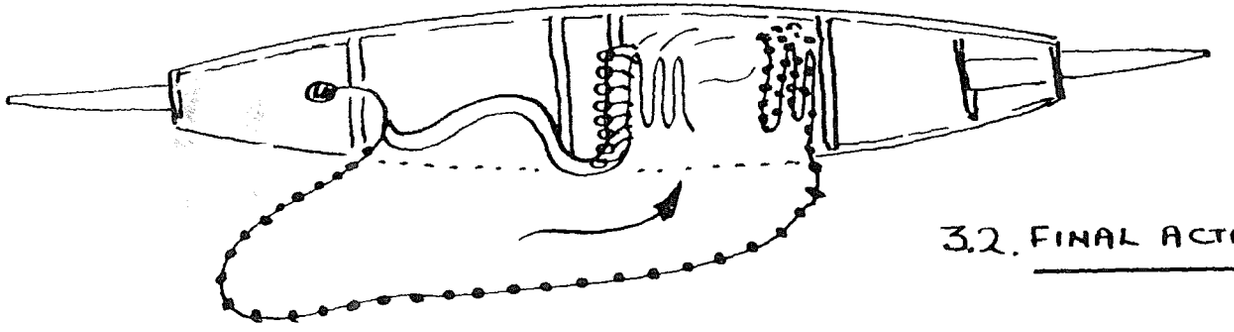
3. PURSE LINE CLOSED ~ Senegal.

DETAILS



3.1. HAULING THE NET

RELAYING THE NET READY FOR THE NEXT SHOT.



3.2. FINAL ACTION OF RELAYING NET.

FIG 7.

GUINEA ~ SHOWING SHALLOW WATER AND BOTTOM CONDITIONS.

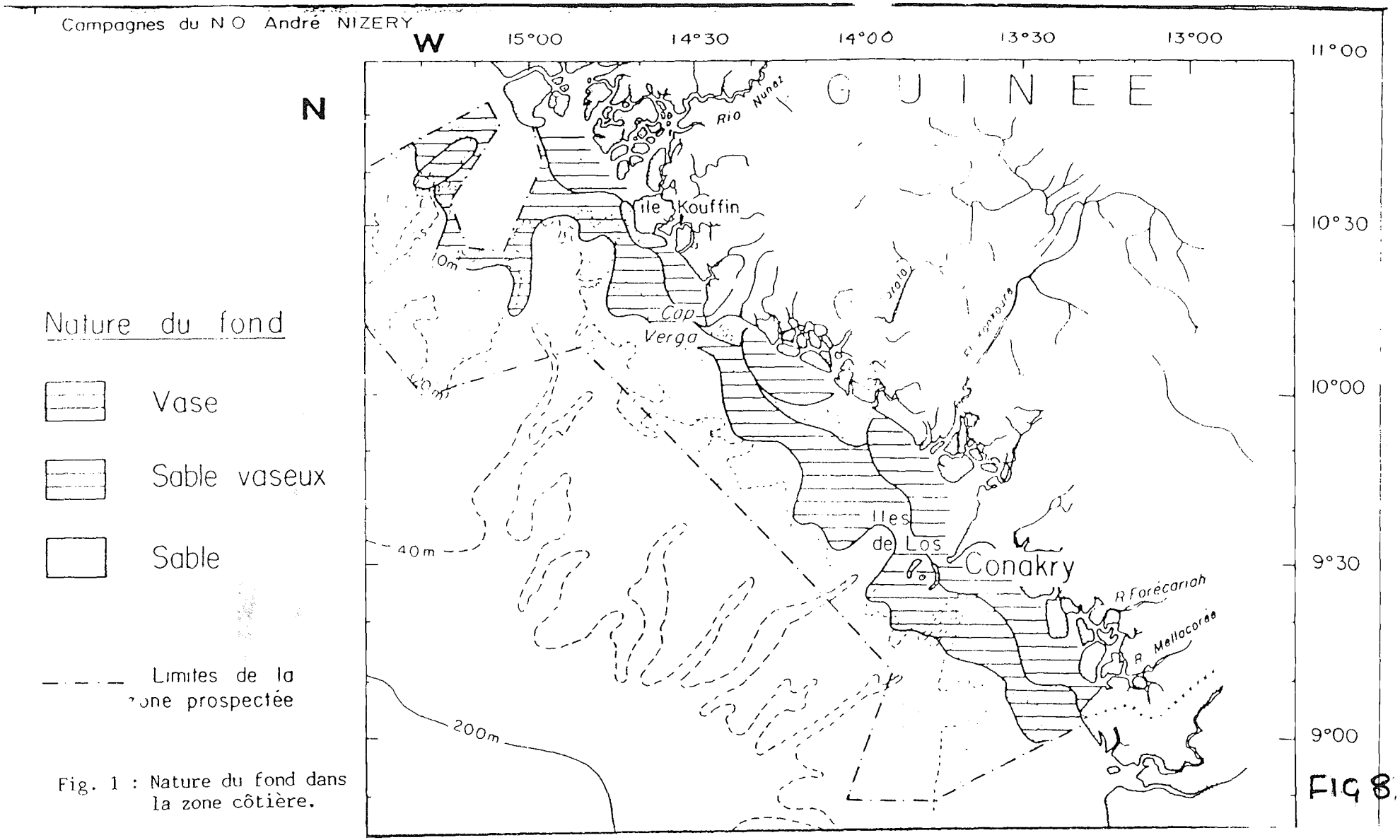


Fig. 1 : Nature du fond dans la zone côtière.

FIG 8.

7. ENCIRCLING NET FISHING IN GUINEA.

7.1 MAIN FEATURES OF THE ARTISANAL FISHERY.

Around 8,000 fishermen using about 2,000 canoes of which approximately one third are motorized are involved in the marine artisanal fisheries of Guinea. They operate from about 90 villages where fish are landed and smoked before distribution to local and inland markets. The dominant method of fish processing in Guinea, as in Sierra Leone, is dry smoking with various types of open sided or covered ovens.

More than a third of the fishing activities are centred around Conakry where some 60% of the national catch is landed . The greatest part of the landings consist of bonga(Ethmalosa fimbriata) and to a lesser extent sardinella which are largely caught by fishermen using Ghana plank canoes and encircling nets of both gill, reggae and "filet mixte" types.

Unfortunately the official statistics do not provide sufficient data to be able to separate the catches derived from various forms of fishing gear so it is not possible to get any credible information on the levels of fish production which can be attributed to the encircling net fishery. Neither is it possible to give artisanal fish production because national statistics have not been available since 1987. The figs given in the Source book for inland fisheries of Africa do however give an estimate of 23,808 tons for 1990 and it would be reasonable to infer that a fairly high proportion of the national catch was derived from ghana plank type canoes engaged in encircling net fishing operations.

The continental shelf of Guinea (see fig 8)supports one of the widest and richest shallow fishing grounds in west africa. It extends some 80 miles to seaward and as far as the 50 metre level has a very smooth slope (0.06 % Domain 1989). This slope consists of various mixtures of sand and clay/mud with the occassional outcrop of laterite rock which form the only seabed obstructions to those encircling nets which are used in contact with the seabed. At the same time SOME 10 % of the shelf has a depth of less than 15 metres which makes it ideal for the type of encircling net fishing which is employed by the majority of Ghana plank canoe fishermen and a significant factor in their reluctance to adopt the purse seine.

7.2 BACKGROUND TO ENCIRCLING NET OPERATIONS.

The employment of encircling nets in the Guinea bonga fishery closely follows the pattern of adoption experienced in Sierra Leone . The Ghana plank canoes adopted in Guinea differ only in very minor ways such as the employment by some very large canoes of metal strengthening to the frames otherwise the type of canoe employed is the same. This similarity also applies equally to the style of fishing nets employed (see appendix 4) and to the methods of shooting and hauling the gear (see figs 11 to 18). All this reflects the influence of the Ghanaian fishermen whose apprentices,many of whom belonged to the Temne tribe common to both countries, adopted and adapted the ghanaian techniques.

In fact the fishermen and their families commonly migrated between Sierra Leone and Guinea to fish the different seasons or to take advantage of the availability of fuel, netting and outboard engines as availability changed with the rise and fall of economic prosperity on each side of the border. Another influence on cross border migration patterns have been the opportunities for credit, gear free gifts etc offered by some development projects to one side or other of the border.

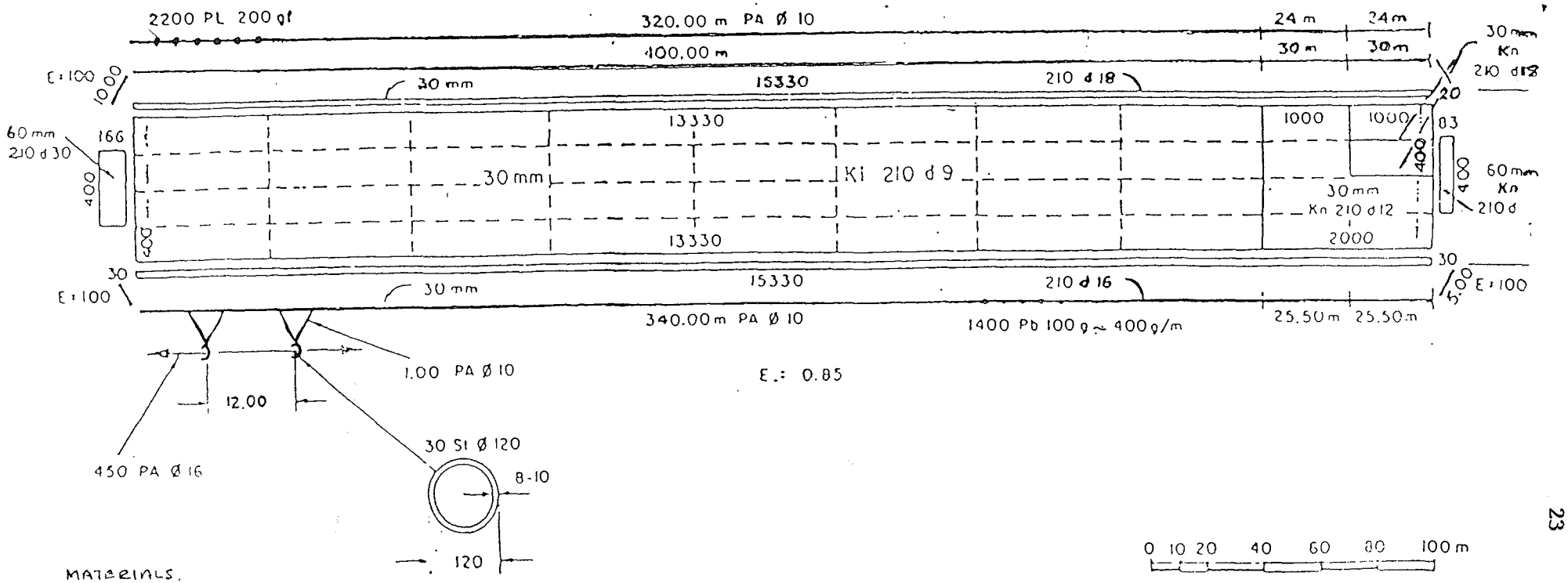
7.3 ENCIRCLING GILLNETS IN GUINEA.

The encircling gillnets of guinea are the same as those in current use in Sierra Leone. They are approximately 400 metres to 1,000 metres in length and from about 35 to 50 metres in depth. the mesh size of the gilling type of encircling nets are usually in the range of 50 to 65 mm with a ligther twine size than is found in the Senegalese purse seine fishery. Usually the twines employed are from R tex 155(210d 6) to R tex 230(210d 9), but some fishermen employ twines as thin as R tex 75 to 100(210d 3 to 210d 4). In consequence much time is spent on the repair and maintenance of these nets. The encircling gill nets tend to be fairly specific in their target fish and most fishermen in Guinea as well as in Sierra Leone want to catch the large or medium bonga. These fish are by far the most popular among the fish processors and the most easily sold to local and inland markets. On the other hand sardinella has a much more limited appeal than in Senegal for example and is not a fish which is targetted by the most prominent fishing communities. Where it is caught by such fishermen the sardinella may be regarded as suitable for home consumption in both guinea and Sierra Leone. On the other hand there are fisheries in in Sierra Leone which do target sardinella on a seasonal basis but their catches receive much lower prices than even the juvenile bonga (awefu).

The encircling gillnet (see figs 12 to 18 and examples in appendix 4) gills the fish which leads to its distribution along the net rather than just concentrated in the end section of the net. It tends to be used for adult bonga and other relatively large pelagics and for this reason is therefore more acceptable in terms of its effects on the sustainability of the fish resource and allows a high proportion of juvenile and other small fish to escape.

However with increased competition for the adult bonga, restrictions on hunting range due to fuel scarcity and high prices the need has arisen for fishermen to be able to catch whatever is available to them rather than exclusively targetting their preferred fish, in this case, bonga. This has led to more fishermen, especially on the fringes of the best bonga fishing grounds, to adopt smaller meshes in the whole of their encircling nets. This makes it possible to target other small pelagics of which awefu or juvenile bonga is currently the preferred next best catch to bonga. These" reggae" nets use smaller mesh than the encircling gillnets and are therefore less acceptable in terms of sustaining stocks than the encircling gillnet. Intermediate between the reggae and gill encircling nets there is the development of the" Filet mixte" type of encircling net. This net employs " a bunt" or area of smaller mesh either at one end or as part of a central section and mixes the large and small

EXPERIMENTAL PURSE-SEINE ~ GUINEA 1989.



0 10 20 40 60 80 100 m

MATERIALS.

1) Nylon Fish Nettings, Blue Color,
   A) 210d/9(4.250m/kg) 400md x 50mtrs. 30mm str. 16pcs. x 2 = 32pcs. Raschel Knotless.
   (Actual making up 1,200md x 50mtrs. 30mm str. 4pcs. x 2 = 8pcs. ")
   (" 400md x 50mtrs. 30mm str. 4pcs. x 2 = 8pcs. ")
   B) 210d/12(3,150m/kg) 400md x 30mtrs. 30mm str. 3pcs. x 2 = 6pcs. English Knot.
   C) 210d/18(2,100m/kg) 400md x 30mtrs. 30mm str. 1pce x 2 = 2pcs. "
   D) 210d/18(2,100m/kg) 20md x 460mtrs. 30mm str. 1pce "
   E) 210d/18(2,100m/kg) 30md x 460mtrs. 30mm str. 1pce "
   F) 210d/30(1,250m/kg) 400md x 10 mtrs. 60 mm str. 1pce "
   G) 210d/30(1,250m/kg) 400md x 5 mtrs. 60 mm str. 1pce "
2) Float Line Nylon Rope 3 strands 10mm dia. Natural White 400mtrs. x 2coils
3) Sinker Line Nylon Rope 3 strands 10mm dia. Natural White 421mtrs. x 2coils.
4) Purse Ring 120mm dia. 15pcs. x 2 = 30pcs.
5) Lead Sinker in oval shape about 100grms. 1400pcs. (140 KG)
6) P.V.C. Float about 200grms. buoyancy 2,200pcs.
7) purse Line Nylon Cross Rope 16mm dia. White 450mtrs. x 1coil.

AFTER S. LO
PROJET PÊCHE ARTISANALE (GUINEE).

T1, 9

meshes. This development appears to mirror directly the similar process in the Ghana fishery where the" watsa" purse seine was adapted and made more versatile through the incorporation of sections of smaller mesh netting such as those incorporated in the" poli/sieve" purse seine. This made it possible to use the "watsa" purse seine for catching a wider selection of different sized fish during different seasons as well as being able to use the net for a greater proportion of the year. This net has become known as the "watsa poli" net.

Another reason for the adoption of smaller meshes according to some fishermen was that small mesh netting was all that was available at the time and the aim was to make the net longer. Whatever the reasons underlying this trend the combined effect of the adoption of smaller meshes in purse seines and encircling nets must cause concern for the sustainability of pelagic fish stocks and the long term viability of both fishing methods.

METHODS OF SETTING AND HAULING THE ENCIRCLING NETS.

NET STOWAGE.

The encircling net is stowed in the aft section of the ghana plank canoe and usually forward of the outboard engine. The outboard normally being offset to starboard while the net is shot over the port hand side and therefore well clear of the outboard propeller. The net normally weighs in the region of 1.25 to 1.5 tons and is laid with lead and floatline bunched and not separated as in the Senegalese method of shooting the purse seine (see fig13).

SHOOTING THE ENCIRCLING NET.

When a shoal of fish is sighted the engine is often stopped and the crew determine which direction and at what speed the shoal is moving. Once the position has been assessed the net is shot over the side of the canoe with a large buoy attached to the wing end. This serves as a marker for aiming towards as the net is closed around the fish. At this stage the crew will often use paddles to set the first part of the net without frightening the fish. When confident that the shoal is in the right position the outboard is stared and the remainder of the net is set at full speed.

SPREADING THE ENCIRCLING NET.

As the net shoots out of the net bin one crew member guides the fast moving net over his forearm towards the stern of the canoe where up to four other crew members spread the net, separating the floatline and leadline, as the net "wall" spreads into the sea. If a snag occurs during the shooting procedure a crew member often dives overboard to release the leadline where it has snagged the floatline.

As the net surrounds the fish other crew members look out for additional sections of the shoal and direct the helmsman to enclose these fish. Turning to starboard to encompass these additional fish causes no problem as the outboard engine is situated on the starboard side and foreward of the setting net. This apparently simple procedure often caused problems to crew using the inboard diesel powered canoes because of the position of the propeller at the very stern of the canoe.

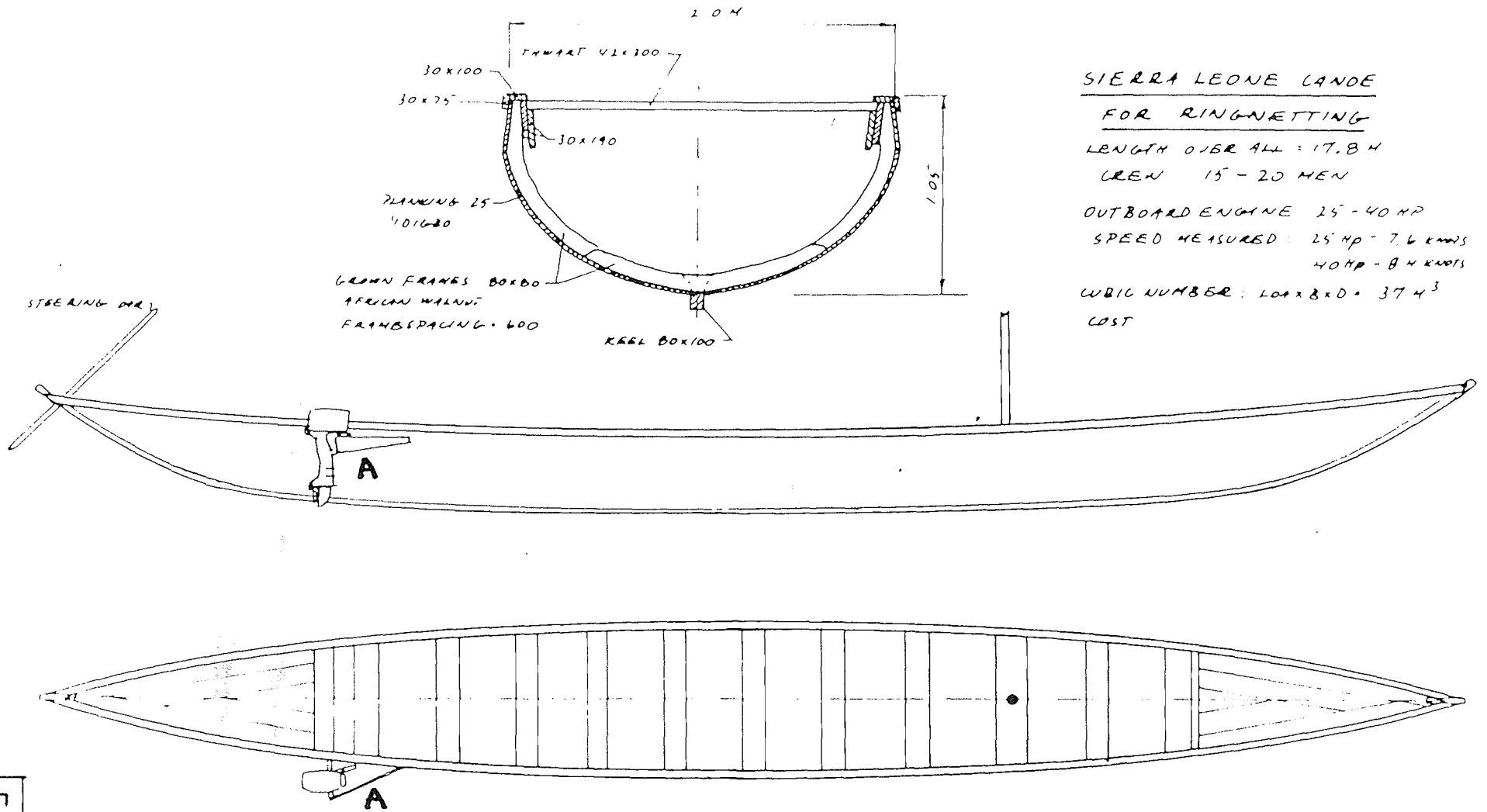
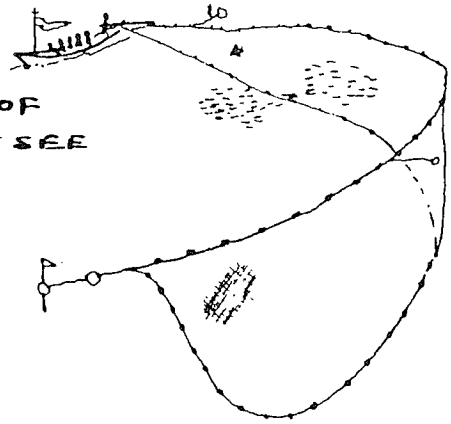


Fig. 10

EXAMPLE OF GHANA PLANK CANOE COMMON TO BOTH GUINEA AND SIERRA LEONE ENCIRCLING NET OPERATIONS. THIS EXAMPLE HAS AN EXTERNAL OUTBOARD ENGINE MOUNTING BRACKET. (A)

FIG 10

A. SHOOTING THE 'REGGAE'

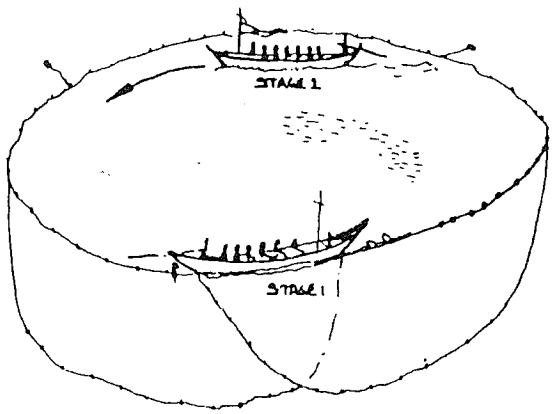


FOR DETAIL OF SETTING NET SEE FIG

NOTE THE REGGAE ENCIRCLING NET HAS SMALLER MESHES THAN THE ENCIRCLING GILL NET. IT IS THEREFORE MORE VERSATILE AND CATCHES LARGE BONGA AS WELL AS AWEFU (JUVENILE BONGA) AND OTHER SMALL PELAGICS. THE REGGAE NET CAN ALSO BE ADAPTED EASILY (DEEPER AND MORE LEADS) TO FISH FOR HERRING.

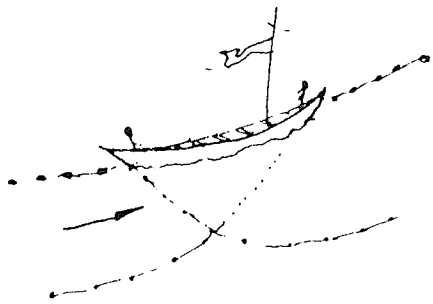
THE TREND TOWARDS SMALLER MESH SIZE APPEARS TO MIRROR THAT OF THE GHANA AND SENEGALESE PURSE FISHERIES WHERE THERE IS ALSO A NEED AND TREND TOWARDS TARGETTING SMALLER LOWER VALUE FISH.

B. CLOSING THE NET.



NOTE MORE WEIGHT OF FISH IS TRANSFERED TO THE FINAL HAULING STAGE AND THERE IS NO NEED TO DRIVE THE FISH INTO THE NET. FOR DETAIL SEE FIG 7.

C. NET ENDS CROSSED.



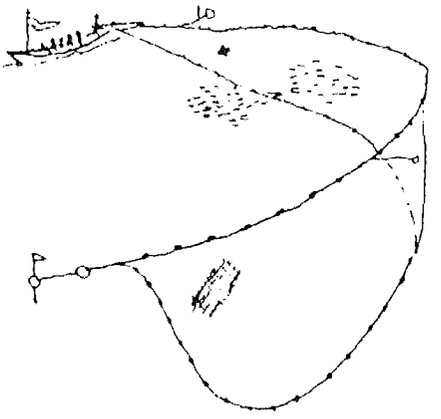
NOTE PROCEDURE SAME AS ENCIRCLING GILL NET FOR HAULING EXCEPT MORE WEIGHT – ESPECIALLY IF LARGE OR MEDIUM BONGA. TRANSFERED TO LAST STAGE OF HAULING.
SEE FIGS 5–7.

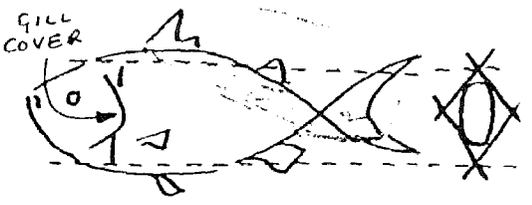
D. See FIGS 16 to 18 FOR DETAIL OF FINAL HAULING METHOD ~ COMMON TO BOTH SIERRA LEONE AND GUINEA.

FIG 11

SETTING THE ENCIRCLING GILL NET. SIERRA LEONE AND GUINEA.

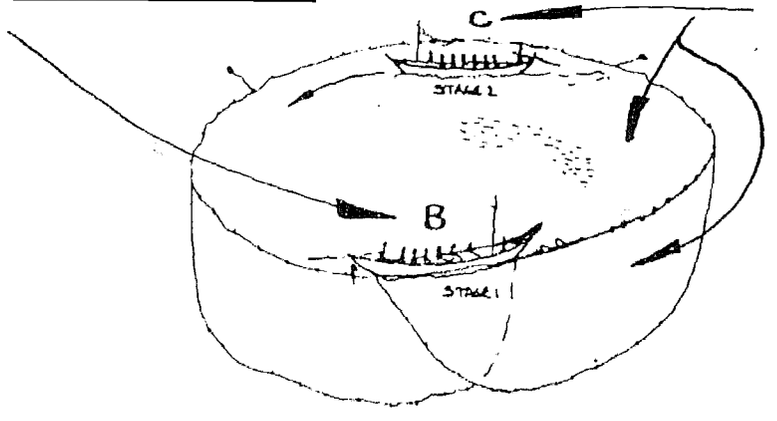
A. SHOOTING THE ENCIRCLING GILL NET.





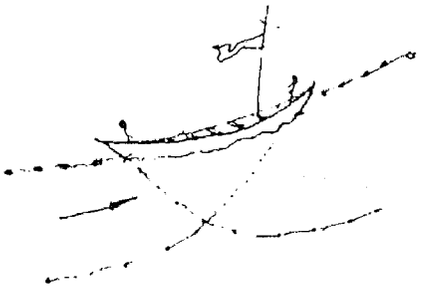
GILLED

B. CLOSING THE NET.



C ENCIRCLING GILL NETTING CANOE DETACHES ITSELF FROM NET JOIN AND DRIVES FISH INTO THE NET

NOTE. GILLING THE BONGA DISPERSES THE CATCH (THEREFORE WEIGHT) ALONG THE LENGTH OF THE NET. THE FINAL 'BAG' OF FREE SWIMMING FISH IS THEREFORE REDUCED.



C. HAULING THE NET.

NOTE CROSSED NETTING AND COMMON GROUND CONTACT EFFECTIVELY PURSES THE CATCH. IF GROUND CONTACT IS NOT ACHIEVED PROCEDURE B ABOVE IS NOT CARRIED OUT IN CASE IT DRIVES THE FISH TO ESCAPE THROUGH THE OPEN BOTTOM.

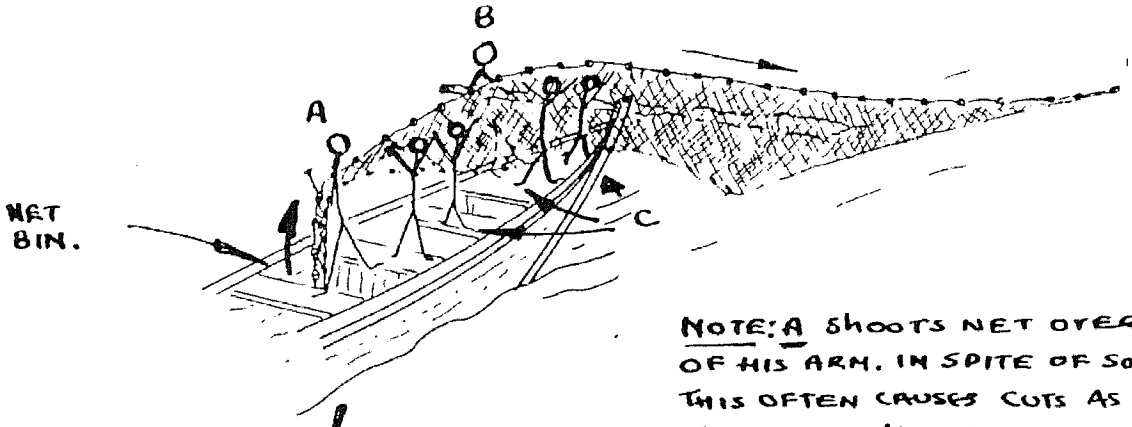
D. SEE FIGS 16 TO 18 FOR DETAILS OF FINAL HAULING METHOD — COMMON TO BOTH SIERRA LEONE AND GUINEA.

FIG 12

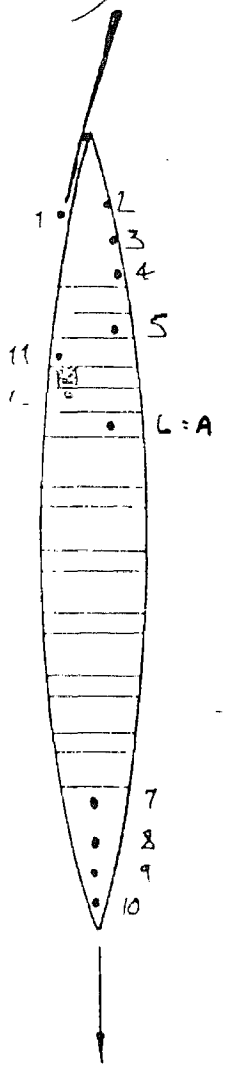
THE ENCIRCLING NET ~ SIERRA LEONE AND GUINEA.

~ SHOOTING PROCEDURE DETAL.

A. NET SHOOTING IS CARRIED OUT AT FULL SPEED.



NOTE: A SHOOTS NET OVER THE CROOK OF HIS ARM. IN SPITE OF SOME PROTECTION THIS OFTEN CAUSES CUTS AS THE LEADS PASS OVER HIS ARM. CREW MEMBERS AT C SPREAD THE NET ~ SEPARATING FLOATLINE FROM LEADLINE ~ BEFORE IT HITS THE WATER. THIS PROCEDURE SPEEDS FALL OF NET AND PREVENTS SIDEWAYS ESCAPE. B. HELMSMAN LEANS AWAY FROM PASSING NET.



B. CREW POSITIONS DURING SHOOTING.

1. HELMSMAN ON STEERING OAR LEANS TO STARBOARD AVOIDING NET BUT KEEPING AN EYE ON LOOKOUTS 7, 8, 9, 10 WHO MAY DIRECT HIM TO ENCLOSE A NEWLY SIGHTED SECTION OF THE SHOAL.

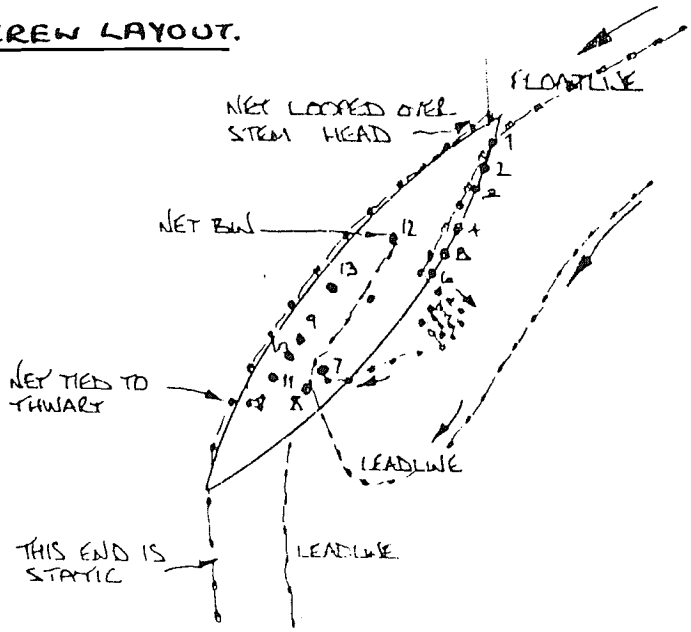
2, 3, 4, 5 SEPERATE FLOATLINE AND LEADLINE USING THE PALM OF THE HAND. FLOATS PASS OVERHEAD LEADS PAST WAIST AND LEGS. SAND FLIES EVERYWHERE.

11, 12 OPERATE OUTBOARD IN ITS INTERNAL WELL READY TO LIFT ENGINE AS CANOE PASSES OVER CLOSED NET AT END OF ENCIRCLING MANOEUVRE.

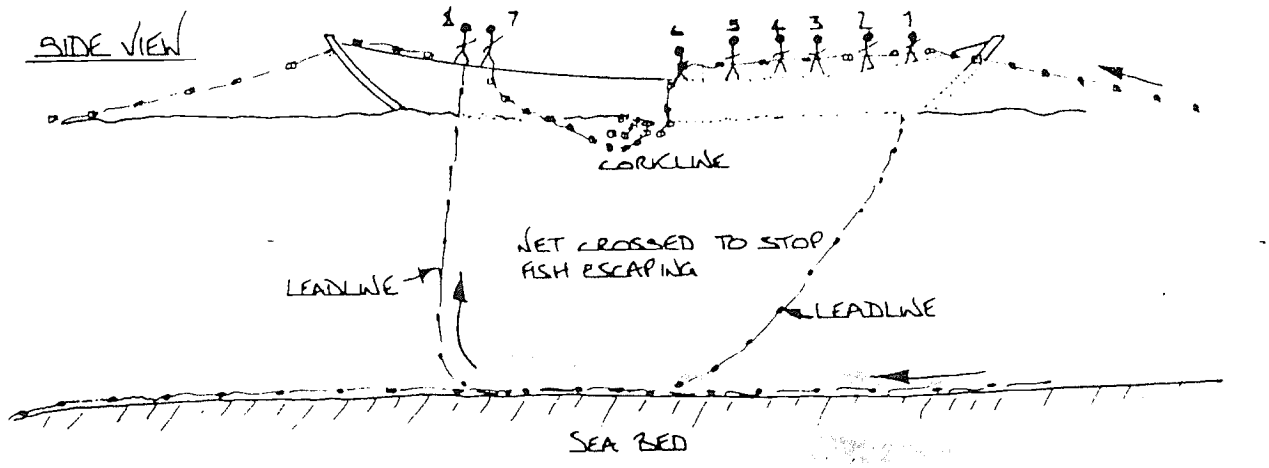
FIG 13

ENCIRCLING GILL AND REGGAE NET HAULING PROCEDURES. SIERRA LEONE AND GUINEA.

A. CREW LAYOUT.



B. TYPICAL CREW ACTIVITY - HAULING.



C. FINAL STAGE ~ SEE FIGS 16 to 18.

FIG4

CLOSING THE WING ENDS.

When the net has been set around the shoal the canoe slides over the wing end and the crew secure it along the starboard side. If the net does not meet around the encircled fish there is an override line which is paid out until the canoe crosses the other wing end. This line is then hauled rapidly to bring the two net wing ends together and the first wing end to be shot is secured to the starboard gunwale and the last wing end is secured along the port side of the canoe. This procedure causes the two wing ends to overlap and create a double curtain of netting either side of the canoe (see fig 16). Escape is still possible at this stage between the two net curtains(see fig 16a) but the crew are normally alert to this and scare the fish back into the circle by splashing the water.

ENCIRCLING GILLNET PROCEDURE.

When the net is closed around the fish there are two types of procedure depending on whether the net is in contact with the bottom or not. If it is in contact the crew pull the wing ends together along the starboard side of the canoe and secure the overlapping ends together. The canoe is then motored around inside the net and the thwarts are drummed to scare the fish into the net where they are gilled. If the net is not in contact with the seabed then the net is secured to the canoe as above and allowed to drift quietly for a period and the fish are not deliberately frightened. In this way some fish are gilled but some may very well escape through the open bottom.

ENCIRCLING NETS OPERATING WITH THE EFFECT OF A PURSE SEINE.

During the hauling procedure of all the types of encircling nets described here the method usually employed by experienced crews in Guinea as well as in Sierra Leone is the one where the ends are crossed to form a frontal barrier to escape under the canoe and where the wing ends are kept crossed and the leadline is in contact with the seabed at all stages of the hauling procedure. This technique has the effect of pursing the net while it is in contact with the ground without a purse line to close off the bottom of the net (see figs 16, 17, 18). These figures clearly show that the pursing effect can be maintained to the very end of the hauling procedure. Naturally there are circumstances where the purse effect is not maintained, such as on uneven ground or when the weather conditions are not favourable, but in the shallow relatively obstruction free waters of both Guinea and Sierra Leone ground contact is usually achieved and the encircling net, in effect, behaves like a purse seine.

To summarize the encircling nets vis a vis the purse seines it can be said that for both Guinea and Sierra leone the encircling nets are appropriate to the shallow water conditions and to catching the most marketable fish in those countries. On the other hand where the depth of water is generally deeper, the continental shelf narrower and the competition higher, as in both Ghana and Senegal, the purse seine provides a more versatile approach to catching pelagics, in both shallow and deeper waters, of those countries and allows fishermen to venture further to sea and thereby help to dispurse fishing effort. However, if both methods of fishing continue to adopt smaller mesh to target smaller species and juvenile fish, especially in the shallow water fisheries, the implications for fish stocks could be serious.

8. ENCIRCLING NET FISHING IN SIERRA LEONE.

8.1. BACKGROUND.

Sierra Leone is located in a roughly central positiuon between Senegal and Ghana. It has a coastline of approximately 500 km in length which is characterized by large river estuaries and mangrove swamps. The continental shelf reaches a width of 125 kms and presents, along with the waters off the coast of Guinea, the most extensive area of shallow water along the West African coast.

The main target fish of the artisanal canoe fishery of Sierra Leone are pelagic fish which include ethmalosa and sardinella. Of these two main species the bonga is by far the most important commercially and while sardinella is targetted in some areas such as Godrich and Tombo in other areas fishermen will ignore shoals of Sardinella to catch bonga. The bonga rarely goes below 20 metres water depth and therefore is well suited to the main method employed in its capture by encircling nets.

There are three main size groups of bonga. these are

_____ Immature fish (Awefu) which are less than 21 cm long and largely confined to the estuaries in about 2 - 4 metres of water.

_____ Adult Bonga having a length ranging between 22 - 32 cm.

_____ Bonga with a length above 33 cm. These larger fish are often found in water of more than 11 metres depth.

Source. Marine fishery resources of Sierra Leone by G.W.Ssentongo.CECAF/ECAF Series 86/34.

The largest aggregations of round sardine are recorded in the northern sector at a depth of 15-20 metres during the period March _ September.

The artisanal fishery.

There are about 18,000 artisanal fishermen operating about 7,000 dugout and planked Ghana type canoes of which about 700 are equipped with outboard motors of between 8-40 hp.

The artisanal fishing canoes consist of the following types.

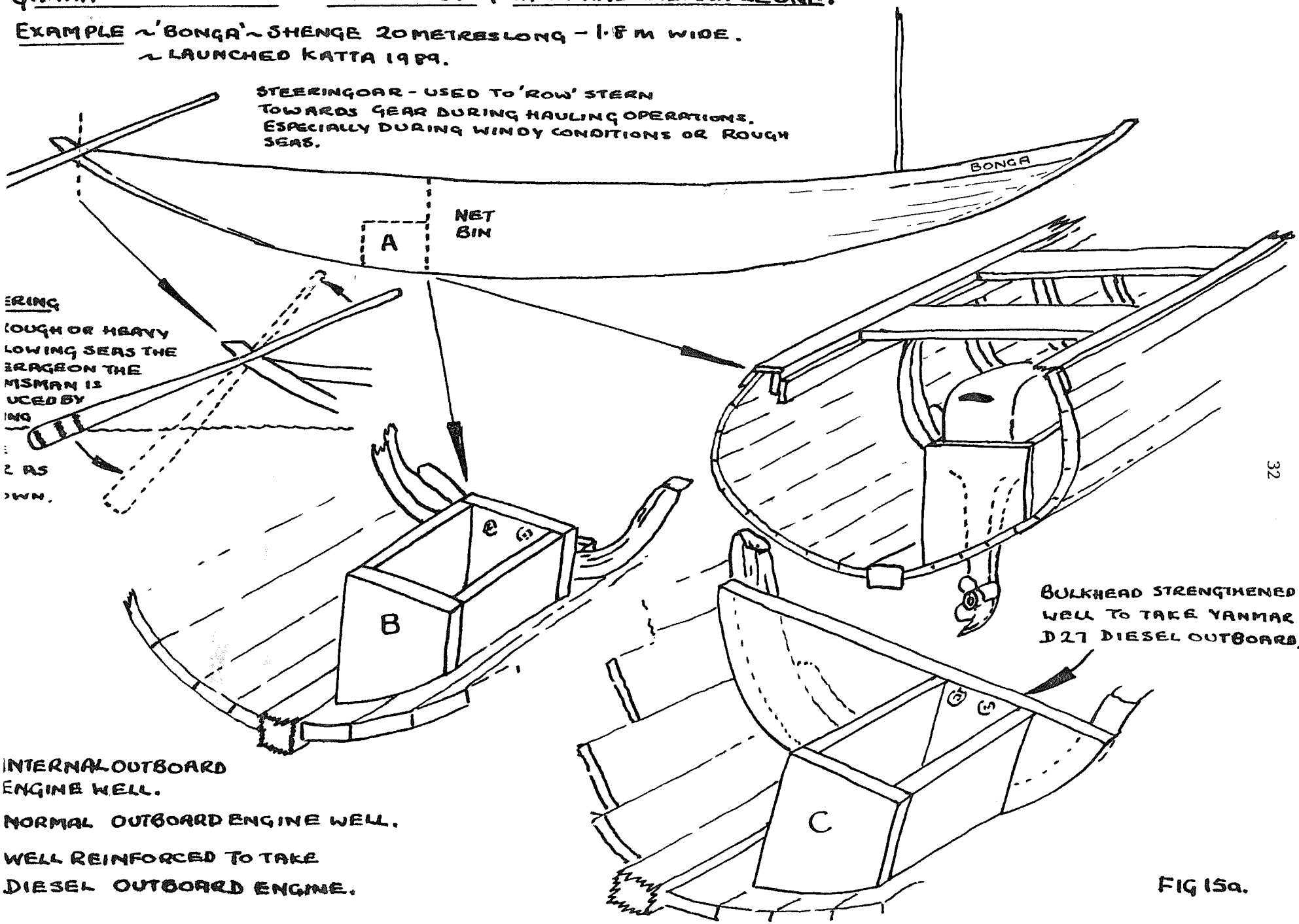
____ The Kru dugout canoe (less than 6m long) usually one or two men operating handlines, cast nets or small gillnets. They are powered by sail and paddle.

____ Standard canoes which can be either dugouts or planked and are larger and longer than Kru canoes with a crew of 3 - 5 men.Sail and paddles are the main form of propulsion but many have a transom for the fitting of a rudder(for sailing) whioch can be used to suport an outboard engine.

____ Ghana type planked canoes(very few old dugouts are still in evidence)with alength of 12 to 20 metres and largely propelled by petrol outboards of 25 - 40 hp.are engaged in encirling net operations almost exclusively. Purse seines are not in current use although experimental nets have been demonstrated from time to time in the past.

GHANA PLANK CANOE ~ TYPICAL OF GUINEA AND SIERRA LEONE.

EXAMPLE ~ 'BONGA' ~ SHENGE 20 METRES LONG - 1·8 M WIDE.
~ LAUNCHED KATTA 1989.



ERING
OUGH OR HEAVY
LOWING SEAS THE
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MSMAN IS
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AS
WN.

INTERNAL OUTBOARD ENGINE WELL.

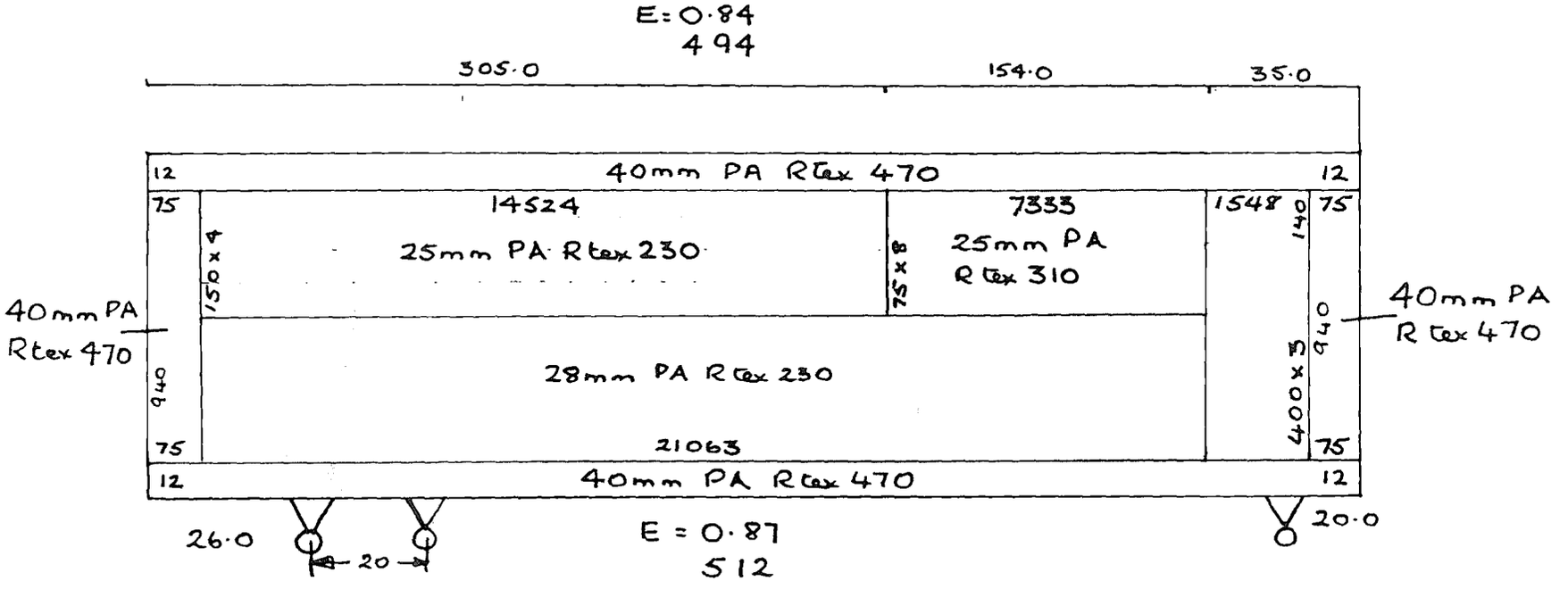
NORMAL OUTBOARD ENGINE WELL.

WELL REINFORCED TO TAKE DIESEL OUTBOARD ENGINE.

FIG 15a.

EXPERIMENTAL PURSE SEINE TOMBO SIERRA LEONE

FOR HERRING AND BONGA.



REFERENCE. OBSERVATIONS ON FISHING METHODS IN WEST AFRICA
B. ANUM DOYI AND J. WOOD.

FIG 15B

The fact that purse seine nets can be operated from Ghana plank canoes (see fig 10) without modification is a significant point when considering the long term need to provide an alternative to the Ghana dugout canoe. The Ghana plank canoe evolved in the Sierra Leone area in response to the need to make a vessel of the same size which was able to carry out the same fishing operations as the ghana dugout canoe.

In the absence of the large relatively durable Wawa trees, used to make the Ghana dugout canoe, the requirements of the Ghana fishermen and shipyard skills of local boatbuilders were combined to produce the Ghana plank canoe. This canoe is constructed with a keel and grown mangrove frames and planked with a variety of timbers among which is the pepperstick which is very resistant to marine borers. The hull is generally slimmer than the Ghana dugout canoe and normally has a more graceful appearance. However, the Ghana plank canoe does not have the rigidity and strength of the dugout and would in consequence not be as suited to landing on heavy surf beaches. It is however a good seaboat and responds as well if not better than the Ghana canoe to the steering oar in rough following seas. This responsiveness to the steering oar is essential to preventing broaching and is assisted by the slightly more pronounced "rocker" than the Ghana dugout canoe.

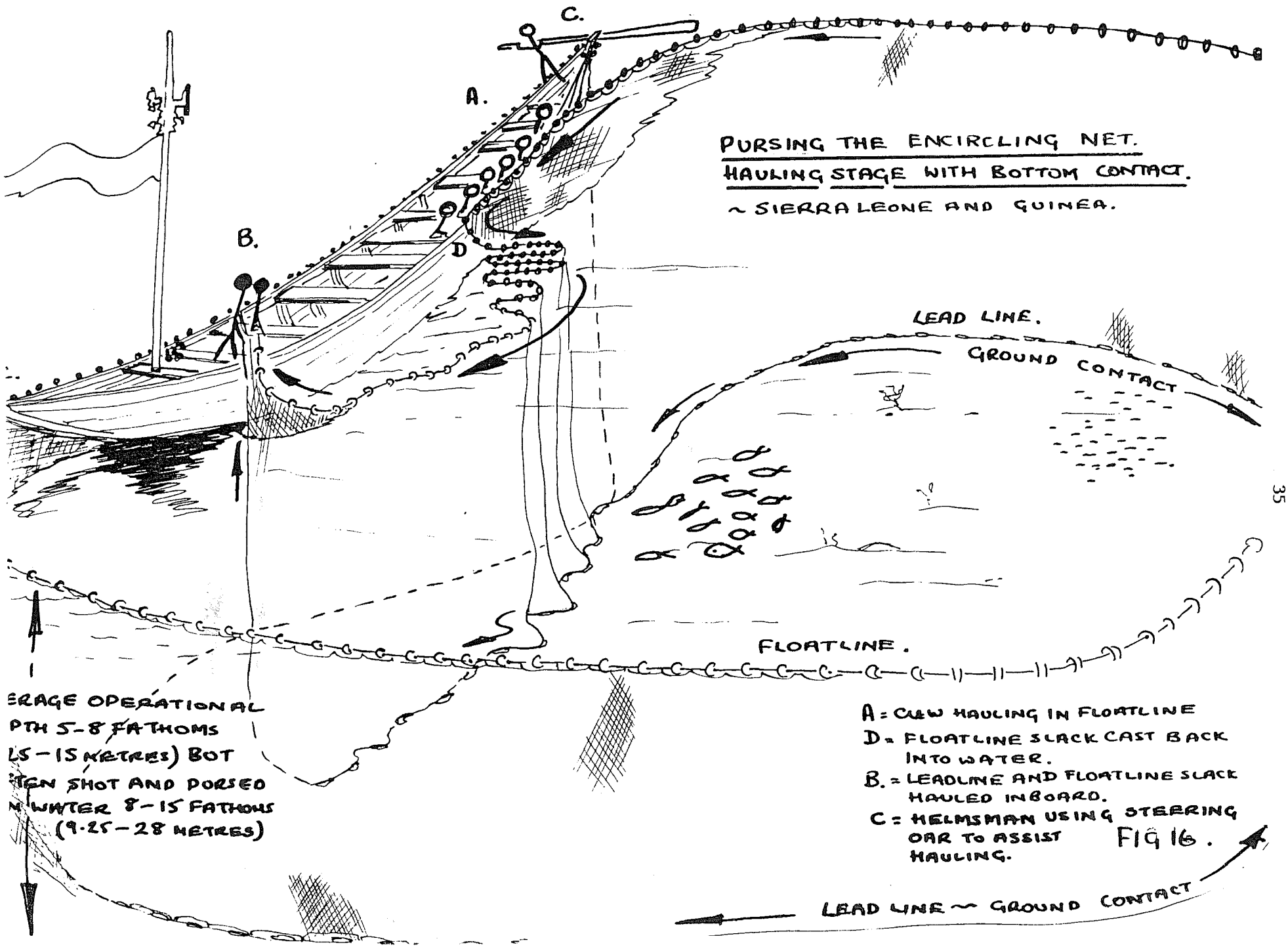
8.2 EXPERIMENTAL INTRODUCTION OF THE PURSE SEINE IN SIERRA LEONE.

According to the testimony of a retired ghanaian fisherman in the Shenge area the migrant Ghana fishermen, who had settled in large numbers along the coast of Sierra Leone, tried to introduce the purse seine technique to the bonga fishery in the period leading up to the mid seventies. This attempt was rejected by the other local fishermen who were afraid of the effect that the purse seine catches were having on the prices they received from their much smaller catches. In addition the other local fishermen were cocerned at the high proportion of immature and small fish which were the result of the purse seine efforts. Another concern at the time was that much of the extra fish landed at that time remained unsold.

What appears to have brought the situation to a head was the construction of a very large purse seine for use in the Godrich area to the south of Freetown. The reaction of the local fishermen to the deployment of this gear was so hostile that its use was prevented and further attempts to introduce the technique were apparently abandoned.

Other attempts to introduce the purse seine in Sierra Leone include demonstrations of the technique in 1985 to the fishermen of Yeliboya Island by the Kambia Fisheries Development Project. Again there was considerable local resistance to the concept, not of pursing, but to the employment of the very small mesh with its consequent threat to the stocks of juvenile fish. The net used for demonstration was 370 metres(200 fathoms) in length and 37 metres (20 fathoms)in depth with a lateral bunt of 12 mm mesh and the body of the net consisting of 25 mm mesh.

A further attempt to introduce the purse seine concept was made by the GTZ Tombo project in 1987 where a net was constructed for demonstration purposes to catch both herring and bonga.See (Fig 15). Again this attempt although demonstably successful in the capture of herring failed to be adopted by local fishermen



PURSING THE ENCIRCLING NET.
HAULING STAGE WITH BOTTOM CONTACT.
~ SIERRA LEONE AND GUINEA.

FIG 16.

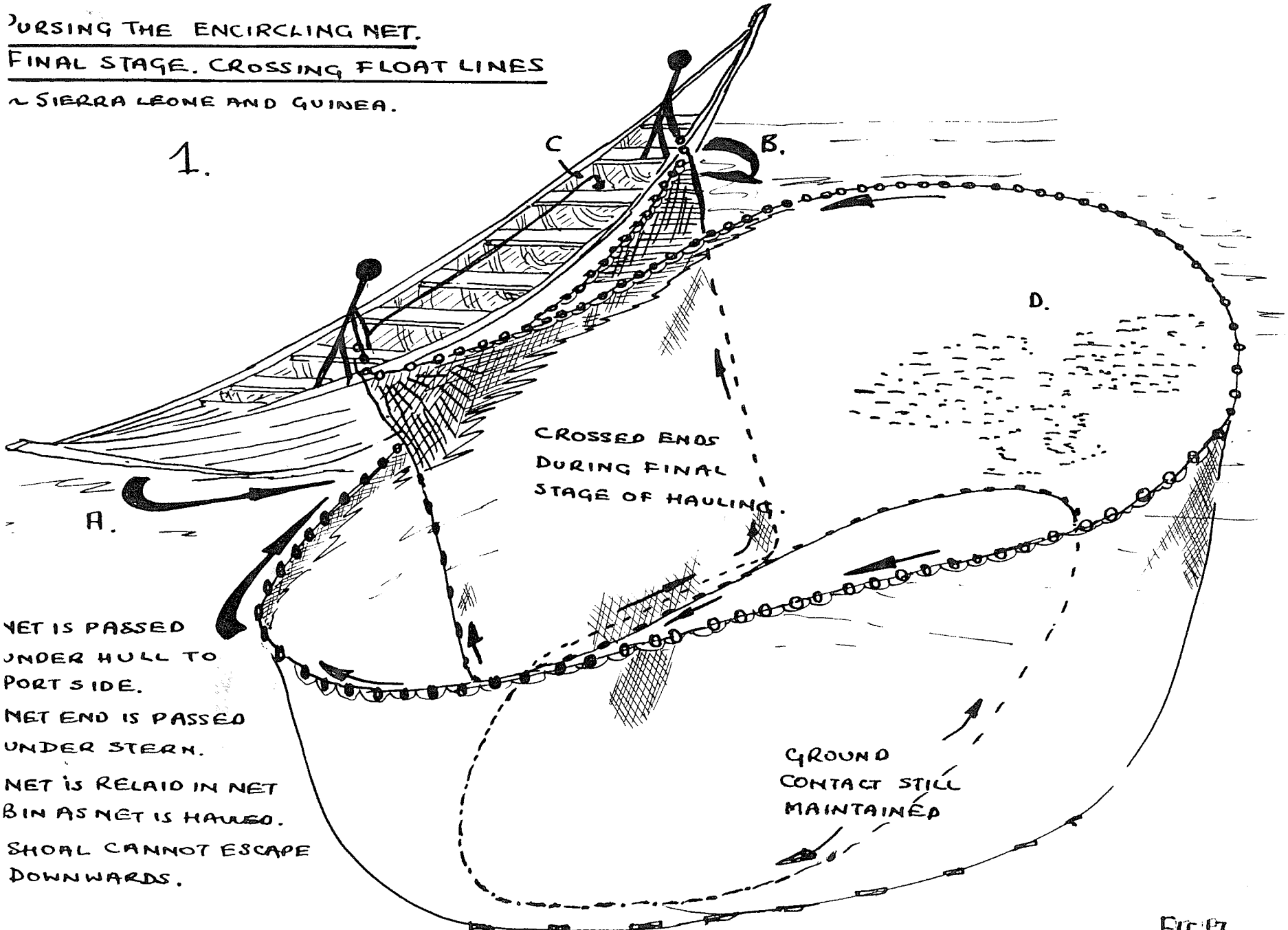
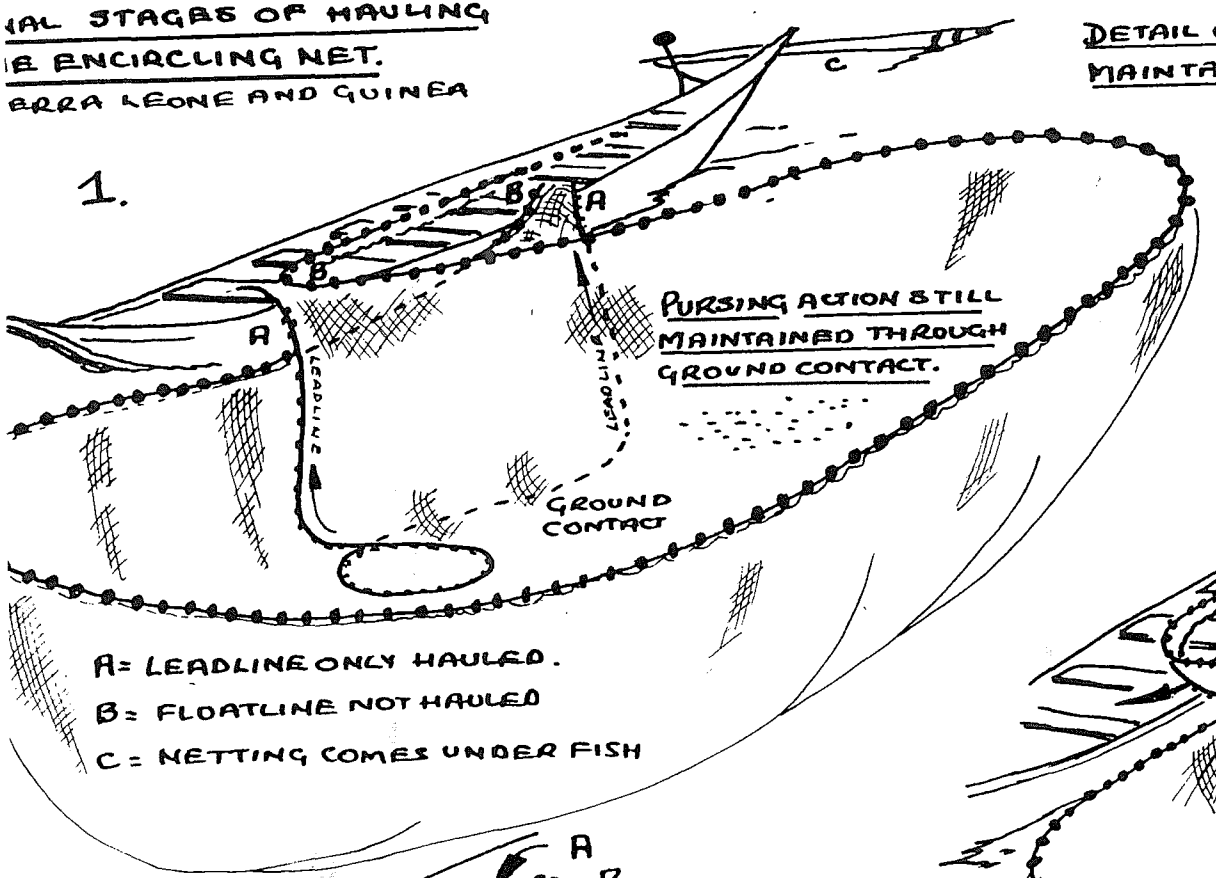

PURSING THE ENCIRCLING NET.
FINAL STAGE. CROSSING FLOAT LINES
~ SIERRA LEONE AND GUINEA.
1.
C
B.
D.
A.
CROSSED ENDS DURING FINAL STAGE OF HAULING.
NET IS PASSED UNDER HULL TO PORT SIDE.
NET END IS PASSED UNDER STERN.
NET IS RELAID IN NET BIN AS NET IS HAULED.
SHOAL CANNOT ESCAPE DOWNWARDS.
GROUND CONTACT STILL MAINTAINED

FIG 17

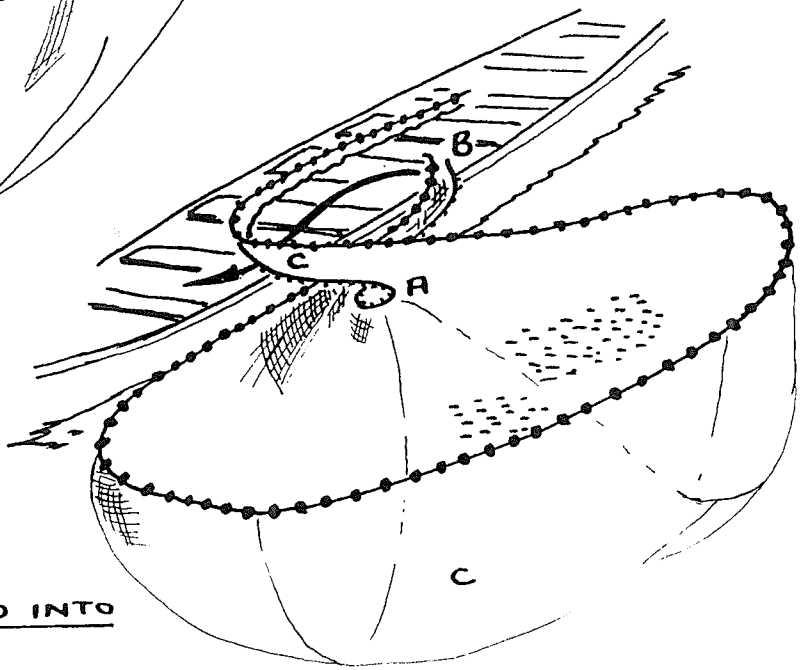
IAL STAGES OF HAULING
E ENCIRCLING NET.
ERRA LEONE AND GUINEA



PURSING ACTION STILL MAINTAINED THROUGH GROUND CONTACT.

DETAIL OF HOW PURSE EFFECT IS MAINTAINED TO THE END OF THE HAUL.

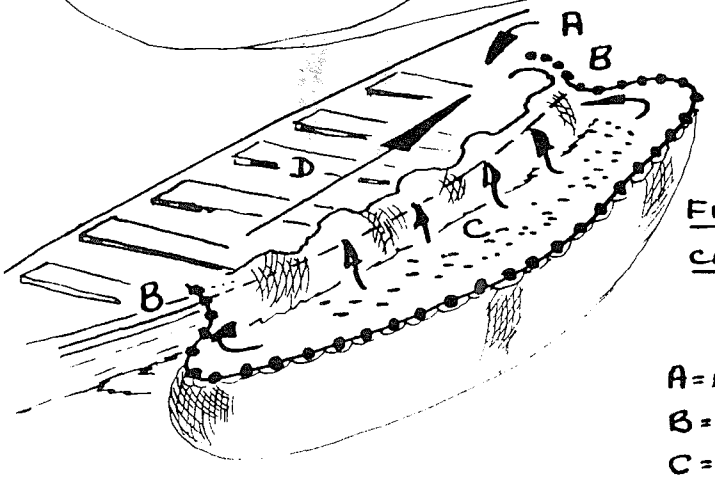
2. WHEN LEADLINE A IS HAULED TO THE SIDE OF THE CANOE NET END (THE END FIRST SET) IS PASSED UNDER C AND THE HAULING PROCEDURE CONTINUED AS IN 3.



A= LEADLINE NEARLY HAULED INBOARD.

B= END B IS PASSED UNDER C IN READINESS FOR FINAL HAULING OF NETTING AND FLOATLINE.

C= PURSE COMPLETE AND OFF BOTTOM.



3. FISH BRAILED INTO CANOE.

A= NETTING RELAID IN NET BIN.
B= FLOATLINE HAULED.
C= NETTING HAULED.
D. NET FINALLY RELAID.

FIG 18.a.

for similar reasons to those expressed by the Yeliboya fishermen.

Underlying these attempts to introduce the purse seine there is another element which is of considerable importance to understanding the reasons for this techniques rejection in both Sierra Leone and Guinea. This rejection can at least in part be attributed to the efficiency of current techniques and the way in which the encircling gill and reggae style nets are used in the shallow waters of both countries.

8.3 PURSING EFFECT OF THE ENCIRCLING NETS IN SHALLOW WATER.

In effect the encircling nets in current use are deployed in such a way that they infact purse through contact with the bottom ,see figs 16 - 18 which show in detail how an encircling the net is retrieved and how the net is hauled in such a manner that it maintains contact and an effective purse without the addition of a purse line. That this effect is not always achieved is not in dispute as there are several instances in which the effect of pursing is not achieved. Such a situation occurs when the water is too deep, the weather unfavourable to maintaining the crossing effect of the ends of the net or the net snags a submerged obstruction. All such instances will result in the pursing effect not being achieved. However, the frequency with which such an effect is achieved makes the current technique as effective or nearly so for there to be little real incentive for the fishermen to adopt the purse seine.

This lack of incentive is reinforced by the aditional expense that the purse seine would involve especially if it employed the heavy twines of the Senegal type seine or the smaller mesh of the poli/sieve type of nets used in Ghana. The fact that the most marketable and therefore the main target fish in both Guinea and Sierra leone are bonga and not sardinella mean also that the currently employed encircling nets are more suited to this fishery than the purse seine. When one also considers that the encircling nets are generally heavier and more difficult to shoot and haul it becomes apparent that the existing nets are appropriate to the fisheries of both Guinea and Sierra Leone.

8.4 CURRENT TRENDS IN THE DEVELOPMENT OF ENCIRCLING NETS.

Although the purse seine has not been an attractive option for the fishermen of either Guinea or Sierra Leone there has been a trend in both countries towards the adoption of smaller meshes in the encircling nets. Evidence of this trend was first noted during studies of encircling nets among the Yeliboya Island fleet in 1985 and 1986 (see appendix 4). The adoption of smaller mesh was prompted among the Yeliboya fleet by the need to exploit the juvenile bonga in the waters immediately adjacent to Yeliboya island thereby avoiding the danger of arrest in Guinea waters where the main adult bonga fishery was situated. That this trend has continued is somewhat ironic in view of the concern expressed in the past over the use of small mesh and appears to closely mirror the trends to smaller mesh seen in the Senegalese and Ghanaian artisanal purse seine fisheries.

The encircling gillnets which were considered appropriate in effect to the purse seines were defined in the opening paragraphs of this report so do not need elaboration. However, the adoption of the reggae and filet mixte, again

END ON VIEW OF HAULING ENCIRCLING NET ~ GUINEA ~ SIERRALEONE.
TO SHOW POTENTIAL ESCAPE GAP

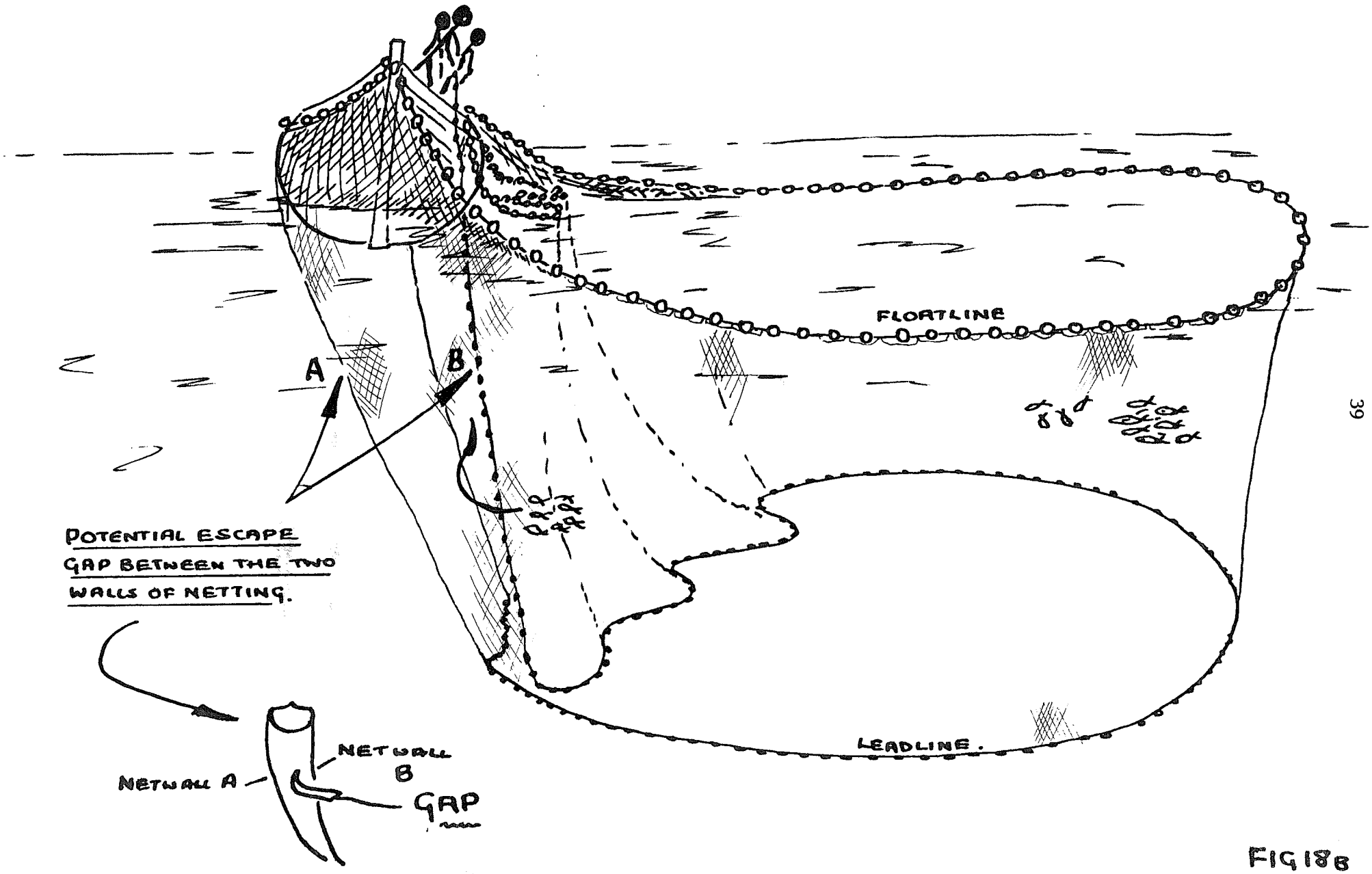


FIG 18B

evident in Yeliboya as well as Guinea, is a trend which may require as careful monitoring as the use of the purse seine.

8.5 ENCIRCLING NET CONTROLS.

There is ample evidence that the operations of artisanal purse seines is causing concern among local fishermen as well as among officals but so far no concensus about how to deal with its effects have been devised. That is with the exception of Guinea which has banned their use and Sierra Leone which has so far discouraged their use. This may not be enough as the way in which the encircling nets are used in many ways duplicates the effects of the purse seine and should therefore be the subject of equal control. The trend towards smaller and smaller mesh in the encircling nets may also duplicate the adverse effects of the purse seine on juvenile fish leading eventually to a convergence of fishing effort on smaller pelagics and juveniles. Without some form of control over unlimitted access to both purse seines and encircling nets there is likely to be a serious depletion of pelagic fish stocks. This may eventually affect employment in the fisheries concerned and to the supply of cheap nutritional food to national markets.

ENCIRCLING NET OPERATIONS.

The methods of deploying the encircling nets used in Sierra Leone are largely the same as those in current use in Guinea and which were described in the section dealing with that country. For details of shooting and hauling procedures see figs 11 to 18.

9.0 PURSE SEINING IN GHANA.

Two main species of sardinella are found in Ghanaian waters. These are sardinella aurita and sardinella maderensis(see fig 1) which together provided the most important seasonal fisheries for the Ghanaian fishermen. The round sardinalla(aurita) is the more popular and therefore marketable of the two species and is most abundant between July and September. On the other hand the flat sardinella(Maderensis) is caught throughout the year.

The sardinellas formed at least 65 % of the Ghanaian total catch(Hammond 1962) and Kwei in 1964 noted that the round sardinella, accounting for over 50 % of yearly landings of marine fish, was the most exploited fish stock in Ghanaian waters in the 1960's. Between 1963 and 1971, for example, between 4,000 and 36,000 tons of sardinella were landed annually and provided the Ghanaian population with an average of 20,000 tons perannum.

In the early 1970's sardinella stocks were thought to have the greatest potential for exploitation in the whole of the Gulf of Guinea(Ansa-Emmim 1973). All appeared satisfactory until the 1972 fishing season when there was a glut of both species of sardinella and some 90,000 tons were landed of which about 94 % was the round sardinella. The consequence of these big landings was that the price of sardinella crashed and those fishermen who were not prepared to accept the very low prices on offer dumped the fish back into the sea.

After the 1972 glut and market slump the sardinella, and especially the round sardinella aurita, virtually disappeared from the catches of the artisanal fishermen. In the two years that followed the sardinella fishery virtually collapsed with the industry recording the lowest catches in a decade and a half. All the additional capital employed in the artisanal fishery to catch sardinella came to nothing. However, in 1976 the trend of decreased catches was reversed and by 1978 a substantial recovery of the sardinella stocks was experienced. This welcome event was shortlived and catches again dropped in the following four years from 1979 -1982. It is apparent that since the excessive landings of sardinella in 1972 the catches, especially of the round sardinella, have become very variable and unpredictable however it should be pointed out that there have been similarly low catches prior to 1972 in 1965 and 1968.

The point of recounting the historical trends of the sardinella fishery is that the main technique used for exploiting the sardinella is the purse seine. Again the variability of the sardinella fishery is shown in Table 6 to be dramatic and liable to cause violent swings in the returns of the fishery. In spite of this it would appear from recent studies into the comparative returns from watsa and poli-sieve purse seines by the Regional project IDAF, and informally confirmed during this study, that the technique is still viable. However,the concentration on the marginally favourable financial aspects of the purse seine fishery should not detract from the necessity for improved monitoring of this technique and the long term effect of such exploitation on fish stocks. Without some form of control the fishery will become"self regulating" through the overexploitation of the pelagic stocks on which purse seining relies.

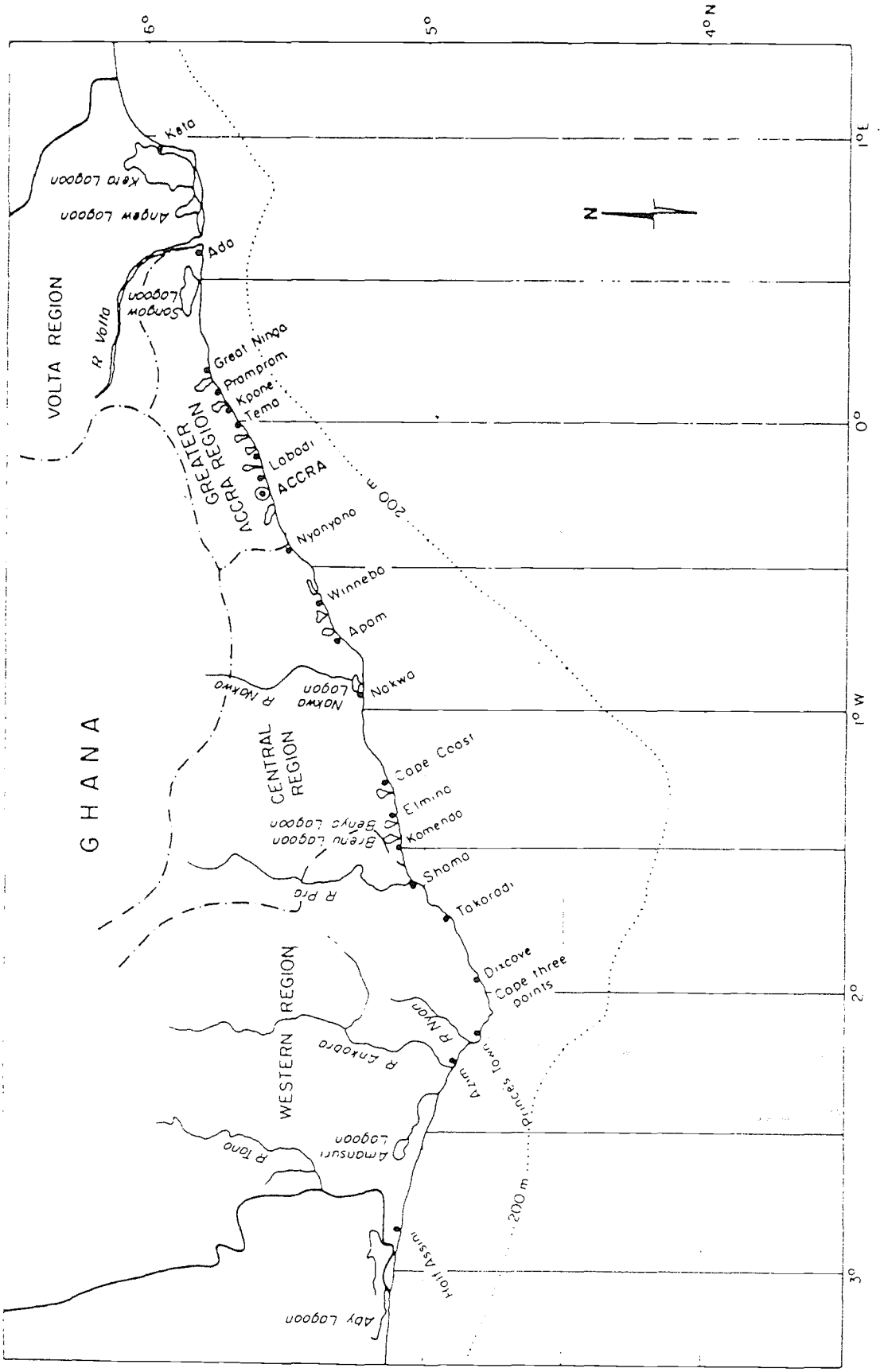


FIG 19

Coastal map of Ghana, showing the 200 m contour line and the most important lagoons and rivers

THE GHANA DUGOUT CANOE ~ GHANA.

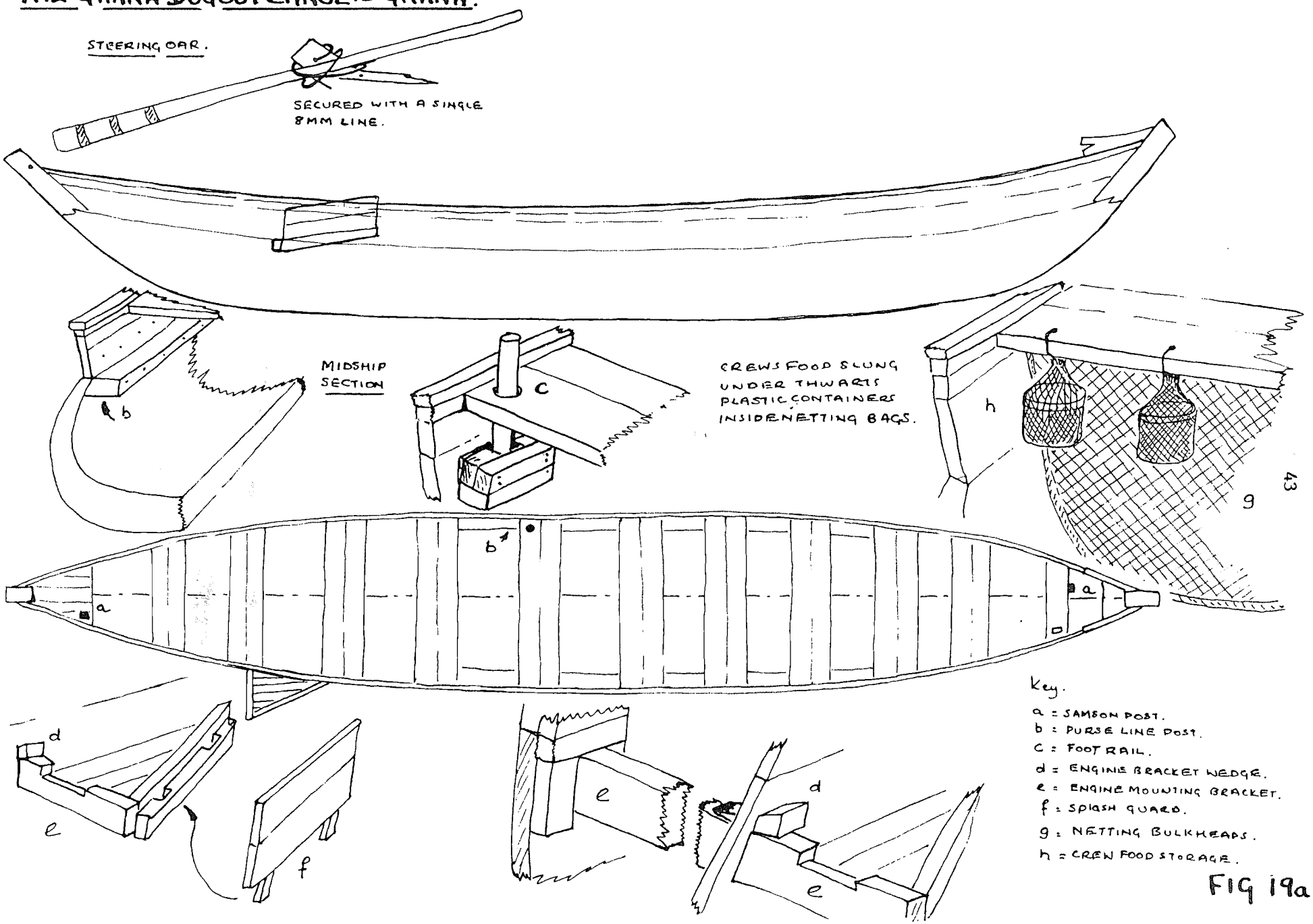
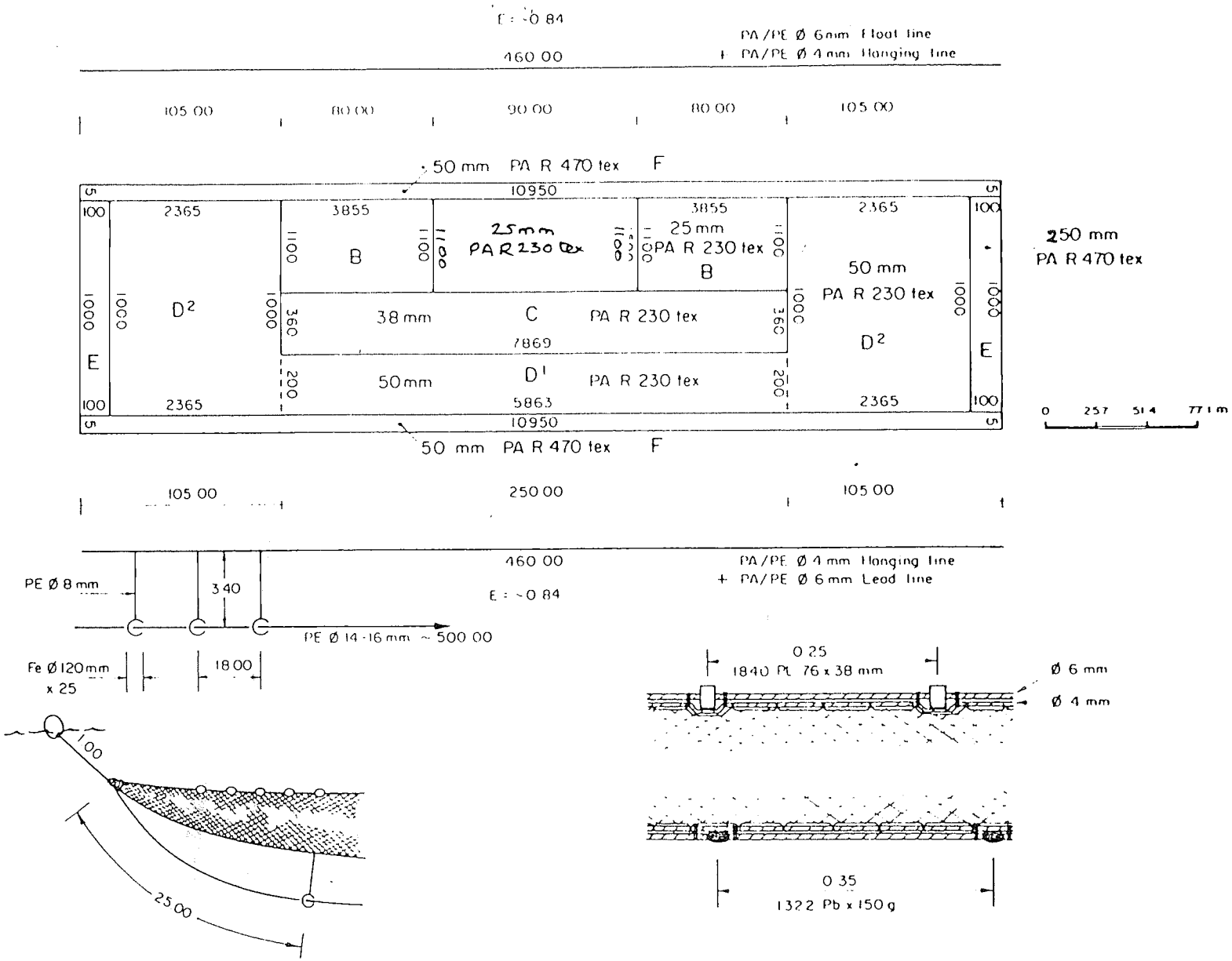


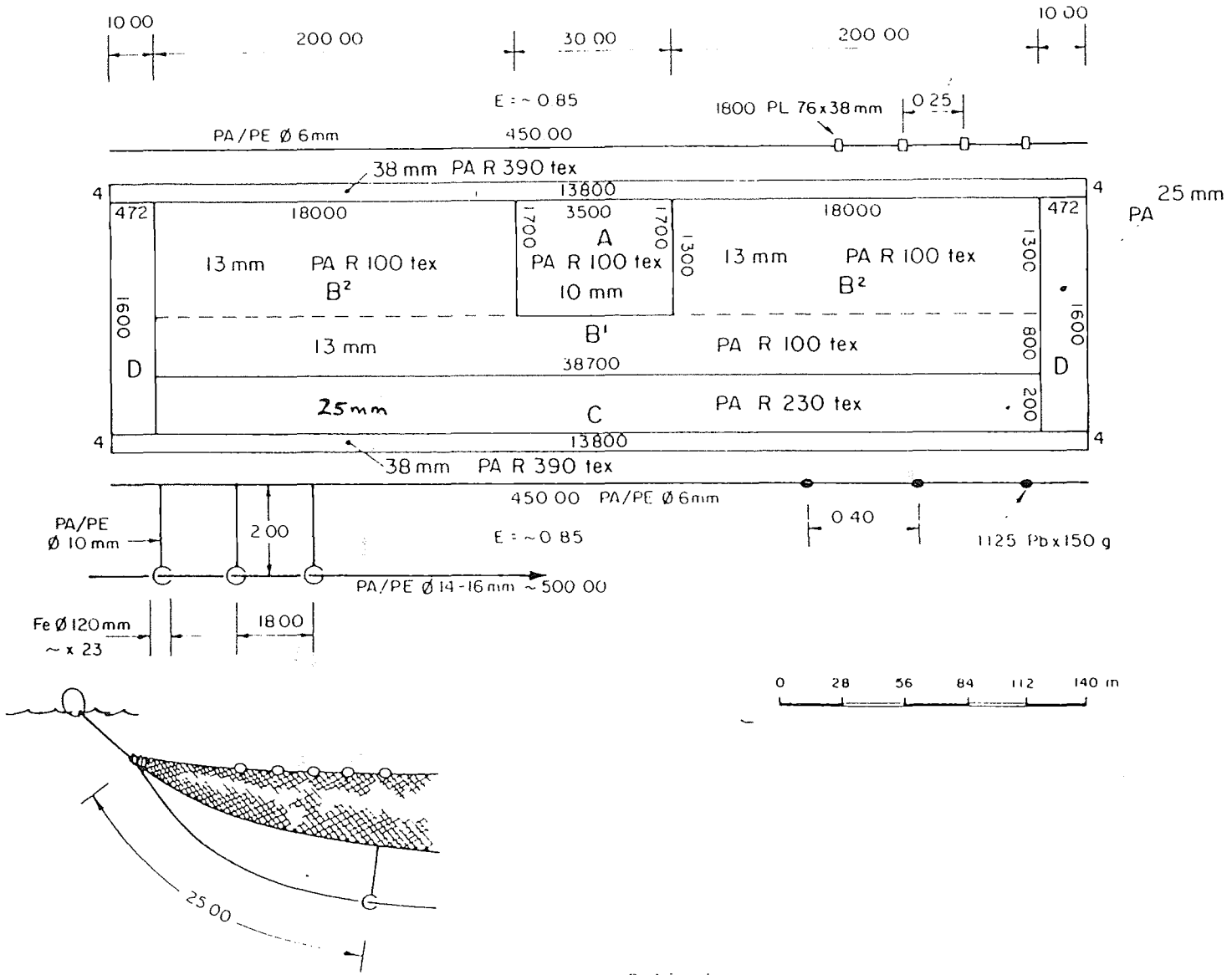
Fig 19a



Watsa purse seine - No # below 25mm.

ADAPTED FROM CATALOGUE OF SMALL SCALE FISHING GEAR OF GHANA. BY B. ANUM DOVI. TO CONFORM WITH LATEST DEFINITIONS

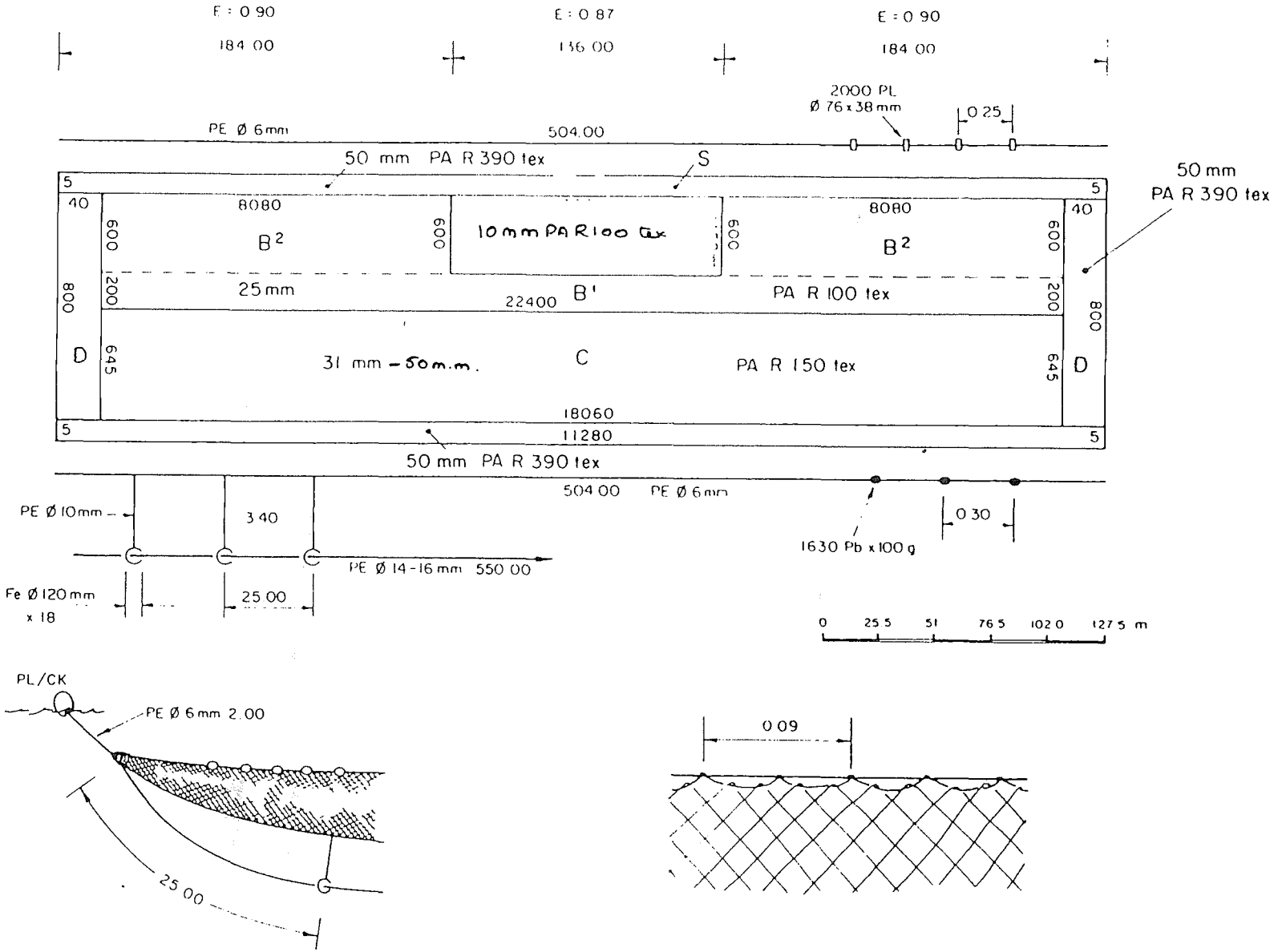
FIG20



Poli-sieve purse seine – No # above 25mm.

ADOPTED TO CONFORM WITH NEW DEFINITION FROM CATALOGUE OF SMALL-SCALE FISHING GEAR OF GHANA BY B. ANUM DOYI.

FIG 21.



ADAPTED TO CONFORM WITH NEW DEFINITION FROM CATALOGUE OF SMALL SCALE FISHING GEAR OF GHANA BY B. ANUM DOYI.

WATSA/POLI — purse seine # SIZE BETWEEN 10–25mm IN BUNT ALL OTHER # ABOVE 25 m.m.

FIG 22.

Table 4. Total annual landings metric tons of sardinella by artisanal fleet in Ghana 1980-1988

Years	Aurita	Maderensis	Total
1963	5 300		5 500
1964	22 230		22 250
1965	2 350		2 350
1966	4 200		4 200
1967	25 200		25 200
1968	2 500		2 500
1969	15 900		15 900
1970	14 700		14 700
1971	27 492	4 036	31 528
1972	72 350	4 575	76 925
1973	4 701	10 906	15 607
1974	1 409	16 111	17 520
1975	1 930	19 523	21 453
1976	12 009	17 962	29 971
1977	13 611	14 716	28 327
1978	40 257	11 070	51 327
1979	9 247	14 249	23 496
1980	19 126	11 310	30 436
1981	10 067	12 445	22 512
1982	14 655	14 007	28 662
1983	36 800	7 667	43 967
1984	34 817	10 077	44 894
1985	54 072	22 234	76 306
1986	45 489	16 633	62 122
1987	46 338	25 851	72 189
1989	75 852	10 450	86 302

Until about 1971, the two species were combined in the statistics.
Source. Information Report N° 23 K.A. Koranteng

9.1 CANOES OF THE ARTISANAL PURSE SEINE FISHERY.

The canoes used by the Ghanaian artisanal purse seine fishery are exclusively dugout canoes made fron the Wawa tree (Triplochiton scleroxylon). Their size and shape is largely determined by the size of the tree from which the canoe is cut and the employment of traditional lines and methods of construction. This creates a very strong and resilient hull which is given additional depth through the addition of gunwale planks (see fig 19a). These side planks are nailed virtically to the dugout and in some cases observed polystyrene and petrol glue is used to seal the join between the dugout and the planks of the gunwales. Strength is of particular importance to those canoes which are beached on heavy surf beaches where there is a high incidence of broaching to the waves and consequent rolling of the hull on hard sand or even rocky landing sites. The hull has also to withstand the daily beaching and launching of the canoe which causes another series of stresses to the hull (see fig 23).

9.2 TREND TOWARDS LARGER CANOES FOR PURSE SEINING.

One significant trend is the increase in the length and size of the Ghana dugout canoes. This trend appears to be in response to the employment of deeper, longer and therefore heavier purse seine nets by the artisanal purse seine fleet(see tab 7). This trend also appears to be taking place at the very time that concern is mounting over the decreasing stocks of the very large wawa trees from which these canoes are made. In fact the long term survival of the surf beach fisheries may depend, to a large extent, on the development of a strategy which will make more effective use of the remaining large trees, restriction of their use to where they are really needed as well as the development and acceptance of alternative surf beach craft. Other alternative craft will need to be developed for the replacement of the dugouts in current use in the harbours and relatively safe havens of the Ghanaian coastline. One such possibility is the Ghana plank canoe typified by those in use in the Guinea and Sierra leone encircling net fisheries.

TABLE 5. AVERAGE SIZE IN METRES OF EACH CATEGORY OF CANOE BY REGION.

Region	A P W	B S	S N	L N	D G N
Volta	12.7	11.1	7.7	8.9	12.3
Greater Accra	14.1	11.9	9.7	9.9	10.7
Central	13.3	11.5	6.6	8.5	8.0
Western	13.6	9.4	7.4	7.8	8.9

APW = Ali/Poli/Watsa
BS = Beach Seine
SN = Set net
LN = Line
DGN = Drift gill net

Table 5. showing the overall figures for dugout ghana canoes disguises the fact that there are large variations in their length. Also the grouping of Ali, Watsa and Poli canoes together disguises the growing difference between the smaller Ali canoe (mainly for drift netting)and the larger Poli and Watsa canoes which are mainly employed in the purse seine fisheries. A recent study associated with the FAO/IDAF canoe replacement programme was carried out to measure Watsa and Poli canoes on various beaches and in the majority of cases they were found to be over 15 metres in length. Another study on Axim beach showed that many of the latest canoes to be constructed were continuing the trend towards bigger vessels (See tab 8).

Table 6. MEASUREMENTS OF CANOES MADE ON AXIM BEACH.
Source : The Ghanaian dugout canoe carving industry - G.T. Sheves

Age of canoe	Length	Beam Hull/log	Beam Criminele	Top side Planking Height
10	13.9 m	142 cm	176,5 cm	33 cm
4	15 m		190 cm	51 cm
4	16 m		174 cm	46 cm
1	16.6 m	198 cm	250 cm	66 cm
1	17 m	175 cm	191 cm	55 cm
1	17 m	180	218 cm	63.5 cm
New	16 m	157	200 cm	38 cm

Regular canoe frame surveys have been carried out in Ghana since 1969 and from these it is possible to see the composition of the canoe fleet over the past twenty years.

Table 7. COMPOSITION OF THE GHANA CANOE FLEET 1969 - 1989

Canoe Type	1969	1973	1977	1981	1986	1989
Ali/Poli/Watsa	2315	2244	3005	3359	3969	3685
Beach seine	1587	1081	761	833	797	850
Set Net	3347	2973	3532	1734	1852	1853
Line	734	767	1174	661	1004	1114
Drift Gill Net				351	450	366
Total	7,983	7,065	8,472	6,938	8,072	7,872

Table 7 shows a tendency for the number of canoes in APW category to increase up to 1986 since when the numbers appear to have decreased. This increase to 1986 is thought by the ghanaian fisheries department to be partly due to the high cost of investment in the inshore trawlers and the lack of spare parts to keep them running. As an alternative the inshore vessel owners and potential owners invested in canoes. Whatever the reasons for the increase up to 1986 there was a decline up to 1989 of some 285 canoes, maybe due to emigration.

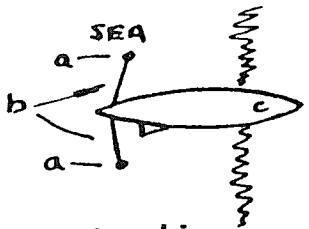
There are several reasons underlying this decrease and include the possibility that many canoe fishermen migrated to other countries to fish in less competitive fisheries. It is also possible that many AWP canoes converted to other forms of fishing such as long lining where there has been a marked trend towards larger vessels to carry out longer trips to more distant fishing grounds (and therefore did not appear in the AWP category). The capacity of the line canoes has also increased due to the need to take more fuel, cool boxes and ice to facilitate these extended trips.

According to fishermen interviewed during this survey many were of the opinion that the high cost of fishing inputs was discouraging new, as well as replacement, investment. Others felt that the low returns from fishing made investment in such craft unattractive and unprofitable to outside entrepreneurs. The latest survey shows that the upward trend in the number of canoes has resumed so there is no certainty about the numbers of canoes in the purse seine fishery except that the method of fishing still appears to attract new entrants. Whether this is the result of the economics of the purse seine fishery or whether other factors such as status enter into the calculations is difficult to judge. Certainly the man with several canoes is regarded as a wealthy man in spite of the fact that the real economic returns from fishing may not merit such a description.

Tab 9. Source. A report on the Ghana canoe Frame Survey
K.A. Koranteng and O.C. Nunoo FRNB Tema.

BOAT LAUNCHING AND BEACHING PROCEDURES (SURF LANDING BEACHES) GHANA.

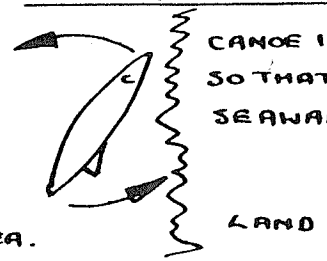
1. LANDING AND UNLOADING FISH.



CANOE BEACHES WITH BOW ON SHORE STERN TO SEAWARD. STERN LINES HOLD STERN TO SURF. FISH IS UNLOADED.

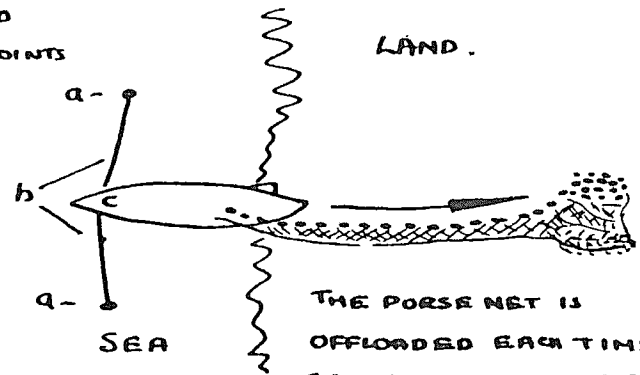
a = stern liner crew
b = stern lines.
c = bow

2. TURNING CANOE TO BEACH.



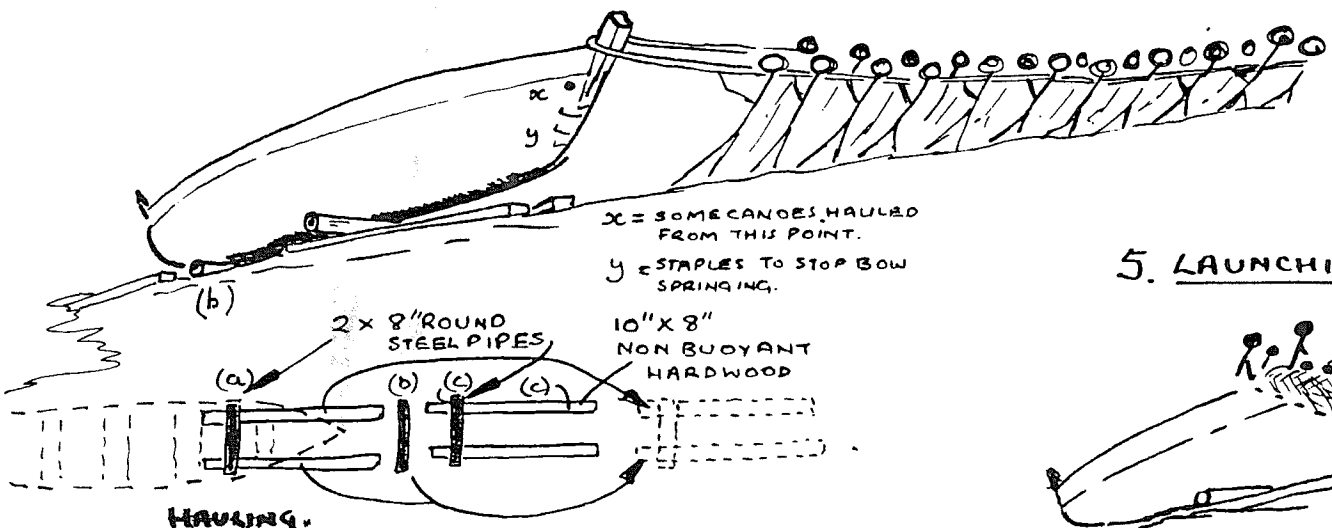
CANOE IS TURNED SO THAT BOW POINTS SEAWARD.

3. UNLOADING NET.



THE PORSE NET IS OFFLOADED EACH TIME CANOE IS HAULED UP THE BEACH. I.E. DAILY.

4. BEACHING THE CANOE.



x = SOME CANOES HAULED FROM THIS POINT.

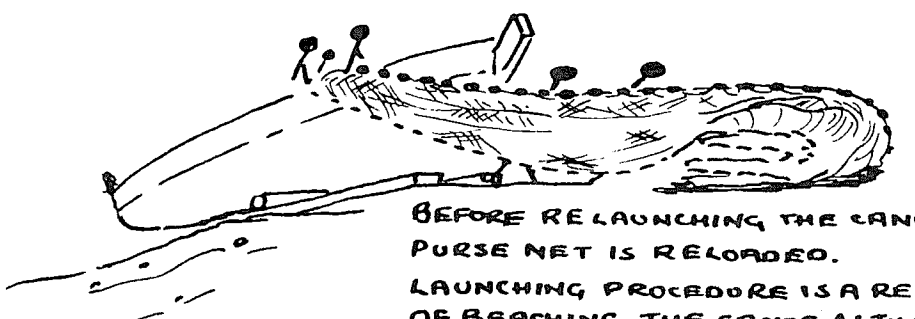
y = STAPLES TO STOP BOW SPRINGING.

HAULING.

HEAVY PLANKS ARE PLACED IN WATER EACH SIDE OF CANOE. EIGHT MEN LIFT BOW ON THEIR BACKS. THE ROLLER (a) IS PLACED UNDER THE BOW ON TOP OF PLANKS. BOW IS THEN LOWERED ONTO ROLLER. (a). UP TO THIRTY HAUL CANOE ALONG RAIL. TWO MORE PLANKS AND ANOTHER ROLLER ARE PLACED IN FRONT OF THE CANOE AND ROLLER (a) FALLS OFF RAILS AT (b). AT THIS POINT CANOE HAS ROLLED ONTO ROLLER (c) AND RAILS (c) AND THE EXERCISE REPEATED.

5. LAUNCHING THE CANOE.

FIG 23



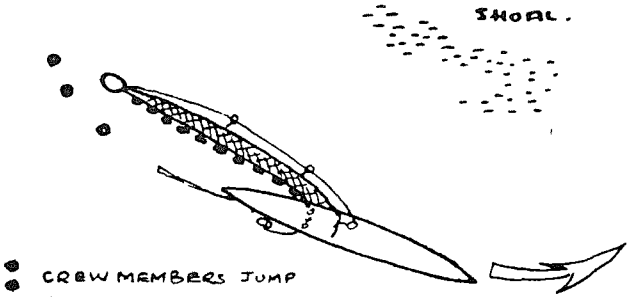
BEFORE RELAUNCHING THE CANOE THE PURSE NET IS RELOADED.

LAUNCHING PROCEDURE IS A REVERSAL OF BEACHING THE CANOE ALTHOUGH EASIER TO PERFORM AND NOT OFTEN NEEDING HAULING ROPES. A PUSH FROM THE CREW USUALLY BEING SUFFICIENT TO LAUNCH.

6. THE CANOE HAS THEN TO PASS THROUGH THE SURF.

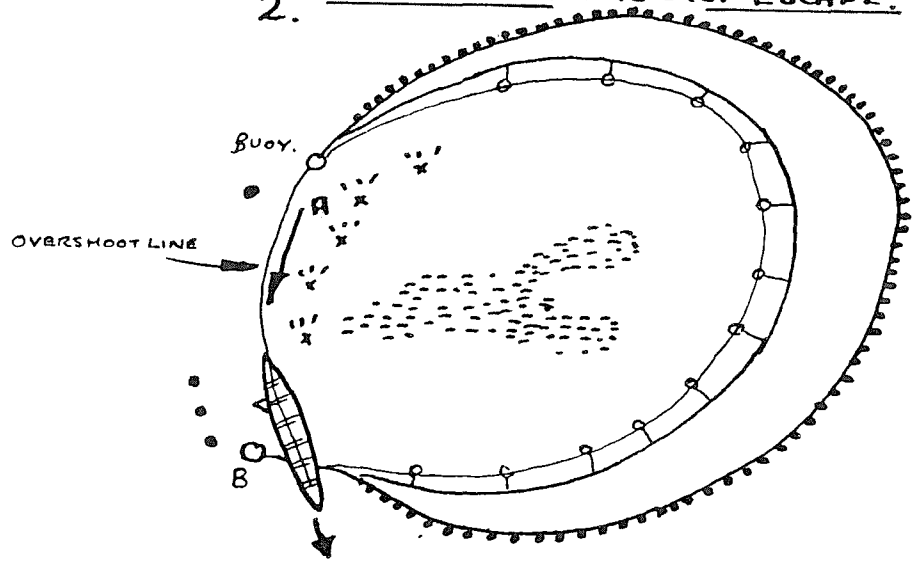
SHOOTING THE PURSE SEINE ~ GHANA.

1. SHOOTING THE PURSE NET.



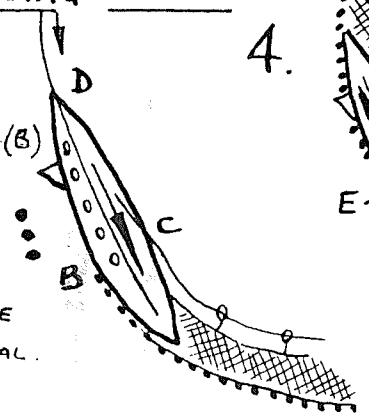
CREW MEMBERS JUMP OVERBOARD TO SPLASH AND SCARE FISH TOWARDS THE ENCIRCLING NET.

2. CLOSING THE NET TO STOP ESCAPE.



● = CREW IN WATER SPLASHING.
O = CREW IN WATER CHECKING LEADLINE FREE.
X = ROCKS THROWN INTO WATER AS CANOE ADVANCES TO CLOSE GAP (OCCASSIONALLY).
A = OVERIDE LINE PAIDOUT OVER STERN.

3. CLOSING: DETAIL

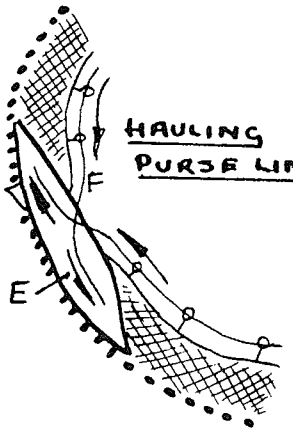


CREW HAULS IN BUOY AND FLOATLINE TO PORT (B) AND PURSELINE TO STARBOARD (C).

OVERIDE LINE D IS HAULED TO CLOSE NET AROUND SHOAL.

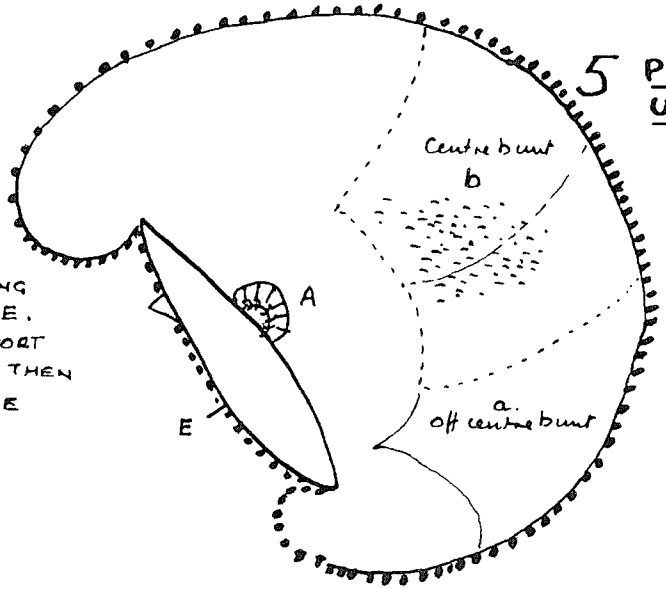
●: CREW IN WATER SPLASHING TO STOP ESCAPE WHILE PURSE IS OPEN.

4. HAULING PURSE LINE.



CREW HAUL NET ALONG STARBOARD SIDE TO E. AND PURSE LINE TO PORT SIDE (F). CREW IS THEN READY TO HAUL THE PURSE LINE.

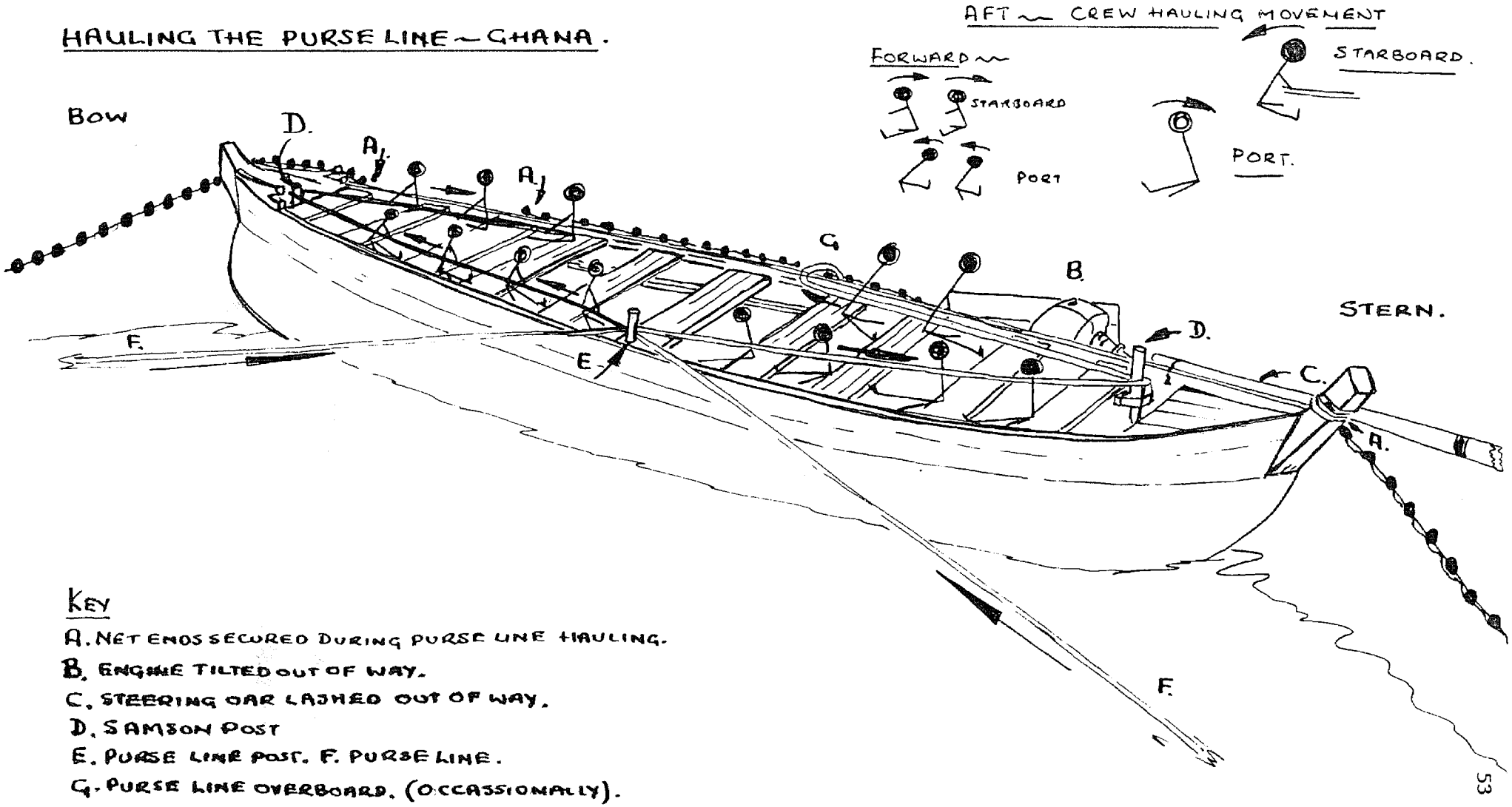
5. PURSE LINE CLOSED. UNDER SHOAL.



AS THE RINGS CLOSE AND COME TOGETHER AT A A SLOWER AND MORE POWERFUL HAULING RYTHM IS ADOPTED. TO TAKE ACCOUNT OF FULL WEIGHT OF RINGS NETTING AND SHOAL.

FIG 24.

HAULING THE PURSE LINE ~ GHANA.



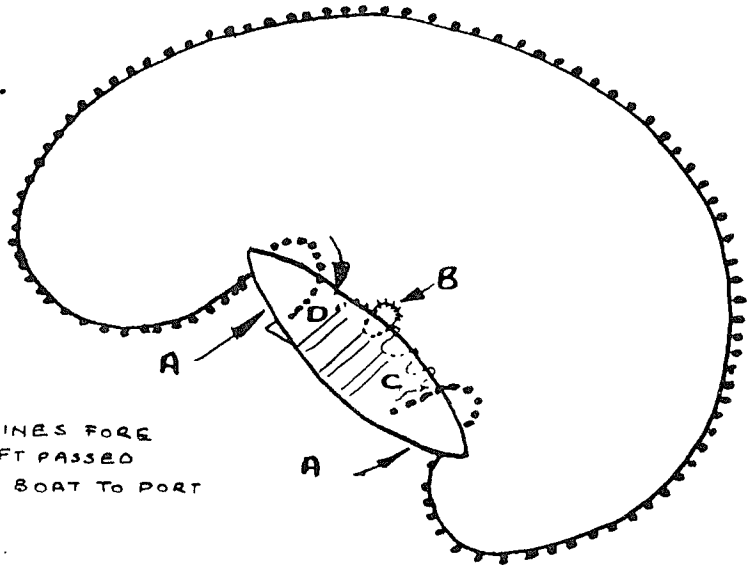
KEY

A. NET ENDS SECURED DURING PURSE LINE HAULING.
B. ENGINE TILTED OUT OF WAY.
C. STEERING OAR LASHED OUT OF WAY.
D. SAMSON POST
E. PURSE LINE POST. F. PURSE LINE.
G. PURSE LINE OVERBOARD. (OCCASSIONALLY).

FIG 25

TRANSFER OF FLOATLINES TO PORT SIDE.

6.



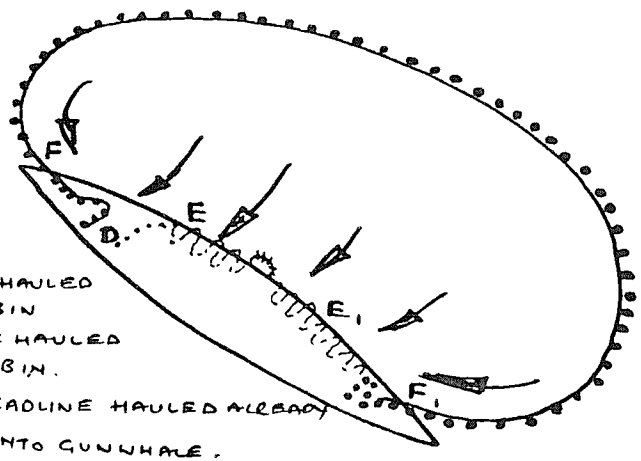
A = FLOATLINES FORE AND AFT PASSED UNDER BOAT TO PORT SIDE.

B = RINGS.

C = HAULING AND STACKING NET. FORWARD.

D = HAULING AND RELAYING NET READY FOR NEXT SHOOT. INTO NET BIN.

7. FINAL STAGE OF HAULING NETTING.



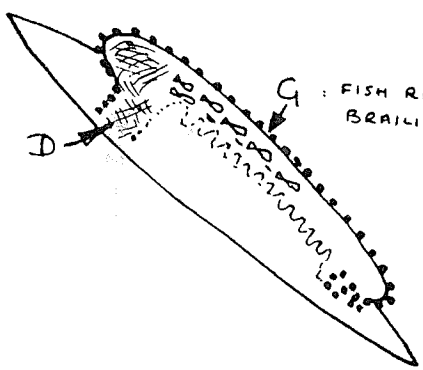
E = LEADLINE HAULED INTO NET BIN

F = FLOATLINE HAULED INTO NET BIN.

E1 LEADLINE HAULED ALREADY ONTO GUNWHALE.

F1 FLOATLINE HAULED IN BOARD.

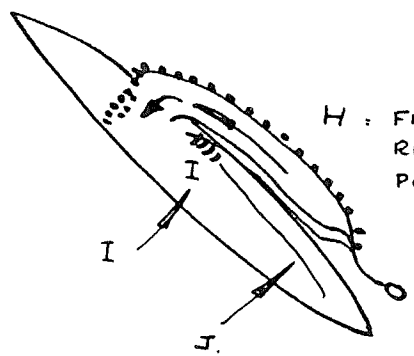
8. BRAILING FISH INTO CANOE



G : FISH READY FOR BRAILING INTO CANOE.

9.

FINAL STAGE OF RELAYING THE NET.



H : FINAL RELOADING OF NET END READY FOR NEXT RING NETTIN PURSING OPERATION.

I : PURSE RINGS STACKED IN ORDER WITH PURSE LINE LEADING FORWARD (J).

FIG26

9.3 THE ARTISANAL PURSE SEINE IN GHANA.

The section at the beginning of this report decribed in sufficient detail the various types of purse seines in current use in Ghana to make it unecessary to repeat these definitions here, see figs 20, 21 and 22 for full technical details of the three basic types of artisanal purse seine in use. These are the Watsa, the Poli sieve and the Watsa Poli.

9.4 PURSE SEINE OPERATIONS IN THE GHANA FLEET.

The basic technique of purse seining is the same in Ghana as it is in Senegal except that there are differences in the canoes themselves (see figs 3 & 19a) and the purse seine nets which are generally slightly lighter than the Senegalese nets and generally have a central rather than a lateral bunt.

As in Senegal the net is shot in relation to wind, tide and the behaviour of the shoal. However, it was apparent in the surf beach fishery of Anchorful that the level of competition to catch the shoals of anchovy and fast swimming little tunny was extremely high. At any one time during the trips the surrounding fleet consisted of up to sixty large canoes of which some thirty were in very close and competitive company. The effects of this were that crews were shooting their gear without regard to wind, tide etc and were obliged due to the concentration of effort to shoot their gear when possible on a first to shoot their gear basis. It was apparent that only in rare circumstances were the captains of the canoes able to position their canoes according to ideals for the encircling of a shoal. Hesitation to shoot gear often meant losing the chance to set the gear at all.

The level of competition meant that when a section of a shoal rose to the surface the canoes in close proximity shot their gear in very close company often leading to false sets due to the uncertainty of who was first to start setting his gear (see fig 23 a for an overall view of a typical days fishing). On other occassions canoes with very long nets would set their nets around those canoes with smaller nets.

Another difference between the Ghana canoes and the Senegalese canoes was the number of crew who were seen leaping into the water in Ghana. The fact that this was not observed Senegal probably reflected the significantly lower water-temperature in that country whereas the water temperature in Ghana was much higher. To prevent fish swimming around the end of the net at the beginning of the shooting operation several, usually young crew members, leapt into the water splashing to divert fish towards the encircling net. Others threw stones and revved up the outboard to stop fish swimming out of the rapidly closing net and yet others dived overboard to undo any snags between the floatline and netting. Although such actions were common to this particular fleet other fleets along the coast employ different tactics in their attempts to catch and prevent the escape of the fish.

9.5 HAULING THE PURSE SEINE.

As can be seen in fig 25 the crew are placed in such a way that they are roughly split into two hauling teams of equal strength and haul simultaneously on the purse line. This

procedure is often accompanied by hauling chants, beating drums gongs, gestures and almost choreographed hauling actions. Some of the chants should be recorded for posterity before they are lost to progress and changed circumstances. The roughly equal strength of the purse line hauling teams reflects the position of the bunt which is often, but by no means always, in a central position. When the bunt is in a lateral position the numbers and strength of the purse line crews reflect the length of line to be hauled with more crew on the longest wing.

DIFFERENCES.

Unlike the Senegalese fishermen the Ghanaians remain largely seated during the hauling of the purse line whereas the Senegalese adopt a standing stance during the hauling procedure (see figs 6 & 25). This sitting stance is maintained until the purse rings are secured along the freeboard and then the crew stand to haul in the leadline and wings which is relaid as hauling proceeds with the rings. As the wings continue to be hauled the fish are guided into the bunt for final transfer to the canoe by brail or bight of net. When the fish are loaded the net is relaid in the net bin usually by running it along the thwarts. This is a relatively quick and simple operation.

RELAYING THE NET.

Unlike the technique observed in Senegal the net is relaid with the leadline along the portside and the floatline to starboard, whereas the Senegalese laid their net with the floats across the net bin with the leadline also set across the pirogue foreward of the floatline (see figs 5,6 & 7). Another difference observed during the shooting of the net was that the Ghanaian fishermen usually held the purse rings in their hand as the net was set whereas the Senegalese placed the rings on a pole from which they were shot automatically. In both cases the purse line was fed manually into the rings as the net was shot away.

INNOVATION IN THE GHANAIAN PURSE SEINE FISHERY.

The ghanaian fishery has been the most inovative of all West African fisheries and the success with which they have adopted and adapted the pursing technique as well as developing inovative adaptations of gill, drift and lining methods clearly shows their willingness to accept new ideas when they are convinced of their effectiveness. The Ghanaian artisanal fishermen were also not slow in adopting petrol outboard engines, cool boxes for the preservation of fish at sea etc. In fact their apparent reluctance to adopt ideas which have been promoted from outside the fishery appears to be more to do with reluctance to adopt untried and, to them, inappropriate ideas, not as is often claimed, the result of innate conservatism.

FUTURE ASSISTANCE TO THE PURSE SEINE FISHERY.

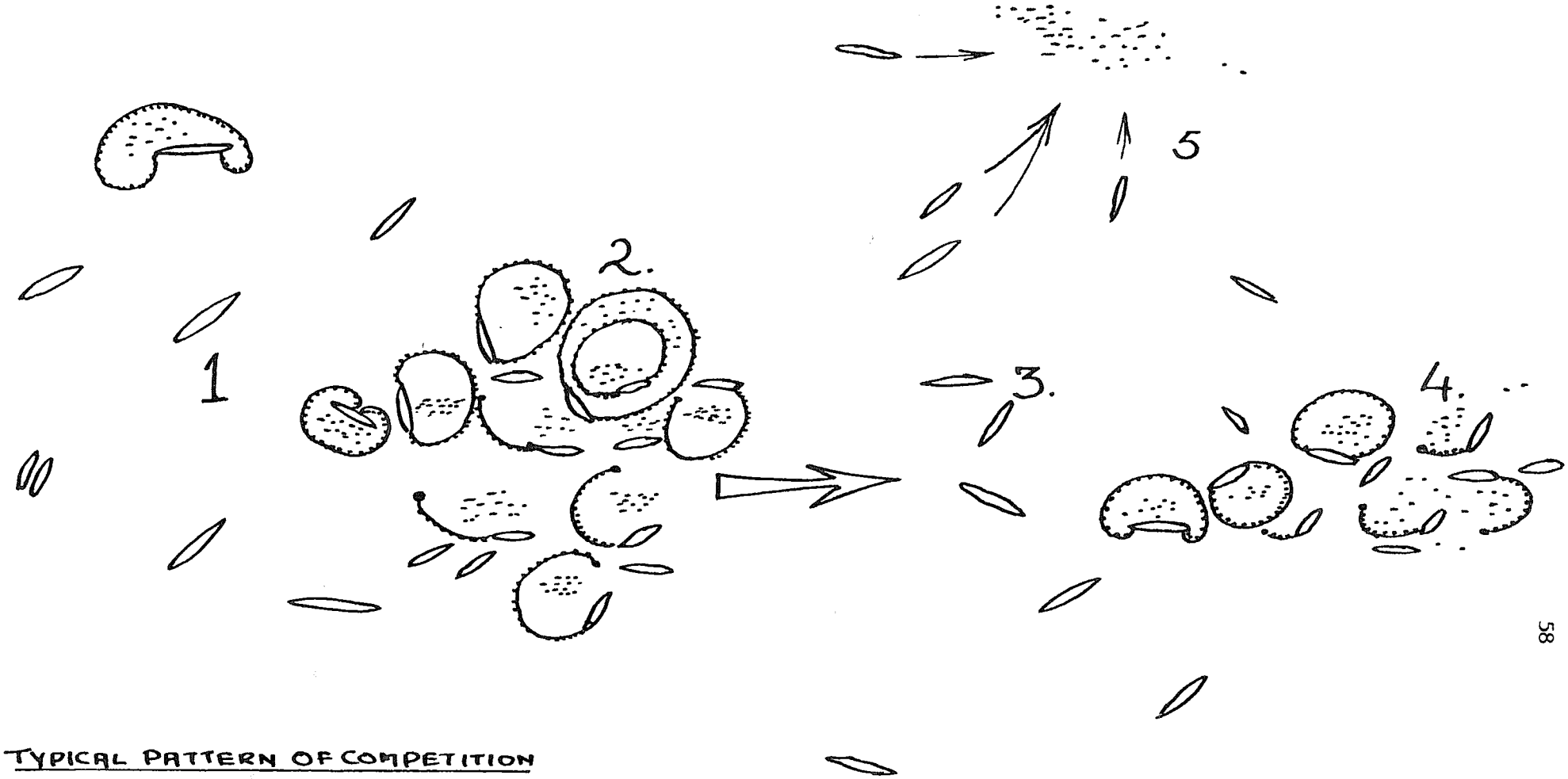
The fishermen may therefore respond more positively to ideas which successfully reduce their costs of operation such as diesel outboards, less costly net designs, and alternative canoe hulls such as those made from modern materials as well as the consideration of traditional canoes such as the ghana plank canoe.

In terms of priorities the recent studies of costs and earnings of the purse seine fisheries seem to show that the

ghanaian fishery is in the most precarious financial position (ignoring social factors) and that in so far as sensitivity to changes in the cost of inputs the most important costs are fuel and outboard engines, fishing gear and the smallest cost being associated with the canoe hull itself. In terms of development assistance most effort, if following the most important priorities for artisanal fishermen, would be directed towards more fuel efficient propulsion.

However, if these activities are carried out in isolation of thorough knowledge of the resource base then any development assistance towards improving the financial viability of the purse seine fishery would fail to be sustainable because the resource itself may not prove sufficient to sustain additional effort.

The end result of such assistance may therefore do more harm to local fishing communities than if they were left entirely without any help towards improving their viability. After all improving the viability of a declining fishery will make the level of exploitation even worse than if allowed to collapse. In this respect consideration could be given to conservation through the removal of all subsidies to fuel, gear and vessels and allowing conservation to arise from economic viability. Research into this area may help in those areas where it is known that there is inadequate knowledge of the resource and little control of the fishery. One cautionary note should be sounded here and that concerns the fact that the artisanal purse seiners are not the only fishermen exploiting the pelagic resources of West Africa and any action to control artisanal purse seines should also examine the industrial purse seine fishery which this report does not address.



TYPICAL PATTERN OF COMPETITION
AMONG GHANAIN ARTISANAL PURSE
SEINE FISHERMAN ~
TAKEN FROM FIELDNOTES-ANCHORFUL FLEET GHANA ~ 1991.

1 and 3 CANOES WAITING OR SLOWLY CRUISING AROUND LOOKING FOR FISH.

2 and 4 CANOES SHOOTING ENCIRCLING NETS AROUND RISING SHOALS OF FISH IN CLOSE COMPANY.

5 CANOES RACING TO NEW SIGHTING OF SHOALS.

FIG 27.

10.0 THE ARTISANAL PURSE SEINE FISHERIES OF BENIN.

The coastline of Benin is only 120 kilometres in length and by West African standards the marine resources are limited and the level of fish landings is insufficient to match local demand. There is no local deep water fleet which can exploit offshore resources and the local fishing fleet is dominated by the artisanal canoes which land a high proportion of the national catch. According to the latest statistics the national catch amounted to some 8,252 tons in 1989. The shortfall between national production and demand has been met through imports from Europe and Russia.

Production.	Tons.
1985	7,832.
1986	8,007.
1987	9,047.
1988	8,153.
1989	8,252.

Among the types of fishing gear employed by the marine artisanal fishermen the purse seine is the most significant (see fig 27) and are largely used by migrant Ghanaian fishermen. The fishery is in consequence almost identical to that in Ghana and the methods of making and setting the gear are similar.

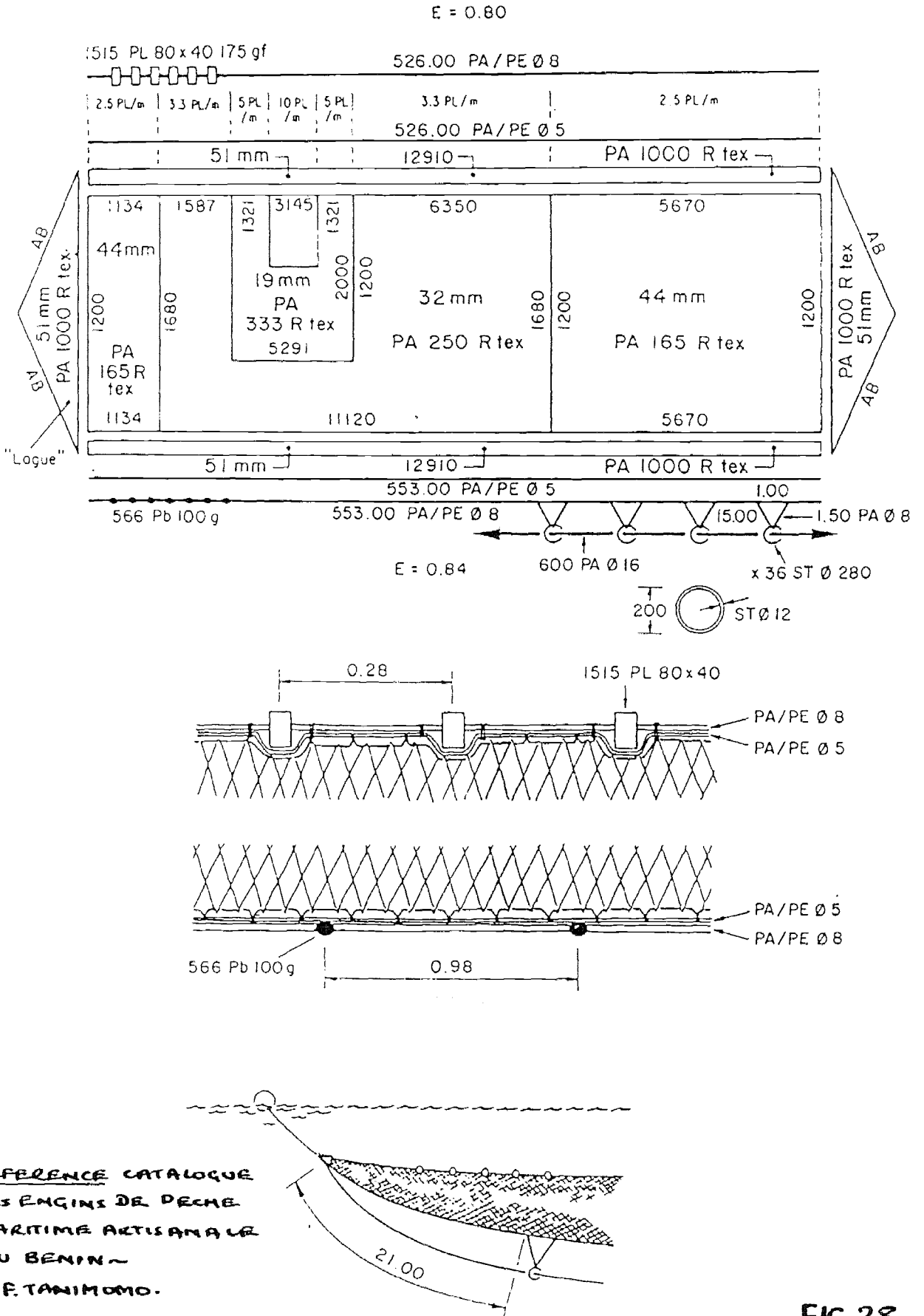
The number of purse seines in Benin are shown below.

	Oueme	Cotonou	Atlantique	Mono	Total.
1984.					
No of purse seines.	0	10	26	26	62
No of fisher -men.	153	-	1,350	1,354	4,000
1988.					
No of purse seines.	0	24	26	22	72
No of fish -men.	223	553	1,281	1,154	3,211

Table 8.

Up to 1989 table 10 shows that there was no dramatic rise in the numbers of fishermen adopting purse seines in Benin. Unfortunately there are no up to date figures to confirm that the slight increase in numbers is due to local fishermen adopting the purse seine technique or to migrant fishermen from ghana being included in these figures. As a result it is also difficult to confirm the impression gained in Benin as well in all the other countries visited that the number of fishermen adopting purse seines had either peaked or is rising only very slowly. Without recent statistics it is impossible to judge whether this impression is correct or not, but if it is correct then it may well reflect that the use of the technique has reached saturation point in relation to the resources of some fisheries as well as numerous other factors which include the high cost and poor

La senne coulissante : "witchy" ou "watcha"



REFERENCE CATALOGUE DES ENGINS DE PECHE MARITIME ARTISANALE DU BENIN — P.F. TANIMOMO.

FIG. 28

supplies of the inputs needed to keep a purse seining canoe in operation.

10.1 BACKGROUND TO THE PURSE SEINE FISHERY IN BENIN.

The adoption of purse seining in Benin followed closely the developments which took place in the purse seine fishery of Ghana and its spread to Benin can be attributed to migratory Ghanaian fishermen.

Before the introduction of purse seining local fishermen were using the encirling nets called Watsa (not the Watsa purse seine) and according to some fishermen this net had a bunt. However, it is not clear whether this "bunt" was a section of stronger netting which formed a bag or whether it was a section of smaller mesh netting to gill smaller fish. Whatever the case this net was claimed to be very close to the Ghanaian Watsa which was later adapted to become the Watsa purse seine. This type of net is still in current use in Ghana and is believed to have been introduced into the Benin fishery in the early 1970's.

IN 1989 P.Tanimomo described in detail the type of purse seine net in use by local and migratory fishermen in the catalogue des engins de peche maritime artisanale du Benin. This net (see fig 27) is basically the same as the purse seines in current use in the Ghanaian fisheries although there appears to have been a similar trend in Benin as in the other countries visited towards the adoption of smaller mesh. In the example quoted by P.Tanimomo the mesh size in the bunt is recorded as 19mm whereas the current everage is nearer 10mm in the bunt. This trend towards smaller mesh in the bunt closely follows the Ghanaian pattern where the Watsa purse seine has evolved into a more versatile net by the inclusion of a small mesh section and has in consquence been given a new name, the Watsa _ poli purse seine (see opening definitions and fig 23). In terms of the canoes and the techniques of operation the purse seine fleet which operates in Benin are similar in all respects to those typically found in the Ghanaian purse seine fishery.

CONCLUSIONS,

II. COMMENTS AND OBSERVATIONS ON ENCIRCLING NET OPERATIONS.

1. There is an increasing trend towards the use of the purse seine in Senegal and Ghana and Benin but not in Guinea where it is banned or Sierra Leone where its use is actively discouraged.

2. There is an increasing trend towards constructing longer and deeper purse seines as well as longer encircling nets.

3. Longer and heavier gear with smaller mesh size has been accompanied by an increase in vessel size.

4. Accompanying 2 & 3 above there appears to be a trend towards the targetting of smaller fish, such as anchovy and juvenile sardinella along the Ghana/Benin coast and juvenile bonga in Guinea and Sierra Leone, as the stocks of the larger pelagics become more scarce or the competition to catch them increases.

5. The adoption of more fuel efficient engines has made no progress. In fact the past failures seem to have reinforced resistance in some areas.

6. The available statistics appear to indicate that the purse seine and encircling net fisheries are still viable methods of fishing, given their current socio/economic organization. However there are signs that if fuel and in some cases gear subsidies were withdrawn the effects on the viability of the large canoes would be serious.

7. Catch statistics,poor as they are, indicate a rising trend from purse seining. How long this trend can be maintained, given current ignorance about stock levels versus purse seining effort, it is impossible to tell.

8. Use of purse seines in Guinea and Sierra Leone is not warranted due to the nature of the fishery (they target mainly Bonga not herring which have a very poor market) and the nature of their extensive continental shelves (shallow water and generally muddy/soft sand substrate).Where herring is targetted, as in Godrich, current nets appear effective enough in relation to the stocks available.

9. The main type of vessel in use for purse seining is the traditional canoe/pirogue. No successful replacement has been as yet identified.

10. With respect to the design of purse seine nets Senegal still follows the basic pattern introduced by FAO in the late sixties, in Guinea it is banned, in Sierra Leone its use resisted while in Ghana/Benin the net is still evolving with the changing nature of the fishery. These changes have been accompanied by the use of smaller mesh and longer and deeper nets to catch smaller fish. This trend is mirrored in the Encircling net fisheries where another trend has been towards smaller mesh as in the reggae and the incorporation of a small mesh central bunt section, in the encircling gill net referred to as a filet mixte.

11. The almost universal use of the external outboard engine mounting bracket by the artisanal canoes (see fig19 for description of Ghana dugout canoe for detail of bracket) not only exposes the engine to excessive amounts of salt water it also leads directly to operator behaviour which frightens away fish. To avoid cavitation of the propeller, especially when setting the net around a shoal of fast swimming pelagics, the operator has to keep raising and lowering the engine revolutions in a manner which alarms the fish which dive before the purse is closed and escape. Cavitation is particularly noticeable during choppy sea conditions when the waves approach from the beam. The obvious cure to this problem would be the adoption of the inboard well which would help with cavitation as well as with outboard protection. However, there is an almost universal aversion to making holes in the dugout hulls for the construction of a well.

12. The more small mesh incorporated into the purse seine net and the greater the hanging ratio(ie the more the net is stretched out lengthwise) the more likely it is that the net will sink too slowly to catch the faster swimming large pelagics.This scenario appears to have accompanied the more widespread use of small meshes as the Ghana canoe fleet have been obliged, by fish scarcity, to make their nets in a manner which will enable them to catch a wider variety of different sized fish. In this respect it was observed that many canoes which had encircled good size shoals of fish had nothing when the nets were finally hauled except the few very small fish upon which they were feeding. This occurred so often to a variety of canoes that the rate of escape was worth recording for future reference.

13. It should be remarked that in relation to item 2. above the consultants fished in company with a fleet of some sixty other canoes of which at any one given time some fifteen to thirty canoes were in close and very competitive proximity. It may be that the apparent innefficiency of current operations in terms of the faster pelagics is of great importance to the conservation of existing stocks.

14. The fishermen themselves attributed the high escape rate to the fish becoming clever and learning to avoid the encircling manoevre of the purse net and especially those nets which had an abundance of small mesh. That is those nets which are currently illegal in Ghana and come under the general heading of Poli-Sieve nets. Another potent reason for the high level of escape appeared to be the high incidence of rotten netting and poor attendance to repairs.

15. The expence of petrol appears to severely limit the hunting range of the artisanal canoes and may be an important factor leading to the concentration of effort in a too narrow coastal band. Improved use of more fuel efficient motors may help to extend range and decrease the localization of fishing effort.

16. The speed at which the purse net was deployed appeared to be markedly slower among those crews observed than the setting of the encircling net (gilling or reggae type)from the Ghana plank canoes of Sierra Leone . This can at least in part be attributed to the generally heavier netting of the ghanaian and

Senegalese purse seines which seem to cause much more drag than the generally lighter twines of the encircling net as well as the spreading activity employed among many Sierra Leonean crews (see fig 13).

17. Several writers on fishing gear appear to be concerned about the rationale behind the position of the bunt in relation to the rest of the net. In fact among the fishing canoes observed by the consultants the bunts were found laterally as well as in a central position. Some lateral bunts were offset from the centre while in others such as in Senegal the bunt of the net was at one end although it was still hauled slowly for a part of the hauling procedure. The reason why the Ghanaian fishermen positioned their bunt in the middle appears to be associated with the fact that they haul from both ends simultaneously and not just from one end as observed in the Senegalese canoes. This reduced by one half the time required to close the purse under the fish and would appear to be a sound reason for situating the bunt in the middle of the net. The fact that the foreward section of the hauled net needs to be run aft for relaying in the net bin after each haul is a simple operation requiring the net to be run over the thwarts to the net bin and taking very little time.

18. Again in relation to the hauling procedure of the purse net it would appear that the position of the bunt also affects the number of crew hauling from each end of the net. for example it was observed that where the bunt was situated to one side more crew members were set to haul the longest section of purse line, again in unison, until the bunt was reached when the effort was occassionally redistributed to hauling with equal effort from both ends.

19. In terms of the design of nets in the purse seine fishery it would appear that too much is being attributed to the reasons which lie behind the employment of such a wide range of mesh sizes in the construction of the various purse nets. What appears to be a much more potent influence on net design is the lack of availability of suitable materials at a cost which is acceptable to the fisherman concerned. Because netting is often scarce and expensive the fisherman will often incorporate a series of different mesh sizes, not because of a conscious design requirement but because that is all that is available at the time. As long as the mesh size combinations allow the fisherman to have a reasonable chance of catching the size and range of fish that he is after then he will settle on that " design ". It therefore becomes apparent that many of the differences in gear meshes found in the purse seine fishery do not merit the description of a new design but rather represent a range of combinations which have evolved from a random mixture of expediency and the design requirements to catch a particular type or range of fish. What can be stated is that where the purse seine mesh sizes are very small it is most likely that most of the fish caught will be small or immature pelagics. Whereas where the mesh sizes are mainly of a large size mainly larger pelagics will be caught allowing immature fish to escape. In between these two extremes there will be a variety of differing nets depending as has been mentioned on a mixture of design and expediency.

20. It was noted in Senegal that many pirogues were using two engines. This trend appeared to be in response to greater travel distance to seaward away from the immediate assistance of a fleet and need for self help. The cost of these two engines may exceed that of an inboard diesel.

21. In many cases it was noticed that petrol outboard engines were lasting longer. This is a trend which may affect the relative benefits of more fuel efficient engines.

22. A possible reason why the internal well is not used by Ghana canoe fishermen for mounting their outboards is that when beaching a canoe, especially if the beach is steep, with the bow to the shore and engine well to seawards, any wave approaching the stern will try to lift the stern upwards. If the purse net weighing approximately 1.5 tons is situated at the stern the canoe may not lift enough to prevent water rising through the well and swamping the canoe.

23. One of the reasons for the APPARENTLY faster fall of the reggae style net is the fact that the crew spread the net before it hits the water. It is not certain how significant this difference is but it may be the difference between success and failure to catch fast pelagics. The reggae net may also be more effective than the purse and is GENERALLY cheaper and lighter than the purse net.

24. It was noticed that the umbrella tree (musanga circropicides) was growing in western Ghana. This tree has very high bouyancy and could be used to improve the safety of Ghana canoes.

25. The mixing of petrol and polystyrine chips to make glue has become a common practice for use in the construction of canoe sides.

26. Operating the purse seine technique from dugout canoes leaves them open to considerable danger especially as the full weight of rings and net is drawn together. The method observed in Senegal was particularly dangerous in this respect.

27. The instability of the Ghana plank and dugout canoes, as well as the Senegalese pirogues is to a greater or lesser extent compensated by the automatic movement of the crew who constantly adjust their position to counter capsizing influences and trim the canoe to suit the operation of the outboard engine. These crew movements are rarely accompanied by orders and can in a way be likened to the unconscous balance of the experienced rider of a bicycle.

28. Major differences were observed in the techniques of the purse nets and their methods of setting and hauling in the Senegalese and Ghanaian fisheries. The Senegalese method reflecting FAO influence and the Ghanaian its separate development from encircling gill nets of the past. The encircling net techniques used in Sierra Leone and Guinea also reflect the influence of the Ghanaian fishermen.

29. There is still much development work to be done in the main fishimg communities of all areas visited. The particular need appears to be of the type which is directed at Integrated development in the fishing communities and paying attention to the marketing of fresh fish to inland communities.

30. The problem of questioning fishermen on their financial position in relation to their fishing operations could be assisted by adopting a common approach to fuel consumption. For example, the outboard engines in current use are well known in terms of their consumption of petrol and the same is equally true of many diesel inboard engines and diesel outboards. By taking known average consumption figures and multiplying them by the horsepower of the engine concerned a more reliable daily consumption figure may be acquired. If for example a fisherman claims he uses 300 litres of petrol a day with a 40 hp outboard the known average consumption figure of about 19 lph would mean that the fisherman would have to cruise for 15.7 hours at full speed. Questions to validate such a claim could then follow.

FUEL CONSUMPTION FIGS.

for petrol outboards. 0.45 x hp = litres per hour.
for diesel " " . 0.20 x hp = " " " " .
for diesel inboards . 0.20 x hp = " " " " .

For other details refer to West North West and community Development Programme Technical Report on propulsion systems for artisanal fishing canoes.

31. The relative costs and earnings of purse seine operations in the countries visited clearly indicate that fuel consumption and the cost of outboard engines and fishing gear rank far higher in all fisheries visited than the cost of the canoe as a major area of concern among fishermen. It would therefore appear that in terms of development priorities more effort should be directed at fuel saving and efforts to reduce the cost of inputs(not by subsidies) through design and material changes. A possible examination of the reasons for the relatively higher returns (IRR of 50 %) among the encircling net canoes of Sierra Leone than the purse seine operations in for example in Ghana may provide clues for their development.

Finally it can be stated that the current state of knowledge of the fisheries resource are insufficient for any reliable projection of the sustainability of the resource and hence the encircling net fisheries. All other considerations concerning development of the encircling net fisheries need to be taken in view of this shortcoming.

Appendix 1.

Terms of Reference: Consultant (Fishing Technologist)

Under the general supervision of the IDAF Coordinator, the Consultant (Fishing Technologist) will :

1. Work closely with fishermen and government extension staff;

2. Describe the designs of the various purse seines in use;

3. Describe their operation and the results of purse seining;

4. Assess their costs and returns;

5. Write a report, and undertake other activities if required, in agreement with the Director, FIO.

6. Make preliminary project identifications during travel for formulation missions IDAF/FAO.

Duration : 1.2 man-months

Itinerary :

Cotonou	2 days
Dakar	8 days
Conakry	5 days
Freetown	8 days
Accra	7 days
Cotonou	5 days

Languages : French/English

Starting date: March 1991

GVE/mpc

Appendix 2

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  K.A. Koranteng & O.O. Nmashie (1987)

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  K.A. Koranteng, Fisheries Department Research and Utilisation Branch Tema, Ghana

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Rapport No. 8 / 70

GRASSET C. 1971(a) Rapport sur les essais des engins de pêche nouveaux, effectués pendant la période janvier 1969 - avril 1971
ibid. Rapport No. 4 / 71

GRASSET C. 1971(b) La pêche expérimentale effectuée avec une senne tournante et coulissante par la pirogue du projet en mai - juin 1971.
ibid. Rapport No. 7 / 71

GRASSET C. 1972(a) Essais - démonstrations comparatifs d'emploi d' une senne tournante et coulissante adaptée à la pêche pirogière.
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ibid. Rapport No. 5 / 72

APPENDIX 7.

COMMENTS ON THE COMPARATIVE COST AND EARNINGS OF THE PURSE SEINE AND ENCIRCLING NET OPERATIONS OF SENEGAL, GUINEA , SIERRA LEONE GHANA AND BENIN.

1. Too few interviews and too little time were allowed to do justice to such a large and complex subject. It is therefore suggested that rather than try to read more into the available statistics than is justified the work so far carried out is used as a basis for a future study to cover large canoe operations for the whole of west africa. The proposed aims of which are set out below.

2. It is proposed that the objectives of an extended study into the comparative cost and earnings of the artisanal fishermen need to be overtly of benefit to the fishermen. In this way the exchange of help for confidential information may produce more reliable data of a financial nature than has been the case so far. In short the need for accurate information can be sold to the prospective donor. If combined with a more formal interview, rather than under the trees with the rest of the village sticking their noses in, results may be improved.

3. An attempt has been made to compare the major costings of the purse seine operations, which have been made in the currencies of their respective countries and in US dollars. This would save researchers the effort of getting out their calculators every time they wished to get a wider international sense of value.

4. The attached summary of comparative costs and earnings of purse seines gives an overall view of the relative cost and earnings in each of the countries visited. Comment is attached as a summary at the end.

SUMMARY OF COST AND EARNINGS OF PURSE SEINE OPERATIONS IN SENEGAL, GUINEA, SIERRA LEONE, GHANA AND BENIN

TOTAL INVESTMENT COST.		LOCAL CURRENCY	DOLLARS
SENEGAL. purse		7,320,000 CFA	27,211 $
GUINEA. purse			
encirc. net.		see note	
SIERRA LEONE			
"	40HP	3,305,000 L	16,525 $
encirc. net	25HP	3,155,000 L	15,775 $
GHANA. purse, watsa		7,200,000 ¢	20,342 $
purse, poli/sieve		6,900,000 ¢	19,495 $
BENIN. purse			
TOTAL FIXED COST DEPRECIATION			
SENEGAL. purse		1,480,285 CFA	5,585 $
GUINEA. purse		see note	
encirc. net			
SIERRA LEONE			
purse	40HP	1,101,195 L	5,505 $
encirc. net	25HP	1,051,660 L	5,258 $
GHANA. purse. watsa		1,350,000 ¢	3,871 $
encirc. net		1,460,000 ¢	4,187 $
BENIN. purse			
TOTAL VARIABLE COSTS			
SENEGAL. purse		8,080,320 CFA	30,491 $
GUINEA. purse		see note	
encirc. net			
SIERRA LEONE			
purse	40HP	3,013,620 L	
encirc. net	25HP	3,127,095 L	
GHANA. purse. watsa		5,112,000 ¢	
encirc. net		5,361,000 ¢	
BENIN. purse			

TOTAL INCOME.		LOCAL CURRENCY	DOLLARS
SENEGAL. purse		11,520,000 CFA	54,339
GUINEA. purse		see note	
encirc. net			
SIERRA LEONE			
purse	40HP	4,655,725 L	23,278 $
encirc. net	25HP	4,049,980 L	23,249 $
GHANA. purse. watsa		7,632,000 ¢	21,888 $
encirc. net		7,830,000 ¢	22,455 $
BENIN. purse			

TOTAL NET PROFIT/LOSS			
SENEGAL. purse		1,950,395	7,393 $
GUINEA. purse			
encirc. net		see note	
SIERRA LEONE			
purse	40HP	540,440 L	2,702.00$
encirc. net	25HP	471,225 L	2,356.00$
GHANA. purse		1,170,000 ¢	3,355.00$
encirc. net		1,009,000 ¢	2,893.00$
BENIN. purse			

Notes

1. Experimental field notes for Canoe purse seine and encirc. net are attached loose. Other held data also attached loose. for keeping IDAF.

2. The Guinea encircling fishery closely approximates to that of Sierra Leone.

3. Experimental experience in Guinea shows considerably more success with the encircling net than with the purse.

SENEGAL

EXAMPLE OF CREW AND OWNER SHARE SYSTEM

Dakar

Average catch per day (18 m purse seine/pirogue) = 40,000 CFA per day

Average annual N° of trips 288

Total average earnings per annum 11,520,000 CFA

DIVISION OF EARNINGS - SHARE SYSTEM

The gross earnings are divided into four equal shares. They are divided after deduction of daily expenses. This includes crew food (one meal each per day after going to sea) and fuel/oil.

e.g. Daily average earnings	40,000 CFA
Daily average expenses	20,640 CFA
Net average earnings per day	19,360 CFA

This is divided into four equal shares as follows.

A. ENGINE

B. BOAT/GEAR

C. OWNER

D. CREW

On an average day the owner, if he actually owned both engine boat and gear would receive 14,520 CFA and the crew 4,840 CFA. Together with the fuel food payment the owner would therefore receive 35,160 CFA , 87.9 % of the catch. The crew 4,840 CFA (+ food in kind) or 12 % in cash.

APPENDIX 4.

EXAMPLES OF ENCIRCLING GILL AND REGGAE NETS USED BY THE FISHERMEN OF YELIBOYA ISLAND --- SIERRA LEONE.

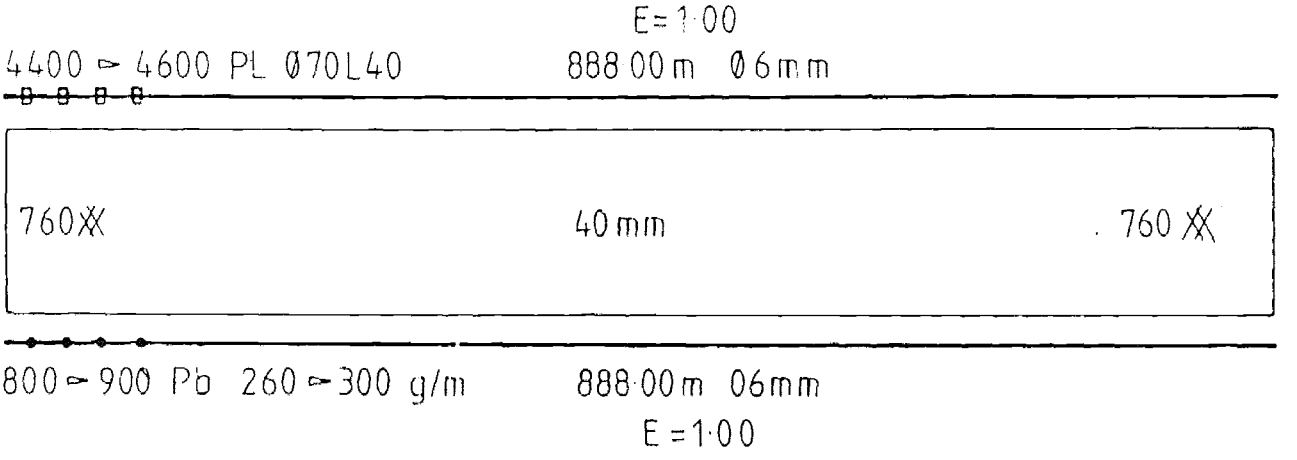
These examples of encircling nets used by the fishermen of yeliboya island can be divided into two main types; the gill type with larger mesh which gills the fish and the reggae type withsmaller mesh which does not gill the fish. There are other types but they do not concern us here because they tend to be of shallowerconstruction and used in very shallow water. Likewise they are not pursed in the deliberate way of the encircling, gill and reggae nets. The examples which are set out below were collected during a survey of the encircling nets of the Yeliboya fleet in 1987. At that time the Yeliboya fleet was experiencing some difficulties with the Guinea authorities due to their expeditions into Guinea waters in search of the large bonga . It should be mentioned that the Yeliboya bonga fishery was in fact a mainly Guinea fishery whereas in the Sierra Leone waters the juvenile bonga (awefu) was by far the most common catch.

The reason for recounting this bit of history will now become apparent. Because the Yeliboya fishermen could not entirely rely on getting to and from Guinea with the ease of the past they had to change the style of their nets to make them more versatile and catch the juvenile bonga as well as the large bonga when suitable opportunities arose. The trend was therefore established whereby more fishermen changed from the relatively specialized encircling gill net and adopted the smaller mesh of the reggae style encircling net. Examples of both these net types are set our below and serve as examples of a trend which in some ways follows the trends in the Senegalese and Ghanaian purse net fisheries.

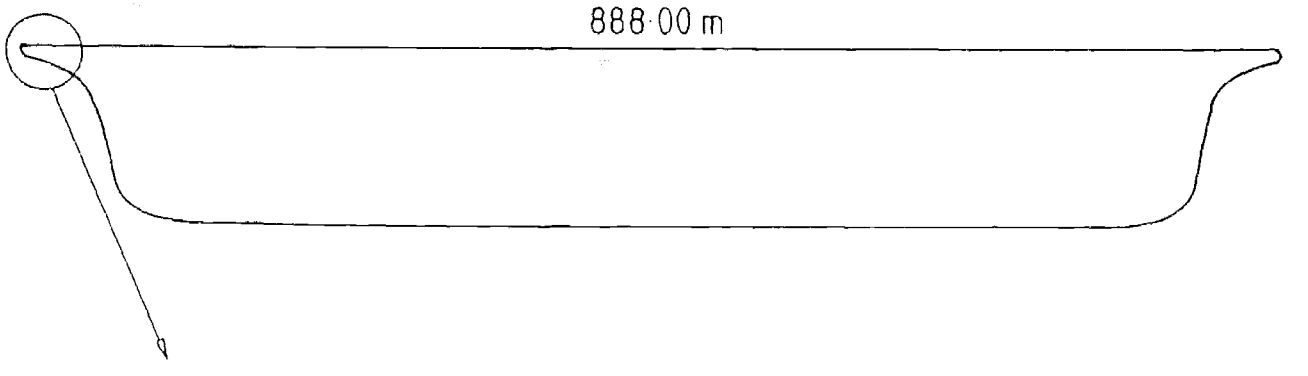
The main reason for including the encircling nets of Sierra Leone and Guinea is that in their operation they are pursed through ground contact. In other words the escape of fish through the open bottom of the net is prevented because the leadline of the net is in contact with the ground. In consequence it can be seen that there is no real incentive for the fishermen of either Sierra Leone or Guinea to adopt the much more expensive purse seines of either the Ghanaian or Senegalese models.

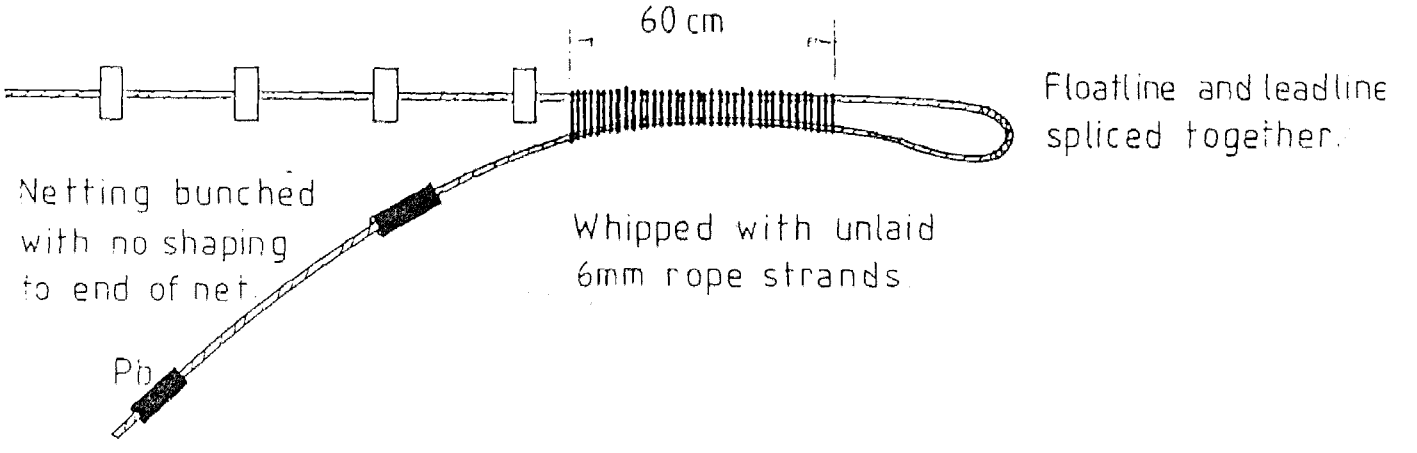
All attempts to encourage the adoption of the purse by the fleets of Sierra Leone or Guinea have so far failed . This includes the attempt at Yeliboya in 1985 and again at tombo in 1987. Attempts by the Ghana fishermen to use their own purse seine nets in the mid 70's also proved a failure not because it did not catch more fish but because of the opposition of other local fishermen who saw in these nets a threat to fish prices and to the stocks of juvenile fish. There are other reasons why the purse concept is not as attractive in these areas and this revolves around the nature of the sea bed and the large shallow continental shelf, much more extensive than in Senegal or Ghana. The use of a purse in the generally shallow waters of Guinea may cause problems if caught in the soft muddy substrate, it may also suffer much more damage than the ring net when in contact with sharp and very damaging laterite rocks. Whereas the ring net leadline would detatch itself the much stronger purse would have to be ripped off with consequently much more damage. By all accounts the ring net is efficient enough.

Vessel name: MAN SHORTAGE.
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET).
REGGAE.



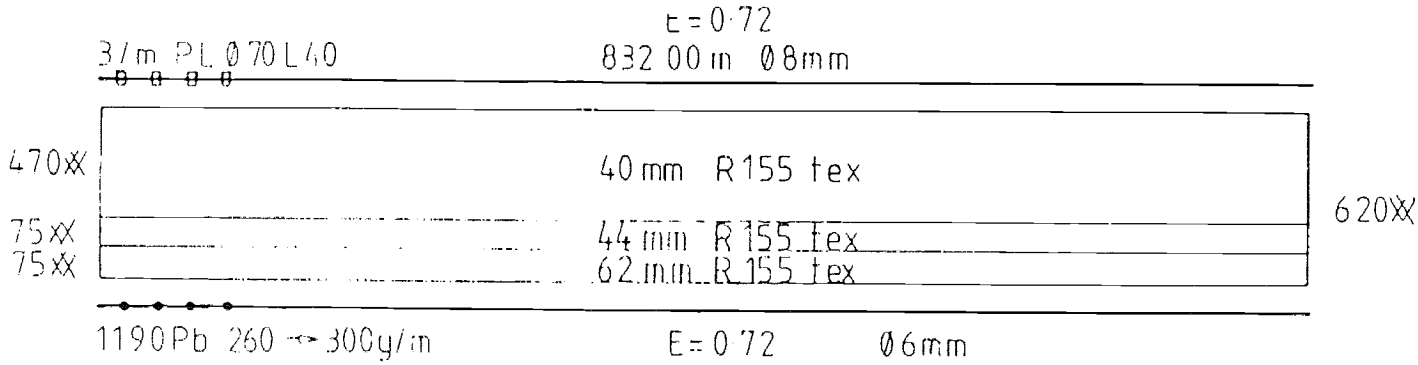
Ends bunched.



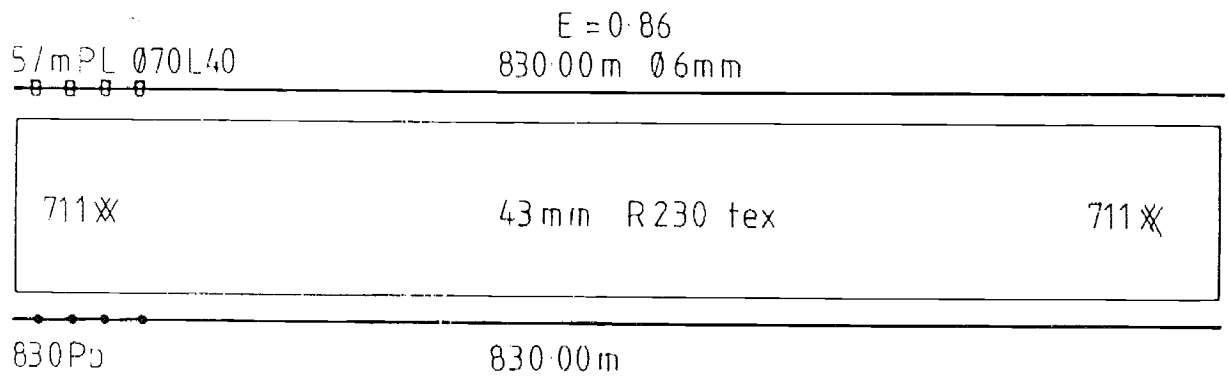


EXAMPLES OF RING NETS USED BY THE FISHERMEN OF YELIBOYA ISLAND ~ SIERRA LEONE

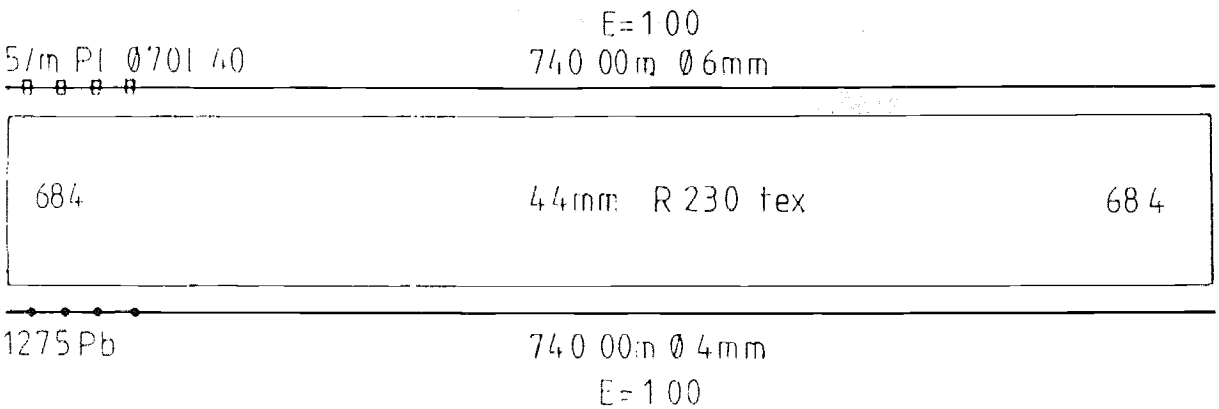
Vessel name: SEA MASTER
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET)
'FILET MIXTE'



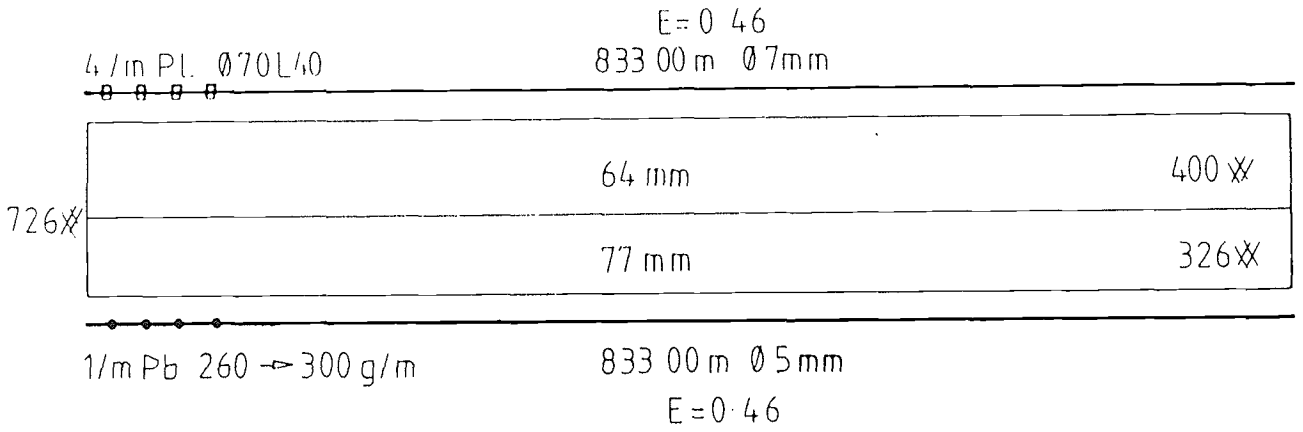
Vessel name: ALHAMDU
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET)
'REGGAE'



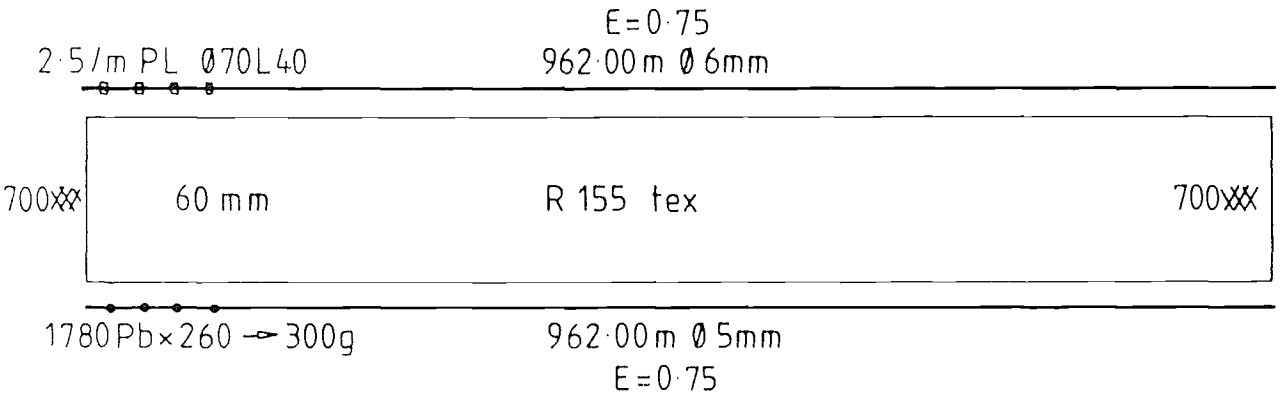
Vessel name: REGGAE STARS
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET
'REGGAE'.



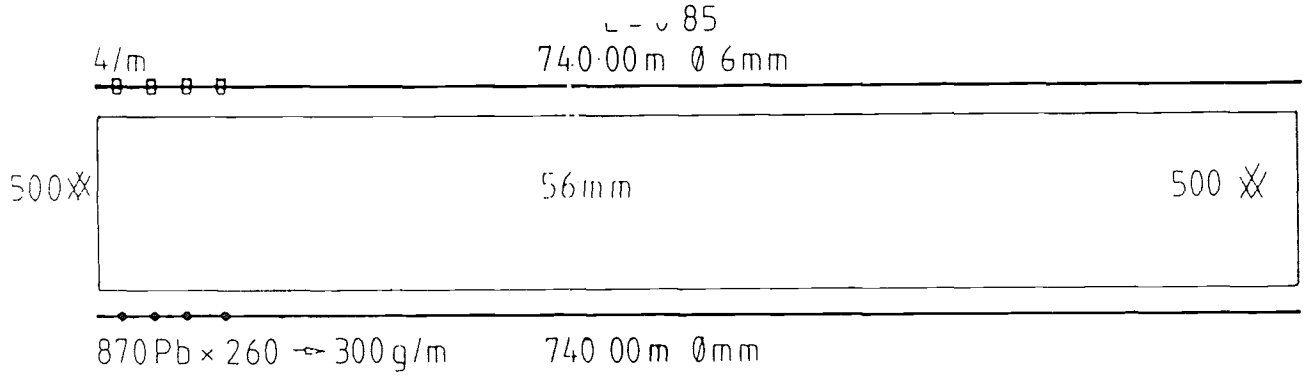
Vessel name: BANGADAE
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET
'GILL'



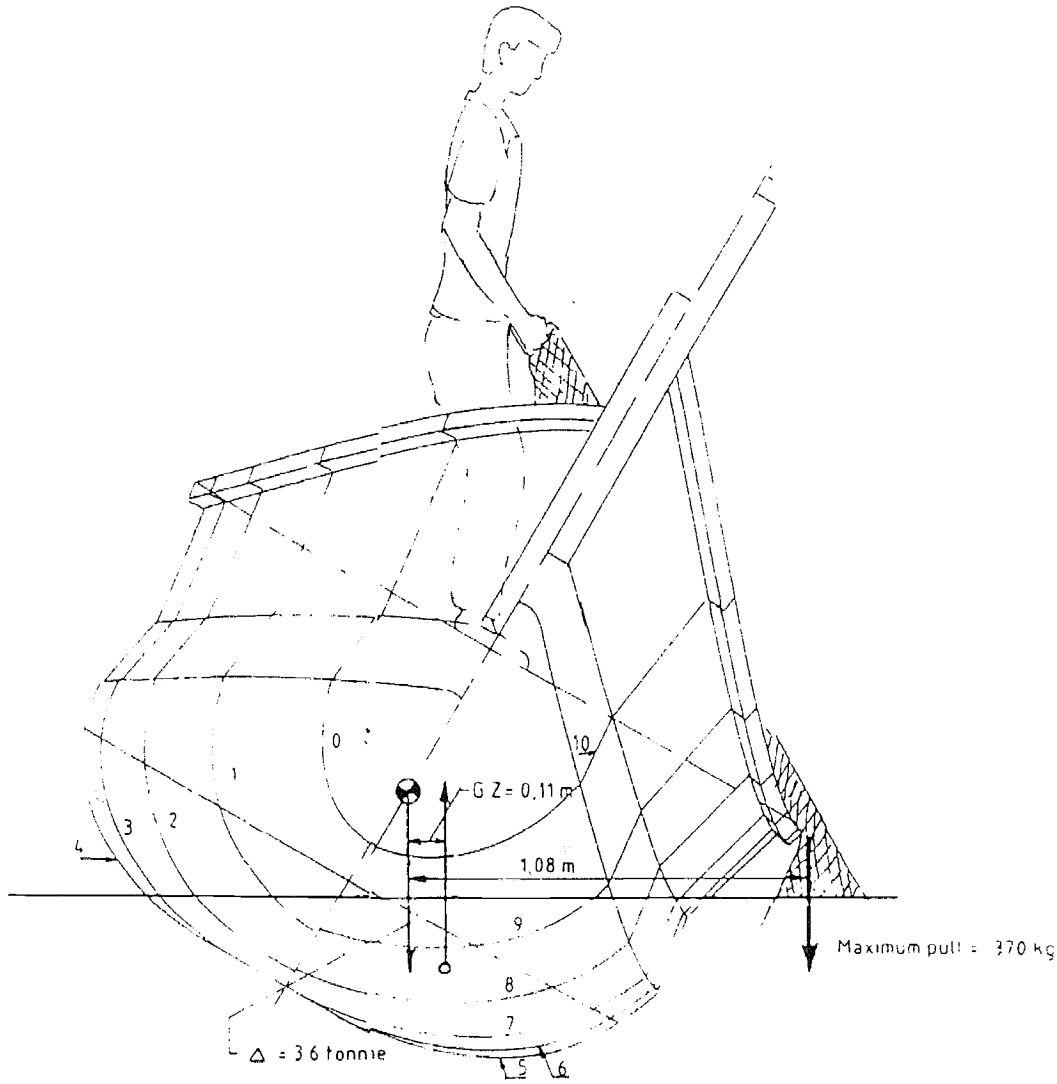
Vessel name: BULLOM STARS
Vessel type : GHANA PLANK CANOE
Net type ENCIRCLING NET
'GILL'

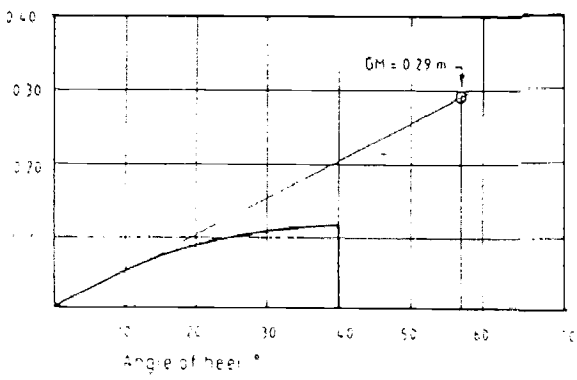


Vessel name: TAITAMY ORNEH
Vessel type : GHANA PLANK CANOE
Net type : ENCIRCLING NET.
'GILL'



Appendix S.





WORST STABILITY CONDITION :

Crew of 12 men standing on the thwarts and pulling the net over the side
At 30° angle of heel, the righting moment RM = Δ × G Z
RM = 3600 kg × 0,11 m = 400 kgm The maximum pull from the net can be 370 kg before the canoe capsizes
The crew compensates by shifting position
At 40° angle of heel water starts to come over the side and stability is lost

GHANA DUGOUT CANOE
STABILITY.

	15.1m Ghana Canoe	
	STABILITY	
SCALE 1 : 10	DESIGN NO	DRWG N°
DESIGN P. Gulbrandsen	GHA - 1	3

APPENDIX 6.

EQUIVALENT VALUES OF R TEX, m/kg, DENIER AND DIAMETER OF TWISTED MULTIFILAMENT YARNS

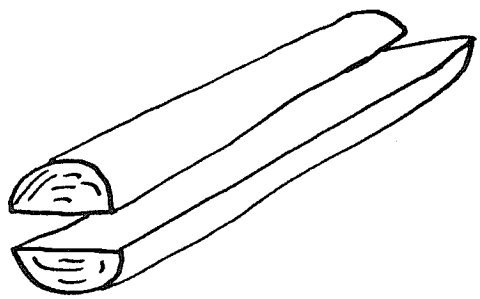
R tex	m/kg	denier number	twine diameter in mm
50	20 000	210 x 2	0.24
75	13 300	210 x 3	0.30
100	10 000	210 x 4	0.33
155	6 460	210 x 6	0.40
230	4 350	210 x 9	0.50
310	3 230	210 x 12	0.60
390	2 560	210 x 15	0.65
470	2 130	210 x 18	0.73
540	1 850	210 x 21	0.80
620	1 620	210 x 24	0.85
700	1 430	210 x 27	0.92
860	1 160	210 x 33	1.13
1 280	780	210 x 48	1.37
1 570	640	210 x 60	1.43
2 500	400	210 x 96	1.90

SAFETY SUGGESTIONS FOR GHANA CANOES.

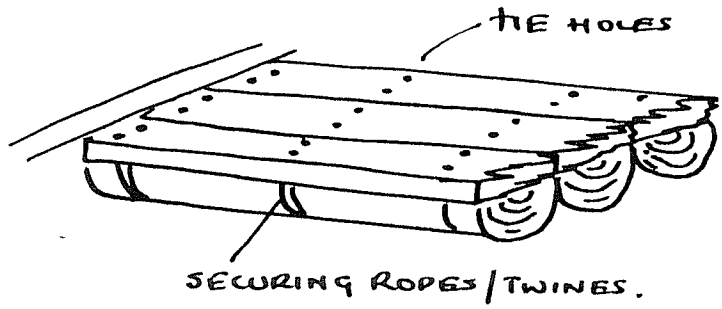
USE LOGS OF MUSANGA CIRCROPIOIDES – UMBRELLA TREE FOR IMPROVING SAFETY.

SUGGESTED PROCEDURE

1. SELECT LOGS (DRY) ABOUT 1·5 to 2′ IN DIAMETER.
2. CUT LOG IN HALF LENGTHWISE.



3. TIE LOG UNDER THWARTS OF CANOE.



4. SECURE SHAPED WOODEN PIECES IN BOW AND STERN.

NOTES.

1 METHOD IS CHEAP/SIMPLE/APPROPRIATE.
2 MATERIAL AVAILABLE LOCALLY – NO IMPORTS.
3 IT CAN BE SECURED OUT OF THE WAY OF WORK.
4 LASHINGS CAN BE CUT AND INDIVIDUAL LOGS USED AS LIFEBOUY.
5. DURING A CAPSIZE IT WOULD HOLD CANOE HIGHER IN WATER. FOR EASIER BAILING.

APPENDIX 7.

PROJECT SUGGESTIONS.

GHANA DUGOUT CANOES : A PROPOSAL TO REPLACE A PROPORTION OF THESE LARGE CANOES MADE FROM A SINGLE LOG WITH GHANA PLANK CANOES OF THE SIERRA LEONE/ GUINEA VARIETY IN THE MORE SHELTERED AREAS OF THE GHANA COASTLINE.

This proposal follows fears that the large Wawa tree, used to construct the ghana dugout canoe, was becoming more and more scarce and expensive and that no ready alternatives were either available in ghana or acceptable to the local fishermen. This raised concern about the long term viability of the surf beach fisheries and their communities.

In a report compiled for the IDAF Regional programme by O. Gulbrandsen on canoes in ghana recommendations were put foreward to build prototype replacement surf beach landing craft from various materials. Following this report which involved recommendations to replace the craft landing on heavy surf beaches it was realized that the problem could be tackled by replacing those canoes which used safe harbours and where the particular qualities of strength and durability of the ghana dugout canoe were not in fact needed. Replacing the canoes of the safe harbours and sheltered landing beaches of the ghana coastline would be an easier, though still difficult task, than trying to find a suitable and acceptable surf beach landing craft. It was also hypothesised that if safe haven vessels could be replaced by an alternative vessel this could, if regulations were introduced to confine the use of Wawa log Ghana dugout canoes to surf beaches only, go a long way towards making more logs available to the surf beach fisheries where they were really needed. This would also give more time for alternative beach landing vessels to be designed and accepted by the fishermen.

This proposal involves the introduction of the Ghana Plank canoe, as typified in Sierra Leone and Guinea, to the fishermen of certain selected shelterd fish landing sites. Preliminary investigations by the consultants have identified Apam, Tema, Accra, Cape coast, Elmina and Takoradi as places where Ghana plank canoes of traditional native construction could be used for fishing immediately without modification. No doubt other beaches all along the coast would also be suitable for the Ghana Plank canoe. Not all fishermen currently using sheltered harbours would be able to transfer to Ghana plank canoes because they may migrate to surf beaches at different seasons of the year.

Procedural outline for formulatuion mission.

1. Initiate survey through the Fisheries department to identify all sheltered beaches in Ghana.

2. Identify at same time the number of fishermen who migrate to surf beaches and/or who do not really need a Ghana dugout canoe.

3. The results of this investigation should reveal the scale

Table 2

EQUIVALENT VALUES OF SINGLE POLYAMIDE MONOFILAMENT

Nominal diameter (mm)	tex	Runnage m/kg	Breaking load in kgf dry unknotted
0.40	155	6 450	7.7
0.45	185	5 400	9.5
0.50	240	4 170	12
0.55	280	3 570	14
0.60	330	3 030	17
0.70	480	2 080	24
0.80	600	1 670	29
0.90	755	1 320	36
1.00	920	1 090	42
1.10	1 110	900	47
1.20	1 320	760	55
1.30	1 540	650	65
1.40	1 790	560	75
1.50	2 060	490	86
1.60	2 330	430	98
1.70	2 630	380	110
1.80	2 960	340	120
1.90	3 290	300	132
2.00	3 640	270	145
2.50	5 630	180	220

of the potential number of trees (Wawa) that could be saved as and when these vessels came due for replacement. It would also give an idea as to the attractiveness of the Ghana plank canoe and whether it would be worth building a couple of prototypes for trial among the fishermen.

4. It should be born in mind that the Ghana plank canoe has direct links with the Ghana dugout canoe and the style, gear and fishing methods employed on these vessels is essentially the same as those currently used by the ghanaian fishermen. This should make the plank canoe the most likely to be acceptable to the fishermen. Even if a small % of fishermen along the coast accepted the plank canoe it would probably do more to divert demand from the Wawa tree than other imported ideas.

5. Once the groundwork and potentials had been established it is recommended that a) a team of traditional Sierra Leonean Ghana plank canoe builders be recruited and with an interpreter (say Momodu Karoma from Shenge) sent to Ghana to build one or two traditionally constructed canoes letting the Ghanaian Boatbuilders assist.

6. In addition to the traditional builders it is suggested that a boatyard trained Ghana canoe builder (there is only one at Kissi Dockyard -- Bola Collins who built several inboard and outboard strenthened Ghana Plank canoes for the Kambia Project, the later failure of these vessels after excellent initial results was not due to construction but more to a lack of training. His purpose would be to build a much stronger version of the Ghana plank canoe.

7. Once built a programme of demonstrations Would be initiated whereby the fishermen would be allowed to use the boat for extensive trials at sea .

8. If cheaper to construct than the Ghana dugout canoe and reasonably durable in the Ghanaian context the vessels would stand a fair chance of acceptance and go some way towards achieving the objective.

9. This proposal while going some way towards a solution does not and should not be seen as a solution to the whole problem. It should be taken up perhaps in conjunction with the proposals made by Gulbrandsen and even associted with the promotion of more fuel efficient forms of propulsion such as the diesel outboard engines. Of these it would appear that there are two acceptable engines, the Yanmar D27 and the Coventry Climax 25 HP which has been observed by the consultant in operation. Both engines would be suitable for the propulsion of Ghana Plank and dugout canoes in the context of the current level of development of the local fisheries. This includes the Climax 25HP which is an electrical start outboard. The reason for this is that the technology of the electrical start requires what is currently available for the recharging of the 12 V vehicle batteries that many fishermen use to power their huge radio sets.

PROJECTSUGGESTIONS. START OF PROGRAMME APPROACH TO

INTEGRATED FISHERIES DEVELOPMENT PROJECT : APAM (GHANA).

The proposed start to a programme approach to the integrated development of the ghanaian coastal fishing villages.

APAM is a fishing community of some 5,000-6,000 people on the edge of a small relatively sheltered bay. From the beaches about 70-80 canoes engaged in lining, drift netting, purse seining, gill netting and trawling land a considerable amount of fish each year. This fish is largely sold fresh to processors and wholesale buyers from inland villages and markets. It has had a little assistance from the EEC funded trawler rehabilitation programme carried out some two years ago. Judging by the large number of inoperative trawlers laid up on the beach it would appear that the improvements initiated by the EEC failed to be sustainable.

In talks with the most promininant local fisherman local problems were as follows .....

1. Block ice and access to cold storage was regarded as a vital necessity to the future of the local fleet. Block ice was needed for vessels to go to sea with to preserve catches on trips of up to five days and when landed cold storage facilities were essential to achieve fair prices from the traders. Currently there were no storage or icemaking facilities in the community. there was however a local plant which was out of commission and owned by the government.

2. Fishermen were having to become more and more versatile in the activities in which they were engaged in order to earn a living. This required more gear types but the credit for such purchases was not available.

3. Fishermen were also having to steam further and further afield to catch fish. With petrol outboards this trend was further reducing their earnings.

4. The community itself appeared to be in considerable need of improved Public health practices although it was claimed that water supplies were good.

The proposal is to tackle the problems outlined by the fishermen, and perhaps others identified during a more prolonged visit to the area, in an integrated manner. It should deal with the technical aspects of the evolving fishery as well as some selected social components.

1. Evaluate the real ice and cold store requirement. Either refurbish existing plant or prepare plans to build a new plant appropriate to the needs of the community

2. Introduce an alternative Ghana canoe construction programme to reduce price of boats and replace ghana canoes with plank canoes.

3. Start an inboard diesel engine training programme taking into account the accumulated experience of the reasons why other

West African Inboard programmes have failed. See Appendix 5.

4. Start a diesel outboard engine familiarization and training programme to introduce more fuel efficient forms of propulsion to the Ghana canoe fleet.

5. Start a trawl net making programme to consolidate the efforts of the EEC in the Apam area.

6. Improve local fish processing methods in terms of range of smoking and salting as well as the encouragement of more fuel efficient ovens.

7. Seek to improve the range of fisheries related income generating activities within the fishing communities to provide alternative forms of employment to the youth of the fishing villages.

8. Examine the role a credit programme could play in the provision of alternative vessels, diesel engines, fishing gear, fish processing methods and various income generating schemes in the fishing community. This assistance would be aimed at reducing the use of the watsa tree in ghana canoe construction, improving the general level of fuel efficiency, increasing the hunting range of vessels to spread fishing effort over a wider area, assisting access to a wider range of fishing gear to disperse fishing effort away from a few species, and to reduce dependence on the fishery as the only source of employment.

9. Examine whether or not the establishment of a fisheries cooperative type of organization could lead to sustainable supplies of inputs as well as the operation of the ice plant facilities.

10. Identify the areas where the project can play a catalytic role in the encouragement of other government and non government organizations to help the community to tackle the various health and environment problems it faces.

The community concerned appeared to be an ideal target for an integrated approach to the development of the whole community. Other fishing communities along the coast of Ghana may also provide opportunities for development where other agencies have not been forthcoming with assistance. It is possible that these communities have been regarded as successful local fishing economies in their own right without external assistance and therefore did not merit aid. However, there are still serious problems in many of the villages concened of the type which FAO can bring its expertise to bear either in technical or socio-technical fields.

Programme Approach to the development of coastal fisheries.

It is also proposed that the type of integrated development outlined above be used as a model for the sequential assistance to the fishing communities of the Ghana coastal region. Up to now the type of assistance provided has been of a kind typified by isolated technical inputs which appear to have largely misssed the artisanal fishing communities. To develop this programme a mission needs to meet with the fishermen in all the main communities of the coastline, identify areas of underexploitation in terms of fish stocks, identify problems in terms of marketing, processing, techniques, gear etc and devise strategies for their solution by credit, maintenance systems, regulations, community development (health and nutrition, public health, training etc).

It is proposed that such an approach will give a more balanced and structured framework within which to direct development work in the fishing villages of Ghana.

PROJECT SUGGESTIONS.

PROPOSAL FOR TECHNICAL ASSISTANCE TO THE FISHERMEN OF EQUATORIAL GUINEA IN THE PROPOSED ASSISTANCE IN THE TESTING EXPERIMENTATION AND ADOPTION OF YANMAR DIESEL OUTBOARD ENGINES IN FISHERIES OPERATIONS.

This TCP project arose out of discussions at the Fisheries Research and Utilization branch of the ministry of Agriculture in Tema Ghana. It was said that Ben Anum-Doyi would go to Equatorial Guinea to assist the fishermen with the adoption trials of the D 27 outboard. It was quite clear that for the successful trials of this engine the proposed programme would need the support of an experienced mechanic in the field of diesel outboard engines. These engines are not as easy to operate as petrol outboard engines and require particular techniques for successful handling. It was felt that while there was no more suitable person for the fishing side of operations there was a distinct need for an experienced mechanic to assist with the technical aspects of these engines.

The Shenge project in Sierrra Leone has the most extensive operational experience of the operation of these diesel outboards in West Africa. In particular Pico Lewis, the project mechanic at Shenge can be regarded as the most experienced mechanic in the repair, maintenance and operation of these engines in West Africa. This View has been reinforced after meeting the Japanese experts in Guinea who appeared to be well behind Shenge in their operational experience with Fishermen and transport boats than is the case in Shenge. They also seemed to have lacked the experience of totally dismantling these sophisticated engines.

It is is therefore proposed that Pico Lewis Accompanies Ben Anum-Doyi on this mission with the purpose of training local operators in the handling and maintenance procedures for these engines. Failure to provide the proper training will almost certainly lead to failure and perhaps undermine attempts elsewhere to introduce more fuel efficient forms of propulsion to the canoes of West Africa. In this respect the Ruggerini diesel outboard has by its indiscriminate and unsupported issue to fishermen already done enough damage without adding to it.

The instalation of the D27 in Ghana canoes is another area where the expertise of the Shenge project can be drawn upon in order to ensure a successful outcome of the Technical assistance.

PROJECT SUGGESTIONS.

TECHNICAL ASSISTANCE TO THE RESEARCH AND UTILIZATION BRANCH OF THE MINISTRY OF AGRICULTURE, GHANA WITH RESEARCH INTO THE EFFECTS OF SMALL MESH SIZES IN PURSE SEINES AND THE IDENTIFICATION OF THE MOST APPROPRITE MESH SIZE FOR REGULATING THE ARTISANAL FISHERY.

Currently the artisanal purse seine fleet of Ghana employs mesh sizes in the bunt of the various types of net varying from 10mm in the Poli-Sieve purse to 30-50 mm in the watsa purse net. The official legal limit on the mesh size is 25 mm. Therefore a high proportion of the artisanal fleet is employing fishing gear, which in terms of current legislation, is illegal.

In addition to this there is growing official concern and alarm at the trend towards smaller mesh sizes as stocks are reduced and the consequent need by the fishermen to adopt more versatile fishing gear increases.

The imposition of the 25 mm mesh regulation was enforced before the current trend towards fishing the small pelagics had occurred. It is therefore a necessary precondition to new regulations to discover scientifically what the catches are in terms of the different species concerned and the the likely long term effects on the fishery of unregulated increases in the use of small mesh sizes. Following this research it is essential that new regulations are determined and recommended to the government for enactment.

It is proposed that contacts are made with the Research Utilization Branch and preliminary discussions held in order to identify the precise form and financial implications such assistance could take. In this respect it could be direct financial assistance for the Institute itself to carry out the work or it could be through the funding of external expertise to assist the Institute with the design and implementation of this important work.

In many ways external assistance may be preferable to entirely local experimentation as the fishermen themselves may perceive such work and its recommendations as more acceptable if derived from an external source. The blame for unpopular consequent legislation may also be diverted to the external source giving the Fisheries department a better chance to enforce the legislation.

Whatever the outcome of the research and consequent recommendations for purse seine mesh sizes it should be kept in mind that the objective of the proposed Technical assistance would be to help the government decide on a particular regulation which will conserve fish stocks and prevent their unregulated overexploitation. This would eventually be reflected in a sustainable fishery with consequent benefits to the artisanal fishing communities.

Once a regulation has been decided consideration could be given to using some form of credit programme to encourage and help fishermen to adapt their gear to conform with legislative requirements and to adopt alternative fishing methods.

PROJECT SUGGESTIONS.

CANOE MOTORIZATION: A PROPOSAL TO CARRY OUT FAO FIELD TRIALS OF THE RELATIVE MERITS OF DIESEL OUTBOARDS IN THE MOTORIZATION OF ARTISANAL FISHING CANOES IN SENEGAL.

The Senegalese fishing fleet is heavily engaged in the capture of all types of fish employing a wide range of fishing techniques and vessels. Like Ghana the Senegalese fisheries are heavily exploited and largely employ similar vessels and fishing gear as well as using similarly fuel intensive forms of canoe propulsion. In both of these major fish landing countries there is a need for the canoe fleets to adopt more fuel efficient forms of propulsion.

It is therefore proposed that a major technical programme involving fishing and transport canoes is carried out to provide West African governments etc with an assessment of the relative performance of diesel outboards in these fields. Such a programme should test the two most acceptable diesel outboard engines in direct comparison with currently used petrol outboard engines.

The rationale for attempting to yet again encourage the use of more fuel efficient engines is testamony to the eventual benefits of such adoption. That all attempts to wean fishermen and transport boat owners away from the use of the petrol outboards have so far failed is also testamony to the success of this initial transfer of technology.

Benefits of adopting more fuel efficient forms of propulsion include the following:

1. Fuel forms the largest element in the variable costs of operating fishing and transport canoes. Reducing fuel consumption improves profits, incomes, standards of living etc it also helps to maintain the viability of artisanal canoe operations especially when there is a bad season or the fleets need to travel further afield in their search of fish.

2. Adopting diesel engines also helps to disperse fishing effort by increasing the financially viable range of fishing canoes in their search for fish.

3. The continued viability of the large fishing canoes in Senegal, Guinea, Sierra Leone and Ghana and thereby the viability of the purse seine and encircling gill net operations in Senegal, Guinea, Sierra Leone, and Ghana as well as other West African countries with smaller fisheries.

It is proposed that a formulation mission visits Senegal to determine the site for the proposed trials and a preliminary attempt made to identify a selection of craft and fishing techniques which could benefit from the trials and be representative enough to relate these trials to the canoe fisheries of other interested fisheries in West Africa.

CANOE MOTORIZATION IN WEST AFRICA.

All attempts at the motorization of artisanal canoes with more fuel efficient forms of diesel propulsion have so far failed. This is not because there have not been some successful vessels launched but more because none of these vessels have been kept in working order for the normal period expected from similar operations elswhere. This has meant that the owner has not had the time needed for this more expensive type of propulsion to recoup the full economic benefits in terms of reduced overall operating costs. In consequence many who have taken the risk of installing diesel inboard engines have returned to the use of the petrol outboard engine when for one reason or another the total package has not met operational requirements.

So far all attempts at inboard diesel engine motorization in Ghana plank canoes as well as the small inshore trawlers introduced into the Ghana fishery have failed. Evidence of this state of affairs is to be seen at Tombo in Sierra Leone where at least five inboard Ghana canoes are out of operation within a short distance of where they were launched and a further inboard, built by the Kambia Fisheries Development Project, lies in Kissi dock awaiting major repairs. Along the Ghana coast from Tema in the east to Takoradi in the west there are also many small trawlers whose engine breakdowns are only one of a number of major problems which keep them high and dry.

To improve the likelihood of successful motorization the following notes are an attempt to identify some of the reasons for the consistant failure of attempts to introduce more fuel efficient forms of propulsion to the artisanal fleets of West Africa.

Solutions to find a fuel efficient canoe.

Consequent needs for canoe motorisation.

All attempts at diesel motorisation must produce a superior catching package than that provided by the 40 hp Yamaha and the 25 hp in the smaller canoe. Failure to match the 40 hp in terms of speed, starting activity, acceleration, and thereby the ability to catch bonga would inevitably mean failure of the programme whaterver the superiority of the fuel economy.

CRITERIA FOR THE SUCCESSFUL INTRODUCTION AND ADOPTION OF MORE FUEL EFFICENT ENGINES.

1. Should have equal or superior SPEED to those engines in current use.
2. Should have no more VIBRATIONS and NOISE than currently used engines.
3. Should have a good or better STARTING characteristics.
4. Should be of equal or superior RUNNING RELIABILITY.
5. Should be capable of being fitted into currently used vessels or at

Appendix II continued.

least by some simple adaptation of existing vessels.

6. The total package (engine and hull) should be CAPABLE OF CATCHING THE MOST IMPORTANT TARGET SPECIES. In this case Bonga and Awelu plus a variety of often less important species.

of Sierra Leone

7. Should be able to push a HEAVILY LADEN VESSEL (20 crew members plus 1 1/2 tons of net plus fish) thorugh the water at speeds comparable to that of the existing outboard engines.

8. Should have a PRICE which is COMPARABLE with petrol outboards.

9. Should exhibit FUEL SAVINGS which can demonstrably recoup the extra cost of purchase by a largely illiterate clientele.

10. The propulsion unit should be easily removed for safe keeping after each trip.

11. The SKILLS REQUIRED FOR TRAINING OPERATORS in the use of the propulsion unit should be either alreacy locally available or can be easily trained.

12. The SPARE PARTS NEEDED TO MAINTAIN the propulsion unit should be available for purchase in country.

13. THE SKILLS, TOOLS, AND EQUIPMENT needed to MAINTAIN all aspeccts of the propulsion unit, should be available - locally. (engine/shaft alignment, propellor repair, engine and gearbase repair, engine timing, injector testing, valve adjusting).

Inboard sterngear

and repair

14. Installation of new propulsion unit SHOULD NOT MAKE FISHING OPERATION MORE DIFFICULT, and if they do then strategies for overcoming those difficulties should be devised before acceptance.

15. Should have at least EQUAL ACCELERATION characteristics.

16. Should FACILITATE ADAPTATION of local vessles (which fishermen trust) and not be replacement by differenct craft. (FOR TRAWLERS THIS IS NOT ALWAYS POSSIBLE).

17. The fuel which is needed to propel the unit should be available locally AT A PRICE WHICH IS FAVOURABLE TO ADOPTION OF DIESEL PROPULSION.

18. The engine should be able to withstand initial learning behaviour by unit operators, who should exhibit some mechanical awareness not to damage the engine when tightening screws, nuts, bolts, spark plugs, etc. A very common problem among mechanically unsophisticated operators.

19. Should be easily removed for safekeeping, particularly important during the rains when a single night's rain is sufficient to swamp a canoe. OR INBOARD INSTALLATIONS SHOULD HAVE ENGINE PROTECTION BUILT IN.

Any moterisation programme which could meets these criteria should be successful. In this reapect it should not be forgotten that there has already been a successful canoe motorisation in the past with the introduction of the 40 and 25 hp Yamaha outboard engins. The problem lies in replacing this form of propulsion by a more fuel efficient system.

20. Should not upset traditional ways of catching and handling gear. UNLESS THE TRAINING OF NEW WAYS IS INCORPORATED WITH THE NEW VESSEL/ENGINE COMBINATION.

BEWARE OF 21. Solutions trying to find problems.

22. Study the behavior of the fish and of the fishermen TO ENSURE THAT PROPOSALS FIT REQUIREMENTS.

TECHNICAL AND FINANCIAL COMPARISON BETWEEN VARIOUS MARINE ENGINES

1. PETROL DRIVEN OUTBOARD ENGINES; P-OBE, LONG SHAFT

BRAND, HP, MODEL	MAX RPM Engine	MAX RPM Prop.	CYL. VOLUME cm3	cm3/hp	WEIGHT kg	BOATSP knots	FUEL CONSUMPTION l/h	l/nm	$/nm	$/1000 h	COST IN US $ Ex Factory	CIF Freetown	Shop Freet.
Mariner 8 Marathon	5500	2640	210	26.5	31	7	3.6	0.51	0.21	1416		1250	1543
Mariner 15 Marathon	5500	2640	246	16.4	37	7	6.8	0.97	0.40	2676	Not	1650	1852
Mariner 25 Marathon	5500	3100	430	17,2	46	7	11.3	1.61	0.67	4447	avail.	2000	2469
Mariner 40 Marathon	5500	2920	659	16.5	65	8	18	2.25	0.94	7085		2500	3086
Yamaha 8 Enduro	5000	2707	165	20.6	29	7	3.6	0.51	0.21	1416	714	1100	1543
Yamaha 15 Enduro	5000	2825	246	16.4	38	7	6.8	0.97	0.40	2676	974	1500	1852
Yamaha 25 Enduro	5000	2403	430	17.2	48	7	11.3	1.61	0.67	4447	1104	1700	1852
Yamaha 40 Enduro	5000	2403	669	16.7	67	8	18	2.25	0.94	7085	1448	2230	2963
Suzuki 8	5700	3021	165	20.6	28	7	3.6	0.51	0.21	1416		1300	Not
Suzuki 15	5500	2864	284	18.9	38	7	6.8	0.97	0.40	2676	Not	1600	avail.
Suzuki 25	5500	2642	499	20	55	7	11.3	1.61	0.67	4447	avail.	1850	yet in
Suzuki 40	5500	2644	696	17.4	72	8	18	2.25	0.94	7085		2210	S. L.

REF. WEST NORTH-WEST FISHERIES AND COMMUNITY DEVELOPMENT PROGRAMME, SIERRA LEONE. TECHNICAL REPORT ON PROPULSION SYSTEMS BY ARILD OVERA (1990)

TECHNICAL AND FINANCIAL COMPARISON BETWEEN VARIOUS MARINE ENGINES

1. DIESEL OUTBOARD ENGINES, D-OBE

BRAND, HP, MODEL	MAX RPM Engine	MAX RPM Prop.	CYL. VOLUME cm3	cm3/hp	WEIGHT kg	BOATSP knots	FUEL CONSUMPTION l/h	l/nm	$/nm	$/1000 h	COST IN US $ Ex factory	CIF Freetown	$/hp
Coventry 25	5000	1860	742	29.7	91	6.8	5	0.73	0.24	1640	-	5523	221
Yanmar 27	4500	2600	808	30	82	7	5.4	0.73	0.24	1771	-	3608	133
Yanmar 36	4500	2600	1109	30.8	114	7.5	7.2	0.96	0.31	2362	-	4590	127

2. DIESEL INBOARD ENGINES, D-IBE

BRAND, HP, MODEL	MAX RPM Engine	MAX RPM Prop.	CYL. VOLUME cm3	cm3/hp	WEIGHT kg	BOATSP knots	FUEL CONSUMPTION l/h	l/nm	$/nm	$/1000 h	COST IN US $ Ex factory	CIF Freetown	$/hp
Lister, 20, STW2M	2300	760	1270	63.5	390	6.5	4	0.62	0.21	1312	-	9329	466
Lister, 30, ST30M	2300	782	1900	63.3	430	7.6	6	0.79	0.26	1968	-	10980	366
Sabb, 10, GG	1800	900	760	76	200	6.5	2	0.31	0.10	656	-	3051	305
Sabb, 30, 2JGR	1900	950	1880	63	375	7.5	6	0.80	0.26	1968	-	6122	204
Yanmar, 26, 2TDGG	2100	668	1806	69.5	400	7.2	5	0.69	0.21	1508	-	5593	215
Yanmar, 39, 3TDGG	2100	668	2710	69.5	500	8.5	8	0.94	0.31	2624	-	7338	188

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PROJECT SUGGESTIONS.

CANOE AND TRAWLER MOTORIZATION IN WEST AFRICA: INBOARD DIESEL ENGINES.

In visits to Sierra Leone and in particular Ghana it was particularly disappointing to see the number of beached inboard diesel engined fishing boats. These were of two main types, the encircling net ghana plank canoes in Sierra Leone and the inboard engined trawlers to be found at various ports along the Ghanaian coastline.

So many attempts have been made to introduce the benefits of the inboard marine diesel to the canoe fleets of West Africa that it is almost embarrassing to suggest that yet another attempt be made to introduce this form of propulsion. However, the benefits of success seem to be so marked that a further attempt is recommended in the port of Elmina (or any other suitable venue in Ghana). However, it is suggested that the criteria for success outlined below are taken carefully into account and that all of the skills and training requirements outlined are incorporated into the proposed venture.

It is proposed that the existing trawler fleet is assisted in rehabilitation and that the accent of the project is aimed at what happens after the rehabilitation rather than on the technical installation of the propulsion units themselves (although of equal importance to a successful outcome). The project should also pay particular attention to such areas as the availability of spare parts on a sustained basis as well as identifying the availability of the particular skills needed by the engine operator in identifying trouble spots before they reach a stage which threatens the continued existance of the boat.

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