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A COMPARATIVE EVALUATION OF FISH CATCH AND ECONOMICS FOR MULTIFILAMENT AND MONOFILAMENT GILL NETS AT VOLTA LAKE

by

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Work carried out under
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A COMPARATIVE EVALUATION OF FISH CATCH AND ECONOMICS FOR MULTIFILAMENT AND MONOFILAMENT GILL NETS AT VOLTA LAKE

Phillip C. Pierce - USAID Aquatic Advisor

ABSTRACT

Two nets each of 102-, 127- and 178mm. stretched measure nylon multifilament and monofilament webbing, and two nets of 229mm. stretched measure monofilament webbing were tested at Volta Lake during an eight month period in 1969 and their catch data compared. During this study the 14 test nets took 19 species totaling 1,332 fish weighing 1,829.3 kg. Tilapia sps. dominated the catch for the 102- and 127mm. gill nets, and Lates niloticus comprised most of 178- and 229mm. nets' catch by weight. Eleven percent of the total catch consisted of species of poor or no commercial value. Monofilament nets took 3,5 and 7 times as much fish by weight as did their multifilament counterparts for mesh sizes 102-, 127- and 178mm. respectively. Of these three mesh sizes, monofilament webbing was the most economic and proved potentially more profitable as mesh and twine sizes increased. No multifilament gill net tested paid for itself during the study period, however, the 127mm. mesh should have within the life of the net.

The catch superiority of the monofilament gill nets was found to be due primarily to this webbing material's lower visibility in Lake Volta's relatively clear water.

The 229mm. mesh monofilament flag net (mono=) was the most economical gill net tested, followed by the 178mm. mono=, 127mm. mono= and the 229mm. (sunken mono+) mesh sizes. The 178mm. mesh floating monofilament gill net (mono+) was the only net tested that proved highly selective in catching Heterotis niloticus, a species of low commercial value at Volta Lake.

INTRODUCTION

This work was carried out in accordance with activities initiated under Project Agreement 641-1C-22-AA-56, dated May 31, 1963 and Project Agreement 641-11-190-028 dated December 4, 1967.

The latter agreement pursues two main objectives: (1) preparing and implementing specific programs for the general development of the fresh water fishing industry on Volta Lake in an effort to increase the fisherman's catch, which this report entails, and (2) outline a contingency program for aquatic weed control and recommend adequate quarantine arrangements. Government statistics show that Ghana has one of the highest demands for fish in Africa, and this demand continues to rise. In 1969 Ghana's per capita fish consumption was 20 kilos (5 kilos for the U.S.) which represents a 42% increase over 1968.

Ghanaian fishermen, and foreign vessels contracted to fish for Ghana, harvested a record fish catch of 139,974 metric tons (117,251 from marine and 22,723 from Volta Lake sources) in 1969. But during this same period Ghana still imported 18,700 metric tons of fish and fish products, valued at N¢5,872,212 (U.S. dollar equivalent $5,754,768) and paid for in foreign exchange. Records show that no price reduction was noted for fish during 1969, indicating that supply still did not exceed demand. It is predicted that Ghana's fish consumption will reach 250,000 metric tons per annum by 1980.

Therefore, if Ghana's present and future fish needs are to be met without increasing foreign exchange expenditures Ghana's marine and fresh water (Volta Lake) fish catch must be substantially increased. Because virtually the entire lake is covered with underwater obstructions, the lake does not lend itself well to more sophisticated fishing methods utilizing movable gear. Therefore, as far as Volta Lake is concerned, this increase must come about through increasing the individual fisherman's efficiency using traditional types of static fishing gear such as gill nets, traps and long lines (hooks).

Gill nets are used more commonly than any other type of fishing gear at Volta Lake, and almost all of these nets are constructed of synthetic fibers, primarily nylon.

The most widely used form of nylon gill net webbing is multifilament twine comprised of many individual filaments. Under most fishing conditions this type of webbing is extremely effective. However, there are some fishing waters where even multifilament nylon gill nets fall short of requirements. These areas are often characterized by having relatively clear water and/or a fish population consisting of many species of fish. In recent years, however, industry has developed a single filament nylon twine (monofilament) that is practically invisible under water and, therefore, more difficult for the fish to see. These monofils have proven to be a major breakthrough in fishing gear technology and are rapidly replacing multifilament nylon netting in many countries.

Fisheries workers in Viet Nam (Trans-Van-Tri and Ha-Khoc-Chu) found during a study conducted between 1956-66 that monofilament nylon gill nets were far superior to other netting materials tested.

Their study revealed that monofilament webbing has the following advantages over other webbing materials normally used for constructing gill nets.

1. It does not retain impurities drifting around in the water.
2. It is easier to work.
3. Spiny fish are especially easier to remove.
4. Less damage is caused when mono nets become snagged.
5. Mono meshes are largely open for true gill netting.
6. During daylight fishing the monofilament is nearly invisible while multifilament give a bright reflection.
7. Monofilament are cheaper by half. (Monofilament webbing is cheaper than multifilament webbing in Viet Nam because

only monofilament is locally produced. Otherwise, monofilament webbing should be as or more expensive than multifilament).

The only disadvantages that these workers found for monofilament nylon webbing were that it was more difficult to mend and that the material became stiff at very low water temperatures. Therefore, the advantages far outweighed the disadvantages, and by 1966 over 75% of all gill nets fished in Viet Nam were of monofilament webbing.

Studies conducted in Germany (Steinberg, 1964) have shown that monofilament gill nets are more effective in clear water than multifilament, and "that a greater number of older and larger fish seemed to be caught with these low visibility nets, indicating that they had a more careful approach towards gill nets than younger specimens."

A Swedish worker (Molin, 1959) found that monofilament was seven times as effective as cotton nets, but in muddy waters no advantage could be demonstrated for using monofilament gill nets.

Government fish statistics reveal that the total fish harvest from Volta Lake has increased significantly each year since the lake started forming in 1964. This has been attributed primarily to the rapidly expanding fish population and an increase in fishing effort brought about by the mass immigration of fishermen from the lower Volta River, as fishing in that area worsened after the closure of the dam at Akosombo. The lower reaches of the river are estuarine and have, in the past, supported a large fishing industry based upon the seasonal flooding of extensive ponds and creeks along the sides of the river, as well as a fishery for the clam, Egeria, which is of economic importance to the area (Ewer, 1966). The closure of the dam has therefore, drastically altered the flow of fresh water into the lower Volta causing stable water levels and no annual flooding, resulting in a decreased fish catch.

However, interviews between gill net fishermen of the lower half of Lake Volta and this writer during the period 1967-1969, have indicated that the average individual gill net fisherman's catch per unit of effort (CPUE) has actually decreased each year since 1967. All available data indicates that this reduction is not due to over-fishing (Evans,1969), but mainly to changes in the physical and chemical characteristics of the Lake which are discussed more fully later in this report.

The future of any fishing industry, apart from wisely managing the resource itself is dependent on the welfare of the primary producer, in this case a canoe fisherman having a limited number of gill nets.

Therefore, if Volta Lake's fish harvest is to increase, or even sustain itself in the future it is imperative that each fisherman is able to function as effectively and efficiently as possible within his means and capabilities.

Taking the Lake's gill net fisherman's limitations into consideration, this study indicated the individual gill net fisherman can at least double his CPUE if he replaces the multifilament gill nets he now uses with monofilament gill nets.

DESCRIPTION OF STUDY AREA

Volta Lake is the largest man-made lake in the world and is located entirely within Ghana's boundaries (Figure 1).

The primary purpose for constructing this mammoth impoundment is to provide hydro-electric power to meet Ghana's rapidly expanding industrial and domestic needs for electric power. However, the Lake's transport, irrigation, fishery and tourism potential are immense and are destined to play an ever increasing role in the future.

The Akosombo dam, located on the Volta River, was closed in May 1964 and the Lake filled to its highest retention level of 84 meters in November 1968.

The reservoir is over 400 km. in length, has a surface area of 8,348 km^2, a shoreline of approximately 5,000 km. a volume of 149 km^3 and has an average depth of 20 meters when full. The water level fluctuates an average of 3 vertical meters, falling between December and June and rising again between July and November each year.

A pre-impoundment fish survey conducted on the Volta River in 1964 revealed that over 100 species of fish were present, and over 70 of these species reached local markets (Roberts, 1967). However, after dam closure it was found that as the river changed into a lake, fluctuation in species abundance occurred. Few species have actually totally disappeared from the Lake, but many have restricted themselves to the upper reaches of the reservoir or its main tributaries where riverine conditions still exist.

Some commercial species, however, apparently preferred the new lacustrine (lake) environment and have flourished (Petr. 1966, 67, 68 abc). This has been particularly true for Tilapia and nile perch (Lates niloticus), and it is anticipated that other species will also greatly increase in numbers in future years as they adapt to lake conditions.

The lake basin was not cleared of standing timber prior to flooding resulting in virtually all of the lake being covered with underwater obstructions (Figure 1). This flooded timber has definitely added to the lake's capability for producing certain types of fish food organisms, particularly Povilla adusta, a mayfly whose larvae burrows into the soft wood of the flooded timber, and Aufwuchs (Periphyton) that grow over the surface of these dead trees (Petr. 1969, a,b). Each of these forms of fish food are known to be heavily utilized by most of the commercially important fish species in the lake (Petr. 1967).

However, these many underwater obstructions can cause the fishermen considerable problems and expense should their gill nets become entangled in them. This hazard has greatly influenced where and how fishing is done at the lake, resulting in extensive areas being virtually unfished while other areas receive unusually high fishing pressure.

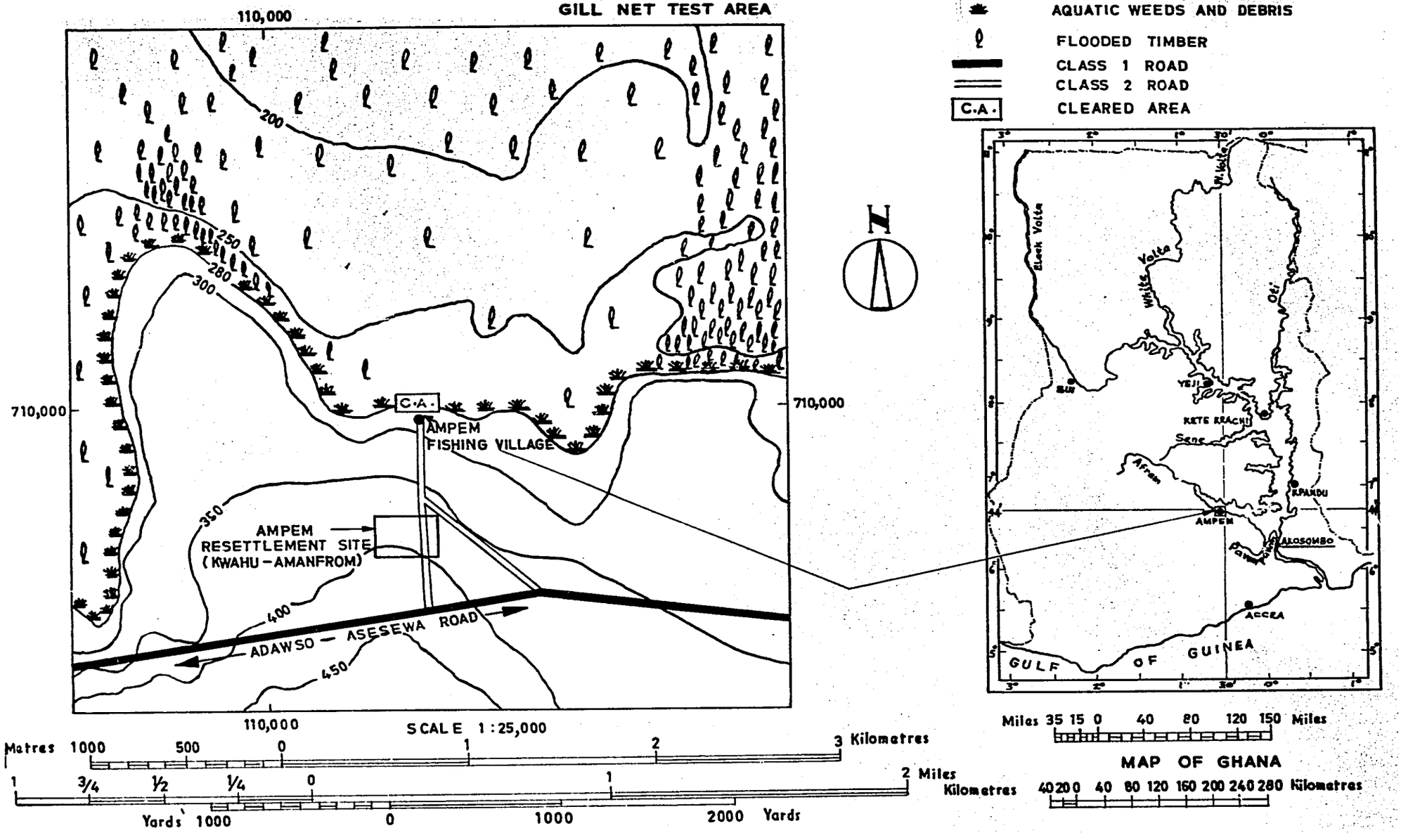
Aquatic plants grow abundantly along much of the lake's margin out to a depth of 3 meters. These plants consist mainly of Polygonum senegalenses, Vossia cuspidata, Alternanthera sessilis and a mixture of sedges, but over 50 species of aquatic and semi-aquatic plants are currently known to exist at the lake. The three species mentioned above become well established on the exposed lake bottom during each drawdown period, and each can tolerate flooding. The width of this weed band is dependent on the slope of the exposed lake bottom. In some areas these weeds extend 150 meters out from shore at high water. However, the average width is closer to 50 meters when the lake level is high. This writer has found Polygonum and Vossia to harbor Povilla larvae in their hollow stems. Therefore, there is every reason to believe that these aquatic weed species will play an important part in the future, in maintaining the Povilla population after the flooded timber, which it now prefers, has finally rotted away.

In addition to the semi-aquatic plant species mentioned above certain areas of the lake are inhabited by true aquatic plants, particularly Ceratophyllum demersum, Pistia stratiotes, Lemna, Salvinia nymphellula and Utricularia inflexa.

Petr. (1968) found Ceratophyllum and Pistia to harbor certain species of fish food organisms, but he acknowledged that they, along with other aquatic weed species, also harbored aquatic vectors, particularly Bulinus snails that carry the human liver fluke, and the Mansonia africana mosquito that is a vector of yellow fever virus. Like the semi-aquatic plants mentioned above, the aquatic weeds occasionally make inshore gill net fishing difficult, by restricting the areas that can be effectively fished and by the nets becoming entangled in the underwater vegetation which causes the nets not to "hang" properly.

Nevertheless, the aquatic plant community in general should be considered an important and beneficial part of the lake environment since it provides the food, shelter and protection that is necessary for sustaining maximum fish yields.

FIGURE 1
GILL NET TEST AREA



EFFECTS OF WATER QUALITY CHANGE ON GILL NET FISH CATCH

Volta Lake is situated 7° north of the equator and at an elevation of less than 85 meters. Therefore, constant high water temperatures (25-31°C) are common.

Data shows that during the first year of lake fill the lake level rose 46.3 vertical meters which was sufficient to quickly and completely cover a large portion of the dense riverine forest and heavy bush that bordered the original river channel for many miles up stream from the Akosombo dam. These conditions created a high biological oxygen demand (BOD) as rapid decomposition occurred, resulting in a significant change in water quality.

The increased fertility resulting from the decaying vegetation, produced an extremely heavy phytoplankton bloom during the first year but restricted the oxygenated layer to the upper 5 to 10 meters of water (Biswas, 1966). Oxygen production through phytoplankton assimilation (photosynthesis) fluctuated from super saturation (300%) during mid-day when sunlight was maximum to below 20% saturation at night when oxygen utilization far exceeded oxygen production (Ewer, 1966). However, studies conducted by Biswas (1969) during 1966-67 showed Volta Lake regularly overturned all along a stretch of almost 320 km. Also the flood and wind actions produced upwelling causing a decrease in surface temperature, oxygen and phytoplankton. These actions were immediately followed by equally strong reactions which resulted in the penetration of warm water, oxygen and phytoplankton almost to the bottom of the lake.

During this period of heavy phytoplankton bloom (1965-66) secchi disc readings seldom exceeded 1.5 meters (Biswas, 1966).

Gill net fishing, as would be expected, was exceptionally good during the first two years since the water was relatively turbid and the entire rapidly expanding fish population was confined near the surface within the well oxygenated layer of the lake.

The reported high fish catch during the first two years of lake fill was definitely attributed to the rapid influx of large numbers of fishermen from the lower Volta and the coast that took advantage of the ideal fishing conditions mentioned above. Also, many farmers living near the reservoir took up fishing as a new, or at least a second, occupation. As more and more fishermen moved to the lake, fish marketing centers became established usually at road accesses to the lake shore. By 1968, virtually the entire shoreline of the lake was experiencing at least some fishing activity; the fisherman density being determined both by fishing success and accessibility to markets. By 1969 the fisherman population at the lake was estimated to be between 15,000 and 20,000 fishermen scattered among 1,200 villages (unpublished UNDP-VLRP reports).

However, after 1967 the water quality of the lake changed considerably. This is attributed to: (1) the volume of the reservoir becoming sufficiently large to dilute the BOD that was already decreasing as less and less new terrestrial vegetation was being flooded; (2) the photosynthetic zone (depth of light penetration) increasing as turbidity decreased, and (3) increased oxygenation and mixing as the lake surface enlarged and wind and wave action increased. Hence, the oxygenated layer changed from a maximum depth of 10 meters during 1964-66 to 30 meters in 1967 and thereafter, (Entz, 1969).

These changes in the chemical and physical (turbidity) properties of the lake after 1967 had a significant impact on the fishery. It is most probably that the fish population, as a whole, has benefited considerably by it (Petr. 1968), since the fish and fish food organisms can now occupy 80% of the total volume of the lake compared to only 20% before 1967 (Table 1). However, these changes have not helped the lake's gill net fishermen proportionately since, now the fish population is more widely dispersed and the water is relatively clear (secchi disc

TABLE 1

Volume Changes For Well-Oxygenated Water Layers During Volta Lake's Formation - May 1964-November 1969

Lake Fill Periods	Max. Lake Elev. Above Sea Level m (ft.)	Vert. Rise in Elev. m (ft.)	Volume at Max. Elev. Km^3 (Acre ft.)10^6	Depth of 1/ Oxygenated Layer m (ft.)	Vol. of Oxygenated Layer (% of Total)	Mean Vol. of Oxygenated Layer (% of Total
V 64 2/-VI 65	59.7 (196)	46.3 (152)	26 (22)	5 (16.5) 10 (33.0)	26 48	38
VII 65-VII 66	71.9 (236)	12.2 (40)	68 (55)	5 (16.5) 10 (33.0)	23 52	
VIII 66-VII 67	78.0 (256)	6.1 (20)	104 (84)	20 (65.5) 30 (98.5)	75 88	80
VIII 67-VI 68	80.8 (265) 3/	2.7 (9)	120 (99)	20 (65.5) 30 (98.5)	73 87	
VII 68-VIII 69	84.0 (276) 4/	3.4 (11)	149 (120)	20 (65.5) 30 (98.5)	72 86	

1/ Dissolved oxygen (0.0) above 25% saturation (0.0 saturation equals 7.8mg/l at 29°C)
2/ Lake filling commenced
3/ Anticipated annual low retention level
4/ Anticipated annual high retention level

readings averaging 3.0 meters) which allows the fish to easily see the fisherman's nets. Consequently, the CPUE for gill nets has lowered in many areas of Lake Volta. Many interviews between this writer and Volta Lake fishermen during the period 1967-69 have supported this conclusion.

Therefore, it is highly probable that unless more effective fishing gear is made available to the lake fishermen, fishing in the lower half of Volta Lake will shift from being the profitable cash crop it has been in the past to a subsistence crop in the future. If this should happen it is possible that many of the Lake's fishermen will leave to choose poverty in the coastal belt cities where a few amenities exist, to poverty at the Lake where no amenities and only hardships prevail.

MATERIALS AND METHODS

Gill Net Description - During the period January 28 through October 3, 1969, 14 gill nets were fished and all catch data recorded.

Two nets each of 102-, 127- and 178mm. (4-,5- and 7-inch respectively) stretched measure multifilament and monofilament webbing, and two nets of 229mm. (9 inch) stretched measure monofilament webbing were used. Each of the 102-, 127-, 178mm. nets measured 3m x 46m. (10' x 150') when hung at 50% and each came complete with 30 floats and a lead core bottom line as accessories (Table 2).

One net for each mesh size and webbing material tested was periodically altered by removing the accessories, whereas, the remaining set of nets of each mesh size remained complete with accessories (multi+ and mono+) and served as a control. Alterations included: (1) removing the floats, but leaving the weighted bottom line (multi- and mono-) and then, (2) also, removing the bottom line thereby producing a "flag gill net" (multi= and mono=) which is the most common type of gill net fished by the local lake fishermen (Figure 2AB and C).

TABLE 2

Gill Net Description[1/]

Multifilament Gill Nets (2 sets of each)

Color	:	Green - No.12
Mesh Sizes (stretched measure)	:	102mm (4") 210d/3 x L3 x 3mx46m (10ft.x150ft.) 127mm (5") 210d/6 x L3 x 3mx46m (10ft.x150ft.) 178mm (7") 210d/15x L3 x 3mx46m (10ft.x150ft.)
Accessories	:	Nylon rope - green No.12 - medium twist 6m/m dia. x R3 x 47m (153 ft.) 6m/m dia. x L3 x 47m (153 ft.) Lead core (polex compound rope) - green 6m/m dia. x 46m (150 ft.) NGR float type No.16-H 30 pcs. Marlon twine - brown No.103-MU/30 L3

Monofilament Gill Nets (2 sets of each)

Color	:	Green - K-4
Mesh Sizes (stretched measure)	:	102mm (4") No.3 x 3m x 46m (10ft. x 150ft.) 127mm (5") No.5 x 3m x 46m (10ft. x 150ft.) 178mm (7") No.14x 3m x 46m (10ft. x 150ft.) 229mm (9") No.30x6 m x 92m (20ft. x 300ft.)
Accessories [2/]	:	Nylon rope - green No.12 - medium twist 6m/m dia. x R3 x 47m (153 ft.) 6m/m dia. x L3 x 47m (153 ft.) Lead core (polex compound rope) - green 6m/m dia. x 46m (150 ft.) NGR float type No.16-H 30 pcs. Marlon twine - brown No.103 MU/30 L3
Accessories for 9" Gill Net	:	Nylon rope - green No.12 - medium twist 6m/m dia. L3 x 94m (306 ft.)

1/ Based on Momoi Fishing Net Mfg. Co. Ltd. specifications.

2/ Applies only to 102, 127 and 178mm. stretch measure counterpart monofilament gill nets.

The 229mm. (9-inch) monofilament nets measured 6m x 92m (20' x 300') at a 50% hanging ratio. One set consisted of only a top line (mono=) while the other contained several small floats and stones (mono+) as accessories (Table 2 and Figure 2C and D). No 229mm. multifilament gill net was available for comparison during this study.

The term "counterpart net" is used throughout this report and refers to those nets that are constructed exactly alike except for their webbing material. Hence, the counterpart net to a 127mm. multifilament net having no floats, but having a lead line (multi-) is a 127mm. monofilament net also having no floats, but having a lead line (mono-) (Figure 2B).

Fishing Methods and Catch Analysis Procedures

During the study period, all nets were fished by a local fisherman and his helper under the supervision of the writer. To provide the necessary incentive the fisherman received the entire catch taken in the nets in payment for his labor.

In return, the fisherman agreed to having his daily fish catch recorded and to repair the test nets as required. Subsequent to this study, project personnel tested these nets and found that monofilament caught three times as many fish, by weight, as did equal amounts of multifilament webbing (Pierce,1968 a and b, and 1969).

The primary purpose of letting a local fisherman fish the nets, rather than continuing with project personnel, was to determine how effective multifilament, and particularly the new monofilament gill nets, are in the hands of non-technical-oriented fishermen.

Limited instructions were given to the fishermen concerning how the counterpart nets had to be fished in order to accurately compare their fish catches. Otherwise, the fisherman was left to make his own decisions on where, when and how to fish the test gear.

Each of the 102-, 127- and 178mm. multifilament gill nets was tied directly to its counterpart monofilament gill net producing one continuous gill net measuring 92 meters (100 yards). However, a one meter space was left between the two nets to allow fish that might be "guided" by the other gill net to escape (Figure 3).

The two 229mm. monofilament gill nets were fished separately. The fisherman selected where the nets were to be set, usually within a 3 km. radius of the Ampem fishing village (Figure 1). The 102- and 127mm. gill nets were normally fished within 100 meters of shore in water less than 5m. in depth. The ends of each net were tied to any suitably available anchorage or to long poles stuck into the lake bottom (Figure 3). The pole method was commonly used since most of the natural anchorages were usually already occupied by other fishermen's nets.

The 178mm. gill nets were also fished close to shore as described above, and off-shore, in water up to 15m. deep.

The 229mm. gill nets were always fished off-shore, in water ranging from 7 to 20m. deep. To set these large meshed nets in deep water, the fisherman tied each end of the nets to heavily anchored ropes attached to marker floats. The distance the nets were fished below the surface was determined by the position they were tied on the anchor rope. A mid-net marker float was usually added (Figure 3).

Each complete gill net (multi+ and mono+) of 102-, 127-, and 178mm. mesh sizes was fished during the entire study period between January 28 and October 3, 1969. However, those nets that experienced accessory alterations (multi- and mono-) and (multi= and mono=) were tested during January 28 and March 15,1969, and March 19 and October 3, 1969 respectively.

FIGURE 2

DESCRIPTIONS OF GILL NETS TESTED (Not to scale)

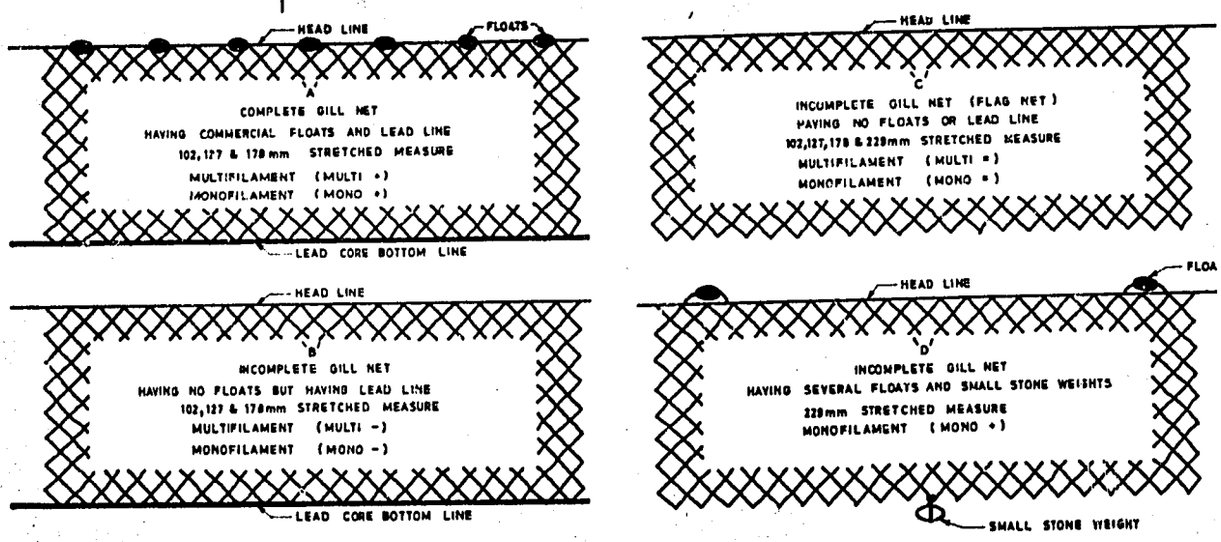
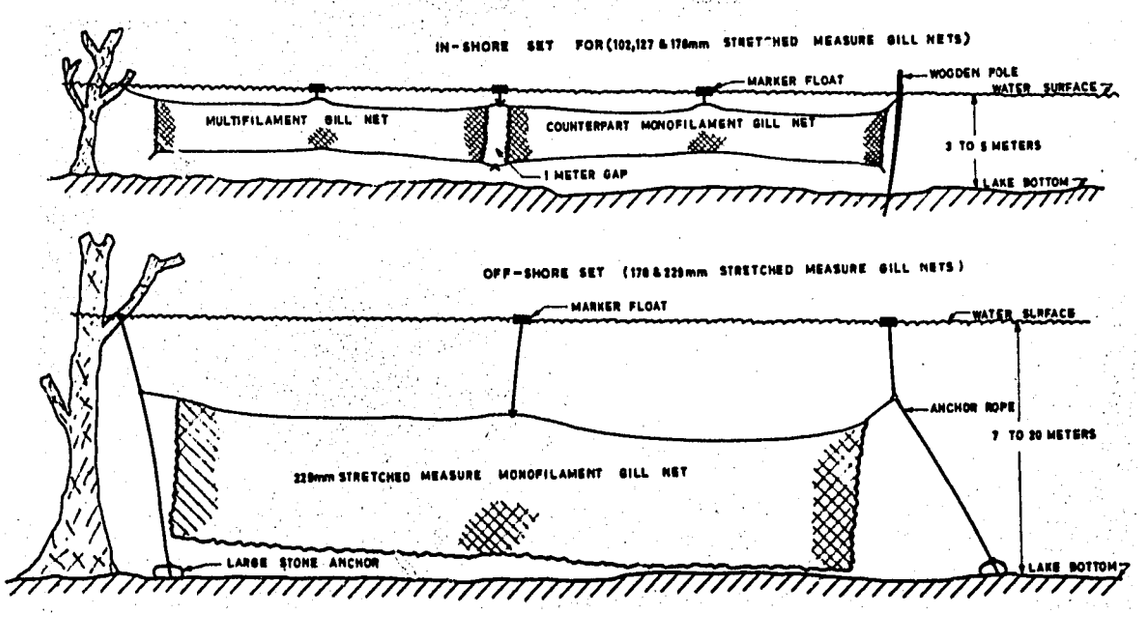


FIGURE 3

TYPICAL GILL NET SET TECHNIQUES USED (not to scale)



The two 229mm. mesh monofilament gill nets were fished between January 29 and October 7,1969. The only difference between these two nets was that one set (mono+) was equipped with a sufficient number of small floats and stone weights to assure that the net wall did not collapse upon itself; whereas, the other net (mono=) was a typical "flag net" having no accessories.

The "set period" for each net was left entirely to the fisherman with the understanding that both counterpart nets were always fished tied together unless one of the nets was out of the water being mended. The average set period was 8 days, with ranges from 2 to 29 days. The nets were normally set between 4 and 6 p.m. and were "run" the following morning.

The fisherman kept each net's daily fish catch separated using appropriately marked plastic bags. These bags were taken to shore where project personnel recorded each net's catch (Table 3). The fish were then returned to the fisherman.

Table 3 - Sample Catch Record Form - Ampem Gill Net Comparison Study

Mesh Size and Description: 127mm. Mono=

Date Set	Date Ran	Species	Measurements Length(mm)	Measurements Weight(grams)	Remarks
7/4/69					
	8/4/69	Tilapia	250	400	
		Tilapia	268	450	
		Tilapia	214	300	
		Lates	305	448	
	9/4/69	Tilapia	250	440	
		Tilapia	300	470	
		Heterotis	410	1,200	Rotten
	10/4/69	No catch	-	-	
12/4/69					
	13/4/69	Tilapia	253	439	
		Tilapia	261	446	
		Tilapia	310	500	
		Chrysi-chthys	404	476	

Catch comparisons for each gill net were determined based on catch per unit of effort (CPUE); whereas, one unit equals $100m^2$ of netting, and effort equals 24 hours. Each of the 102-, 127- and 178mm. gill nets was

comprised of 1.4 units ($140m^2$) compared to 5.6 units ($560m^2$) for each of the 229mm. gill nets (Figure 4,6,8 and 10, and Tables 4-7, 11-14, and 18,19,23,24 and 27).

Economic comparisons, expressed in Fish Catch to Gear Cost are discussed for each gill net tested. The economics for each mesh size and webbing material was determined by comparing the income from the catch (Total weight in kg. x .22 New Cedis, or 10 cents/lb.) and the estimated cost of each $100m^2$ of netting to the fishermen based on the FOB price provided by the manufacturer. Since the netting material normally passes through several middle men before it reaches the fisherman, and because the fishermen usually buy small quantities at a time, the fishermen's cost average approximately 100% above the FOB Tema price.

These economic data are graphically illustrated and show the length of time it took for each gill net tested to pay for itself. The only exception to this being for the multi- and mono- gill nets that were not fished long enough to fully evaluate their potential (Figures 5,7,9 and 11).

Moonlight and rainfall data were also collected at Ampem during the study period and their effect on each net's fish catch determined (Figure 4,6,8,10 and 12 and Tables 8-10,15-17, 20-22 and 25 and 26).

In assessing what effect moonlight (changes in night time visibility) had on each gill net's catch, each month during the study period was divided into 30 days. Based on data furnished by the Ghana Meteorological Department, each month was sub-divided into the 9 brightest, 9 darkest and 12 intermediate nights. The effect of night time illumination on the fish catch was determined by calculating and comparing each net's CPUE for these periods. To further pinpoint what effect moonlight had, calculations were also made for the 3 brightest nights (full moon), 3 darkest nights (new moon) and for the 24 intermediate nights each month.

RESULTS AND DISCUSSIONS

102mm. Mesh Gill Nets

Since the primary objective of this study was to compare gill net webbing materials (multifilament vs. monofilament) and not to compare different styles for gill nets constructed of the same material, these data will not be discussed in detail except where distinct differences that are of economic importance are noted. All catch comparison data given below are based on weight alone, unless stated otherwise.

The 102mm. mesh size was selected for inclusion in the study because a pre-study survey indicated that it was the smallest mesh commonly used by fishermen in the lower half of the Volta Lake.

During twelve nights (20.4 unit days) of fishing in 1968, Taylor and Denyoh found that their 102mm. mono+ gill net was three times as effective as their counterpart multifilament net. Each net measured 2.5m. x 46m. and was floated at the surface. The mono+ CUPE was 1.0 kg. compared to .33kg. for the multi+ net. These data are comparable with the more extensive study discussed below.

First Study Period (January 28-March 15,1969)
Multi+ vs. Mono+

During this study period mono+ caught 1.4 times as much fish as did its counterpart multifilament net. For all of the twelve gill nets (having counterparts) tested during this study, these two nets had the closest catch ratio. Normally, the monofilament catch far exceeded the multifilament catch.

In 54.6 unit days (UD) of fishing multi+ took 58 fish (7 species) weighing 23.6kg. Sixty-seven percent of the catch was Heterotis niloticus, followed by Tilapia sps. which made up 19 percent. The CPUE for the total catch was .43 kg. Heterotis are air breathers and therefore they die very quickly in nets. This results in this species being usually rotten when the gill nets are run the following morning. Consequently, Heterotis bring a low price compared to most other species taken. A majority of the

rotten Heterotis are split open and salted heavily and then dried in the sun. Since their market value is so poor most of the salted rotten Heterotis are eaten by the fishermen or fed to their animals. The poison puffer fish, Tetraodon fahaka, is the only species that is not eaten at the lake. This species was often caught in each of the 102mm. mesh gill nets, but they were discarded and not recorded.

The mono+ gill net caught 112 fish (9 species) weighing 25.3kg. in 42.0 UD of fishing for a CPUE of .6 kg. The catch was made up of 46 percent Tilapia and 28 percent Heterotis (Figures 4 and 12; Tables 4, 27, and 28).

Multi⁻ vs. Mono⁻

Unfortunately, no multi⁻ gill net was available during the study period for comparison. However, data showed that mono- was highly effective. In 42.0 UD this net took 146 fish, comprised of nine species weighing 41.2 kg. and having a CPUE of 1.0 kg. Even though 69 percent of the catch was Tilapia (41 percent by weight), thirty-one (21 percent) Heterotis made up 43 percent of the total weight, (Figures 4 and 12; Tables 5,27 and 28).

Second Study Period (March 18-September 20,1969)

The relative difference in the fish catch between monofilament and multifilament gill nets was much greater during this second period than during the first phase of the study. However, the CPUE for both webbing materials was much poorer. This is attributed to seasonal movements of fish, the deteriorating condition of the gill nets, clearing of the waters turbidity and heavy inshore aquatic weed infestations that made it difficult to set nets properly in shallow water.

Multi⁺ vs. Mono⁺

In 116.2 UD of fishing the multi+ net took only 26 fish (11 species) weighing 6.9 kg. which represented a CPUE of .06 kg. Thirty-six percent of the catch consisted of Tilapia and 28 percent was Lates niloticus.

Heterotis comprised only seven percent of the catch during the second study period.

The mono+ gill net was fished for 138.6 UD and caught 109 fish (10 species) weighing 33.2 kg. This gave a CPUE of .24 kg. which is four times greater than its counterpart's. Tilapia comprised 63 percent of the catch followed by Lates (13 percent) and 10 percent for Heterotis (Figures 4 and 12; Tables 6,27 and 28).

Multi= vs. Mono=

The floatless and unweighted gill net (flag net) is the most common type of gill net used in shallow water in the lower half of the Volta Lake. It should be remembered that these nets were constructed from the same webbing materials used for the mono- gill net and one set of the multi+ gill nets during the first study period.

In 172.2 UD of fishing the multi= gill net took 85 fish (10 species) weighing 22.1 kg. and had a CPUE of .13 kg. Tilapia comprised 64 percent of the total catch followed by Heterotis with 18 percent. Lates made up only 2 percent of the catch.

This compares with the mono= gill net which took 210 fish (9 species) weighing a total of 52.2 kg. in the same number of unit days (172.2). The CPUE for mono= (.30 kg.) is 2.3 times that of the multi= (Figures 4 and 12; Tables 7,27, and 28). Tilapia dominated the catch with 69 percent, followed by Lates with 11 percent and Heterotis with 8 percent.

Therefore, based on the CPUE, the mono- gill net was the most effective 102mm. gill net tested during the first study period and mono= was the most effective during the second study period. However, if the Heterotis catch is removed from the analysis then the mono+ gill net was the most effective gill net tested during the first period (Figure 12). No comparison can be made between mono- and mono= since they were not fished concurrently. However, since the control nets (multi+ and mono+), which were fished during both periods, show that fishing was much better during

the first period, when the mono- was being tested than during the second period when mono= was fished, it is possible that if both mono- and mono= had been fished together their catches might have been comparable.

No significant difference in species selectivity could be noted for any of the 102mm. gill nets tested (Table 28).

In analyzing what influence the moon had on the 102mm. gill nets' catch, it was found that during the first period the mono+ gill net took considerably more fish during the darkest nights each month, whereas the multi+ and mono- gill nets were more effective during the brightest nights. But during the second study period all nets took more fish during the darkest periods. The exact reason why the multi+ gill net catch was higher during the brightest phase of the moon is not clearly understood by the writer. However, it may have been merely because turbidity, due to phytoplankton, is usually much greater in the Afram during the drawdown period (first study period) than it is during the flood season (second study period). Therefore, the fish would not have been able to detect the multi+ gill net during the first season as easily as they could during the second period.

In comparing the difference in the catch for multifilament gill nets during the 9 darkest and brightest nights during the second study period it was found that 275 percent more fish was taken during the darkest period than during the brightest phase of the moon. For the same periods monofilament gill net caught only 96 percent more fish (weight) during the darkest phase of the moon. This indicates that moonlight (visibility) affected the multifilament catch much more than it did the monofilament catch (Figure 4 and Tables 8, 9).

Interviews conducted at Volta Lake revealed that most fishermen felt that they caught considerably more fish when it rained. However, as is shown in Figure 4 and Table 10, no significant difference was noted for any of the 102mm. nets tested. The fishermen's belief that their catch

is better during or soon after rains is probably a holdover from the recent past when they fished the Volta River and its tributaries which were influenced tremendously and quickly by rainfall; whereas the Lake, because of its size, is not.

Furthermore, this study was not carried out near where any sizable stream enters the lake, therefore, increased fish movement or turbidity were not noted near Ampon even after heavy rains. However, the writer feels that where streams do flow into the lake fishing would definitely improve when these streams flooded, particularly for those species that normally migrate up-stream to spawn during the rainy season.

In determining the economics (catch to cost) relationship for each 102mm. gill net tested it was found that no net paid for itself within the study period (Figure 5).

Based on information provided by the net manufacturer, 102mm. (No.3) monofilament webbing costs 80 percent more than 102mm. (No.210d/3) multifilament webbing (FOB Tema). Accessories (floats and lead line) cost the same for each and increases the cost of the net approximately 100 percent. However, these accessories can be used on subsequent nets; therefore, this should be considered when comparing the cost to catch relationship between these nets and those not having the same amount of accessories.

Even if the cost of accessories is not included catch data show that the multi+ and mono+ gill nets realized only 90 percent of their original costs. Furthermore, because of the small diameter of the webbing material all of these nets were very badly damaged by the end of the study period and could not be expected to last for an entire year. Therefore, it is very doubtful that either the mono+ or the multi+ gill nets could have done much more than pay for themselves before they had to be discarded. However, there is a strong indication that the mono- gill net could

FIGURE No. 4

102mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM-VOLTA LAKE-1969
EACH NET MEASURED 3m x 46m (140 SQ METERS)

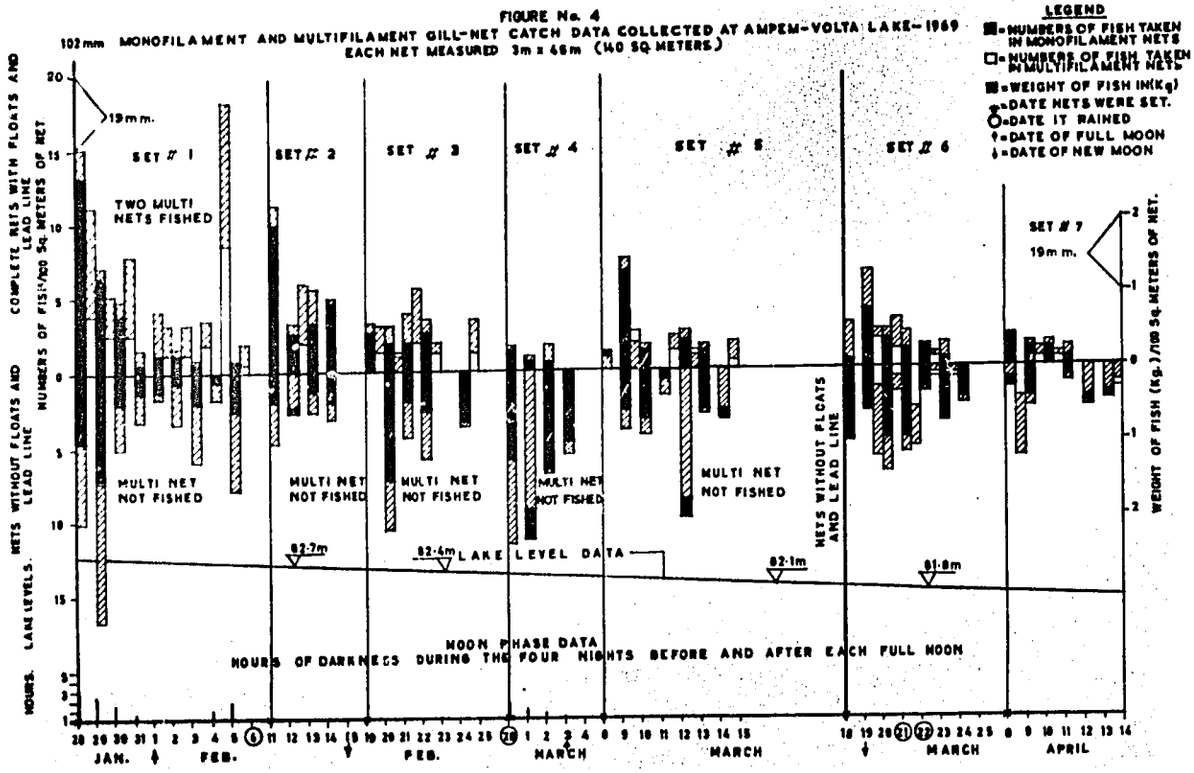


FIGURE No. 4 (CONT.)

102mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE - 1969
EACH NET MEASURED 3m x 46m (140 SQ METERS)

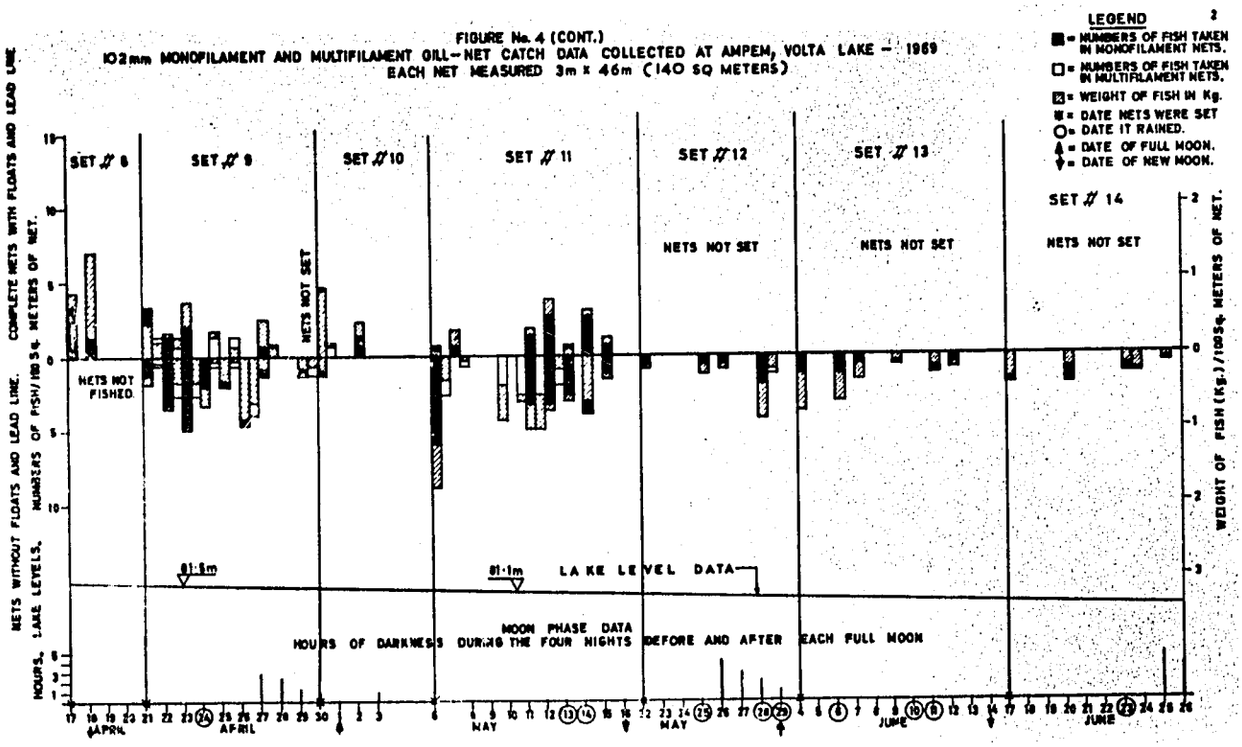


FIGURE No. 4 (CONT.)

102 mm MONOFILAMENT AND MULTIFILAMENT GILL NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

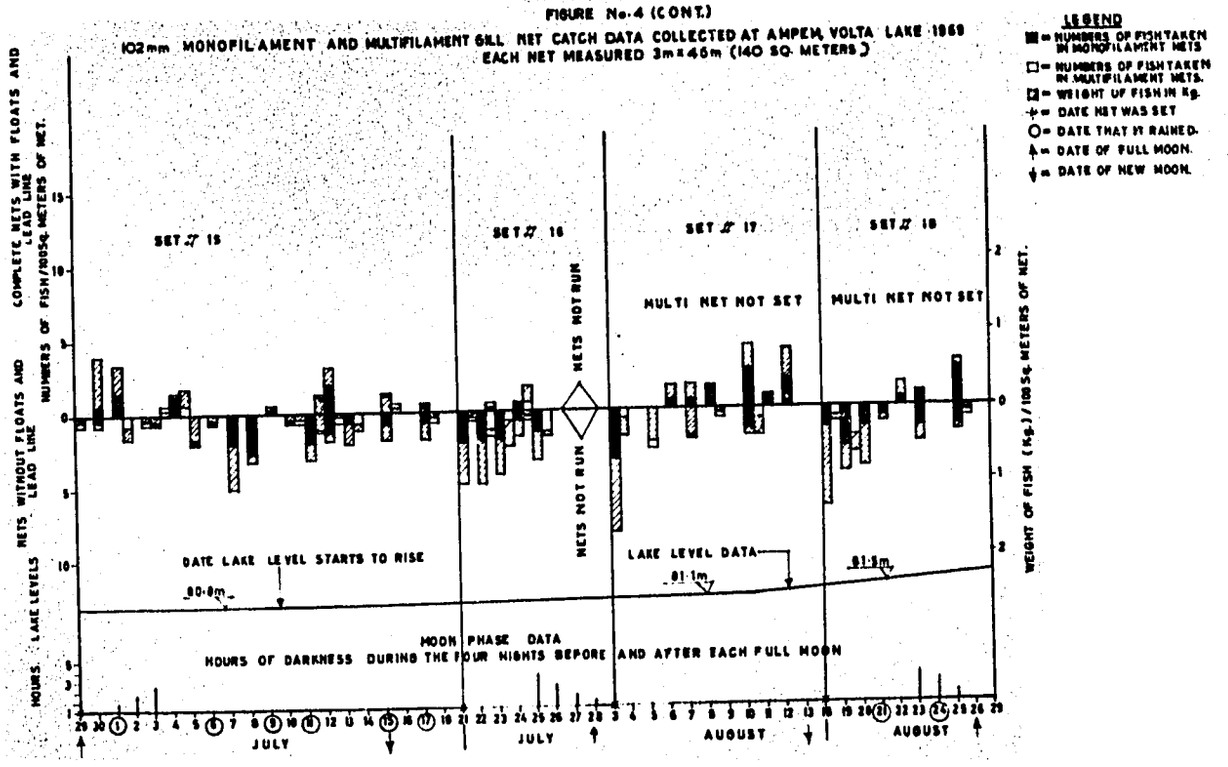


FIGURE No. 4 (CONT.)

102 mm MONOFILAMENT AND MULTIFILAMENT GILL— NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE – 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

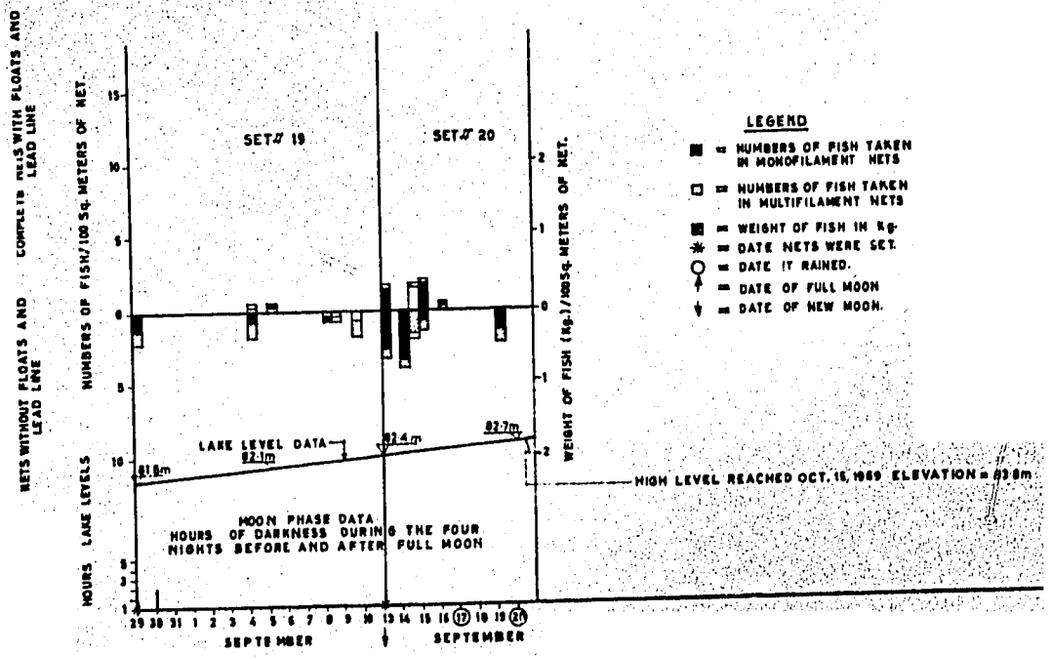


FIGURE 5

CATCH TO COST RELATIONSHIP PER 100 m^2 METERS OF GILL NET

102mm GILL NETS

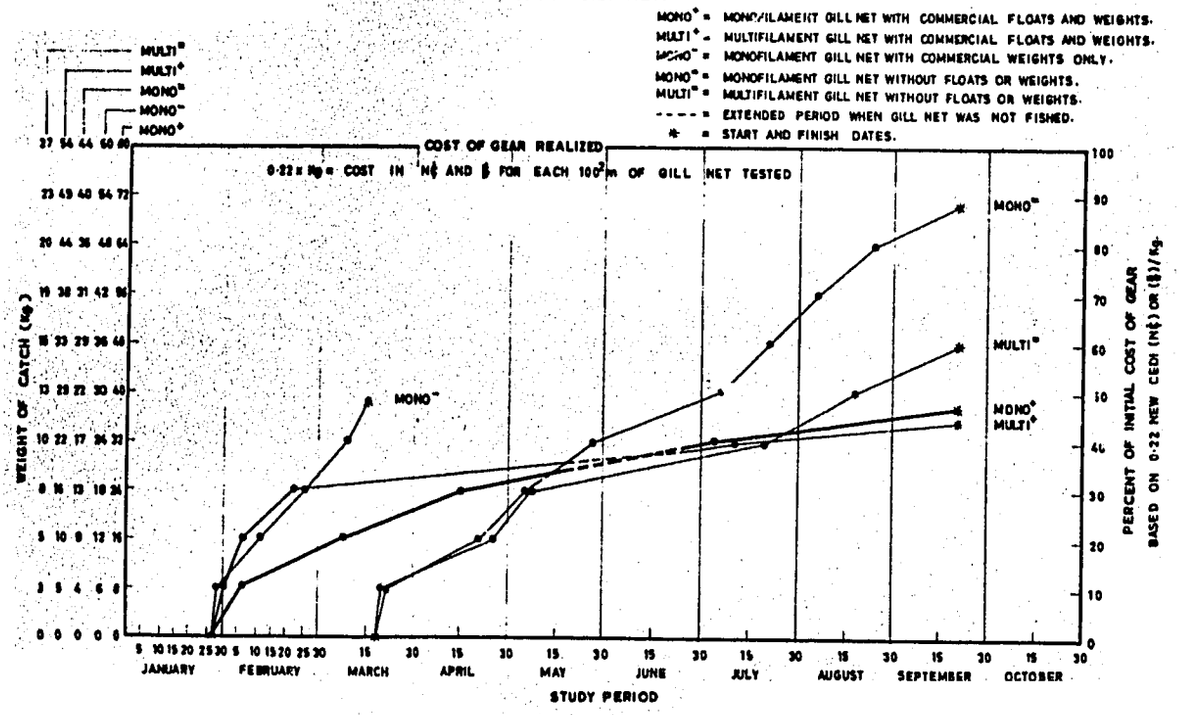


FIGURE No. 6

127mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE — 1969

EACH NET MEASURED 3m x 46m (140 SQ. METERS)

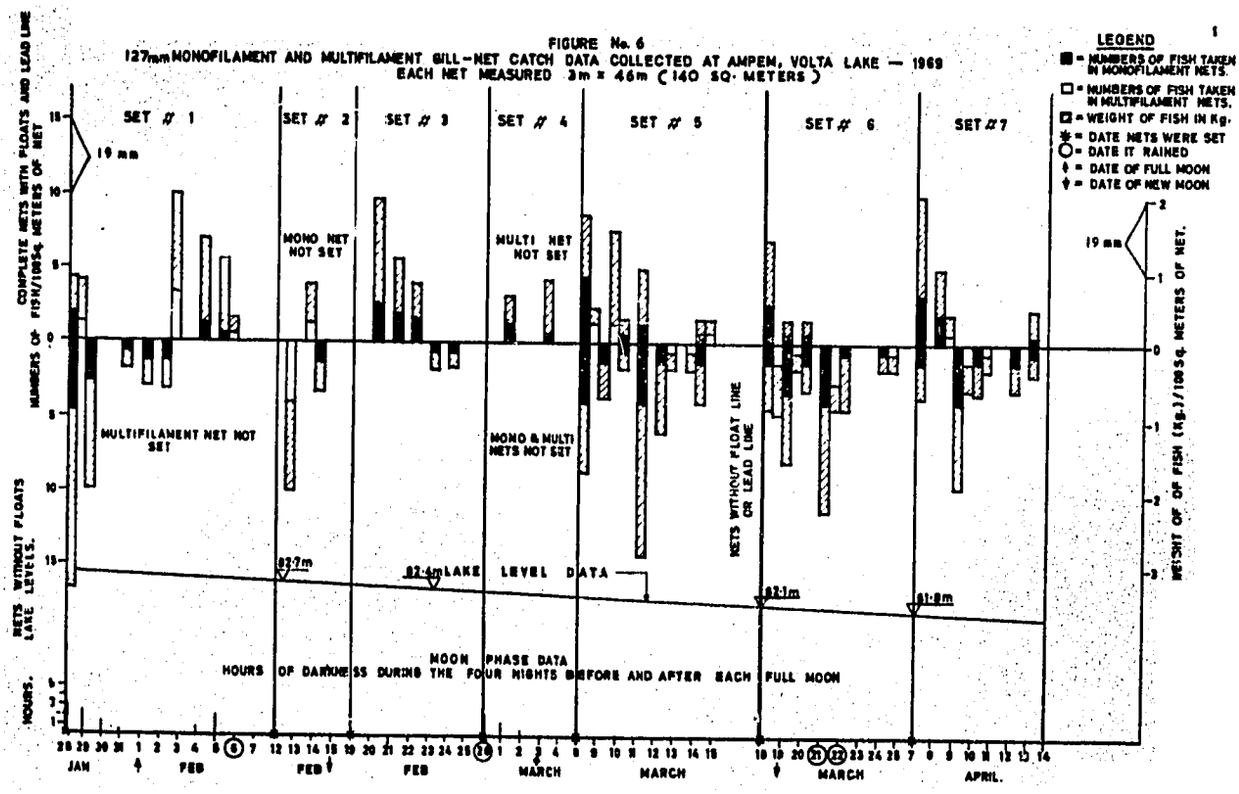


TABLE 4

CATCH DATA PER 100 ^{2} METERS OF GILL NET

January 28, 1956 - March 15, 1956

102mm. Multi + 1/

Species 2/	No.	Weight kg.	Weight lbs.	Ave. Lenth mm.	Ave. Lenth in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia spp. 3/	24	4.54	10.0	287	11.3	.18	.4	41	19	229-356	9.0-14.0	.05- .50	.1-1.1
Lates niloticus	2	.91	2.0	338	13.5	.45	1.0	03	04	330-356	13.0-14.0	- .05	1.0-1.0
Heterotis niloticus	26	15.78	34.8	438	17.5	.59	1.3	41	67	394.533	15.5-21.0	.05-1.36	1.0-3.0
Gymnarchus niloticus	4	2.22	4.9	625	25.0	.55	1.2	6	9	610-711	24.0-28.0	.50- .60	1.1-1.3
Chrysichthys spp.	2	.18	.4	330	13.0	.09	.2	T	T	330-330	13.0-13.0	.09- .09	.2- .2
Total	58	23.53	52.1					100	100				
Unit Days Fished: 54.6													
Catch/Unit Effort:	1.1	.43	.95										

102mm. Mono + 1/

Species 2/	No.	Weight kg.	Weight lbs.	Ave. Lenth mm.	Ave. Lenth in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia spp. 3/	84	11.75	25.9	267	10.5	.14	.3	75	46	216-330	8.5-13.0	.09- .45	.2-1.0
Lates niloticus	8	3.00	6.6	348	13.7	.38	.8	7	12	305-366	12.0-14.5	.23- .45	.5-1.0
Heterotis niloticus	13	7.35	16.2	434	17.1	.60	1.3	12	28	381-483	15.0-19.0	.45- .91	1.0-2.0
Gymnarchus niloticus	2	1.68	3.7	698	27.5	.86	1.9	2	7	610-787	24.0-31.0	.68-1.00	1.5-2.2
Chrysichthys spp.	3	1.27	2.8	432	17.0	.41	.9	3	5	381-483	15.0-19.0	.23- .54	.5-1.2
Auchenoglanis occidentalis	1	.23	.5	356	14.0	.23	.5	T	T	-356	14.0-14.0	- .23	- .5
Synodontis spp.	1	.05	.1	140	5.5	.05	.1	T	T	-137	5.5- 5.5	- .05	- .1
Total	112	25.33	55.9					100	100				
Unit Days Fished: 42.0													
Catch/Unit Effort:	2.6	.6	1.3										

1/ Gill net having commercial floats and lead line.
2/ Many Tetrodon fahaka taken, but not recorded.
3/ T. Galilaea, T. nilotica and T. zillii common in Volta Lake.

TABLE 5

Catch Data Per 100^2 Meters of Gill Net
January 28, 1969 - March 15, 1969
102mm Mono - 1/ 2/

Species 3/	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 4/	100	16.83	37.1	259	10.2	.18	.4	69	41	229 - 381	9.0 - 15.0	.09 - .68	.2 - 1.5
Lates niloticus	8	3.08	6.8	351	13.8	.41	.9	6	8	318 - 432	12.5 - 17.0	.23 - .54	.5 - 1.2
Heterotis niloticus	31	17.60	38.8	432	17.0	.59	1.3	21	43	381 - 508	15.0 - 20.0	.36 - .91	.8 - 2.0
Gymnarchus niloticus	3	2.58	5.7	749	29.5	.86	1.9	2	6	737 - 762	29.0 - 30.0	.68 - 1.00	.5 - 2.2
Chrysichthys sps.	1	.36	.8	356	14.0	.36	.8	T	T	- 356	- 14.0	- .36	- .8
Synodontis sps.	2	.59	1.3	267	10.5	.32	.7	1	1	229 - 305	9.0 - 12.0	.14 - .45	.3 - 1.0
Schilbe mystus	1	.14	.3	254	10.0	.14	.3	T	T	- 254	- 10.0	- .14	- .3
Total	146	41.18	90.8					100	100				

Unit Days Fished: 42.0

Catch/Unit Effort: 3.5 1.0 2.2

1/ Gill net without floats, but having lead line.
2/ No multifilament counterpart gill net was fished during this period.
3/ Many Tetradon fahaka were taken, but not recorded.
4/ T. galilaea, T. nilotica and T. zillii common in Volta Lake.

TABLE 6

CATCH DATA PER 100² METERS OF GILL NET
March 18, 1969 - Sept.20,1969

102mm. Multi+ 1/

Species 2/	No.	Weight Kg.	Weight Lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lb
Tilapia sps. 3/	14	2.45	5.4	257	10.1	.18	.4	54	36	152-330	6.0-13.0	.05- .36	.1
Lates niloticus	5	1.91	4.3	356	14.0	.41	.9	19	28	229-432	9.0-17.0	.09- .54	.2
Heterotis niloticus	1	.50	1.1	432	17.0	.50	1.1	4	7	432-432	17.0-17.0	- .50	.1
Gymnarchus niloticus	1	.50	1.1	610	24.0	.50	1.1	4	7	610-610	24.0-24.0	- .50	.1
Chrysichthys sps.	1	.36	.8	381	15.0	.36	.8	4	6	381-381	15.0-15.0	- .36	.8
Auchenoglanis occidentalis	1	.50	1.1	457	18.0	.50	1.1	4	7	457-457	18.0-18.0	- .50	.1
Eutropius niloticus	1	.23	.5	330	13.0	.23	.5	4	3	330-330	13.0-13.0	- .23	.5
Mormyrus rume	2	.41	.9	457	18.0	.41	.9	8	6	432-483	17.0-19.0	.18- .23	.4
Total	26	6.86	15.2					100	100				
Unit Days Fished: 116.2													
Catch/Unit Effort:	.22	.06	.13										

Period: March 18 through October 3

1022mm. Mono + 1/

Species 2/	No.	Weight Kg.	Weight Lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lb
Tilapia sps. 3/	85	20.91	46.1	267	10.5	.23	.5	77	63	229-381	9.0-15.0	.09- .59	.2
Lates niloticus	10	4.17	9.2	358	14.1	.41	0.9	9	13	279-406	11.0-16.0	.23- .64	.5
Heterotis niloticus	3	1.59	3.5	432	17.0	.54	1.2	3	5	406-483	16.0-19.0	.45- .68	1.0
Gymnarchus niloticus	3	3.45	7.6	805	31.7	1.10	2.5	3	10	737-864	29.0-34.0	.73-1.59	1.6
Chrysichthys sps.	2	.68	1.5	368	14.5	.40	.8	2	2	256-381	14.0-15.0	.23- .45	.5
Auchenoglanis occidentalis	3	.82	1.8	348	13.7	.40	.9	3	3	330-356	13.0-14.0	.23- .36	.5
Mormyrus rume	2	.64	1.4	457	18.0	.30	.7	2	2	406-508	16.0-20.0	.18- .45	.4
Heterobranchus sps.	1	.91	2.0	533	21.0	.90	2.0	1	3	-533	-21.0	.91	
Total	109	33.17	73.1					100	100				
Unit Days Fished: 138.6													
Catch/Unit Effort:	.79	.24	.53										

1/ Gill net having commercial floats and lead line.
2/ Many Tetraodon fahaka taken, but not recorded.
3/ T. Galilaea, T. nilotica and T. zillii common in Volta Lake.

TABLE 7

Catch Data Per 100^2 Meters of Gill Net
March 18, 1969 - September 20, 1969

102mm Multi = 1/

Species 2/	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 3/	73	14.06	31.0	259	10.2	.18	0.4	86	64	216 - 356	8.5 - 14.0	.05 - .50	.1 - 1.1
Lates niloticus	1	.45	1.0	406	16.2	.45	1.0	T	2	- 406	- 16.0	- .45	- 1.0
Heterotis niloticus	4	4.00	8.8	508	20.0	1.00	2.2	5	18	406 - 584	16.0 - 23.0	.45 - 1.45	1.0 - 3.2
Gymnarchus niloticus	2	1.91	4.2	737	29.0	.95	2.1	3	9	- 737	- 29.0	.91 - 1.00	2.0 - 2.2
Chrysichthys sps.	1	.45	1.0	381	15.0	.45	1.0	T	2	- 381	- 15.0	- .50	- 1.1
Anchenoglanis occidentalis	1	.23	.5	13	14.0	.23	.5	T	1	- 356	- 14.0	- .23	- .5
Mormyrus rume	2	.27	.6	15	14.5	.14	.3	3	1	279 - 457	11.0 - 18.0	.05 - .23	.1 - .5
Malapterurus electricus	1	.68	1.5	406	16.0	.68	1.5	T	3	- 406	- 16.0	- .68	- 1.5
Total	85	22.05	48.6					100	100				
Unit Days Fished: 172.2													
Catch/Unit Effort:	.49	.13	.28										

102mm Mono = 1/

Species 2/	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 3/	177	36.11	79.6	264	10.4	.22	.45	84	69	216 - 356	8.5 - 14.0	.05 - .54	.1 - 1.2
Lates niloticus	16	5.89	13.0	358	14.1	.36	.80	8	11	330 - 406	13.0 - 16.0	1.40 - .59	.3 - 1.3
Heterotis niloticus	4	3.95	8.7	541	21.3	1.00	2.20	2	8	432 - 635	17.0 - 25.0	.54 - 1.59	1.2 - 3.5
Gymnarchus niloticus	3	2.72	6.0	752	29.6	1.07	2.00	1	5	737 - 762	29.0 - 30.0	.68 - 1.13	1.5 - 2.5
Chrysichthys sps.	4	1.81	4.0	419	16.5	.45	1.00	2	4	305 - 483	12.0 - 19.0	.09 - .82	.2 - 1.8
Anchenoglanis occidentalis	1	.45	1.0	381	15.0	.45	1.00	T	T	- 381	- 15.0	- .45	- 1.0
Mormyrus rume	5	1.27	2.8	432	17.0	.25	.56	3	3	381 - 483	15.0 - 19.0	- .59	.3 - 1.1
Total	210	52.20	115.1					100	100				
Unit Days Fished: 172.2													
Catch/Unit Effort:	1.2	.30	.67										

1/ Gill net without floats or lead line.
2/ Many Tetraodon fahaka were taken, but not recorded.
3/ T. galilaea, T. nilotica and T. zillii common in Volta Lake.

TABLE 8

Moonlight Influenced Fish Catch Data for 102mm Gill Nets During January 28 - March 15, 1969
Moon Phase

9 and 3 Brightest Nights Each Month

	Mono+ 1/ 9 nights	Mono+ 1/ 3 nights	Multi+ 1/ 9 nights	Multi+ 1/ 3 nights	Mono- 2/ 9 nights	Mono- 2/ 3 nights	Multi- 2/ 3/ 9 nights	Multi- 2/ 3/ 3 nights
Wt. kg. (lbs.)	11.4 (25.1)	2.5 (5.5)	18.3 (40.3)	1.8 (4.0)	24.6 (54.1)	5.6 (12.3)	- -	- -
Unit Days	18.2	5.6	30.8	11.2	18.2	7.0	-	-
Catch/U.E. kg. (lbs.)	.63 (1.4)	.45 (1.0)	.6 (1.3)	.16 (.35)	1.4 (3.1)	.8 (1.8)	- -	- -
% Increase over Dark Nights		-	150	-	197	43	-	-
9 and 3 Darkest Nights Each Month								
Wt. kg. (lbs.)	7.4 (16.3)	1.4 (3.1)	1.7 (3.7)	- 3/	3.3 (7.4)	.84 (1.9)	- -	- -
Unit Days	7.0	1.4	7.0	-	7.0	1.4	-	-
Catch/U.E. kg. (lbs.)	1.1 (2.4)	1.4 (3.1)	.24 (.53)	- -	.47 (1.0)	.56 (1.2)	- -	- -
% Increase over Dark Nights	75	211	-	-	-	-	-	-
Intermediate Period Each Month 4/								
	12 nights	24 nights	12 nights	24 nights	12 nights	24 nights	12 nights	24 nights
Wt. kg. (lbs.)	6.6 (14.5)	21.5 (47.3)	3.7 (8.1)	21.9 (48.1)	13.2 (29.3)	34.7 (76.3)	- -	- -
Unit Days	16.8	35.0	16.8	43.4	16.8	33.6	-	-
Catch/U.E. kg. (lbs.)	.39 (.86)	.61 (1.9)	.22 (.48)	.5 (1.1)	.79 (1.7)	1.1 (2.3)	- -	- -

1/ Nets with floats and lead line.
2/ Nets without floats but with lead line.
3/ Net not fished.
4/ Based on a 30-day month.

TABLE 9

Moonlight Influenced Fish Catch Data for 102mm. Gill Nets During March 18 - September 20, 1969

Moon Phase

9 and 3 Brightest Nights Each Month

	Mono+ 1/		Multi+ 1/		Mono- 2/		Multi- 2/	
	9 nights	3 nights	9 nights	3 nights	9 nights	3 nights	9 nights	3 nights
Wt. kg. (lbs.)	6.3 (13.9)	3.6 (7.9)	.5 (1.1)	.56 (1.2)	5.4 (11.9)	2.2 (4.8)	2.2 (4.4)	.21 (.46)
Unit Days	25.2	9.8	21.0	9.8	32.2	9.8	32.2	7.0
Catch/U.E. kg. (lbs.)	.25 (.55)	.39 (.9)	.02 (.04)	.06 (.13)	.17 (.37)	.22 (.48)	.06 (.13)	.03 (.07)
% Increase over dark nights	-	-	-	-	-	-	-	-
9 and 3 Darkest Nights Each Month								
Wt. kg. (lbs.)	19.3 (42.5)	9.8(21.6)	3.9(8.6)	1.5(3.3)	18.0(39.7)	6.6(14.5)	7.0(15.4)	2.1(4.6)
Unit Days	46.2	16.8	40.6	16.8	47.6	14.0	47.6	14.0
Catch/U.E. kg. (lbs.)	.42 (.92)	.58(1.3)	.1 (.22)	.08(.18)	.38 (.84)	.47(1.0)	.15(.33)	.15(.33)
% Increase over bright nights	68	49	400	33	124	114	150	400
Intermediate Period Each Month 3/								
Wt. kg. (lbs.)	7.6(16.7)	19.8(43.6)	2.5(5.5)	4.8(10.6)	28.9(63.5)	43.5(95.7)	13.1(28.8)	19.8(43.6)
Unit Days	70	114.8	54.6	89.6	92.4	148.4	92.4	151.2
Catch/U.E. kg. (lbs.)	.11(.24)	.17(.37)	.05(.11)	.05(.11)	.31(.68)	.29(.64)	.14(.31)	.13(.29)

1/ Nets with floats and lead line.

2/ Nets without float or lead line.

3/ Based on a 30-day month.

TABLE 10

Rain Influenced Fish Catch Data for 102mm Mesh Gill Nets
March 18 - September 19, 1969

	Mono+ 1/	Multi+ 1/	Mono- 2/	Multi- 2/
Rain Days Fished	14	12	20	20
Amount of Rainfall mm. (in.)	298.5 (11.9)	281.3 (11.3)	444.8 (17.8)	444.8 (17.8)
% Success for Rain Days	57	25	75	40
% Success for Non-Rain Days	43	22	58	34
Unit Rain Days 3/	19.6	16.8	29.4	29.4
Total Catch for Rain Days kg. (lbs.)	3.9 (8.6)	1.3 (2.9)	9.2 (20.2)	2.8 (6.2)
Rain Days Catch/U.E. kg. (lbs.)	.20 (.44)	.08 (.18)	.31 (.68)	.1 (.22)
Non-Rain Days Catch/U.E. kg. (lbs.)	.24 (.53)	.06 (.13)	.30 (.66)	.14 (.31)
% Difference in Catch for Rain and Non-Rain Days	20	25	3	40

1/ Nets with floats and lead line.
2/ Nets without floats or lead line.
3/ 100^2m of net fished during a 24-hour period when rain occurred.

have at least paid for itself during the life of the net and possibly would have even made a profit. Also, indications are that the mono= would have been profitable if it had been fished for the same period of time as the mono+ gill net. The writer did not attempt to determine the difference in the economics of each net if the Heterotis catch was subtracted, since it would have been impossible to determine their actual worth, which was dependent on the conditions of the individual fish and the scarcity of fish at that particular moment. During a period of fish abundance a rotten Heterotis might well be discarded, whereas when fish are scarce the fish would be either eaten by the fishermen or even sold or bartered.

But it is evident from these data that none of the 102mm. mesh gill nets would have been a sound investment for Volta Lake fishermen, at least in the Afram, since the nets would not last long and would require more maintenance than they would be worth.

127mm. Mesh Gill Nets

During the period 1968-69 the 127mm. mesh gill net was found to be one of the most popular sizes used by Volta Lake fishermen at Ampem.

First Study Period (January 28-March 15,1969)

Multi+ vs. Mono+

Taylor and Denyoh found during their short study in 1968 that 127mm. mono+ had a CPUE of 1.1 kg. compared to .42 kg. for the multi+ gill net. Even though their total catch rate for each net was greater, their ratio (2.6 to 1) was comparable to the data below.

In 36.4 UD of fishing multi+ caught twelve fish (3 species) totaling 7.4 kg., representing a .2 kg. CPUE. Tilapia comprised 50 percent of the catch by weight while Heterotis made up the remainder. In the same number of UD mono+ took twenty-eight fish (5 species) weighing 19.1 kg. for a CPUE of .54 kg., 2.5 times more than for the multi+ net. Tilapia made up 55 percent of the total catch, followed by Heterotis with 29 percent (Figures 6 and 12; Tables 11,27 and 28).

Multi⁻ vs. Mono⁻

The multi- gill net caught eleven fish (3 species) weighing 5.5 kg. in 22.4 UD giving a CPUE of .25 kg. Tilapia comprised 92 percent of the catch followed by Ophiocephalus obscurus (8 percent) which was the only other species taken.

In 36.4 UD of fishing the mono- gill net took thirty-eight fish (3 species) weighing 23.6 kg. The mono-'s CPUE of .64 kg. is 2.7 times greater than its multifilament counterpart's. Sixty-two percent of the catch comprised of Tilapia while 38 percent consisted of Heterotis (Figures 6 and 12; Tables 12,27 and 28).

Second Study Period (March 18-September 20,1969)

As was found for the 102mm. gill nets, the CPUE for 127mm. gill nets was poorer during the second study period than during the first.

Multi+ vs. Mono+

Multi+ was fished 175.0 UD and caught twenty-two fish (4 species) weighing 18.0 kg., and had a CPUE of .1 kg. Heterotis comprised 46% of the weight of the catch, followed by Tilapia with 42 percent.

The catch for the mono+ during an equal period of time was 138 fish (5 species) that weighed 71.9 kg. Its CPUE of .41 is four times greater than for the multi+ gill net. Tilapia made up 93 percent of the total catch, followed far back by Lates with 4 percent. No Heterotis were taken (Figure 6 and 12; Tables 13,27 and 28).

Multi= vs. Mono=

In 162.4 UD of fishing, the multi= gill net took thirty-eight fish (8 species) weighing 24.0 kg. for a CPUE of .15 kg. Sixty-seven percent of the catch, consisted of Tilapia followed by Heterotis (9 percent), and Lates and Gymnarchus niloticus each had 8 percent.

Mono= was also fished for 162.4 UD and had a catch of 112 fish (8 species) weighing 66.4 kg. The CPUE for this gill net was .41 kg. which is 2.7 times greater than its multi= counterpart. Tilapia made

up 72 percent of the total weight of the catch, followed by Lates with 13 percent and Heterotis with 8 percent (Figure 6 and 12; Tables 14, 27 and 28).

Based on these data mono- was the most effective gill net in the 127mm. mesh size. This was followed by mono+ and mono= which each had a comparable CPUE. For the multifilament gill nets multi- was also the most effective, followed by multi= and then multi+.

No significant difference in selectivity was noted for the two webbing materials, but there was a definite difference between net styles. This was particularly true for the multi= and mono= gill nets which caught eight species of fish each, compared to five or less species taken by the other styles tested (Table 28).

As was found for the 102mm. gill net, moonlight did not appear to have a significant effect on the test nets during the first study period (January 28-March 15,1969) for possibly the same reasons as mentioned before. Consideration should also be given to the fact that during the first period each net could be fished as close to the shore as the fisherman chose since no shoreline weed growth was present during that period of lake drawdown. This could have had a marked effect on the close inshore gill net fish catch because shoreline turbidity caused by wave action against the unprotected shoreline, was common. However, during the second study period (March 18 - September 15, 1969) when the lake was in different stages of flooding, the shoreline area was well protected by a extensive band of flooded stands of Polygonum that had become established on the exposed lake bottom during the previous drawdown period and which protected the shoreline from excessive wave action. Hence, during that period the shallow water was never muddied.

Catch data for the second study period showed that all nets caught more fish during the darkest nights each month with the exception of the mono+ gill net that caught more fish during the 3 brightest nights, but not during the 9 brightest nights.

Furthermore, the difference in the catch rate between the dark and bright periods was much greater for the multifilament gill nets than for the monofilament gill nets, indicating that visibility significantly affected the multifilament catch, but not the monofilament catch (Figure 6 and Tables 15 and 16).

Data collected during the study period indicated that rainfall had no favorable influence on the 127mm. gill net's fish catch. With the exception of the mono= gill net, the non-rain day CPUE was greater than the rain day CPUE (Figure 6 and Table 17).

Information provided by the gill net manufacturer shows that 127mm. (No.5) monofilament gill net webbing costs 89 percent more than 127mm. (No. 210d/6) multifilament webbing (FOB Tema).

As mentioned earlier in this report gill net webbing normally doubles in price from dock to fisherman, and that commercial accessories (floats and lead core line) also increase the cost of the net by approximately 100 percent.

Even though the monofilament gill nets were 89 percent more expensive than their multifilament counterparts, the monofilament net's increased fish catch more than compensated for it.

The mono= gill net paid for itself in approximately 4 months, and by the end of the study period (5.5 months) it had made a 30 percent profit over the initial investment and it should be remembered that webbing material for the mono= gill net was not new since it had been fished for 2.5 months as a mono- gill net during the first study period.

Because of the added expense of the accessories the mono+ gill net only realized 90 percent of its original cost during the eight-month study period. However, if used or natural accessories had been employed, and assuming that the gill net would have remained as effective, the net would have realized 80 percent profit by the end of the study.

FIGURE No. 6 (CONT.)

127mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA-LAKE 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

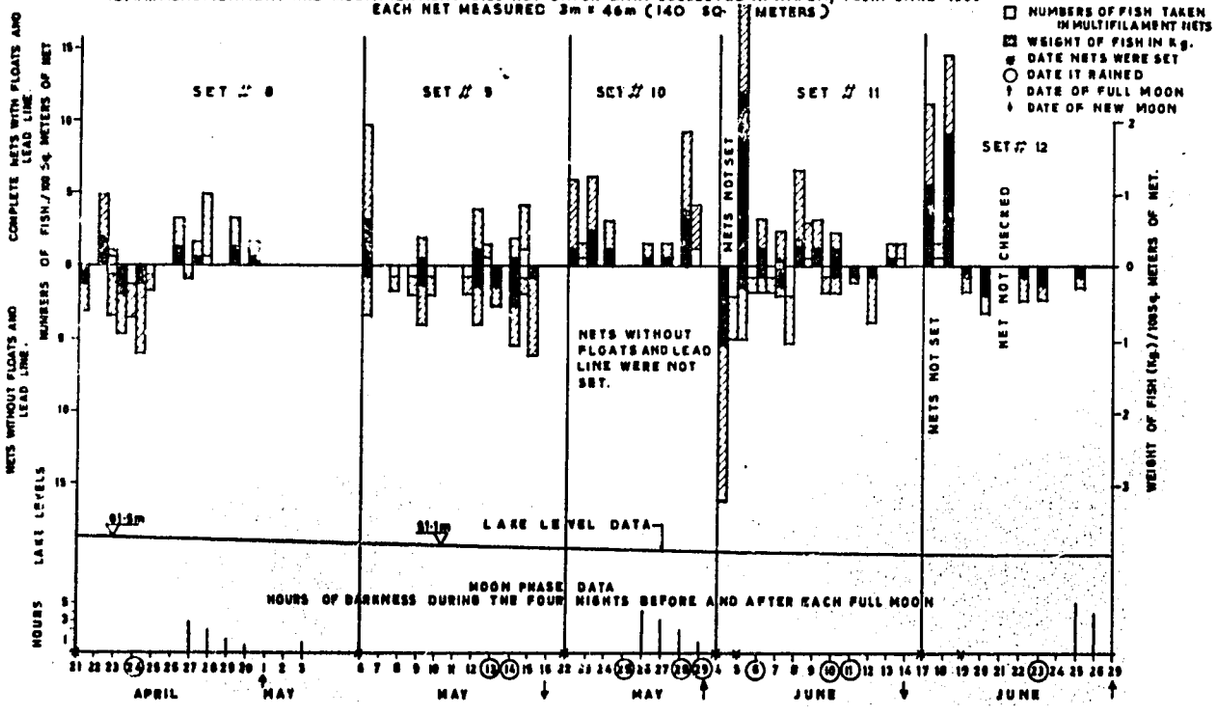


FIGURE No. 6 (CONT.)

127mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE — 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

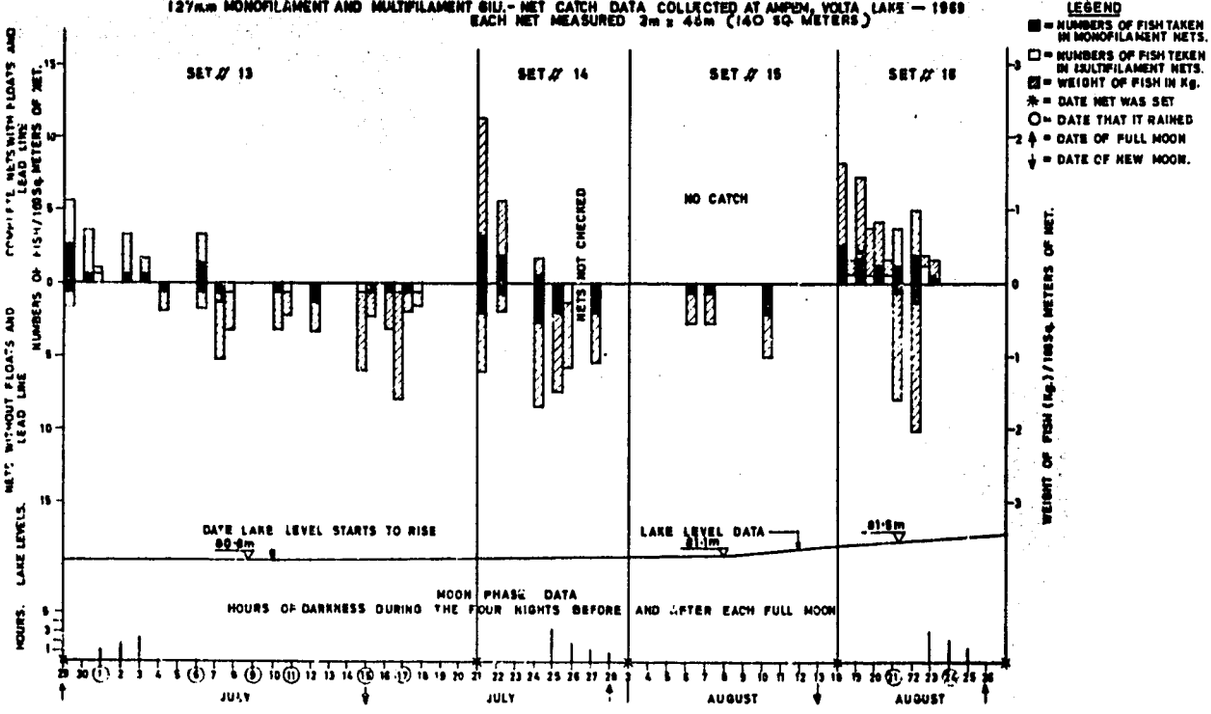


FIGURE No. 6 (CONT.)

127mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEH, VOLTA LAKE — 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

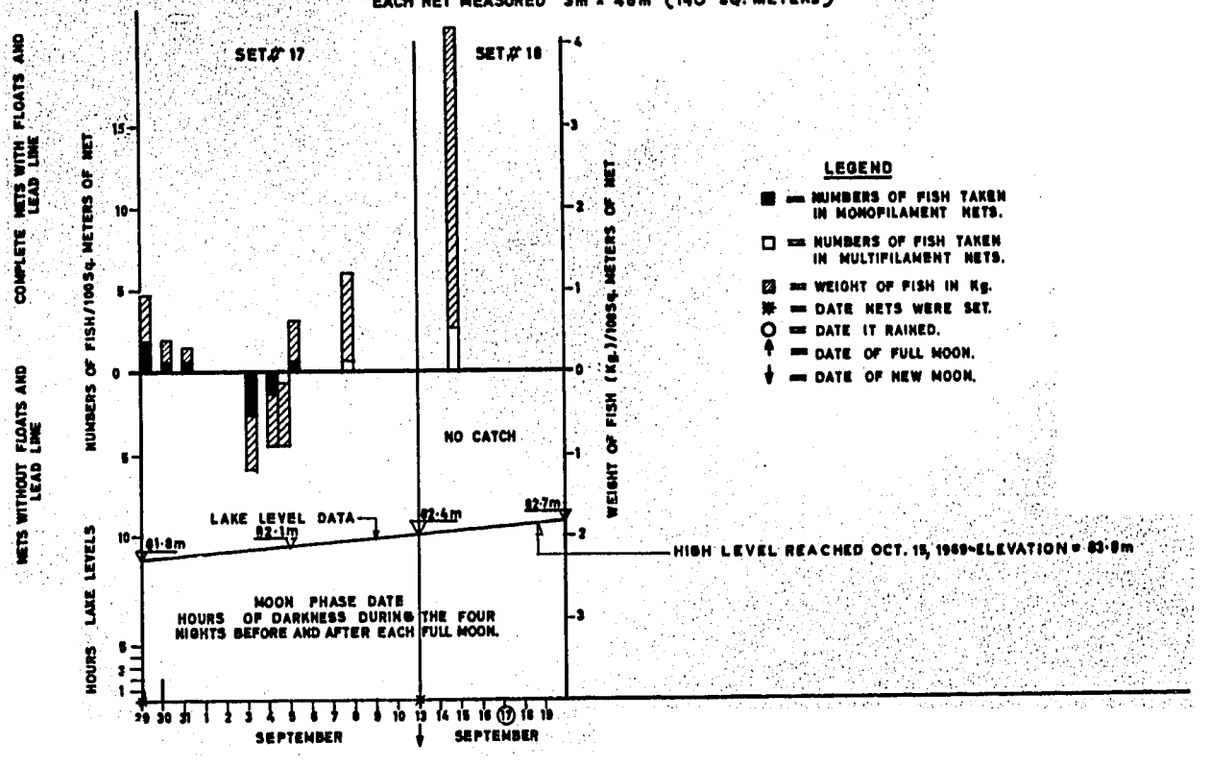


FIGURE 7
CATCH TO COST RELATIONSHIP PER 100^2 METERS OF GILL NET
127mm GILL NETS.

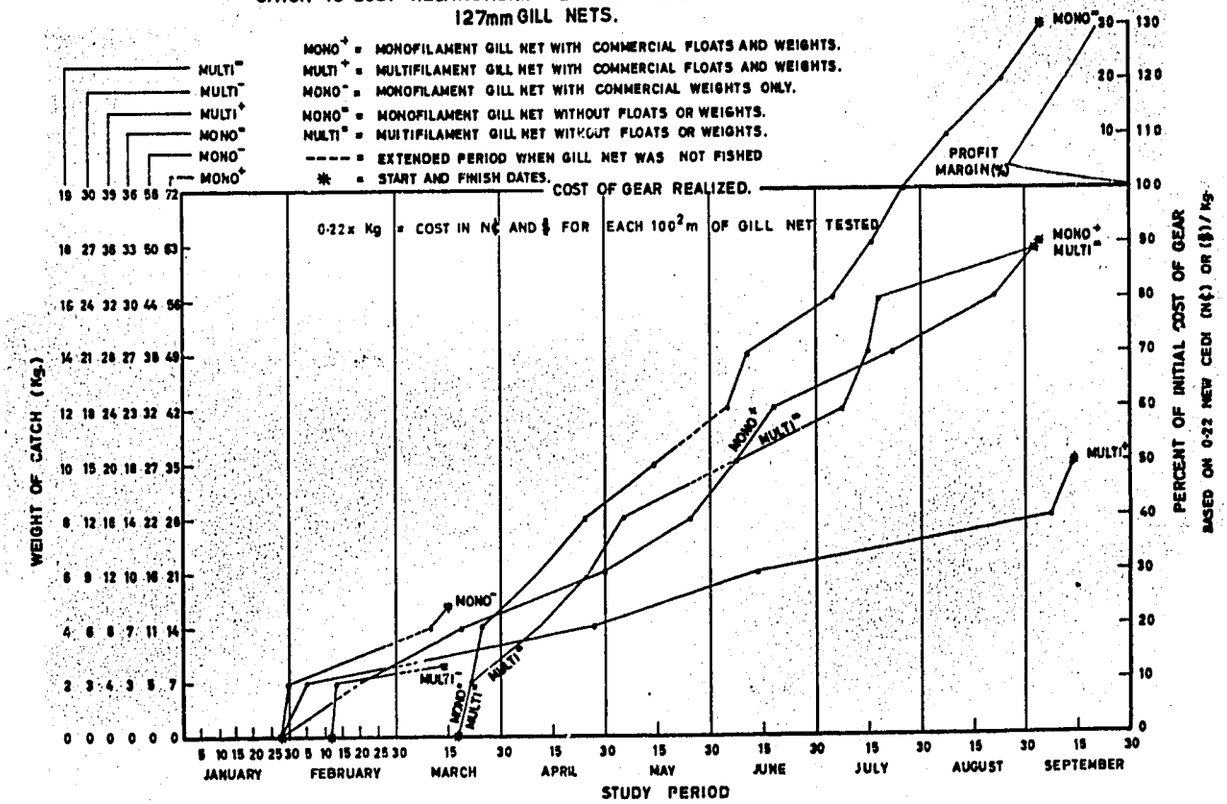


TABLE 11

CATCH DATA PER 100^2 METERS OF GILL NET
January 28, 1969-March 15, 1969

127mm Multi+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 2/	8	3.72	8.2	330	13.0	.45	1.0	67	50	279-368	11.0-14.5	.27- .59	.6-1.3
Heterotis niloticus	4	3.67	8.1	508	20.0	.91	2.0	33	50	457-610	18.0-24.0	.59-1.81	1.3-4.0
Total	12	7.39	16.3					100	100				
Unit Days Fished: 36.4													
Catch/Unit Effort:	.33	.20	.45										

127mm Mono+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 2/	21	10.39	22.9	330	13.0	.50	1.1	75	55	279-356	11.0-14.0	.36- .64	.8-1.4
Lates niloticus	1	1.36	3.0	483	19.0	1.36	3.0	4	7	-483	-19.0	-1.36	-3.0
Heterotis niloticus	5	5.58	12.3	536	21.1	1.09	2.4	18	29	457-635	18.0-25.0	.77-1.36	1.7-3.0
Heterobranchus sp.	1	1.72	3.8	610	24.0	1.72	3.8	4	9	-610	-24.0	-1.72	-3.8
Total	28	19.05	42.0										
Unit Days Fished: 36.4													
Catch/Unit Effort:	.77	.54	1.2										

1/ Gill net having commercial floats and lead line.
2/ T. galilaea, T. nilotica, and T. zillii common in Volta Lake.

TABLE 12

Catch Data per 100^2 Meters of Gill Net
February 13, 1969 - March 15, 1969

127mm Multi- 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs
Tilapia sps.2/	10	5.00	11.0	330	13.0	.50	1.1	91	92	330 - 343	13.0 - 13.5	.45 - .68	1.0 - 1.5
Ophiocephalus obscurus	1	.45	1.0	454	15.0	.45	1.0	9	8	- 394	- 15.5	.45	- 1.0
Total	11	5.45	12.0					100	100				
Unit Days Fished: 22.4													
Catch/Unit Effort:	.49	.25	.54										

127mm Mono- 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs
Tilapia sps.2/	31	14.70	32.4	315	12.4	.45	1.0	82	62	279 - 381	11.0 - 15.0	.27 - .82	.6 - 1.8
Heterotis niloticus	7	8.94	19.7	569	22.4	1.30	2.8	18	38	483 - 660	19.0 - 26.0	1.04 - 1.72	2.3 - 3.8
Total	38	23.64	52.1					100	100				
Unit Days Fished: 36.4													
Catch/Unit Effort:	1.0	.64	1.4										

1/ Gill net without floats, but having lead line.
2/ T. galilaea, T. nilotica and T. sillii common in Volta Lake.

TABLE 13

Catch Data Per 100^2 Meters of Gill Net
March 18, 1969 - September 20, 1969

127mm Multi+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 2/	15	7.48	16.5	330	13.0	.50	1.1	68	42	305 - 381	12.0 - 15.0	.14 - .91	.3 - 2.0
Lates niloticus	2	2.18	4.8	470	18.5	1.09	2.4	9	12	457 - 483	18.0 - 19.0	1.04 - 1.13	2.3 - 2.5
Heterotis niloticus	5	8.35	18.4	610	24.0	1.68	3.7	23	46	584 - 660	23.0 - 26.0	1.36 - 1.91	3.0 - 4.2
Total	22	18.01	39.7					100	100				
Unit Days Fished: 175.0													
Catch/Unit Effort:	.13	.10	.23										

127mm Mono+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps. 2/	132	67.08	147.9	333	13.1	.45	1.0	96	93	279 - 381	11.0 - 15.0	.23 - 1.00	.5 - 2.2
Lates niloticus	3	2.54	5.6	447	17.5	.62	1.8	2	4	406 - 508	16.0 - 20.0	.50 - 1.36	1.1 - 3.0
Chrysichthys sp.	1	1.28	2.6	559	22.0	1.18	2.6	1	2	- 559	- 22.0	- 1.18	- 2.6
Anchenoglanis occidentalis	2	1.19	2.4	376	14.8	.54	1.2	1	2	368 - 381	14.5 - 15.0	- .54	- 1.2
Total	138	71.89	158.5					100	100				
Unit Days Fished: 175.0													
Catch/Unit Effort:	.78	.41	.9										

1/ Gill net having commercial floats and lead lines.
2/ T. galilaea, T. nilotica and T. zillii common in Volta Lake.

TABLE 14

CATCH DATA PER 100^2 METERS OF GILL NET
March 18, 1969-September 20, 1969

127mm Multi* 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps.2/	31	16.01	35.3	333	13.1	0.50	1.1	85	87	279-406	11.0-16.0	0.23-1.00	0.5-2.2
Lates niloticus	2	1.81	4.0	406	16.0	0.91	2.0	5	8	305-508	12.0-20.0	0.45-1.40	1.0-3.0
Heterotis niloticus	1	2.27	5.0	635	25.0	2.27	5.0	2	9	-635	-25.0	-2.30	-5.0
Gymnarchus niloticus	1	1.81	4.0	762	30.0	1.81	4.0	2	8	-762	-30.0	-1.81	-4.0
Anchenoglanis occidentalis	1	0.54	1.2	356	14.0	0.54	1.2	2	2	-356	-14.0	-0.54	-1.2
Chrysichthys sp.	1	1.04	2.3	508	20.0	1.04	2.3	2	4	-508	-20.0	-1.04	-2.3
Bagrus bayad	1	0.54	1.2	419	16.5	0.54	1.2	2	2	-419	-16.5	-0.54	-1.2
Total	38	24.02	53.0					100	100				
Unit Days Fished: 162.4													
Catch/Unit Effort:	.23	.15	.33										

127mm Mono* 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps.2/	91	47.70	105.0	348	13.7	0.55	1.2	80	72	279-394	11.0-15.5	0.23-1.00	0.5-2.2
Lates niloticus	9	8.80	19.4	450	17.7	1.00	2.2	8	13	406-533	16.0-21.0	0.59-1.45	1.3-3.2
Heterotis niloticus	4	5.50	12.0	597	23.5	1.36	3.0	4	8	584-635	23.0-25.0	1.13-1.81	2.5-4.0
Anchenoglanis occidentalis	3	1.80	3.9	483	19.0	0.59	1.3	3	3	406-610	16.0-24.0	0.45-0.68	1.0-1.5
Bagrus bayad	1	0.23	0.5	432	17.0	0.23	0.5	1	1	-432	-17.0	-0.23	-0.5
Momyrus rume	3	2.00	4.5	483	19.0	0.68	1.5	3	3	483-508	19.0-20.0	0.45-0.91	1.0-2.0
Distichodus sp.	1	0.45	1.0	432	17.0	0.45	1.0	1	1	-432	-17.0	-0.45	-1.0
Total	112	66.48	148.6					100	100				
To													
Unit Days Fished: 162.4													
Catch/Unit Effort:	.69	.41	.9										

1/ Gill net without floats or lead line.
2/ T. galilaea, T. nilotica, and T. zillii common in Volta Lake.

TABLE 15

Moon Influenced Fish Catch Data for 127mm Gill Nets During January 28 - March 15, 1969

	Mono+ 1/		Multi+ 1/		Mono- 2/		Multi- 2/	
Moon Phase								
9 and 3 Brightest Nights Each Month								
	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights
Wt. kg. (lbs.)	6.7 (14.7)	1.1 (2.4)	4.0 (8.8)	2.0 (4.4)	10.1 (22.2)	2.3 (5.1)	- 3/	- 3/
Unit Days	18.2	7.0	14.0	7.0	14.2	4.2	-	-
Catch/UE kg. (lbs.)	.37 (.8)	.16 (.35)	.29 (.64)	.28 (.12)	.72 (1.6)	.5 (1.1)	- -	- -
% Increase over Dark Nights	5/	5/	81	5/	300	-	-	-
9 and 3 Darkest Nights Each Month								
Wt. kg. (lbs.)	0 (0)	0 (0)	.9 (2.0)	0 (0)	1.0 (2.2)	.91 (2.0)	4.2 (9.2)	0 (0)
Unit Days	1.4	1.4	5.6	1.4	5.6	1.4	5.6	1.4
Catch/UE kg. (lbs.)	0 (0)	0 (0)	.16 (.35)	0 (0)	.18 (.40)	.65 (1.4)	.75 (1.7)	0 (0)
% Increase over Bright Nights	-	-	-	-	-	30	5/	5/
Intermediate Period Each Month 4/								
	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights
Wt. kg. (lbs.)	12.4 (27.3)	18.0 (39.6)	2.5 (5.5)	5.4 (11.9)	12.5 (27.5)	20.4 (44.9)	1.3 (2.9)	5.5 (12.1)
Unit Days	16.8	28.0	16.8	28.0	16.8	30.8	16.8	21.0
Catch/UE kg. (lbs.)	.74 (1.6)	.6 (1.3)	.15 (.33)	.19 (.42)	.74 (1.6)	.19 (4.2)	.08 (.18)	.21 (.46)

1/ Nets with floats and lead line.
2/ Nets without floats but with lead line.
3/ Net not fished.
4/ Based on a 30-day month.
5/ Undeterminable.

TABLE 16

Moon Influenced Fish Catch Data for 127mm Gill Nets During March 18 - September 19, 1969

	Mono+ 1/		Multi+ 1/		Mono= 2/		Multi= 2/	
Moon Phase								
9 and 3 Brightest Nights Each Month								
	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights
Wt. kg. (lbs.)	9.8 (4.6)	5.9 (13.0)	3.1 (6.8)	3.9 (8.6)	4.8 (10.6)	1.8 (4.0)	1.6 (3.5)	0 (0)
Unit Days	32.2	11.2	32.2	15.4	28.0	9.8	28.6	9.8
Catch/U.E. kg. lbs.	.30 (.66)	.53 (1.2)	.1 (.22)	.26 (.57)	.17 (.37)	.18 (.40)	.06 (.13)	0 (0)
% Increase over Dark Nights	-	141	-	-	-	-	-	-
9 and 3 Darkest Nights Each Month								
Wt. kg. (lbs.)	17.0 (37.4)	3.1 (6.8)	8.2 (18.0)	5.9 (13.0)	20.3 (44.7)	6.3 (13.9)	9.1 (20.5)	5.0 (11.0)
Unit Days	50.4	14.0	50.4	14.0	46.2	14.0	46.2	14.0
Catch/U.E. kg. (lbs.)	.34 (.75)	.22 (.48)	.16 (.35)	.42 (.92)	.44 (.97)	.45 (1.0)	.20 (.44)	.35 (.77)
% Increase over Bright Nights	13	-	60	62	159	150	233	4/
Intermediate Period Each Month 3/								
	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights
Wt. kg. (lbs.)	45.2 (99.9)	63.0 (138.6)	6.8 (15.0)	8.3 (18.3)	41.3 (90.9)	58.3 (128.3)	13.4 (29.5)	19.1 (42.0)
Unit Days	92.4	149.8	92.4	145.6	88.2	138.7	88.2	138.7
Catch/U.E. kg. (lbs.)	.49 (1.1)	.42 (.92)	.07 (.15)	.06 (.13)	.47 (1.0)	.42 (.92)	.15 (.33)	.13 (.29)

1/ Nets with floats and lead line.
2/ Nets without float or lead line.
3/ Based on a 30-day month.
4/ Undeterminable.

TABLE 17

Rain Influenced Fish Catch Data for 127mm Gill Nets
During March 18 - September 19,1969

	Mono+ 1/	Multi+ 1/	Mono- 2/	Multi- 2/
Rain Days Fished	30	20	19	18
Amount of Rainfall mm. (in.)	444.8 (17.8)	444.8 (17.8)	389.0 (15.7)	389.0 (15.7)
% Success for Rain Days	30	10	72	27
% Success for Non-Rain Days	40	13	40	10
Unit Rain Days 3/	29.4	29.4	25.2	25.2
Total for Rain Days kg. (lbs.)	7.4 (16.3)	2.4 (5.3)	14.6 (32.1)	2.9 (6.4)
Rain Days Catch/U.E. kg. (lbs.)	.25(.55)	.08(.18)	.57(1.3)	.1 (.22)
Non-Rain Day Catch/U.E. kg. (lbs.)	.44(.97)	.11(.24)	.38(.84)	.16(.35)
% Catch in Rain Days Catch Over Non-Rain Days.	-43	-27	50	-38

1/ Net with commercial floats and lead core bottom line.

2/ Net without floats or weights.

3/ 100^2m of net fished during a 24-hour period when rain occurred.

The multi= net also came within 10 percent of paying for itself by the end of the study period and would definitely have been profitable by the end of the net's life.

Results of this study indicate that each of these 127mm. webbing materials should last between eighteen and twenty-four months before they are too rotten to use. This does not imply, however, that their catch rates would continue at the same pace throughout their lives.

Since multi- and mono- gill nets were only fished for one month, their true economics could not be measured. However, based on their initial catch rates, it is anticipated that they too would have been able to more than pay for themselves during the life of the net (Figure 7).

178mm. Mesh Gill Nets

Based on data collected during a survey in 1968 very few gill nets as large as 178mm. in size were being fished in the lower half of the Volta Lake prior to 1969. This was found to apply through 1969 also. This mesh size was included in the study in an effort to measure rate of recruitment for certain fish species and to determine the availability of intermediate sized fish that were too large to be readily taken in the smaller mesh sizes commonly used by lake fishermen. Pre-study interviews with fishermen at Ampem revealed that between 1964 and 1967 the 102mm. gill net was the most effective mesh size for catching Tilapia. But from 1967 until 1969 the 127 to 152mm. mesh sizes were better. This shift to a larger mesh size should be expected for new lakes experiencing a rapidly expanding fish population and where conditions for fast individual fish growth exist.

During 1969, the fish catch from the 178mm. gill nets showed no indication that the Tilapia population had reached a size large enough to be readily taken in this mesh size. (But in 1970, one year after the study, the 178mm. monofilament gill nets proved to be extremely effective for taking

large Tilapia weighing over 1 kg. each, as well as Lates weighing between 3 to 4kg. each).

Taylor and Denyoh (1968) found that the 178mm. gill net was the least effective mesh size they tested during a twelve day (20 4 unit days) period. These data showed the CPUE for mono+ to be .73kg., and .0 kg. for multi+. These gill nets measured 3.5m. in depth and were floated at the surface; therefore, the fish should have been able to easily see the relatively large webbing in the clear water.

This same factor proved to have an effect on our 178mm. gill net catch too.

First Study Period (February 10-March 15,1969)

Multi+ vs. Mono+

Neither gill net caught a fish during 9.8 UD of fishing (Figures 8 and 12; Table 18.)

Multi- vs. Mono-

In 30.8 UD of fishing the multi- gill net caught two Lates weighint a total of 6.7kg. for a CPUE of .22 kg.

The mono- gill net took three Lates and one Heterotis weighing a total of 19.7kg. The CPUE for this net was .64kg. which is three times greater than for its counterpart (Figures 8 and 12; Table 19).

Second Study Period (March 18-October 3, 1969)

Unlike the 102mm. and 127mm. gill nets, fishing was better during study period than it was during the first.

Multi+ vs. Mono+

Only one fish (Heterotis) weighing 5.9kg. was taken with the multi+ gill net during 138.6 UD of fishing. The CPUE was .045kg. The mono+ gill net took sixteen Heterotis and one Tilapia weighing a total of 82.7 kg. during the same period, for a CPUE of .6 kg. This represents a CPUE ratio of 13 to one in favor of the mono+ gill net. However, the practicability of using this gill net commercially was not demonstrated, since the entire catch consisted virtually of Heterotis which is usually of little commercial value at Volta Lake (Figures 8 and 12; Table 18).

Multi= vs. Mono=

For some unexplained reason the multi= gill net did not catch any fish during 151.2 UD of fishing even though it was fished deep and along side its counterpart mono= gill net that caught 24 fish (5 species) weighing a total of 98.5 kg. for a CPUE of .65 kg. Of the 24 fish taken in the mono= gill net, fifteen were Lates--a species of high commercial value, and only four were Heterotis (Figure 8, Table 19, 28).

Since virtually no fish were taken in 178mm. multifilament gill nets, no useful comparison could be made for their catch during dark and bright moon phases. However, for the monofilament nets it was found that shallow set mono+ gill net caught 70 percent more fish, by weight during the 9 darkest nights each month, compared to the deep set mono= gill net that took 75 percent more fish during the 9 brightest nights each month. This indicates that visibility affected the catch effectiveness for the 178mm. mesh monofilament gill nets (Figure 8, Tables 20, 21).

Data presented in Figure 8 and Table 22 show that rainfall did not appreciably affect the fish catch for 178mm. gill nets during the study period.

According to the manufacturer, the 178mm. monofilament webbing (No.14) cost 69 percent more than its counterpart multifilament(No.210d/15). But in economic terms, only the monofilament webbing could be considered a sound investment for the fishermen based on the above data (Figure 9).

Multifilament webbing, with or without accessories, realized no more than 30 percent of the original cost of the gill net during the study period, and in some instances no fish were taken at all. Therefore, even though this heavy and durable webbing would be expected to last at least two years, it still could not be considered economical to use based on our findings. However, the mono= gill net paid for itself within five months and by the end of the 6.5 month study period it made a net profit of 46 percent.

Based on the actual initial cost of the complete mono+ gill net it only realized 62 percent of the original cost during the study period. But if the cost of the commercial accessories are removed, this net would have shown a 24 percent profit during the same period, assuming, of course, that Heterotis were of commercial value (See Multi+ vs. Mono+ second study period above, Figures 9 and 12; Table 28).

FIGURE No. 8

178mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE – 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

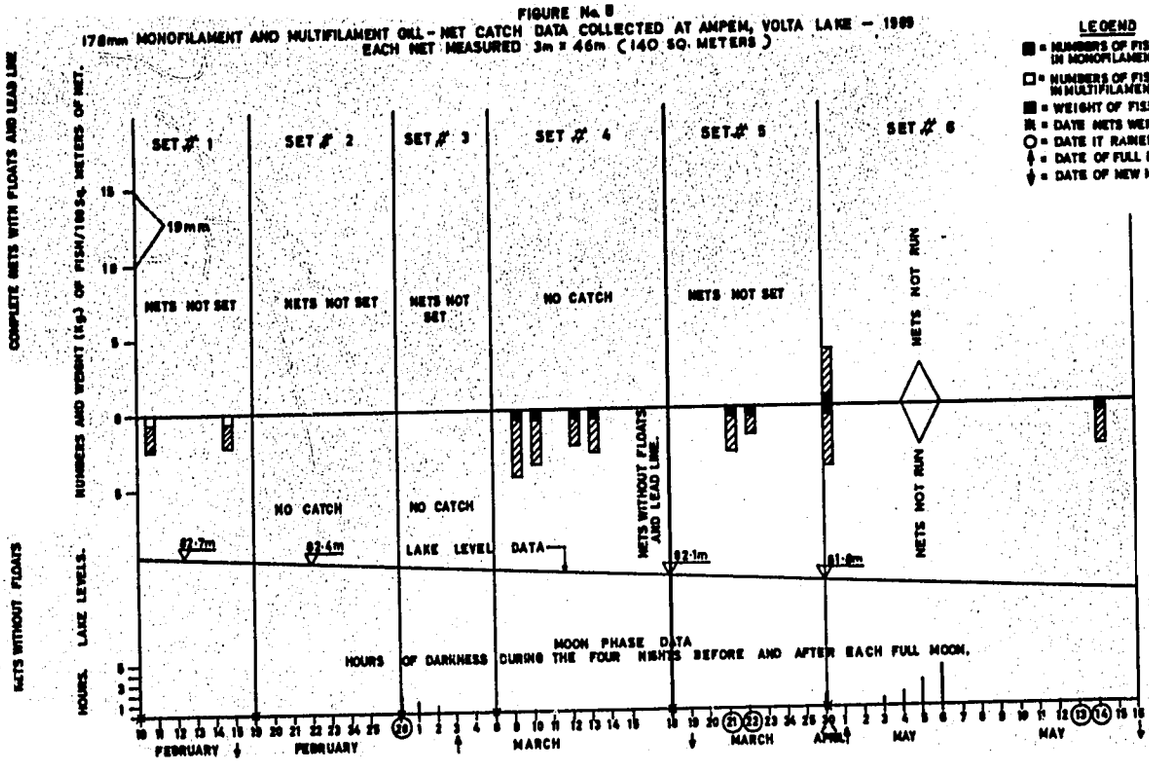


FIGURE No. 8 (CONT.)

178mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE – 1969
EACH NET MEASURED. 3m x 46m (140 SQ. METERS)

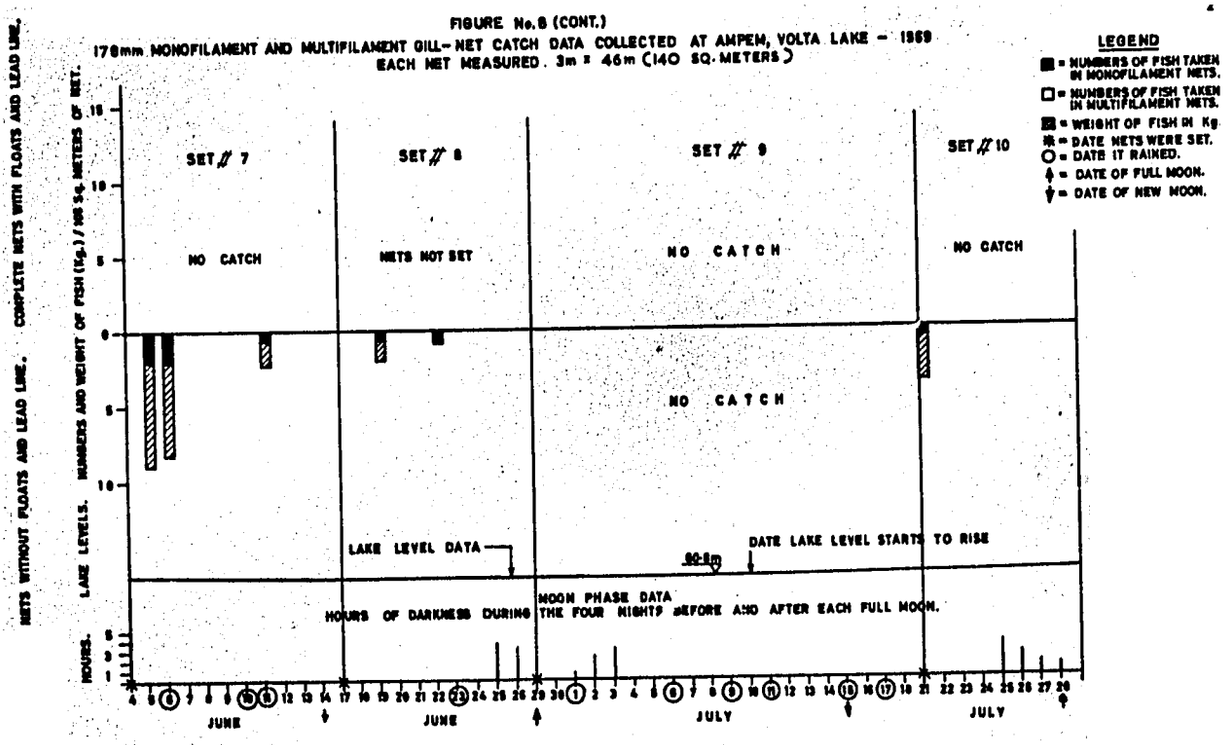


FIGURE No. 8 (CONT.)
178mm MONOFILAMENT AND MULTIFILAMENT GILL-NET CATCH DATA COLLECTED AT ANPEM, VOLTA LAKE — 1969
EACH NET MEASURED 3m x 46m (140 SQ. METERS)

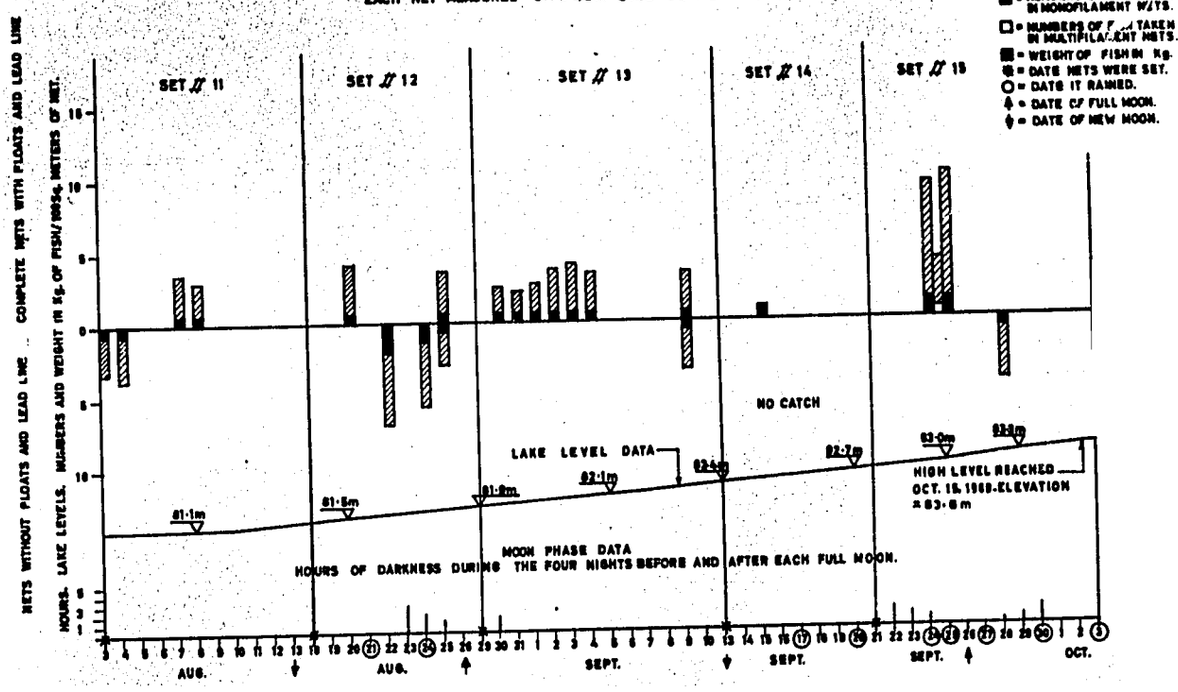


FIGURE 9
CATCH TO COST RELATIONSHIP PER 100² METERS OF GILL NET
178mm GILL NETS.

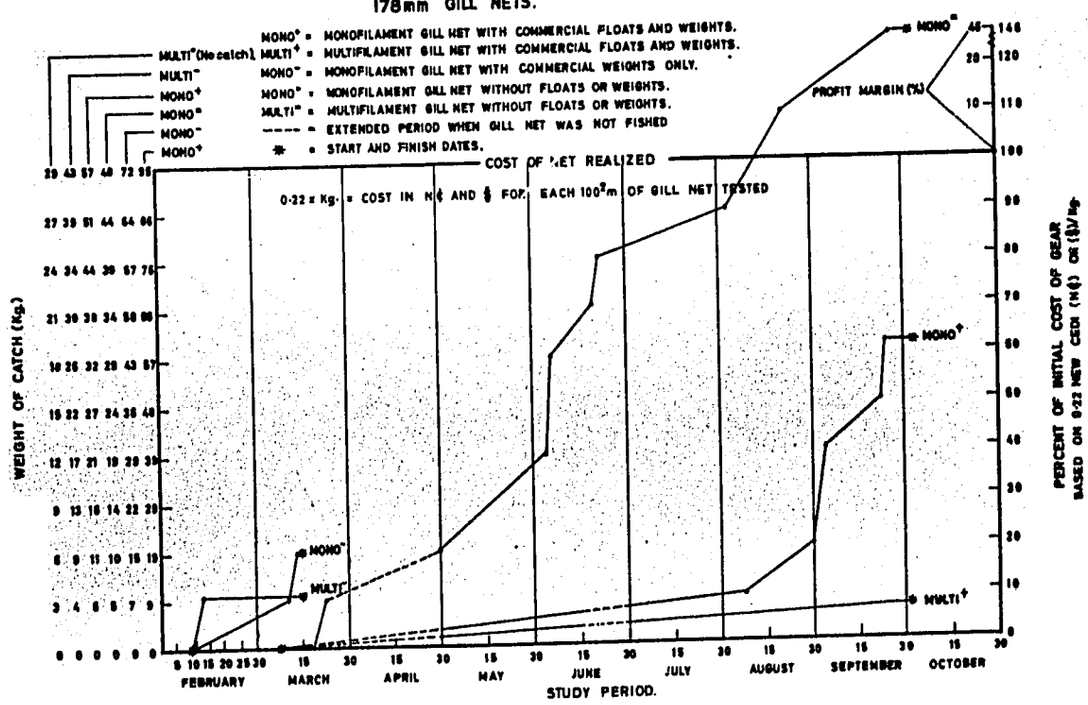


TABLE 16

CATCH DATA PER 100^2 METERS OF GILL NET
March 9, 1969-March 15, 1969

178mm Multi+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approx. % of Catch No.	Approx. % of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unit Days Fished: 9.8													
Catch/Unit Effort:	0	0	0										

178mm Mono+ 1/

Species													
0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unit Days Fished: 9.8													
Catch/Unit Effort:	0	0	0										

March 18, 1969-October 3, 1969

178mm Multi+ 1/

Species													
Heterotis niloticus	1	5.90	13.0	864	34.0	5.90	13.0	100	100	-864	-34.0	-5.90	-13.0
Unit Days Fished: 138.6													
Catch/Unit Effort:	.01	.045	.1					100	100				

178mm Mono+ 1/

Species													
Tilapia nilotica	1	1.10	2.5	432	17.0	1.10	2.5	6	1	-432	-17.0	-1.10	- 2.5
Heterotis niloticus	15	81.59	179.8	864	34.0	5.40	12.0	94	99	635-914	25.0-36.0	3.30-5.48	7.3-14.3
Total	16	82.69	182.3					100	100				
Unit Days Fished: 138.6													
Catch/Unit Effort:	.12	.60	1.3										

1/ Gill net having commercial floats and lead line.

TABLE 19

CATCH DATA PER 100^2 METERS OF GILL NET

February 10,1969 - March 15,1969

178mm. Multi- 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	% of Catch No.	% of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Lates niloticus	2	6.71	14.8	673	26.5	3.42	7.4	100	100	660-686	26.0-27.0	3.2-3.49	7.3-7.5
Unit Days Fished: 30.8													
Catch/Unit Effort:	.06	.22	.45										

178mm. Mono- 1/ Period: February 4 through March 15,1969

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	% of Catch No.	% of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Lates niloticus	3	13.21	29.0	719	28.3	4.40	9.7	67	75	686-762	27.0-30.0	3.44-5.41	7.5-12.0
Heterotis nuloticus	1	6.53	14.3	914	36.0	6.53	14.3	33	25	-914	-36.0	-6.53	-14.3
Total	4	19.74	43.3					100	100				
Unit Days Fished: 30.8													
Catch/Unit Effort:	.11	.64	1.4										

March 18, 1969 - October 3, 1969
178mm Multi- 2/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	% of Catch No.	% of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Unit Days Fished: 151.2													
Catch Unit Effort:	0	0	0										

178mm. Mono- 2/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	% of Catch No.	% of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Tilapia sps.	2	2.10	4.7	406	16.0	1.02	2.3	2	9	-406	-16.0	1.00-1.10	2.2-2.5
Lates nilcticus	15	60.53	135.5	711	28.0	4.04	8.9	62	63	635-787	25.0-31.0	2.73-5.81	6.0-12.8
Heterotis niloticus	4	21.41	47.3	838	33.0	5.35	12.0	22	17	762-889	30.0-35.0	5.00-6.11	11.0-13.[illegible]
Heterobranchus sp.	2	11.40	25.0	927	36.5	5.70	12.5	11	9	914-940	36.0-37.0	5.00-6.40	11.0-14.0
Distichodus sp.	1	3.00	6.5	610	24.0	3.00	6.5	3	2	-610	-24.0	-3.00	- 6.5
Total	24	98.54	219.0					100	100				
Unit Days Fished: 151.2													
Catch/Unit Effort	.15	.65	1.4										

1/ Gill net without floats but having lead line.
2/ Gill net without floats or lead line.

TABLE 20

Moon Influenced Fish Catch Data for 175mm Gill Nets During February 10 - March 15, 1969

	Mono+ 1/		Multi+ 1/		Mono- 2/		Multi- 2/	
	Moon Phase							
	9 and 3 Brightest Nights Each Month							
	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights
Wt. kg. (lbs.)	- (-) 3/	- (-) 3/	- (-) 3/	- (-) 3/	0 (0)	0 (0)	0 (0)	0 (0)
Unit Days	-	-	-	-	5.6	2.8	5.6	2.8
Catch/U.E. kg. (lbs.)	- (-)	- (-)	- (-)	- (-)	0 (0)	0 (0)	0 (0)	0 (0)
% Increase over Dark Nights	-	-	-	-	0	0	-	-
	9 and 3 Darkest Nights Each Month							
Wt. kg. (lbs.)	- (-) 3/	- (-) 3/	- (-) 3/	- (-) 3/	0 (0)	0 (0)	3.0 (6.6)	.40 (.90)
Unit Days	-	-	-	-	7.0	2.8	7.0	2.8
Catch/U.E. kg. (lbs.)	- (-)	- (-)	- (-)	- (-)	0 (0)	0 (0)	.43 (.95)	.14 (.31)
% Increase over Bright Nights	-	-	-	-	0	0	5/	5/
	Intermediate Period Each Month 4/							
	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights
Wt. kg. (lbs.)	0 (0)	0 (0)	0 (0)	0 (0)	19.7 (43.3)	19.7 (43.3)	3.7 (8.2)	6.3 (13.9)
Unit Days	9.8	9.8	9.8	9.8	18.2	25.2	18.2	25.2
Catch/U.E. kg. (lbs.)	0 (0)	0 (0)	0 (0)	0 (0)	1.1 (2.4)	.78 (1.7)	.20 (.44)	.25 (.55)

1/ Nets with floats and lead line.
2/ Nets without floats but with lead line.
3/ Net not fished.
4/ Based on a 30-day month.
5/ Undetermined.

TABLE 21

Moon Influenced Fish Catch Data for 178mm Gill Nets During March 18 - October 3, 1969

	Mono+ 1/		Multi+ 1/		Mono- 2/		Multi- 2/	
Moon Phase								
9 and 3 Brightest Nights Each Month								
	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights	9 Nights	3 Nights
Wt. kg. (lbs.)	40.6 (89.3)	5.3 (11.7)	5.9 (13.0)	0 (0)	28.2 (62.7)	1.8 (4.0)	0 (0)	0 (0)
Unit Days	39.2	15.4	39.2	15.4	40.6	15.4	40.6	15.9
Catch/U.E. kg. (lbs.)	1.0 (2.2)	.35 (.77)	.15 (.33)	0 (0)	.7 (1.5)	.11 (.24)	0 (0)	0 (0)
% Increase over Dark Nights	-	4/	4/	0	75	4/	0	0
9 and 3 Darkest Nights Each Month								
Wt. kg. (lbs.)	5.9 (13.0)	0 (0)	0 (0)	0 (0)	15.0 (33.0)	0 (0)	0 (0)	0 (0)
Unit Days	35.0	9.8	35.0	9.8	37.8	14.0	37.8	14.0
Catch/U.E. kg. (lbs.)	1.7 (3.7)	0 (0)	0 (0)	0 (0)	.4 (.88)	0 (0)	0 (0)	0 (0)
% Increase over Bright Nights	70	-	-	0	-	-	0	0
Intermediate Period Each Month 3/								
	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights	12 Nights	24 Nights
Wt. kg. (lbs.)	36.2 (79.6)	77.4 (170.3)	0 (0)	5.9 (13.0)	54.3 (120.0)	96.7 (212.7)	0 (0)	0 (0)
Unit Days	64.4	113.4	64.4	113.4	72.8	121.8	72.8	121.8
Catch/U.E. kg. (lbs.)	.56 (1.2)	.68 (1.5)	0 (0)	.05 (.11)	.75 (1.7)	.79 (1.7)	0 (0)	0 (0)

1/ Nets with floats and lead line.
2/ Nets without float or lead line.
3/ Based on a 30-day month.
4/ Undeterminable.

TABLE 22

Rain Influenced Fish Catch Data for 178mm. Gill Nets
March 18 - October 3, 1969

	Monot 1/	Multi + 1/	Mono- 2/	Multi- 2/
Rain Days Fished	19	19	22	22
Amount of Rainfall mm. (in.)	359.0 (14.4)	359.0 (14.4)	405.0 (16.2)	405.0 (16.2)
% Success for Rain Days	10	5	27	0
% Success for Non-Rain Days	16	0	14	0
Unit Rain Days 3/	26.6	26.6	30.8	30.8
Total Catch for Rain Day kg.(lbs.)	26.6 (58.5)	5.9 (13.0) 4/	33.6 (73.9)	0 (0)
Rain Days Catch/U.E. kg. (lbs.)	1.0 (2.2)	.22(.48)	1.1 (2.4)	0 (0)
Non-Rain Days Catch/U.E. kg. (lbs.)	.5 (1.1)	.0 (0)	.54(1.2)	0 (0)
% Change in Rain Days Catch Over Non-Rain Days	100	Undeterminable	103	0 (0)

1/Net with a few floats and small stone weights.
2/ Net without floats or weights.
3/ 100^2m of net fished during a 24-hour period when rain occurred.
4/ Total catch taken during one net night.

Since the monofilament gill nets were also constructed of relatively large diameter monofilament webbing (No. 14) they should be expected to last at least two full seasons and require a minimum of mending, and should therefore prove to be a profitable investment. It should be noted, however, that monofilament nets fished near the surface (Mono+) were effective in catching mostly Heterotis, a species of poor commercial value; whereas the deep nets (mono- and mono=) caught mostly Lates which is of high commercial value (Figure 12 and Table 28).

229mm. Mesh Gill Net

Prior to this study no 229mm. gill nets were known to this writer to exist at Volta Lake. Nevertheless, this mesh size was chosen to be included in the study to ascertain the availability of large fish species off-shore and to determine their vulnerability to monofilament gill nets. Even though no counterpart multifilament webbing was available for comparison, fish catch comparisons were made between the mono= and mono+ gill nets (Figure 2 c,d). Each net was fished separately at depths ranging from 7-20m. below the surface of the water; (Figure 3).

Both of the 229mm. monofilament gill nets webbing were constructed of a very large monofil (No.30). Each net measured 6m x 92m., or four times as large in area (m2) as the 102, 127 and 178mm. gill nets discussed earlier in this report (Table 2). Catch data for these nets are expressed in catch per 100^{m2} of hung webbing, the same as for the smaller mesh sizes tested. For comparison and continuity, catch data for both 229mm. gill nets are separated into the same two study periods (January 29 - March 15 and March 18 - October 8, 1969) as was done for the other nets tested.

First Study Period (January 29 - March 15, 1969)
Mono+ vs. Mono=

During 128.8 UD of fishing the mono+ gill net, which was equipped with just enough floats and weights to assure that the net wall did not collapse, caught five Lates and one tiger fish Hydrocynus lineatus weighing a total of 47 kg., representing a CPUE of .36 kg.

In 173.6 UD of fishing the mono= gill net took sixteen Lates weighing a total of 156.4 kg. for a CPUE of .89 kg., which is 2.5 times greater than the mono+ gill net catch above (Figures 10 and 12; Tables 23, 27, and 28).

Second Study Period (March 18 - October 7, 1969)
Mono+ vs. Mono=

During the longer second study period the mono+ gill net caught thirty-nine Lates, one Heterobranchus sp. and one Bagrus bayad weighing a total of 325.5 kg. during 772.8 UD of fishing, for a CPUE of .42 kg. Lates comprised 96 percent of the total catch.

In 884.8 UD of fishing the mono= gill net took 76 fish (5 species) weighing a total of 647.5 kg. giving a CPUE of .77 kg. which is 1.8 times that of the mono+ net (Tables 24, 27 and 28). Lates made up 86 percent of the total weight of the catch (Figures 10 and 12; Tables 24, 27 and 28).

For the entire study period both 229mm. gill nets consistently caught more fish (as much as 600 percent more) during the darkest phase than during the brightest phase of the moon. This indicates that even with monofilament, if the webbing's filament size is large enough, visibility is a significant factor (Figure 10 and Table 25).

According to meteorological data collected at Ampen rainfall did not significantly influence the 229mm. gill net fish catch (Figure 10 and Table 26).

In comparing the fish catch to gear costs for each of the 229mm. gill nets it was found that the mono= gill net paid for itself within 3.5 months, and by the end of the study period (eight months) it had realized a 153 percent profit; whereas, the mono+ gill net only paid for itself during the last week of the study period and therefore only realized a 15 percent profit above the initial investment (Figure 11). Since only a few floats were used on the mono+ gill net the cost of these accessories was not included when determining the catch to cost relationship for this net.

FIGURE No. 10

229mm MONOFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM – VOLTA LAKE – 1969

EACH NET MEASURED 6m x 92m (560 SQ. METERS)

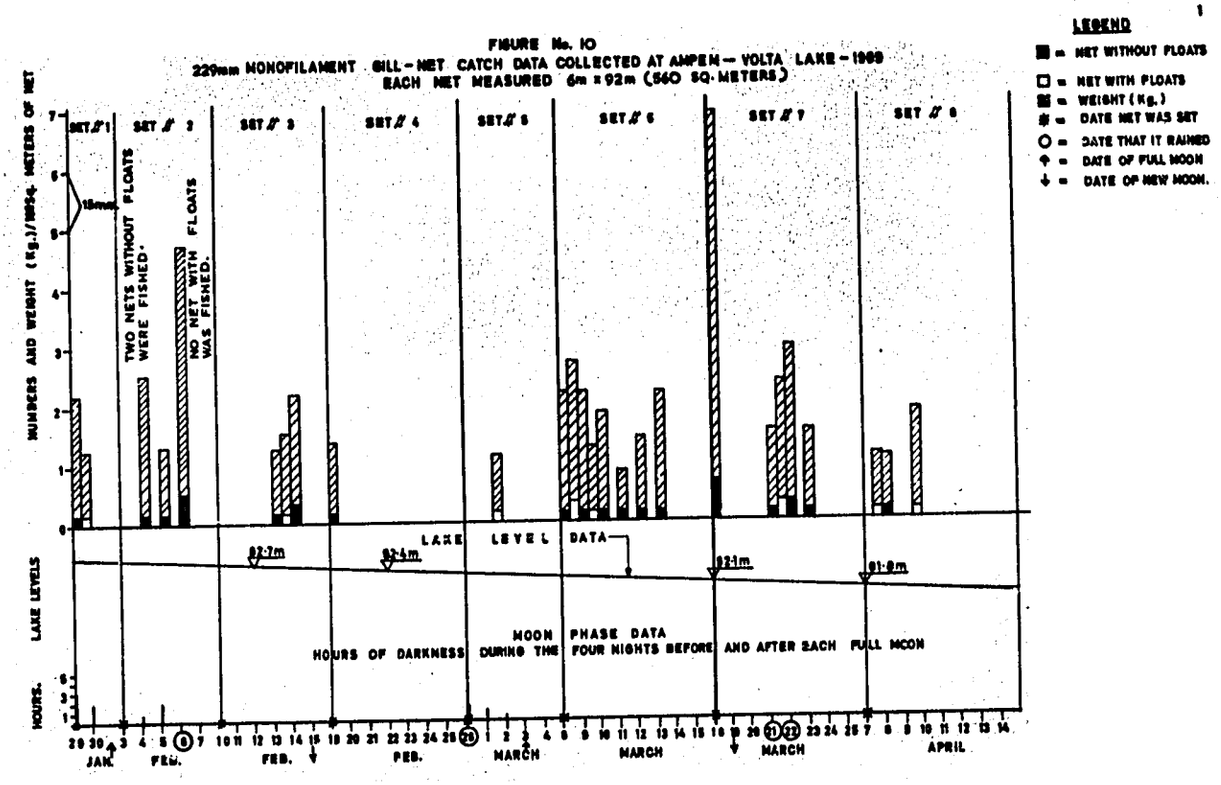


FIGURE No.10(CONT.)

229mm MONOFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM,-VOLTA LAKE 1969

EACH NET MEASURED 6m x 92m (560 SQ. METERS)

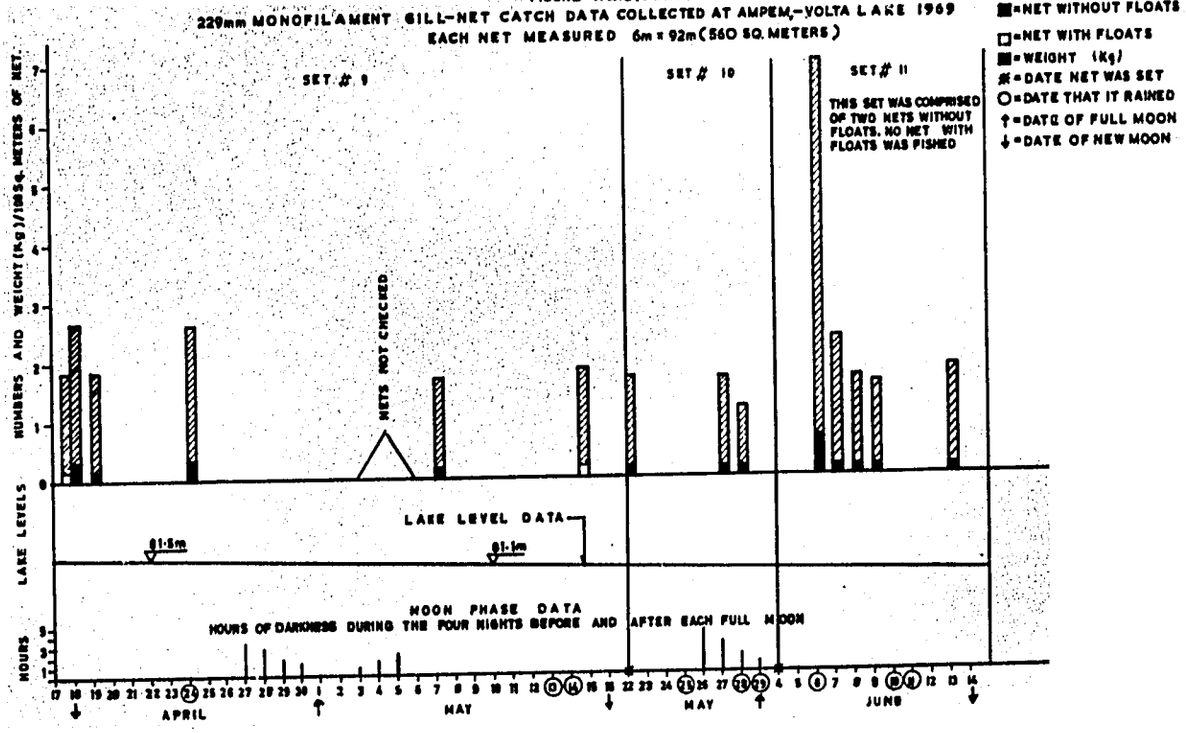


FIGURE No.10 (CONT.)

229mm MONOFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE-1969

EACH NET MEASURED 6m x 92m (560 SQ. METERS)

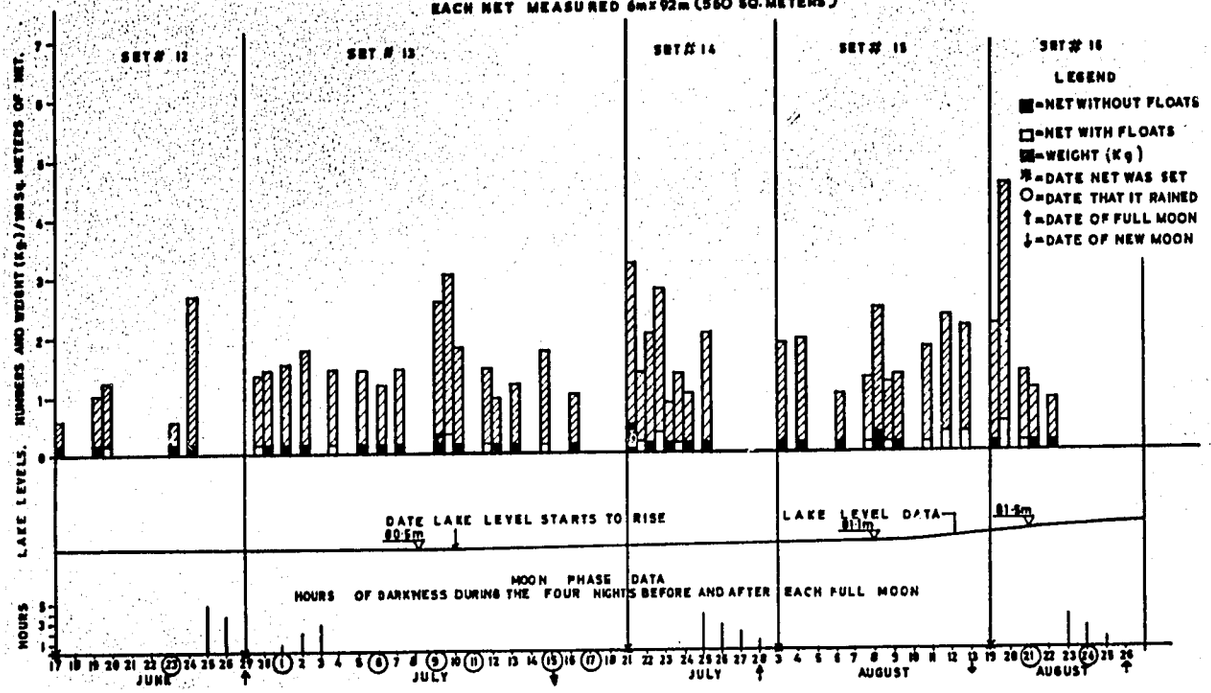


FIGURE No.10 (CONT.)

229mm MONOFILAMENT GILL-NET CATCH DATA COLLECTED AT AMPEM, VOLTA LAKE-1969

EACH NET MEASURED 6m x 92m (560 SQ. METERS)

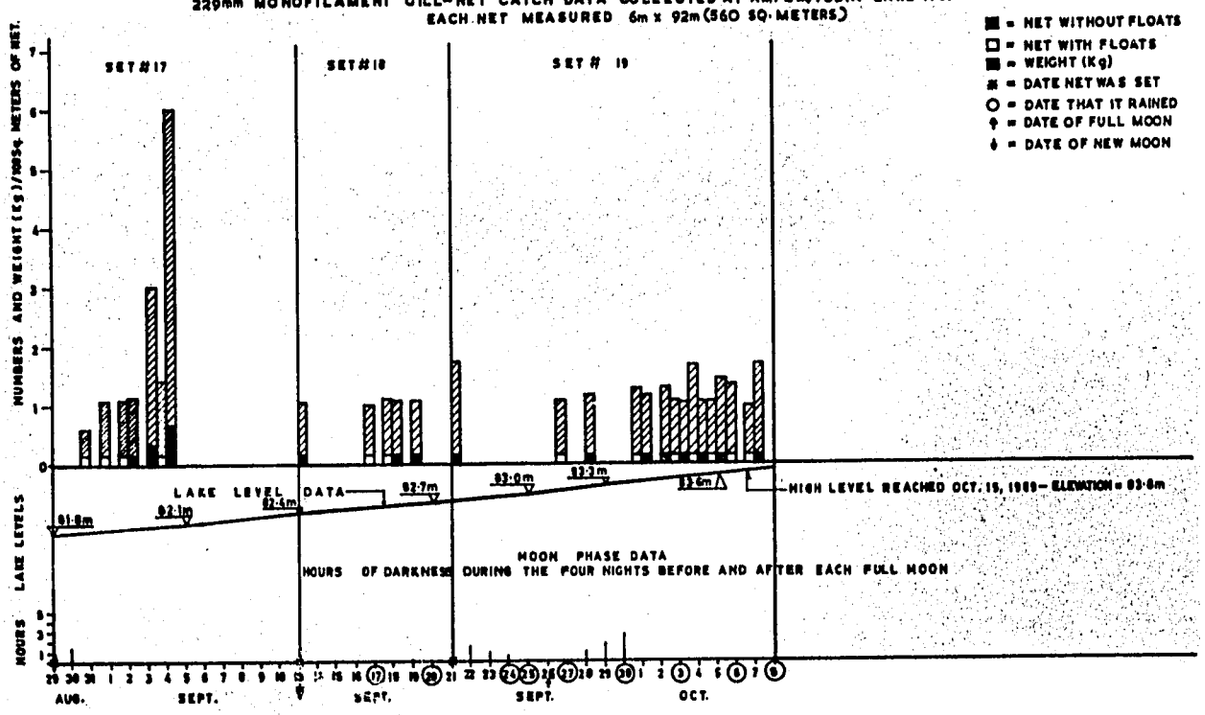


FIGURE 11
CATCH TO COST RELATIONSHIP PER 100² METERS OF GILL NET
229mm GILL NETS

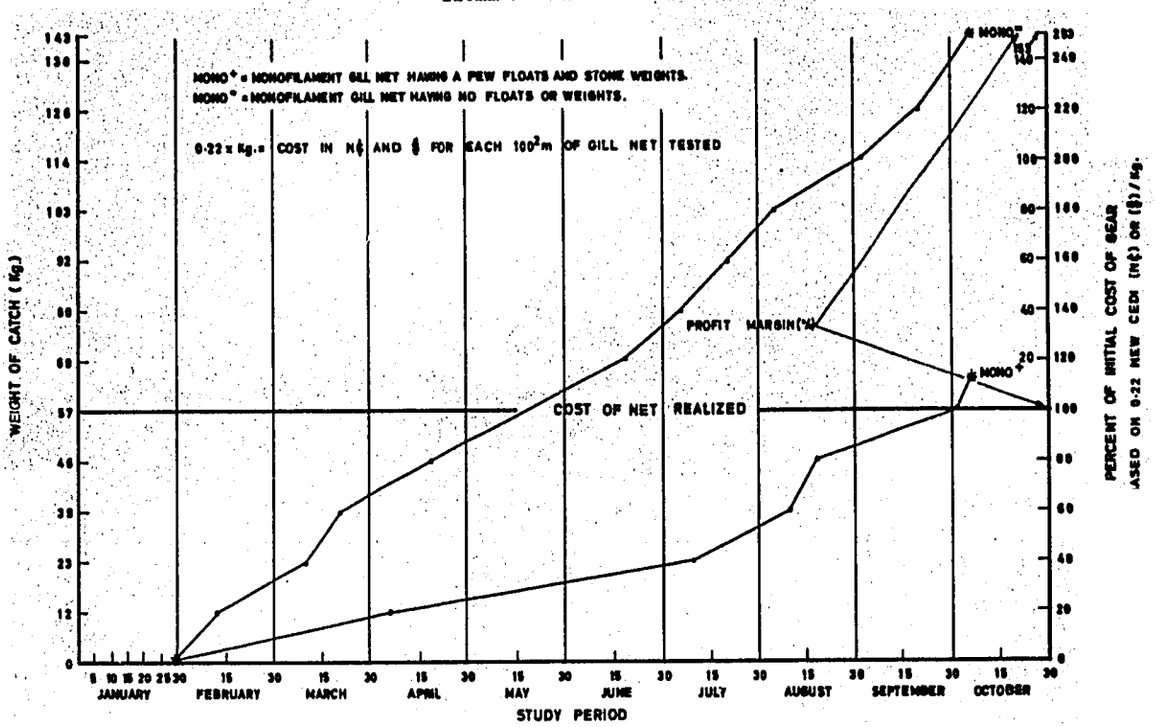


FIGURE 12
CATCH COMPARISON BASED ON CATCH PER UNIT OF EFFORT FOR EACH GILL NET TESTED.
(Weight (Kg.) of catch/100m² of gill net fished for 24 consecutive hours.)

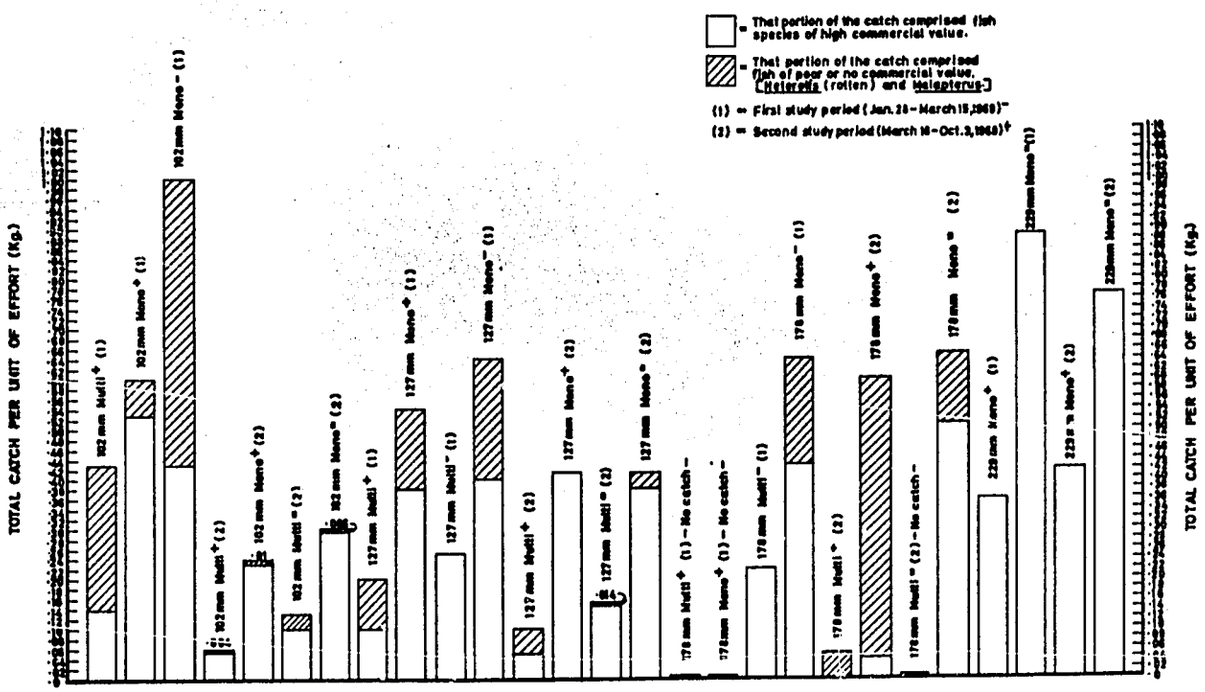


TABLE 23

CATCH DATA PER 100^2 METERS OF GILL NET

January 29,1969 - March 15,1969

229mm. Mono+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch wt.	Approximate % of Catch no.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Lates niloticus	5	37.83	83.4	910	36	7.58	16.7	83	81	840-970	33-38	7.03-7.94	15.5-17.5
Hydrocynus linestus	1	9.07	20.0	840	33	9.12	20.1	17	19	-840	-33	-9.07	-20.0
Total	6	46.90	103.4					100	100				
Unit Days Fished: 123.8													
Catch/Unit Effort:	.04	.36	.80										

229mm. Mono= 2/

Species													
Lates niloticus	16	156.04	340.4	935	37	9.66	21.3	100	100	560-1120	22-44	5.22-15.78	11.5-34.8
Unit Days Fished: 173.6													
Catch/Unit Effort:	.09	.89	1.96										

1/ Gill net having several small floats and stone weights.

2/ Gill net without floats or weights.

TABLE 24

CATCH DATA PER 100^2 METERS OF GILL NET
March 18,1969-October 7,1969

229mm. Mono+ 1/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Lates niloticus	39	311.30	686.3	910	36.0	7.83	17.6	96	96	690-1090	27-43	3.81-11.57	8.4-25.5
Heterobranchus sp.	1	7.71	17.0	1020	40.0	7.71	17.0	2	2	-1020	-40	- 7.71	-17.0
Bagrus bayad	1	6.49	14.3	910	36.0	6.49	2	2	2	- 910	-36	- 6.49	-14.3
Total	41	325.50	717.6					100	100				
Unit Days Fished: 772.8													
Catch/Unit Effort:	.05	.42	.93										

229mm. Mono+ Gill Net 2/

Species	No.	Weight kg.	Weight lbs.	Ave. Length mm.	Ave. Length in.	Ave. Weight kg.	Ave. Weight lbs.	Approximate % of Catch No.	Approximate % of Catch Wt.	Length Range mm.	Length Range in.	Weight Range kg.	Weight Range lbs.
Lates niloticus	64	555.64	1225.0	910	36	8.75	19.3	84	86	740-1090	29.0-43	5.22-17.92	11.5-39.5
Heterobranchus sp.	9	65.86	145.2	890	35	7.30	16.1	11	10	740-1140	29.0-45	5.13- 8.89	11.3-19.6
Bagrus bayad	2	12.84	28.3	810	32	6.40	14.1	3	2	760-860	30.0-34	5.13- 7.71	11.3-17.0
Hydrocynus sp.	1	9.80	21.6	940	37	9.80	21.6	1	1	-940	-37	- 9.80	-21.6
Distichodus sp.	1	3.40	7.5	660	26	3.40	7.5	1	1	-660	-26	- 3.40	- 7.5
Total	76	647.54	1429.6					100	100				
Unit Days Fished: 884.8													
Catch/Unit Effort	.09	.77	1.72										

1/ Gill net having several small floats and stone weights.

2/ Gill net without floats or weights.

TABLE 25

Moonlight Influenced Fish Catch Data for 229cm. Monofilament Gill Nets
January 29 - October 3, 1969

	Mono+ 1/	Moon Phase	Mono- 2/	
	9 and 3 Brightest Nights Each Month			
	9 Nights	3 Nights	9 Nights	3 Nights
Wt. kg. (lbs.)	47.7 (104.9)	9.5 (20.9)	100.5(221.1)	11.2(24.6)
Unit Days	224.0	67.2	257.6	67.2
Catch/UE kg. (lbs.)	.21(.46)	.14(.31)	.39(.86)	.17(.37)
% Increase over dark nights	-	-	-	-
	9 and 3 Darkest Nights Each Month			
Wt. kg. (lbs.)	120.2 (264.4)	31.9(70.2)	178.6(392.9)	99.1(218.0)
Unit Days	224	84.0	286.8	84.0
Catch/UE kg. (lbs.)	.54(1.2)	.38(.84)	.66(65)	1.2(2.6)
% Increase over bright nights	157	171	69	606
	Intermediate Period Each Month 3/			
	12 Nights	24 Nights	12 Nights	24 Nights
Wt. kg. (lbs.)	204.5 (450.8)	331.4 (729.1)	523.3 (1151.3)	629.1 (1522.6)
Unit Days	453.6	669.0	532.0	669.0
Catch/UE kg. (lbs.)	.46(1.0)	.5 (1.1)	.98 (2.1)	1.0 (2.2)

1/ Net with several small floats and small stone weights.
2/ Net without floats or weights.
3/ Based on a 30-day month.

TABLE 26

Rain Influenced Fish Catch Data for 229mm. Gill Nets
March 18 - October 8, 1969

	Mono+ 1/	Mono= 2/
Rain Days Fished	25	28
Amount of Rainfall mm. (in.)	518.8 (20.8)	574.3 (23.0)
% Success for Rain Days	44	28
% Success for Non-Rain Days	42	20
Unit Rain Days 3/	140.0	156.8
Total Catch for Rain Days kg. (lbs.)	71.7 (157.7)	124.9 (274.8)
Rain Days Catch/U.E. kg. (lbs.)	.51 (1.2)	.79 (1.74)
Non-Rain Days Catch/U.E. kg. (lbs.)	.40 (.88)	.72 (1.6)
% Change in Rain Days Catch Over Non-Rain Days	28	10

1/ Net with a few floats and small stone weights.

2/ Net without floats or weights.

3/ 100^2m of net fished during a 24-hour period when rain occurred.

TABLE 27

Comparison Between Counterpart Nets 1/
Based on Catch Per Unit of Effort

	Multi+ 2/	Mono+ 2/	Multi- 3/	Mono- 3/	Multi- 4/	Mono- 4/
		102mm. Gill Nets				
Number of Fish	.49	1.22	Net not tested	3.5	.49	1.22
Weight kg.(lbs.)	.18(.39)	.32(.70)		1.0 (2.2)	.13(.28)	.30(.67)
% Increase (wt.) over counterpart net		78		undeterminable		130
		127mm. Gill Nets				
Number of Fish	.16	.78	.49	1.0	.23	.69
Weight kg.(lbs)	.12(.26)	.43(.95)	.24(.54)	.65(1.4)	.15(.33)	.41(.90)
% Increase(wt.) over counterpart net		258		171		173
		178mm. Gill Nets				
Number of Fish	.06	.11	.06	.11	.00	.15
Weight kg.(lbs.)	.04(.1)	.56(1.2)	.22(.45)	.64(1.4)	.00(00)	.65(1.4)
% Increase (wt.) over counterpart net.		1300		191		undeterminable
		229mm. Gill Nets				
		Mono+ 5/			Mono- 4/	
Number of Fish		.005				.009
Weight kg.(lbs.)		.41(.90)				.76(1.7)
% Increase (wt.) over other net						85

1/ Unit of effort equals 100^2m of net fished for 24 consecutive hours.

2/ Gill net having commercial float and lead line.

3/ Gill net with only commercial weight.

4/ Gill net without floats or weights.

5/ Gill net having several small floats and stone weight.

TABLE 28

Fish Species Taken with Fourteen Experimental Gill Nets

Volta Lake During 1969 1/

Stretched Measure Mesh Sizes

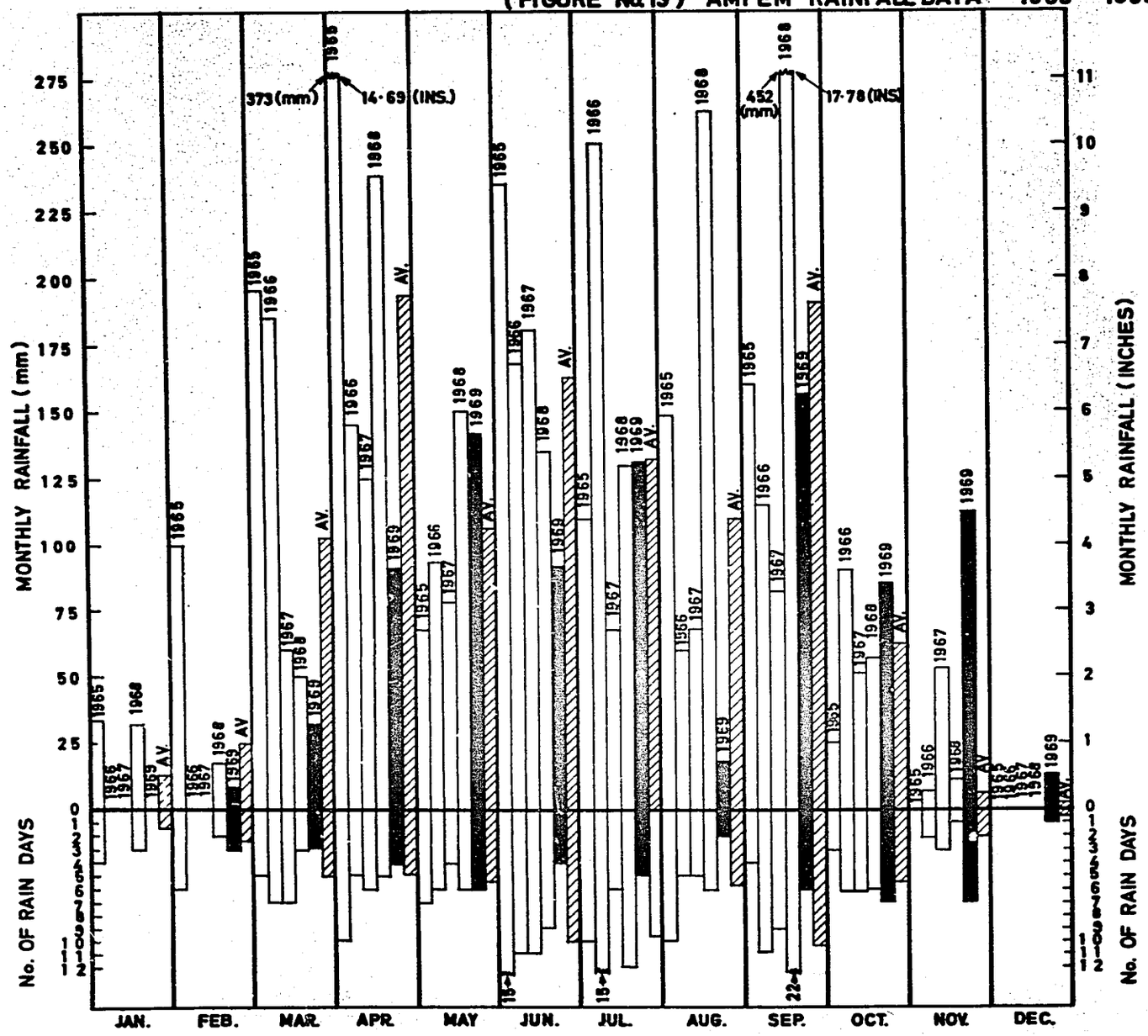
Species	102mm. Multi+	102mm. Mono+	102mm. Mono-	102mm. Multi=	102mm. Mono=	127mm. Multi+	127mm. Mono+	127mm. Multi-	127mm. Mono-	127mm. Multi=	127mm. Mono=	178mm. Multi+	178mm. Mono+	178mm. Multi-	178mm. Mono-	178mm. Multi=	178mm. Mono=	229mm. Mono+	229mm. Mono=	Total No.	Total wt(kg)	% of Total Catch No.	% of Total Catch wt(kg)
Tilapia sps. 1/	38	169	100	73	177	23	153	10	31	31	91		1				2			899	290.9	68	13
Lates niloticus	7	18	8	1	16	2	4			2	9			2	3		15	44	80	211	1177.4	16	64
Heterotis niloticus	27	16	31	4	4	9	5		7	1	4	1	15		1		4			129	200.4	9	11
Gymnarchus niloticus	5	5	3	2	3					1										19	16.8		
Chrysichthys sps.	3	5	1	1	4		1			1										16	7.3		
Auchenoglanis Occidentalis	1	4		1	1		2			1	3									13	5.7		
Synodontis sps.		1	2																	3	.6		
Schilbe mystus			1																	1	.1		
Hetropius niloticus	1																			1	.2		
Heterobranchus sps.		1					1										2	1	9	14	87.6		
Bagrus bayad										1	1							1	2	5	20.1		
Malapterus electricus		1																		1	.7		
Distichodus sps.											1						1		1	3	6.9		
Mormyrus rume	2	2	2	5							3									14	4.6		
Ophiocephalus obscurus																							
Hydrocynus lineatus							1													1	.5		
Tetraodon fahaka 3/	?	?	?	?	?													1	1	2	18.9		
																				?	?		
Total No.	84	221	145	85	210	34	166	11	38	38	112	1	16	2	4	0	24	47	93	1332			
Total wt.(kg.)	30.3	58.5	41.2	22.1	52.2	25.4	90.9	5.5	23.6	24.0	66.5	5.9	82.7	6.7	19.7	0	98.7	372.4	808.6		1829.7	Grand Total:	

1/ These figures do not represent each net's catch per unit of effort (CPUE), therefore data from this Table should not be used for such comparisons.

2/ Tilapia galilaea, T. nilotica and T. zillii are common in Volta Lake.

3/ Many of these poison puffer fish were taken in the 102mm. gill nets, but they were discarded and nor recorded.

(FIGURE No. 13) AMPEM RAINFALL DATA 1965 — 1969.



TOTAL ANNUAL RAINFALL

YEAR	mm	INS.	DEVIATION FROM 5yr.Av. (%)	RAIN DAYS	DEVIATION FROM 5yr.Av. (%)
5yr. AV.	1147	45·18	00	63	00
1969	890	35·07	−21	48	−23
1968	1549	61·04	+25	73	+15
1967	766	30·15	−34	59	− 6
1966	1130	44·53	− 2	68	+ 7
1965	1453	57·20	+21	74	+15

The only explanation the writer has for this significant difference in the fish catch for these two nets is that either the few stones and floats on the mono+ gill net "spooked" the fish, or there was a distinct advantage in having a very loosely hung net wall, as was the case for the mono= gill net.

Since the filament size of the 229mm. webbing was very large (#30) the nets did not require repairing during the entire study period. (Furthermore, these nets were still being fished after two years of use, and from the condition of the nets at that time it appears that they should still be effective for at least one more year).

Conclusions

During an eight month study at Ampem on Volta Lake Tilapia species dominated the inshore fish catch in 102mm. and 127mm. stretch measure gill nets, and Lates comprised most of the catch in 178mm. and 229mm. mesh sizes fished offshore.

Monofilament webbing proved to be far more effective than multifilament webbing for taking fish at Volta Lake, and monofilament's catch superiority increased as the diameter of the twine (for the multifilament nets) and the filament (for the monofilament nets) sizes increased. This indicated that net visibility was greater for multifilament than for monofilament webbing, and that this was a primary reason why the monofilament gill nets had a higher (as much as 7 times) catch rate than their multifilament counterparts.

The most effective gill net style, as far as numbers and weight of fish are concerned, for the 102-, 127-, and 178mm. stretch measure mesh sizes was nets having no floats, but having a bottom lead line (mono- and multi-). The next most effective style was found to be the flag net that had no floats or bottom lead line (mono= and multi=) and which was the most common net style used by local fishermen at Lake Volta at Ampem during the study period.

Of the two 229mm. mesh monofilament gill nets, which did not have multifilament counterparts, the flag net (mono=) proved to be twice as effective as the 229mm. mesh monofilament gill net that was equipped with just enough floats and stone weights to keep the net wall from collapsing. Since both nets were fished at the same depth this indicates that there was a distinct disadvantage in adding these accessories to this type of gill net.

Based on fish catch to gill net cost data collected, and the anticipated life expectancy of each gill net test, only the 229 and 178mm. monofilament nets, and the 127mm. monofilament and multifilament nets proved to be economic commercial gear, since each of these nets either made or surely would have made a profit before their webbing became too weak to be mended. However, the 178mm. floating monofilament net (mono+) was highly selective in catching Heterotis, a species of fish that is normally of very low commercial value since this species dies very quickly in nets and therefore is usually rotten when the nets are run the following morning. For this reason it is concluded that this monofilament mesh size should be fished below the surface where Lates are common and the Heterotis are fewer.

Even though the 102mm. mesh gill nets caught more fish (numbers) than any of the mesh size tested they were not found to be economic since, because of their small twine and filament size, these nets did not last long enough to catch enough fish (weight) to more than pay for themselves.

Also, the catch rate of the 178mm. multifilament gill nets was too low for them to be expected to pay for themselves even if, because of their large twine size, they should have a life expectancy of at least two years.

Acknowledgments

I am particularly grateful to Emmanuel Osei-Adu of VRA for his valuable assistance in recording the daily fish catch data from Dzekle Galinor, our Volta Lake fisherman.

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