PROGRESS REPORT ON IDENTIFICATION OF "ORGANISMS" IN LAKE VICTORIA RESPONSIBLE FOR ECHOSOUNDER TRACES

Almo J. Cordone and A. Kudhongania

UNDP(SF)/FAO Lake Victoria Fisheries Research Project and
East African Freshwater Fisheries Research Organisation, Jinja
Uganda

ABSTRACT

Exploratory fishing with midwater trawls in the pelagic zone of Lake Victoria generally yielded low quantities of fish even where dense traces appeared on the echosounder. Efforts to identify the "organisms" met with limited success. Types of gear tested were the midwater trawl, high-speed beam trawl, Lampara net, zooplankton net and SCUBA. This information plus that of earlier investigators indicate that the bulk of the traces are not caused by fish. The evidence however is not conclusive and further studies are warranted. Some recommendations for study are presented.

INTRODUCTION

The Lake Victoria Fisheries Research Project (LVFRP) and the East African Freshwater Fisheries Researeh Organization (EAFFRO) are cooperating in a long-term investigation of the fisheries resources of Lake Victoria. In the absence of a comprehensive understanding of the distribution and relative abundance of the fish fauna, it was decided that stock assessment studies should begin with exploratory fishing operations. A bottom trawl survey of demersal fish stocks constituted the first phase of the operation. Results are now beine analyzed and a preliminary report describing the objectives, methods and some of the findings has been prepared (BERGSTRAND and CORDONE, 1971). The second phase consisted of a midwater trawl survey of the pelagic zone of Lake Victoria.

The initial gear trials with midwater trawls began in June 1970 and were soon followed by three major cruises (June, July and August 1970) which also included further gear development. Despite the large size of the trawls used, the catches tended to be low and highly variable. This might be assumed to reflect pelagic fish populations, except that the same low catches occurred in areas where very dense traces appeared on the echosounder. Before resuming the

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midwater trawl cruises, therefore, it was decided at a meeting in September 1970 to identify the "organisms" responsible for the dense traces. Unless this were done, there was no assurance that midwater trawling was yielding meaningful results. Various techniques were utilized in an attempt to identify the agent responsible, and sampling was generally confined to the bays and channels north of Buvuma Island in Uganda. The purpose of this report is to describe the results thus far attained (through 1970) and to recommend a future course of action.

MIDWATER TRAWLING

Midwater trawling on a limited scale was carried out in the past on Lake Victoria. The work comprised experiments with both midwater and surface trawls in the mid-1960's (GEE and GILBERT, 1967). The study area was located in Uganda waters off Jinja and Entebbe. Results were considered inconclusive since fishing effort was limited and gear problems forced abandonment of the project. Midwater trawling in particular was deemed unsuccessful since very few fish were caught; Haplochromis spp. and Engraulicypris argenteus being the main constituents. Surface trawling was somewhat more promising, yielding an overall catch per hour of about 10.7 kg. Haplochromis constituted 90% of the catch with Alestes jacksonii, A. sadleri and Engraulicypris being the only other species which occurred regularly. This is surprising since the only specimens of Alestes captured during the present midwater trawling program were taken in Speke Gulf.

Midwater trawling refers to deployment of midwater trawls at any level in the water column - from the surface to just off the bottom. All mesh sizes mentioned are given in stretched measure. Two different trawls were used almost exclusively during the three cruises completed in 1970; one with a headrope length of 30m and a fishing height of 12m and a second with a 27m headrope length and a height of 8m. When fishing, the actual horizontal opening of these nets apparently varies between 8 and 10m whereas the full vertical height is attained. Thus, these nets strain a very large volume of water, but because of their size and the weight of the doors they cannot be towed faster than 2.5 knots without seriously overloading the boat engine. The end result, however, conforms to current midwater trawling practices; i.e., a very large net towed at slow speeds. The codend

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used most often had a mesh size of 19mm. Full details of the materials and methods involved in midwater trawling will appear in future reports.

The combined results for 118 midwater trawl drags made during the first three cruises are given in Table 1. 1/ Only data for hauls made with the 30 and 27m trawls and utilizing the 19mm mesh size codend are shown. The catches are substantially lower than bottom trawl catches in which the same mesh size codend was used. Fully 50% of all hauls yielded less than 75 kg per hour. About 75% of the catch was made up of Haplochromis species. The contribution of other species was generally low and varied greatly from one area to another. The catches in general varied enormously as can be ascertained from the values in Table 1 for range and standard deviation.

TABLE 1

Summary of Catches Made with the 30 and 27m Midwater Trawls on Lake Victoria; 19mm Mesh Size Codend Only

Item	Night hau s (50 hauls)		Day hauls (68 hauls)	
	All fish	Hap1ochromi	All fish	Haplochromis
Mean kilograms per hour	124.2	98.2	82.5	63.8
Range	4.6-427.6	2.9-304.5	3.7-541.6	1.6-529.2
Standard deviation	96.9	71.0	102.7	94.8
Standard error of the mean	13.7	10.0	12.5	11.5
95% confidence limits	97.3-151.1	78.6-117.9	58.1-101.0	41.3-86.3
Kilograms per hectare 1/	29.8	23.5	19.8	15.3
Kilograms per 10,000 cubic metres 2/	3.7	2.9	2.5	1.9

1/ A 9m trawl opening is assumed and trawl height is ignored.

2/ A trawl opening of 9m and height of 8m are assumed. The fishing height of the 27m trawl was used since this net was used most often (61% of all hauls).

A misleading impression of fish densities is gained froo the hourly catch rate data since the large volume saopled is ignored. Conversion of these data to catches per unit volume of water strained (lO,00am^3 is the basic unit) indicates very sparse fish densities in the pelagic zone (Table 1). This was not surprising since during the three cruises, few traces on the echosounder could be detected in

1/ Two additional cruises to explore the pelagic zone with midwater trawls were undertaken in April and May 1971. Dr. J. Schärfe, Gear Technologist of UNFAO in Rome, acconpanied the first cruise and adjusted the eear which resulted in a greater net opening. Considerably larger catches were recorded during these cruises, but Virtually all of them were made under conditions of darkness with the footrope close to the bottom.

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midwater (the echosounder was operating almost continuously when the *Ibis* was underway). On those few occasions when traces were observed, the catch rates generally did not increase. This led to skepticism regarding the suitability and efficiency of both the trawls and the echosounder. During this period, a number of modifications of the trawls, rigging and procedures were instituted in an attempt to increase the catching powers of the midwater trawls. Tested were (i) towing speed within the limits imposed by the combined weight of the net and the doors, (ii) bridle arrangement and length, (iii) weight variations and angle of attack of the doors, and (iv) a new midwater trawl. The latter was smaller than the others, had smaller mesh in the wings, a more gradually tapering configuration and a 13mm mesh size codend. None of these modifications appreciably altered the pattern of relatively low fish catches using midwater trawls in the pelagic zone.

From at least two standpoints, the midwater trawling results seem reasonable. First, neatly contrasting with the pattern shown by bottom trawling, day versus night sampling with nidwater trawls demonstrated higher night than day catches of *Haplochromis* (Table 1). They apparently move off the bottom at night and thus become more susceptible to capture in midwater trawl gear. On two occasions, 24-hour trawling on the same transect provided further documentation of this phenomenon. Virtually all other species were captured at higher rates during night hours also, according to results of the 24-hour work. Nevertheless, night catches still were lower than one would expect considering the large net opening and the fact that for some hauls the fishing height covered almost the entire water column from the surface to within several netres of the bottom. However, although we know that *Haplochromis* disperse from the bottom at night, we do not know what pattern this movement takes; i.e., how far off the bottom they move and in what concentrations. Second, although the daytime midwater trawl catches of *Haplochromis* are probably lower than they should be, the species caught appear to be different from those taken at night. The latter are similar to those taken in bottom trawls which again reflects nocturnal movement off the bottom. Thus, in daytime trawling we are probably catching what is available in midwater (this includes mainly the pelagic *Haplochromis* and *Engraulicypris*) but perhaps with very low efficiency.

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A second echosounder was installed on the Ibis in August 1970. It seems more sensitive than the original, and displayed very dense traces throughout the bays and channels from Jinja to Buvuma Island. Sanpling was concentrated in these areas in an attempt to identify what was responsible for the traces. The traces have remained in this region throughout the study period. They tend to be more dense in bays like Ingira and Hannington than in channels like Buvuma and Napolean Gulf. In general they are darker and more dense near the bottom. When the Ibis is underway at trawling speeds from 2.5 to 3.5 knots, the traces appear to project irregularly from the bottom as spears or pinnacles. The edges of these projections are fuzzy rather than sharp, and the heights vary considerably within relatively short distances. The appearance of traces detached from the substrate (true pelagic traces) vary greatly in size, shape and density. However, they are definitely vertical in orientation and usually have a plume or comet-shaped configuration. At times, definite horizontal layerings of traces can be seen. Superfica11y there seened to be little day versus night difference in the appearance of the traces.

Using the 27m midwater trawl with the 19mm mesh size codend, three hauls were made on October 8th and nine hauls on October 13th and 14th in the Ingira Bay-Buvuma Channel area. The first hauls made in the early morning hours of October 8th resulted in a record catch for midwater; about 1000 kg in half an hour. The catch was composed of approximately 700 kg of *Haplochromis*, 300 of *Clarias mossambicus* and a few *Xenoclarias* and *Synodontis victoriae*. The next haul was a half hour also and was made in the same area but during daylight and the catch declined appreciably: about 150 kg of *Hap1ochromis*, 50 of *Clarias* and several specimens of other species. The finnl drag yielded only a few kilograms of fish, mostly *Haplochromis*. For the remaining nine hauls, the daytime catches ranged from about 40 to 70 kg per half hour and the night-time catches from 100 to 150. These catches, although somewhat higher than the average, did not resolve the question of the identification of the traces. If fish were responsible then they must have been able to avoid the trawl, and sight is implicated since the catch increases at night when the fish are less able to detect the trawl.

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HIGH-SPEED BEAM TRAWL

If the traces are fish, then they are either able to avoid the trawls or the traces are being misconstrued and the fish are not as abundant as they appear on the tapes. To clarify the former possibility, a beam trawl was constructed which permits towing speeds to 4 or 5 knots without critical pressure-wave buildup. This trawl does not use doors but instead the opening is maintained by a rectangular pipe frame measuring 4m wide and 2.5m high. A long, gradually-tapering net was fitted to the frame and the usual 19mm mesh size codend was attached.

Ten hauls were made with this net on October 21st and 22nd at various locations in Itome, Ingira and Thruston bays where dense traces were observed on the echosounder. Daytime catches as usual were very low, consisting of a few kilograms of Hap10chromis. Night hauls increased as expected but not to very high levels; 100 to 150 kg per half hour at the most. An unusual catch was 50 kg of Engraulicypris from a half-hour haul in Itome Bay. Daytime bottom trawl catches of 1,000 to 1,500 kg of Haplochromis per hour were made at about the same time and vicinity as the beam trawling. This indicates dense quantities of fish in the area which makes the relatively low night-time catches difficult to understand. Although the beam trawl has a smaller opening than the bottom trawls, it is towed at a faster speed; usually between 4.0 and 4.5 knots. Thus the greater distance covered by the beam trawl compensates in large measure for its smaller opening and the catch rates for both types of gear should be fairly comparable.

Skis were added to the beam trawl so it would slide over the bottom without hanging-up and permit sampling close to the bottom where the most dense traces were observed. On October 30th, four daylight hauls were made with the beam trawl on the bottom in the usual areas where dense traces were found; Ingira Bay, Buvuma Channel and Napolean Gulf. The hourly catch rates ranged from 300 to 400 kg of Haplochromis. Hourly catch rates fron four hauls made in the same manner on Novenber 16th and 17th in Pilkington and Hannington bays ranged from about 125 to 450 kg of Haplochromis. Converted to a unit area basis these catches average about 135 kg per hectare, whereas by volume they average about 50 kg per $10,000m^3$. The former are about one half and the latter are about one third the corresponding averages for bottom trawl catches made with the 24m net using the same 19mm nesh size codend.

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The relatively low catches with the beam trawl fished on the bottoo are puzzling. It may be that the absence of otter doors is responsible. When used with standard bottom trawls, the doors stir and roil the substrate, thus tending to obscure the oncoming trawl and rendering fish more susceptible to capture. The beam trawl is used without doors and the wire warp alone may not provide sufficient agitation and thus the fish would be better able to detect and avoid the trawl. For this to occur it would have to be assumed that the fish also are able to escape a net towed at speeds between 4.0 and 4.5 knots. This does not seem likely since, if the traces reflect fish, there is probably an abundance of they would most likely be small Haplochromis and Engraulicypris (the mean size for both genera probably ranges between 5 and 10 co). Perhaps a more likely explanation is that the skis prevent the trawl from scraping the bottom and instead maintain about a half-metre space between the substrate and the net opening. If the Haplochromis are as bottom orientated as is suspected, then this space could account for the relatively lower beaD trawl catches. On several occasions, botton trawls with greater fishing heights were constructed and tested. Enhanced catches did not accrue which suggests, assuming the trawls fished as anticipated, that Haplochromis are closely associated with the substrate during daylight hours and that perhaps the traces projecting from the bottom are not caused by fish. Insight into this question could be gained by comparing beam trawl catches both with and without the presence of otter doors.

LAMPARA NET

A small Lampara net was built to aid in identifying "organisms" responsible for the dense midwater traces, to obtain fish for tagging and for training of the crew. The handling of this net presents problems similar to those of the purse seine which will be used extensively in the future. The net was 56m long and 12m deep and had 10mm webbing in the bag and 29mm webbing in the wings.

It was fished for the first time in the afternoon of September 29th. Two hauls were made in Napolean Gulf but very low catches were recorded. Three additional hauls were made in Ingira Bay on September 30th where abundant traces were observed on the echosounder. The net was set in a circle from two small boats. The first set was

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made in water about 8m deep and the next two in progressively shallower water. The third haul was made right against papyrus plants at a depth of about 2m. In each case the catch was low. Between 4 and 12 kg of Haplochromis spp. and a few Xenoclarias spp. were caught in each haul, but no fish large enough to tag. Also, a large amount of mud fouled the shallow set which portends difficulties in operating a purse seine in some shallow water areas.

Because of the small size of the net, which surrounds an area of only 0.025 hectare, it was decided to attach 30m of netting to each of the wings. This increased the length of the Lampara to 1160 which encloses an area of 0.11 hectare. Several sets were made on October 7th, 8th and 13th in Hannington and Ingira bays where dense traces were noted on the echosounder. Again low catches were recorded and no fish taken of a size suitable for tagging. Small Haplochromis continued to dominate the catches except for two night sets made around an electric light which was left on for about one hour before each haul. Here the largest catch consisted of about 6 kg of Engraulicypris argenteus and 1.5 of Haplochromis. The echosounder indicated abundant traces in the area of the light when the night sets were made.

In one respect, the low catches in the Lampara net are not surprising. Although theoretically covering an area of 0.11 hectare, the actual area encompassed is less than this since the ends of the wings are pulled off the bOttOD to complete pursing the net. Thus, catches between 5 and 10 kg per set yield standing stock estimates of between 50 and 150 kg per hectare. This is less than the estimated 200 kg per hectare derived from bottom trawl catches using a 19mm mesh size codend. There is certainly ample opportunity for fish to escape this net before it is fully pursed.

It does not appear that the Lampara will assist in either identifying traces in the pelagic zone or providinG fish for tagging purposes.

PLANKTON STUDIES

Efforts in utilizing this technique to identify the echosounder traces have been extremely lirnited. Low daytime midwater trawl catches in locations where traces are dense may mean that the "organisms" responsible are not fish. Concentrations of zooplankton or phytoplankton or even clouds of sediment stirred off the bottom by the activities of large fish may be responsible.

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Two vertical hauls with large plankton nets were made in Ingira Bay on October 7th. The dense traces through which the nets were drawn apparently were not caused by zooplankton since so few were caught. Sampling was too limited however to justify drawing conclusions and the phytoplankton were not sampled since the mesh size was too large.

Much more work is required before the role of Lake Victoria plankton in producing echosounder traces can be elucidated. Studies elsewhere have demonstrated that dense zooplankton populations can be discerned by echosounders. At Lake Victoria, typical zooplankters such as cladocerans and copepods are not considered abundant. However, lake flies (Chaoborus or Chironomus) emerge in great concentrations at times. When in midwater they probably would show up as echosounder traces. Chaoborus is not only abundant in some areas but performs a diel vertical migration through the water column which the echosounder likely would record. Phytoplankton are believed to be very dense in Lake Victoria and also might appear as traces.

SCUBA STUDIES

The use of SCUBA (Self-Contained Underwater Breathing Apparatus) in conjunction with a sampling program would seem like an efficient means of identifying the traces. The advantage of SCUBA is tempered by the general lack of clarity of Lake Victoria waters, although light penetration does vary from one locality to another. Clarity tended to be limited to several metres or less in the study area. We secured the services of a professional SCUBA diver with years of experience who works for the Uganda Electricity Board on dam safety and maintenance problems at the Owen Falls Dam. On October 18th, he dove froo the Ibis in waters of the Ingira Bay - Buvuma Channel area where dense traces were found. He saw no fish but observed a one-metre layer of flocculent plant material covering the bottom. 2/. With or without lights, visibility was limited and it is possible that fish moved out of the diver's sight range. However, the diver maintains that f1sh,

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2/ This material has the appearance of phytoplankton remains. GEE and GILBERT (1968)mention a 2 to 3m semi-flocculent layer of soft mud over a harder substrate. The surface mud contained much plant debris and supported quite a lar3e population or molluscs. Such muds were common at the 5 to 15m depth zone.

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especially small fish, are not elusive when approached under water. He is often surrounded by them when working on the upstreao face of the dam. Nevertheless, on three occasions when he dove close to the bottom the traces in his vicinity disappeared or became much less dense. Were these fish or was the flocculent material disturbed, becoming less dense, and thus not discernab1e to the echosounder ? These and other questions could be answered by further work with SCUBA. One approach might involve the diver remaining motionless on the bottom for an extended period to observe whether or not fish returned to his vicinity. Another approach would be to work with lights at night when Haplochromis are known to move off the bottom and determine how readily they are observed.

PREVIOUS INVESTIGATIONS

The trawling done by EAFFRO investigators in the mid-1960's has been referred to previously. They made considerable use of the echosounder and hoped to correlate traces with the trawl and gill net catches. However, they were not able to do this. A description of their early work with the echosounder was given by GEE (1966). He found that discrete traces in daytime hours had become diffuse and scattered during night-time hours. He believed that the traces were fish because of their characteristic "comet" or "plume" shape. In some instances we observed this same pattern, whereas on other occasions night traces did not differ traces. Gee also observed concentrations of traces around underwater projections which we also observed. This too would indicate the traces were caused by fish.

Further studies however created considerable doubt regarding the "organisms" responsible for the echo traces. GEE and GILBERT (1967) concluded that there was no correlation between the density of bottom traces and the catch of Haplochromis in bottom, midwater or surface trawls or in gill nets. They felt that the visible traces therefore emanated from either shoals of fish too small to be retained in a one-inch mesh codend or "organisms" other than fish, of which plankton seemed the most likely. They also made the following pertinent observations: "If however, the echosounder would pick up either of the above items /very small fish or plankton_7 it should also pick up the Haplochromis caught in the trawl. Most of these however are bottom feedine forms, mollusc eaters, insectivores and bottom

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detritus feeders. They will presumably therefore be in close contact with the bottom and if this is so they will be very difficult to distinguish (if it is possible at all) from the bottom echo itself. This hypothesis is borne out by observations made by the authors over a sand botton using an aqualung. Large numbers of Haplochromis are often seen within 6" or 1' of the bottom or actually restine on the bottom, but if the diver pauses for any length of time in mid-water, very few if any Haplochromis are ever encountered. "

GEE and GILIICRT (1967) discuss the possibility of other fish species beine responsible for the traces. They noted that catches of Alestes sadleri were high in shallow bays and very high over sandy bottoms in sheltered areas. This correlated fairly well with the density of the echo traces. This could hardly be expected to apply in the present study however since not a single Alestes has been captured in the study area. They also noted a correlntion between the presence of Tilapia esculenta and a very fine diffuse trace present over the mud bottom up to about 5 metres from the bottom along with a patchy or sometimes heavy comet-shaped trace. They hypothesized that the comet trace was T. esculenta, whereas the diffuse trace was Melosira - a silicaceous, filamentous diatom. T. esculenta is a phytoplankton filter feeder in which Melosira forms a significant quantity (about 20% by weight) of the stonach contents. "Other evidence that many of these traces may in fact be a3sresations of plankton was noticed while diving off Ramafuta Island in an attempt to identify sone traces seen on the echosounder. They were very sioilar to those described above but rather patchy. On two successive dives no fish were seen but water masses where the light intensity was drastically decreased were passed throuBh at the sane depth as the traces produced on the sounder. These facts are strong corroborating evidence for the above hypothesis and it is hoped that plankton analysis of water samples taken in and above these types of traces will give more direct evidence."

A few samples were taken on January 10th, 1967, with a Nanson-Peterson bottle and preserved in LU301's icdine solution(J.M. Gee, EAFFRO). In the laboratory, cell counts of Melosira were made. The unpUblished results are shown in Table 2. They indicate that the very fine feather traces on the echosounder are probably concentrations of Melosira, but

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Haplochromis species in the waters north of Buvuma Island. It may be that durins the study period (at least from September to December), these waters support large swarms of Melosira which are fed upon by H. erythrocephalus and that this coobination accounts for the dense echo traces.

CONCLUSIONS

1. Daytime sampling with midwater trawls in the Ingira-Buvuma area yielded small quantities of Haplochromis, Eneraulicypris and incidental catches of other species. This indicates that at least some segment of the echo traces are caused by these fishes.

2. The results of observations made with SCUBA and the absence of larse fish catches from a variety of sear (beam and midwater trawls and the Lampara net) in areas with dense echo traces, infer that fish are not responsible for the bulk of these traces. The consistent lack of correlation between fish catch and echo trace density provides further evidence.

3. Although Engraulicypris fry cannot be discounted, it would appear, based on Gee's earlier work, that a segment, possibly a large segment, of the echo traces are caused by swarms of phytJplankton. The presence of Haplochromis and Tilapia esculenta feeding en these concentrations perhaps accounts for the heterogeneous appearance of the traces.

4. Evidence for the above statements however is not conclusive and the possibility remains that the bulk of the traces are caused by fish. The traces in some respects have the appearance af typical fish traces. Also, the sampling gear seems inefficient. Eor example, relatively small catches per unit volume of water strained are made at night with midwater trawls despite the fact that the trawl samples almost the entire water column and Haplochromis are known to move off the bottom at that time.

5. We have not yet identified the asents causing dense echoscunder traces. More intensive studies are required to achieve this goal.

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RECOMMENDATIONS

The direction and extent of further studies depends largely on available manpower and equiprJcnt. At this stage, continued exploratory fishing in the pelagic zone with midwater trawls would appear to have relatively low priority. True pela3ic fish stocks are apparently not extensive and those that exist are widely scattered. This results in hi8h1y variable catches which, in a water the size of Lake Victoria, would be difficult to describe either qualitatively or quantitatively. Present information indicates that the preponderance of the stocks are essentially deoersal in orientation with the exception of the night-time movement off the bottom. It seems desirable, however, to pursue the work started on identification of the echo traces. The followine study areas can be expected to explain the ori8in of the traces:

1. Key personnel should become intimately acquainted with the workings of the echosounder. Special trainin3 courses may be necessary. They should be able to keep the echosounder operating at peak efficiency at all times.

2. A careful description of the echo traces should be made in the study area at different times of the day and night. Another study area, preferably well offshore, also should be established.

3. To clarify the size relationships of the echo traces, objects of known size and perhaps fish themselves should be set cut (usin8 monofilament line and floats) and then cruised over to ascertain their appearance on the echosounder tape.

4. SCUBA should be useful in locations where the water is relatively clear and should be employed in the manner described earlier in this report and surely will be valuable in other ways also; e.g., in helping assess size relationships of the echo traces and possibly in observing plankton and fish sampling gear in action.

50 The role of phytoplankton swarms in producing echo traces should be examined. This would have to be done in close conjunction with SCUBA and echosounder operationso

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6. Gill nets have not yet been tried as a sampling tool to help resolve the echo trace question. Multifilament eill nets have been used extensively in past studies at Lake Victoria, and they very effectively sample Haplochromis but apparently only in overnight sets. Now that monofilament gill nets are available, their effectiveness in daytime sampling should be assessed. We are optimistic about this technique because of results attained in other lakes, and because the opacity of Lake Victoria waters should pronote their usefulness. If initial results are encouraging, vertical panels of eraded monofilament eill nets coverine the entire water column can be set in some pattern in areas of differing echo trace type and density. The results of this effort in conjunction with the SCUBA and phytoplankton findings should resolve the echo trace question. In passing, it is worth observing that fleets of vertical monofilament gill nets could also facilitate a description of the diel movements of Haplochromis.

Some seneral comments and recommendations regarding midwater traw1inc and purse seining also seen worthwhile at this point. The midwater trawl survey thus far indicates very low concentrations of fish in the pelaeic zone durine daylight hours. Dense traces seen in some areas during daylight may be fish and larger catches may accrue following further gear development. In any event, daytime catches will either remain at their present very low level or may increase somewhat but still remain extremely variable. The catches at night are already highly variable and largely reflect movement of fish from the bottom. Our present standing stock estimates are based on daytime bottom trawling and what we need from midwatcr trawling is an estimate of pelagic stocks for the daytime period also. Night midwater trawling cannot tell us this and only provides fish for tagging plus limited information on die1 movements which is better gained using other techniques. Thus, the midwater trawl survey cannot be expected to greatly enhance the stock assessment picture of Lake Victoria fishes. It also has limitations for tagging since the larger species are not taken in proportion to their abundance; i.e. only occasional concentrations of Tilapia and Clarias are caught and generally very few individuals of the remaining species. Bagrus docmac in particular is seldon found in midwater trawls.

We would be better able to proceed with the tagging and stock assessment studies, if we would sample with a purse seine. Admittedly, there are some serious problems to be faced in successfully using this gear in areas where the substrate consists of soft mud. However, its ability to capture within a given area virtually all fish above a certain size has such a great value in stock assessment studies that every effort should be made to obtain and test the purse seine in Lake Victoria. In previous progress reports, we recommended against using the large purse seine (160 fathoms long) originally slated for Lake Victoria. We were under the impression at that time that such a net would capture many tons of fish which would present difficult subsampling problems and the possible wastage of much fish life. However, in view of the current standing stock estimates from bottom trawling and the low catches in the midwater trawls and Lampara net, it now seems that a net of this size, which encompass an area of only 0.7 hectare, would not be too large and anything smaller might be too small. Before expending funds on a purse seine which may or may not be sufficiently large or in other respects fit the particular conditions at Lake Victoria, it would be desirable to borrow one or more existing purse seines to conduct preliminary trials before deciding on the most effective type.

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