15th April, 1970

To: P.B.N. Jackson, Project Manager,

From: Almo J. Cordone, Fishery Biologist,

Subject: Lake Victoria Stock Assessment - Status Report.

This report will bring you up-to-date on the status of our Stock assessment activities. It will also fulfill the request made by D.W. Kelley in his 30th January, 1970 letter for our " approach to stock assessment" for use at the Stock Assessment Seminar this May. It is also a timely exercise since we have just completed bottom trawling and will soon begin another phase of the lakewide survey.

Almo J. Cordone
Fishery Biologist - Stock Assessment

Enclosures:

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LAKE VICTORIA STOCK ASSESSMENT-STATUS REPORT

I. INTRODUCTION

The first phase of a general lakewide survey of Lake Victoria fish stocks is completed. This involved widespread bottom trawling over various depths and lake areas from the research vessel Ibis. Experimentation with various types of trawls, codends, towing speeds, warp lengths, etc., began in September 1968 and was completed towards the end of 1968. Full-scale exploratory fishing began in January 1969 and was well-advanced by the time I arrived in August 1969. However, the Ibis was idle for three months - July through September 1969. Work resumed in October and continued until mid-March 1970 when the bottom trawling phase was terminated. We assumed that for this particular technique, we had achieved adequate coverage for both qualitative purposes and to permit a crude estimate of "potential" yield.

With the completion of preliminary data analyses for the forthcoming Stock Assessment Seminar, it is timely to examine what we have accomplished thus far, particularly those aspects which influence our future plans. It is well at this point to restate our objectives:

II. OBJECTIVES

A. To conduct a general lakewide survey of the fish stocks in Lake Victoria. What is required here is a broad knowledge of species distribution and relative abundance by major habitat types, depth, and season. Information on length, weight and sex of the important commercial species would also be forthcoming. The main purpose is to provide the background data necessary to design quantitative population studies and also to design a continuing standard survey for monitoring the status of the stocks, i.e., trends in indices of abundance, species composition, size composition, etc. Information on movements, migration and stock identity is also essential.

B. To obtain estimates of the "potential" yield of the Lake Victoria commercial fishery. Efforts are underway to modernize and expand the present fishery by adding a fleet of modern trawling vessels. Estimates of the possible magnitute of increased yields are urgently required to help regulate and guide the course and degree of expansion. It is recognized that accurate yield estimates will not be forthcoming for many years, therefore it was hoped that some type of rough estimate might accrue from our studies.

C. To train counterparts in fishery science. As the commercial fishery on Lake Victoria grows in size and complexity, East Africa will require highly trained personnel, skilled in the very latest techniques of fishery science.

III. PROCEDURES

When the Lake Victoria Fisheries Research Project began, the background information necessary for the successful application of quantitative stock assessment was lacking. For this reason and also due to the size of Lake Victoria, the complexity and variety of its many habitats, and its multi-species fishery, it was decided that initial stock assessment studies should consist of a lakewide survey using a variety of exploratory fishing methods.

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This was the recommendation of our consultants, Drs. P.A. Larkin and J.A. Crutchfield, following interviews with research and manageme,;t personnel from LVFRP, EAFFRO, Uganda, Kenya and Tanzania. With one phase of the survey behind us, this approach continues to appear to be the correct one and we will continuo to use it. Ideally, the various types of exploratory fishing techniques (bottom trawling, midwater trawling, and purse seining) should have been employed simultaneously. However, for various reasons it was not possible to do this.

We were fortunate to have available the services of a skilled Masterfisherman and excellent collecting equipment, highlighted by our research vessel Ibis. The lake was divided into 12 major areas and eight 10-meter depth zones. Combinations of these represent our "habitat types." We attempted to sample each area on a systematic basis and achieved fairly adequate coverage. Detailed procedures will be presented in forthcoming reports.

Or. Larkin maintained that the existing commercial catch statistics for Lake Victoria were virtually useless for stock assessment purposes. Examinations of the records and consultation with other LVFRP and EAFFRO personnel reaffirm this judgement. Apart from some gross yield figures, we do not intend to use these in our stock assessment work.

One other approach to stock assessment was tested but was found infeasible. We hoped to use the DeLury regression method of declining catch rates to estimate population size. However, intensive trawling along a single transect for prolonged periods failed to bring about the necessary decline.

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Only the basic findings as they influence future plans and estimates of possible commercial yields are presented below. Pertinent details regarding fish distribution, relative abundance, and biomass estimates are included in the attached tables•

We may be able to derive a preliminary rough estimate of the "potential" yield based on biomass estimates. The latter were obtained by applying efficiency factors to mean hourly catch rates and then expanding the data to a unit of surface area. A number of key assumptions are involved. At the Stock Assessment Seminar, we hope to learn just how valid and useful these assumptions and the resultant estimates really are.

Biomass estimates are presented for the whole lake and major depth zones. These data are preliminary and in the future we will provide final data by the major lake areas which will include specific information on distribution, relative abundance, and length, weight, and sex composition of the catch.

The following comments highlight the findings of the demersal fish survey. Important concepts are involved which will influence future fish sampling of either the exploratory or monitoring type.

A. Because it is virtually flat and very largely free of obstructions, Lake Victoria is ideally suited to bottom trawling. The Ibis and its collecting gear performed very well in most areas at all depths from about 5 meters to the deepest waters. The data obtained can be used as a type of "baseline" against which future results may be compared.

B. There are indications that bottom type and dissolved oxygen right at the bottom are important factors involved in the distribution of demersal fishes. Unfortunately we did not critically investigate these relationships, but such an analysis should be made part of future bottom trawling studies.

C. As expected, the bottom trawl catch varies inversely with the codend mesh size. However, for all practical purposes it is the Haplochromis group which is responsible for this difference since it strongly dominates the catch in all areas and depths. For the mesh sizes we tested, the Haplochromis were the only commercially important species in which mesh selection appears operative. Here further work was stymied because of our inability to identify the species involved. Someone experienced in identification of Haplochromis should be intimately involved in future trawling investigations.

D. The Haplochromis species undergo a vertical diel migration in Lake Victoria. It is strongly pronounced in all but the shallowest depth zone. A number of important biological and commercial implications are involved.

E. Data on the seasonal distribution of Lake Victoria fishes have not been analysed. However, we cannot expect too much because they are based on periodic sampling at only three restricted areas, all of them in shallow water, and two of these have serious time gaps.

V. RECOMMENDATIONS

A. Midwater trawling from the Ibis. While bottom trawling, we almost always had the fathometer operating. Very often what appeared to be fish traces could be seen in mid-water. At times very dense and widespread traces were observed. Thus, our plan to begin midwater trawling at the cessation of bottom trawling appears justified. It may be that large, unexploited or lightly exploited stocks of fish are found here. Surface trawling should be made part of this programme since there is evidence that Engraulicypris is abundant in surface waters, in some areas at least.

According to our Masterfisherman, it will require several weeks to complete the necessary gear trials and training of the crew because of the complexities involved in midwater trawling. Thus, since the midwater trawls and related gear have not yet arrived, it may be well towards the end of 1970 before full-scale midwater trawling begins.

B. Purse seining from the Ibis. It may be best to reconsider the plan to sample with a large purse seine on Lake Victoria for stock assessment purposes. The Masterfisherman envisions a net 160 fathoms long and 50 fathoms deep. This is a costly net, difficult to operate, and would present serious sampling difficulties if it catches the quantity of fish predicted by the Masterfisherman. It may be that these problems will outweigh possible benefits. For the present, it may be best to postpone ordering the large purse seine. MeanWhile the midwater trawling survey should be started, and also purse-seining in shallow water as described in the following section. The Ibis would be used for trawling only. Midway in the surveys enough information would be available to permit a final determination of the need for a large purse seine.

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C. PROPOSED SHALLOW-WATER PURSE SEINING

The major gap in our survey of the distribution and relative abundance of Lake Victoria fishes is shallow water less than 5 meters deep. A bottom trawl cannot be operated effectively from the *Ibis* at depths less than this. Also, midwater trawling will be limited to waters greater than 10 meters. One purpose of purse seining in shallow water, therefore, would be to fill this gap. Other objectives would be:

1. To obtain critical life history data on certain important commercial fishes. Many of them spawn in the shallows and their progeny utilize them as nursery grounds.
2. To obtain direct estimates of biomass of the important species and unbiased size and age data for stock assessment purposes. Since this method supposedly collects all fish above a certain minimum size dictated by mesh size, it should not be subject to the many biases which afflict other collecting methods.
3. To evaluate the efficiency of the various bottom trawls and codend sizes. Biomass estimates from bottom trawl sampling would be adjusted to retlect true biomass as revealed by purse seining. This would probably be feasible only in shallow water where the effects of vertical fish distribution are minimized.
4. To obtain more explicit information on movements, migrations and stock identification of important commercial species. Tagging affords one of the best means of obtaining such data. With a purse seine it should be possible to obtain any number of virtually all of the important commercial species in excellent condition for tagging.

Because it is essentially non-selective, the purse seine is believed to be much superior to other sampling devices for collecting fish in shallow water for tagging and other types of stock assessment work. In EAFFRO there are a number of vessels which, with minor changes in rigging, could be readied for purse seining. This would free the *Ibis* for trawling and both programs could proceed simultaneously. The Kenya Fisheries Department has a small purse seine which our Masterfisherman claims would be adequate following minor modifications, for sampling at depths to 10 meters. The Kenya people have agreed to let us use it. It is recommended that this work be initiated as soon as possible. By working closely with EAFFRO, it should be possible to staff both this programme and the midwater trawling survey.

D. TRAINING OF COUNTERPART. I believe my counterpart has both the interest and the ability to develop into an excellent stock assessment biologist. The experience and knowledge gained from the survey work, data analysis, and the Seminar itself will be very valuable to him. However, because the field of fishery science continues to grow in complexity, and because his background is in general zoology, it is recommended that a fellowship program be initiated. Two years of course work at one of the universities (the University of Washington at Seattle for example) offering a Masters Degree in Fishery Science would provide him with a background necessary to effectively cope with the complexities of stock assessment problems at Lake Victoria. For the relatively minor expense involved, this is certainly one of the most significant investments to be made.

EXPLANATION OF TABLES

TABLE 1: Description of sampling areas in Lake Victoria.

TABLE 2: Mean kilograms par hour by depth intervals. The duration of most hauls was one hour, with others adjusted to one hour. Only daylight hauls (0700 to 1900 hours) were used. Data were first arranged by lake areas and then summed to obtain means by depth interval.

TABLE 3: Percentage by weight for the means shown in Table 2.

TABLE 4: Percentage frequency of occurrence by species for each depth interval.

TABLE 5: Mean kilograms per hectare by species for each depth interval. Assumptions include trawl speed of 3 knots and trawl opening of 9 meters. Thus each one hour haul covered about 5 hectares.

TABLE 6: "Biomass" in kilograms per hectare. The data in Table 5 were adjusted by assuming a 10% trawl efficiency.

TABLE 7: The surface area of Lake Victoria by depth intervals.

TABLE 8: "Biomass" in metric tons by species for each depth interval. Derived from data in tables 6 and 7.

TABLE 9: Pertinent life history information for the important commercial species.

TABLE 10: Species of Haplochromis arranged by food habits.

TABLE I

Description of Areas Established for Exploratory Bottom Trawling Operations at Lake Victoria

Uganda	
Area I:	Tanzania - Uganda Border to Bugoma Channel in Depths less than 50 meters.
Area II:	Bugoma - Salisbury Channels to Rosebery Channel in Depths less than 50 meters.
Area III:	Rosebery Channel to Uganda - Kenya Border in Depths less than 50 meters.
Area IV:	Deepwaters 50 meters and over.
Kenya	
Area V:	Kavirondo Gulf.
Area VI:	Uganda - Kenya Border to Kenya - Tanzania Border in Depths less than 50 meters.
Area VII:	Deepwaters 50 meters and over.
Tanzania	
Area VIII:	Kenya - Tanzania Border to Ukerewe Island in Depths less than 50 meters.
Area IX:	Speke and Mwanza Gulfs.
Area X:	Between Mwanza Gulf and Igusa Channel in Depths less than 50 meters.
Area XI:	Igusa Channel to Tanzania - Uganda Border in Depths less than 50 meters.
Area XII:	Deepwaters 50 meters and over.

TABLE 2

Mean Kilograms of Fishes Caught Per Hour of Exploratory Bottom Trawling by Depth Interval in Lake Victoria

Species	Depth in meters (number of hauls)							
	4-9 (r1)	10 - 19 (93)	20 - 29 (66)	30 - 39 (30)	40 - 49 (37)	50 - 59 (47)	60 - 69 (42)	70 - 79 (12)
Haplochromis sp.	320.4	524.0	462.8	524.0	465.9	496.7	185.2	20.0
Tilapia esculenta	52.6	31.7	3.5	0.3	0.1	0.0	0.0	0.0
Other Tilapia sp.	15.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Bagrus docmac	24.6	42.3	45.1	35.5	31.3	30.6	21.9	0.3
Clarias mossambicus	22.4	41.5	31.7	22.5	15.1	17.9	15.8	7.9
Protopterus aethiopicus	40.4	24.8	7.8	4.4	1.9	0.3	0.0	0.0
Synodontis victoriae	0.6	1.6	4.3	10.3	6.9	27.1	23.9	17.3
Other species	2.3	3.0	1.7	1.3	2.6	0.4	0.3	0.2
Totals	478.3	670.6	556.9	598.3	523.8	501.0	247.1	54.5

TABLE 3.

Percentage by Weight of Total Catch by Depth Interval from Exploratory Bottom Trawling in Lake Victoria

Species	Depth in meters (number of hauls)							
	4 - 9 (61)	10 - 19 (93)	20 - 29 (66)	30 - 39 (38)	40 - 49 (37)	50 - 59 (47)	60 - 69 (42)	70 - 79 (12)
Haplochromis Spa	67.0	78.3	03.1	07.6	80.9	85.5	74.9	52.8
Tilapia escu1enta	11.0	4.7	0.6	0.1	0.0	0.0	0.0	0.0
Other Tilapia Spa	3.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Bagrus docmac	5.1	6.3	8.1	5.9	6.0	6.6	0.9	0.6
Clarias mossambicus	4.7	6.2	5.7	3.0	2.9	3.1	6.4	14.5
Protopterue aathiopicU5	8.4	3.7	1.4	0.7	0.4	0.1	0.0	0.0
Synodontis victoriae	0.1	0.2	0.0	1.7	1.3	4.7	9.7	31.7
Other species	0.5	0.4	0.3	0.2	0.5	0.1	0.1	0.4
Totals	99.9	99.9	100.0	100.0	100.0	**100.1**	100.0	100.0

TABLE 4

Percentage Frequency of Occurrence of Fishes Caught During Exploratory Bottom Trawling in Lake Victoria

Species	Depth in meters								
	4 - 9	10 - 19	20 -29	30 - 39	40 - 49	5] - 59	60 - 69	70 - 79	All depths
Haplochromis Spa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	91.7	99.7
Tilapia esculenta	100.0	88.3	73.0	36.0	16.7	0.0	0.0	0.0	53.4
Other Tilapia Spa	71.2	36.2	7.7	5.3	0.0	0.0	0.0	0.0	21.1
Bagrus docmac	94.9	97.9	100.0	100.0	100.0	05.1	**47.6**	16.7	88.8
Clarias mossambicus	09.0	100.0	90.8	94.7	91.7	100.0	**97.6**	100.0	95.4
Protopterus aethiopicus	91.5	95.7	50.5	47.4	19.4	4.3	0.0	0.0	53.2
Synodontis victoriae	35.6	62.0	04.6	94.0	100.0	100.0	100.0	100.0	78.4
Other species	64.4	74.5	03.1	04.2	06.1	05.1	85.7	03.3	79.1

TABLE 5

Mean Kilograms Caught Per Hectare by Depth Interval from Exploratory Bottom Trawling in Lake Victoria

Species	Depth in Meters							
	4 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
Haplochromis sp.	64.08	104.96	92.56	104.00	93.18	99.34	37.04	5.76
Tilapia esculenta	10.52	6.34	0.70	0.06	0.02	0.00	0.00	0.00
Other Tilapia sp.	3.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Bagrus docmac	4.92	8.46	8.02	7.10	6.26	7.72	4.38	0.06
Clarias mossambicus	4.48	0.30	6.34	4.50	3.02	3.58	3.16	1.58
Protopterus aethiopicus	8.00	4.96	1.56	0.08	0.38	0.06	0.00	0.00
Synodontis victoriae	0.12	0.32	0.06	2.06	1.30	5.42	4.70	3.46
Other species	0.46	0.60	0.34	0.26	0.52	0.00	0.06	0.04
Totals	95.66	134.12	111.30	119.66	104.76	116.20	49.42	10.90

TABLE 6

"Biomass" in Kilograms per Hectare of Lake Victoria Fishes by Depth Intervals; Based on Exploratory Bottom Trawling and Assuming 10% Trawl Efficiency

Species	Depth in Meters.							
	4 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
Haplochromis sp.	640.0	1049.6	925.6	1040.0	931.0	993.4	370.4	57.6
Tilapia esculenta	105.2	63.4	7.0	0.6	0.2	0.0	0.0	0.0
Other Tilapia sp.	30.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Bagrus docmac	49.2	84.6	90.2	71.0	62.6	77.2	43.3	0.6
Clarias mossambicus	44.0	83.0	63.4	45.0	30.2	35.0	31.6	15.8
Protopterus aethiopicus	00.0	49.6	15.6	G.O	3.0	0.6	0.0	0.0
Synodontis victoriae	1.2	3.2	8.6	20.6	13.8	54.2	47.8	34.6
Other species	4.6	6.0	3.4	2.6	5.2	0.8	0.6	0.4
Totals	956.6	1341.2	1113.0	1196.6	1047.6	1162.0	494.2	109.0

TABLE 7

THE SURFACE AREA OF LAKE VICTORIA BY 10-METER DEPTH INTERVALS AND BY COUNTRY
(Preliminary estimates only)

Depth interval (m)	Uganda		Kenya		Tanzania		Combined	
	Hectares	% of total	Hectares	% of total	Hectares	% of total	Hectares	% of total
0-9	240,300	7.7	134,730	32.3	309,060	0.2	684,170	9.3
10 -19	260,750	0.6	65,190	15.6	340,300	9.0	674,240	9.2
20 -29	270,790	8.9	45,900	11.0	301,040	0.0	625,730	8.5
30 -39	235,420	7.5	36,360	8.7	274,930	7.3	546,710	7.5
40 -49	180,460	5.7	59,200	14.2	430,570	11.6	670,230	9.3
50 - 59	556,640	17.7	39,050	9.4	690,360	18.5	1,294,050	17.7
60 -69	666,710	21.2	36,300	0.7	773,810	20.5	1,476,020	20.2
70 -79	712,740	22.7	-	-	631,420	16.0	1,344,160	18.4
Totals	3,139,890	100.0	416,730	99.9	3,767,490	99.9	7,324,110	100.1
% of total by country	42.9		5.7		51.4		100.0	

TABLE o

"BIOMASS" IN METRIC TONS WEIGHTED AREA WITHIN EACH DEPTH INTERVAL, DASED ON EXPLORATOny BOTTOM TRAWLING IN LAKE VICTORIA

Species	Depth in meters									% of total
	0 - 9*	10-19	20-29	30-39	40-49	50-59	60-69	70-79	All depths	
Haplochromis sp.	438,416	707,602	579,176	572,952	631,975	1,2135,509	547,014	77,424	4,840,148	80.7
Tilapia esculenta	71,975	42,747	4,300	320	136	-	-	-	119,566	2.0
Other Tilapia sp.	20,525	1,214	-	-	-	-	-	-	21,739	0.4
Bagrus docmac	33,661	57,041	56,441	30,016	42,457	99,901	64,685	006	393,808	6.6
Clarias mossambicus	30,651	55,962	39,671	24,602	20,483	46,327	46,660	21,230	205,602	4.8
Protopterus aethiopicus	55,201	33,442	9,761	4,811	2,577	776	-	-	106,640	1.8
Synodontis victoriae	021	2,150	5,301	11,262	9,360	70,130	70,592	46,500	216,220	3.6
Other species	3,147	4,045	2,127	1,421	3,527	1,035	006	538	16,726	0.3
Totals	654,477	904,291	696,937	654,192	710,515	1,503,686	729,845	146,514	6,000,457	100.2
% of total by depth	10.9	15.1	11.6	10.9	11.0	25.1	12.2	2.4	100.0	

* Catches in 4 to 9 meters assumed representutive of catches in 0-9 meters.

TABLE 9

LIFE HISTORY RESUME OF COMMERCIALLY IMPORTANT LAI<E VICTORIA FISHES

ITEM	TILAPIA ESCULENTA	TILAPIA NILOTICA	8AGRUS DOCMAC	CLARIAS MOSSAMBICUS	PROTOPTERUS AETHIOPICUS	SYNOOONTIS VICTORIAE
1. OISTRIBUTION	Indiginous species confined waters less than 20 m., but generally more than 5 m, concentrated in scattered locations usually over mud bottom, may be found in midwater also.	Introduced 1954 onwards. Highest localized concentrations in western lake in inshore waters less than 10m. Associated with T. esculenta and T. variabilis	Tends to be concentrated between 10 and 30 m. off rocky areas, depth varying with locality.	Very widespread at all depths and areas throughout lake.	Marginal swamps and shallow bays, uncommon at depths over 40 m.	Found throughout lake, biomass and fish length increase with depth; Most abundant at depths over 50 m.
2. FOOD HABITS	Principally phytoplankton of which diatoms are most important item, insect larvae and planktonic crustacea are less important	Principally phytoplankton in suspension or in bottom deposits, diatoms most important item.	1.Below 10cms - mainly Chironomids, Chaoborus, and Caridina. 2. Starts feeding piscivorously at 10 em. 3. Changeover from principally invertebrate to fish diet at 15 ems. 4. Entirely dependent on fish(Haplochromis) at 25 ems.	Omnivorous, but at larger sizes mainly piscivorous (Haplochromis). Large invertebrates such as Anisoptera nymphs and decapods are common	Young - mainly insects in marginal swamps. Adults - mainly molluscs and some small fish	Insect larvae and molluscs most important

LIFE HISTORY RESUME OF COMMERCIALLY IMPORTANT LAKE VICTORIA FISHES (CONTO•••••)

ITEM	TILAPIA ESCULENTA	TILAPIA NILOTICA	BAGRUS DOCMAC	CLARIAS MOSSAMBICUS	PROTOPTERUS AETHIOPICUS	SYNODONTIS VICTORIAE
3. GROWTH RATE	1 year -15 em. TL 3 years-23 " " 5 years-2B " " ? years-30 " " 9 years-31 " "	5.0 cm TL in 4 mths. 10.0 em TL in 0 mths. 15.0 em TL in 12 "	1 year- 0.6 em.SL 2years-19.6 " " 3 " -20.0 " " 4 " -36.8 " " 5 " -43.6 .. " 6 " -49.3 " " ? " -54.2 " "	No data, but probably similar to Bagrus doemae	Young attain 30-40 mm. after ? to 0 weeks, probably slow-growing and long-lived.	No data
4. SIZE AND AGE AT MATURITY	3"nets-20% mature 4"nets-60-65% mature 5"nets-100% mature 50% mature at 25-26 ems. TL	Onset of maturity at about 13.0 em. but many fish still immature at 20.0 em. SL.	At 5 years - 39 to 45 em. SL.	No data	No data	Riverine spawners as small as ? em. have been taken.
5. MORTALITY	See Garrod (1963): Journal Fisheries Research Board of Canada, Vol.20 No.1	No data	No data	No data	No data	No data
6. MOVEMENTS AND MIGRATIONS	No data but probably no lengthy migrations undertaken.	No data but probably no lengthy migrations undertaken.	No data	Probably makes extensive migration since it is a riverine spawner. Very few small fish less than 30 em. are taken in the trawl.	Young found in marginal swamps, then move to shallow bays; no other data.	No data

3.

LIFE HISTORY RESUME OF COMMERCIALLY IMPORTANT LAi<E VICTORIA FISHES (CONTD•••••)

ITEM	TILAPIA ESCULENTA	TILAPIA NILOTICA	8AGRUS DOCMAC	CLARIAS MOSSAMBICUS	PROTOPTERUS AETHIOPICUS	SYNOOONTIS VICTORIAE
7. OTHER BIOLOGICAL INFORMATION	Month brooder, spawns in inshore waters less than 10 m deep, not seasonally. Few parasites. Decreasing commercial importance. Nursery areas important.	Month brooder, spawns in inshore waters less than 10 m deep, not seasonally. Few parasites. Increa-sing commercial importance (up to 64 cm TL, 7.7 ng.). Nursery areas important.	-	-	Breeds from Nov-ApriL Builds nest. Parental care of young 2000-5000 eggs.	Tolerant of low dissolved oxygen.

TABLE 10

SPECIES OF HAPLOCHROMIS AND MONOTYPIC GENERA CLOSELY RELATED TO HAPLOCHROMIS ARRANGED BY FOOD HABITS

Primarily herbivorous: periphyton, algae, etc.	Primarily mollusc feeders	Primarily piscivorous	Both piscivorous and insectivorous	Primarily insectivorous
1. H. acidens	1. Astatoreochromis sp.	1. H. cronus 2/	1. H. longirostris	1. H. tyrianthinus
2. H. paropius	2. Macropleurodus sp. 1/	2. H. obesus 2/	2. H. mento	2. H. chlorochrous
3. H. cinctus	3. Hbplotilapia Spa	3. H. maxillaris 2/	3. H. pellegrini	3. H. cryptogramma
4. H. erythrocephalus	4. H. sauvagei 1/	4. H. melanopterus 2/	4. H. argenteus	4. H. fusiformis
5. Platytaeniodus sp.	5. H. prodromus 1/	5. H. parvidens 2/	5. H. dolichorhynchus	5. H. laparogramma
6. H. obliquidens	6. H. granti 1/	6. H. cryptodon 2/	6. H. decticostoma	6. H. melichrous
7. H. lividus	7. H. xenognathus 1/	7. H. microdon 2/	7. H. gilberti	7. H. xenognathus
8. H. nigricans	O. H. pharyngomylus	O. H. barbaraa 2/	8. H. brownae	O. H. plagiodon
9. H. nuchisguamulatus	9. H. ishmaeli	9. H. martini		9. H. chilotes
10. H. nubilis		10. H. guiarti		10. H. chromogynos
11. H. phytophagus		11. H. bayoni		11. H. aelocephalus
		12. H. serranus		12. H. lacrimosus
		13. H. victorianus		13. H. pallidus
		14. H. nyanzae		14. H. macrops
		15. H. bartoni		15. H. cinereus
		16. H. estor		16. H. humilior
		17. H. dentex		17. H. riponianus
		18. H. mandibularis		10. H. saxicola
		19. H. goweri		19. H. theliodon
		20. H. macrognathus		20. H. empodisma
		21. H. percoides		21. H. obtusidens
		22. H. flavipinnis		22. H. piceatus
		23. H. cavifrons		23. H. wolcommGi 3/
		24. H. Elagiostoma		24. H. tridens
		25. H. michaeli		25. H. megalops
		26. H. spekii		
		27. H. £achycephalus		
		20. H. maculipinna		
		29. H. boops		
		30. H. thuragnathus		
		31. H. xenostoma		
		32. H. pseudopellegrini		
		33. H. altigenis		
		34. H. dichrourus		
		35. H. paraguiarti		
		36. H. prognathus		
		37. H. squamulatus		

1/ These species shell the molluscs before consuming them. Remaining species eat the shells also.

2/ These species are specialized feeders on cichlid embryos and fry.

3/ Considered a specialized fish-scale eater.

SUMMARY

Type of diet	No. of species of Haplo. or monotypic genera	% of total
1. Primarily herbivorous	11	12.1
2. Primarily mollusc feeders	9	9.9
3. Primarily piscivorous	37	40.7
4. Both Piscivorous and Insectivorous	8	0.0
5. Primarily insectivorous	26	20.6
	91	100.1
Species described but diet unknown	9	
Probable number of species not yet described	30-50	
Total number species - genera	130 to 150	

TOTAL ANNUAL FISH PRODUCTION FROM KENYA WATERS OF LAKE VICTORIA 1962-1968 LONG TONS

YEAR	1962	1963	1964	1965	1966	1967	1968
TOTAL	10,918	11,641	12,000	13,000	15,200	15,500	16,100

KENYA: TOTAL ANNUAL PRODUCTION FROM LAKE VICTORIA BY SPECIES 1968. LONG TONS

SPECIES	1968	1969 M. Tons.
Alestes	346	56
Bagrus	1,129	66
Barbus	494	185
Clarias	1,710	1326
Engraulicypris	720	520
Haplochromis	3,684*	6427*
Labeo	566	467
Mormyrus	52	73 x
Nile Perch		
Protopterus	2,764	1626
Schilbe	388	248
Synodontis	177	256x
Tilapia esculenta	2,107	395
Tilapia other	274	694
Unspecified	1,669	630
TOTAL	16,100	17442

LANDING: ESTIMATED FISH CATCH FOR SIX REPRESENTATIVE FISH LANDINGS OF KENYA WATERS OF LAKE VICTORIA. 1968

	1968
BUKOMA	332.2
KALOKA	141.6
DUNGA	383.6
KENDU BAY	299.1
HOMA BAY	193.4
KARUNGU	244.4
OTHERS	14,505.7
TOTAL	16,100.0

TOTAL ANNUAL FISH PRODUCTION FRO ANDA WATERS OF LAKE VICTORIA 1962- 8 LONG TONS

YEAR	1962	1963	1964	1965	1966	1967	1960
TOTAL	23,500	24,000	24,000	24,600	27,600	36,590	33,008

UGANDA - TOTAL ANNUAL PRODUCTION BY SPECIES: 1967 - 1968. LONG TONS

	1967	1960
Tilapia	12,054.9	15,207.4
Bagrus	6,372.5	4,768.1
Barbus	642.2	1,615.8
Mormyrus	523.6	1,618.5
Protopterus	3,143.1	3,564.5
Ciarias	2,367.1	4,513.8
Labeo	290.2	218.7
Alestes	203.5	153.5
Lates		528.8
Haplochromis	1,339.0	1,037.2
Schilbe	29.3	105.8
Synodontis	145.8	475.7
Islands *	9,478.0	
TOTAL	36.590.0	33.800.0

ESTIMATED CATCH OF FISH IN VARIOUS DISTRICT - LANDINGS FOR UGANDA WATERS OF LAI<E VICTORIA 1967 - 1968

1967	Tilapia	Bagrus	Barbus	Mormyrus	Propt.	Clarias	Labeo	Alestes	Hapl0.	Schilbe	Synod.	TOTAL	
BUKEDI	1938.0	878.6	80.2	72.2	433.3	325.0	40.1	28.1	184.6	4.0	20.1	4012.2	
BUSOGA	4390.1	1994.2	200.5	164.0	983.4	737.6	91.1	63.8	419.0	9.1	45.5	9106.3	
E. MENGO	1716.5	778.2	78.1	63.9	384.3	297.9	35.4	24.8	163.5	3.6	17.8	3554.9	
W MENGO	2023.3	917.3	92.0	75.4	452.4	339.4	41.4	29.2	192.0	4.2	21.1	4188.5	
MASAI<A	1979.0	1004.2	101.4	140.1	889.7	667.2	02.2	57.7	379.1	8.4	41.3	6238.3	
ISLANO complex												9478.3)	36,590 LONG TONS
TOTAL	12054.9	6372.5	640.2	523.6	3143.1	2367.1	290.2	200.6	1339.0	29.3	145.8	27100.0)	

1968	Tilapia	Bagrus	Barbus	Mormyrus	Propt.	C1arias	Labeo	A1estes	Lates	Haplo.	Schilbe	Synod.	TOTAL
BUKEDI	2673.0	1212.6	131.7	123.0	612.8	529.9	53.4	37.5	109.4	07.9	20.6	35.3	5627.9
BUSOGA	5350.5	907.2	276.3	300.6	1178.5	847.3	09.8	64.6	178.1	479.9	36.9	56,3	9774.0
E.MENGO	2263.3	1247.7	76.4	375.7	644.5	980.5	30.1	21.3	222.3	100.8	6.1	35.0	6092.5
WMENGO	2191.5	316.4	994.3	700.9	560.6	1692.3	3.2	2.4	19.0	53.3	36.4	325.3	6095.6
MASAKA	340.3	148.2	17.1	14.3	76.1	59.8	6.2	3.7	-	31.3	0.8	3.0	700.0
Island Complex													4717.0) 133,800
TOTAL	12819.4	3882.1	1495.0	1522.5	3072.5	4117.0	102.7	129.5	520.0	033.2	100.0	455.7	29090.8) LONG TONS

TANZANIA WATERS OF LAKE VICTORIA: TOTAL ANNUAL CATCH STATISTICS BY SPECIES

	1958	1959	1960*	1961	1962	1963	1964	1965	1966	1967	1968	1969
Tilapia es	6077	2511	870	1422	1408	11042	19789	11722	10692	5736	8176	5230
Tilapia v.	2092	2134	568	538	880	2135	1469	958	999	1360	1499	1452
Tilapia z.	-	139	-	-	37	476	294	273	362	358	725	292
Haplochromis	4736	4219	3503	2499	2985	7452	3964	2631	6229	14471	21063	20527
Labeo	2760	1722	239	255	97	1052	398	1017	274	1493	583	11085
Bagrus	5528	12420	5157	5250	9218	10482	14827	14076	10357	9105	9293	
Barbus	306	481	225	371	127	466	464	517	370	1177	476	
Mormyrus	608	1566	580	310	339	398	524	599	228	[illegible]	426	
Clarias	916	1394	940	1303	1078	2750	2499	6057	3986	2802	7164	3852
Schilbe	726	907	246	218	149	1369	274	241	753	1383	1818	
Alestes	161	208	57	112	22	206	244	158	603	446	757	
Protopterus	1566	1172	1265	1701	1051	3628	3699	8462	5516	3098	5125	5005
Synodontis	756	2651	756	760	1423		968	152	587	1212	2248	6484
Others												
Total:	26235	31302	14406*	14730	18814	42542	49413	46863	40956	43152	59353	53927