# Ministry of Natural Resources and Surveys

# Department of Game, Fish and Tsetse Control

# Annual Report

for the

# Year 1962

# Part I

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# MINISTRY OF NATURAL RESOURCES AND SURVEYS

# DEPARTMENT OF GAME, FISH AND TSETSE CONTROL

# ANNUAL REPORT FOR THE YEAR 1962

## PART I

MINISTRY OF NATURAL RESOURCES & SURVEYS

# Annual Report of the Department of Game, Fish & Tsetse Control for the year 1962

## (a) Staff & General

The staff position in the various sections was virtually unchanged in 1962 except that Mr. C.M.Chisala was formally appointed to the Division I post of Fish Breeder on completion of his training. Details of Staff State are at Appendix I.

2. Mr. K.T.Howard, Fish Ranger, returned from overseas leave in March and took charge of the Fort Johnston station in place of the Fisheries Officer, Dr.E.C.L. Birkenmeier, who was on leave from April to mid-December. Mr.O.J.Carey, Game Ranger, returned to the Northern Province Game Station in July on conclusion of his leave and Mr.A.V.Gifkins, Senior Ranger (Fish), was absent from the Domasi Fish Farm on leave from April to September.

3. The absence of the Northern Province Game Ranger during the first part of the year threw a considerable strain on the Central Province Ranger, who had to manage both stations for the time being. Periodic ill health of the Ranger in charge of Game matters in the Southern Province also inhibited work to some extent. In these circumstances it was impossible to attempt any ambitious programme with respect to game but there were some further minor improvements in the observation camps in the Reserves and the initiative of local authorities led to the proclamation of three new Controlled Areas under the Game Ordinance. Planned protective burning of the Nyika grasslands was successfully carried out for the second year in succession and much work was done on preparing a boundary description for a projected National Park in this area. Control of marauding animals proceeded normally, with an extra effort against the much publicised man-eating hyaenas of Mlanje District.

4. Reports from the Fisheries Officer and Fish Ranger which formed the basis for most of the Fishery Section of this report showed that there was good progress in this branch of the work.

5. The Fish Ranger, Lake Chilwa, working from the newly opened station at Kachulu, established good relations with the local fishermen and the Department is much indebted to Mr. G.W.Kumtumanji, M.L.A., for his assistance in this connection. The Fish Ranger's efforts materially improved the position of the east side fishermen with respect to firewood for fish curing and he also took charge of the completion of a jetty at Kachulu after the Agricultural Department's Mechanical Soil Conservation Unit had built the main earthwork.

6. The Fort Johnston station produced some very interesting results from its experimental work with gill-nets and successfully established a mobile unit for the maintenance of engines of fishing craft in the small-scale fishery. Boat building proceeded at an increased rate, in response to a revival of demand, and there were renewed efforts to train boat builders for Lake Chilwa.

7. The Fishery Research Unit moved to its new base at Monkey Bay in July, though its buildings, started by the Ministry of Works and Transport early in 1961, were still not absolutely complete by the end of 1962.

8. Finally, in late December, the Fisheries Research launch 'Ethelwynn Trewavas' was launched on Lake Nyasa, having been purchased with the aid of a Research Grant from Britain. Since its inception fifteen years ago the Department has been without any launch for most of the time and for the rest has had to make do with rather unreliable launches, not designed for fisheries work. The arrival of 'Ethelwynn Trewavas' properly designed and equipped for the task was therefore a most important event for the Fisheries Branch of the Department.

9. Tsetse infestation continued to decline in almost all areas and the work of the Tsetse Control Section mainly consisted of patrols and surveys to keep in touch with the situation.

10. There were a number of visits from experts sent by outside assistance agencies.

11. At the request of Government the International Union for the Conservation of Nature, acting in concert with the Food & Agricultural Organization of United Nations, sent a team consisting of Mr. T. Riney and Mr. P. Hill to make a

brief survey of the wild life situation in the territory and to advise on the potential for development. Their visit, which occupied three weeks, covered the Vipya Plateau, Vwaza Marsh and the Kota-Kota Reserves. Their interim report suggested considerable, though naturally not vast, possibilities and was much more encouraging than might have been expected in this densely populated territory.

12. The Food & Agriculture Organization also responded to a request from Government for advice on fish marketing and related problems. Mr.J.Dibbs, F.A.O. Fisheries Economist working in Tanganyika, made a very valuable preliminary visit in September and was followed by a team consisting of Messrs. G.Valran (Fisheries Economist), M.Aref (Processing Expert) and W.Steen (Gear Technologist). The first two arrived in October and left in early December, while Mr.Steen arrived in early December to stay till the end of February. Unfortunately his work in the early part of his stay was much inhibited by the fact that both the launches then allocated for Fisheries use were out of commission.

13. Dr. C.M.Yonge, C.B.E., F.R.S., (Chairman of the Fisheries Advisory Panel for East & Central Africa to the Department of Technical Co-operation) paid a visit to the Fort Johnston and Monkey Bay stations during September.

14. As part of the general plan for integrating the Ministry, and in view of the impending retirement of the Director, Game, Fish & Tsetse Control in 1963, it was decided to effect a gradual winding up of the Department during 1962 and to re-allocate its functions. Tsetse Control, as being primarily an ecological problem at present, was transferred to the Department of Agriculture on 1st July and Dr. Steele, Tsetse Botanist, transferred at the same time. The other two sections remained as they were until the dose of the year, the Chief Conservator of Forests assuming the responsibility for game and trout fishing during the first week of December and the Director of Agriculture taking over fisheries and the management of commercial crocodile hunting at the end of the year.

15. Th 1962 Report thus becomes the last report of the Department of Game, Fish & Tsetse Control, which henceforth ceases to exist. Further reports on game matters will appear in the Annual Reports of the Department of Forestry & Game, as it now comes to be called, while those on fisheries will be found in the Annual Reports of the Department of Agriculture & Fisheries.

16. The retiring Director wishes all success to the Directors and staffs of the new organizations.

## (b) Game

### Crop Protection

17. There is nothing particularly outstanding to report in connection with the control of marauding animals of the larger species. Action proceeded much as usual throughout the year, though the absence of one of the three Rangers on leave and the occasional ill health of one of the other two made proper superivsion diffi cult.

18. With respect to vermin it was decided to discontinue the financing of bounty payments for destruction of wild pig, monkeys and baboons, the decision taking effect from 1st July. From the inception of the scheme in 1948 to 31st December 1961 the African Development & Welfare Fund had paid rewards on the destruction of some 123,900 head of vermin and District Councils had provided finance for rewards on another 83,200. This very considerable lead and assistance having been given from public funds it was considered that the individual cultivator could properly be expected to continue by himself. Some 7,800 head were dealt with under A.D.W. bounties during the first half of 1962 before the system was discontinued.

19. In place of this system the Rumpi District Council asked for assistance in financing their own organised effort. In the hope of establishing a more concerted and directed attack than could well be expected of separate, unco-ordinated individuals, the Council was given a free issue of 1,000 rounds of shot-gun cartridges. These were issued on the understanding that Council would be responsible for organizing and directing the attack, for the recovery of used and unused rounds, and for the collection of a 2/- fee in respect of each round issued and not subsequently accounted for by return of the unused cartridge or empty case.

20. The main part of the effort was made during the period March to June but continued at a diminishing tempo until the end of October. Some 631 head of vermin were killed, with an expenditure of 827 rounds. A further 69 rounds were accounted for by unused cartridges returned or lost cartridges paid for, so that at the end of the year about 100 rounds were still outstanding. No doubt the greater part of these will be accounted for in due course

and, considering the difficulties of keeping control of an effort of this sort, the comparatively small percentage error in accounting reflects credit on the Rumpi organization.

21. Similar requests for assistance were made by the Nkata Bay and Karonga District Councils and issues of 1,500 rounds to Nkata Bay and 1,000 to Karonga were accordingly made in May and November respectively. Up to the end of 1962 it had not been possible to obtain reports from either Council.

22. During the months of May, June and July organized action was taken against hyaenas at the northern end of the Mlanje Mountain range where, in the latter part of 1961, there had been several cases of attacks on human beings. A really organized effort could not then be made because of the illness of the Senior Ranger but with his return to duty and the onset of the dry season it was decided to take action.

23. After a preliminary reconnaissance by the Director and Senior Ranger, the latter moved into the area with 10 hunters in early May. A search for lairs was duly made and a general attack by armed night patrols, gun traps and poisoned baits was organized.

24. Operations went on until late July on these lines. Some fourteen lairs were found and blocked, after preliminary burning of fires at the entrances to suffocate any animals which might be within. In addition to an unknown number of animals destroyed in this way a further 33 were killed outright by gun-traps, activities of armed patrols, etc., and although no claim of complete eradication could be made it appeared, from the disappearance of spoor and other hyaena traces in the area, that the population had been materially reduced.

25. No attacks on human beings were reported during the dry season of 1962 so it would appear that the operation was reasonably successful. It must be emphasised, however, that such relief as it may have afforded cannot but be short lived. On the other hand an operation of this sort, involving the whole hunter force of the Southern Province for nearly three months, means leaving the rest of the Province unprotected and can scarcely be mounted every year.

26. As in the vermin problem generally the long term answer is patient and persistent attacks by those members of the general public who possess firearms, coupled with the erection of small stockades by those who wish to sleep in

the open during hot weather.

27. There was no great progress with the effort to establish the use of electric fences for protection of crops against marauding animals.

28. The two fences established by the Senior Ranger in the Southern Province during 1961 round fields cultivated by Division II staff of the Agricultural Department gave good results initially but were unsuccessful in the long run. The reason was neglect of even the simplest form of maintenance by the cultivator, weeds being allowed to grow up and touch the wire, fallen branches being left lying across it, etc., so that short circuits occurred and the fences were put out of action. Admittedly the frequent ill-health of the Senior Ranger made it impossible to exercise as much supervision on the fences as had been hoped but clearly very obse supervision should not have been necessary to ensure the simple maintenance required.

29. In the Central Province attempts were made to persuade the rice cultivators at the Bua River mouth, who frequently complain of hippo damage, to erect a trial fence with the assistance of the Game Ranger. These were only successful at the very end of the year when work was begun on a 1,000 yard fence. This was not quite complete by the 31st December.

30. The detail of animals destroyed by the Crop Protection teams during 1962 is shown at Appendix II, Table I. Value of ivory collected and revenue from sale of game meat and hides is shown at Appendix II, Table II.

## Game Conservation

31. A study of the routine observations made in the Reserves by the Game Guards suggests that the general level of game population in the Southern Province Reserves continued the decline which began to be evident in 1961. Appendix III shows the detail of the observations.

32. Space does not permit the setting out of a full comparison of the figures but the yearly averages of the quarterly figures of observations per 10 days patrol for the commoner animals is perhaps sufficient to convey a general impression of the position. The figures relating to the Mwabvi Reserve are as follows:

| | 1960 | 1961 | 1962 |
|---|---|---|---|
| Rhinoceros | 1.4 | .6 | .5 |
| Buffalo | 21.1 | 8.4 | 10.3 |
| Sable | 37.0 | 22.6 | 19.6 |
| Kudu | 32.7 | 19.4 | 18.0 |
| Impala | 25.0 | 15.7 | 10.5 |

33. Admittedly a produce extraction road, designed to put the villages on the watershed to the west in touch with the Shire Valley cotton markets, was made through this Reserve during 1962. Nevertheless though it was to be expected that this would disturb the game in the vicinity of the road line it could scarcely account for a general decline; moreover figures for the other two Southern Province Reserves have a rather similar appearance.

34. In the Central Province Reserves of Kota Kota and Kasungu there appeared, by contrast, to be a perceptible rise in game population levels, despite the establishment os some human settlement and cultivation in the latter.

35. For these Reserves the yearly averages per 10 days patrol are as follows:

| | 1960 | 1961 | 1962 |
|---|---|---|---|
| Kota Kota | | | |
| Elephant | 19.3 | 23.3 | 34.0 |
| Buffalo | 13.6 | 20.6 | 29.0 |
| Sable | 4.4 | 5.4 | 7.7 |
| Roan | 4.1 | 4.8 | 7.6 |
| Kudu | 1.3 | 4.1 | 7.7 |
| Kasungu | | | |
| Elephant | 23.7 | 40.7 | 59.4 |
| Buffalo | 13.8 | 16.8 | 29.3 |
| Sable | 3.6 | 6.5 | 10.9 |
| Roan | 6.3 | 7.3 | 10.2 |
| Kudu | 4.2 | 3.9 | 5.5 |

36. Although the general level of game populations in these Reserves showed this tendency to rise it was clear from the extreme wariness of the game that there was still a considerable amount of poaching going on.

37. There was an apparent increase in some species on the Nyika Plateau after the slight check in 1961, which, as discussed in the report for that year, may have been the initial, short-term, effect of the new burning policy.

Yearly averages of the quarterly figures per ten days patrol are as follows:

| | 1960 | 1961 | 1962 |
|---|---|---|---|
| Zebra | 68.6 | 52.3 | 104.3 |
| Roan | 61.4 | 45.1 | 42.3 |
| Eland | 137.1 | 81.8 | 141.2 |
| Reedbuck | 18.5 | 21.4 | 37.7 |
| Bushbuck | 3.4 | 4.6 | 2.1 |

38. Buffalo were seen rather more frequently than in previous years, though in very small numbers, and the presence of cheetah and serval on the plateau was confirmed. Much speculation was caused by several reports of the siting of sable by visitors to the plateau, though the Game Reserve Guards made no such observations. The latter did, however, see what they identified as impala in the eastern part of the grasslands, but the identification was not a firm one as the Guards in question were unfamiliar with impala, which is not common in the north. Whatever it may have been, it seemed that something not previously recorded on the plateau had made its appearance.

39. Game animals in the Vwaza Marsh Controlled Area showed very obvious increases in the main species. Unfortunately routine observations were not started in this area till the second half of 1961 so that there is not a very full range to compare, but taking the averages of the second half of 1961 and 1962 the figure per 10 days patrol are as follows

| | 1961 | 1962 |
|---|---|---|
| Elephant | 20.4 | 46.8 |
| Zebra | .5 | 3.6 |
| Buffalo | 10.9 | 50.4 |
| Sable | 3.5 | 7.7 |
| Roan | 32.2 | 61.1 |

40. Protective burning to an organized plan was carried out on the Nyika in July for the second year in succession, in conjunction with the Department of Forestry who provided the Staff, funds and labour for the purpose, and though some fires were later started inside the protective fire traces these did not spread nearly as far as in the years before the policy was adopted.

41. Plans are on foot to declare a National Park on this Plateau and much time was spent in trying to define a practicable boundary, no easy task in this complicated terrain. The combination of a game conservation area on

the Nyika and a game utilization area in the nearby Vwaza Marsh looks an ideal one and should make a considerable contribution to the amenities of the country.

42. This idea of complementary areas was taken further during the year by the declaration of a Controlled Area, at the request of Chief Chikulamayembe, in his domains fringing the Nyika. This area covers a section of the migration route down to the Runyina-Rukuru Valley and the Vwaza Marsh and should help materially to perpetuate game and hunting opportunities in this part of Nyasaland.

43. New Controlled Areas were also declared in the vincinity of Pirilongwe Mountain in Fort Johnston District and in Chief Liwonde's area in Kasupe District. The Pirilongwe Area adjoins the Pirilongwe Forest Reserve and the two together, though scarcely large enough to constitute a self-contained unit in themselves, may possibly provide a useful reservoir of game stocks for the Cape Maclear peninsula in general. Chief Liwonde's area is rather larger but is moderately well settled and a good deal of restraint will have to be exercised by the actual residents, in addition to preventing illegal hunting by intruders, if the game population is to survive for any considerable period.

44. Some fifty-two people visited the Lifupa Game Camp in Kasungu Reserve during the year and nineteen visited Chipata Camp in Kota-Kota. These figures do not include official visitors.

45. The Game staff position did not permit any great efforts at propaganda in favour of wild life conservation and, in any case, no funds were voted for the purpose during 1962. Nevertheless one party of schoolboys from the Malosa School was taken for a week-end visit to Kasungu Game Reserve. They saw a satisfactory variety and quantity of animals and were plainly very interested.

46. Judging by the overall figures of revenue from Game and Wild Bird Licences collected during 1962 there was little significant change from previous years. The copies of licences sent in by the Treasury licensing staff are, however, obviously incomplete and the overall revenue returns are not sufficiently detailed to permit of analysis by type of licence. Revenue from Game or Wild Bird Licences totalled £2,970 against £2,911 in 1961.

## Crocodile Hunting

47. The number of licensed hunters varied from ten to fifteen during the year, with an average of approximately thirteen. Two of these were registered companies and the remainder were private individuals, operating with very varying degrees of persistence.

48. Returns submitted showed a kill of 1,383 reptiles, a figure slightly above that for 1961. Some 69 per cent of these were listed as being under seven feet in length and are presumed to have been immature and in the interests of the industry and of preserving a proper natural balance amongst the aquatic population it may well be necessary to check this emphasis on immature reptiles in the future. Very few of these small specimens were taken by the private operators who probably cropped in a more opportunist style than the larger firms and did not hunt with great persistence.

## (b) Fishery

## State of the Fish Stocks

49. Yields of Tilapia from the ring-net fishery in the south east arm of Lake Nyasa continued to indicate that the stocks of the off-shore species were in a satisfactory condition. There was a rise in both total effort and catch per unit effort, landings being 439,107 dozen fish in 7,649 pulls in 1962 as against 306,788 in 5,995 pulls in 1961, or a 42% rise in catch for a 27% rise in effort.

50. The yield, in fact, tended to bear out the prediction made by the Fisheries Officer, on the basis of the 1961 figures, that the stock could probably stand an increase of ring net effort up to approximately 7,000 pulls without bringing the yield per pull undesirably low.

51. It was also reported, with respect to 1962, that length frequency measurements from the ring net catches indicated that the catch from January to April included a good proportion of fish estimated as being older than three years and that for this part of the year catches were similar in composition to those of late 1958 and of 1959. Thereafter the ring nets seemed to crop more uniform size groups, apparently consisting of three year old fish.

52. In general it appeared that the 1962 effort might be in reasonable balance with the rate of recruitment to these off shore Tilapia stocks cropped by the ring nets and that if the number of ring nets and their rate of using could be held at 1962 levels a satisfactory stable rate of production might be achieved. Attempts to put the fishing rate above the 1962 level or lengthen the fishing time by the removal of the two months close season would probably result in catches declining again.

53. Data on the inshore Tilapia stocks in Lake Nyasa and Lake Malombe are less precise and complete than those on the offshore species, but judging by the catch per unit effort of the seine nets they were generally less abundant than in 1960 and 1961. The fall may be, in part, a simple reflection of an increase in the number of nets in use. Such increase was not obvious, but unfortunately data from previous years are not really complete enough to be definite on the point. On the other hand the considerable rise in lake level which took place during 1962 clearly affected the situation at individual beaches, putting seine nets out of use at some beaches and bringing them in at others.

54. There was a distinct improvement in the Labeo fishery during 1962, with increased total catches and increased catch per unit effort in the large scale fishery. Data on the inshore fishery for this species showed increased catches per unit effort at most places and the Fisheries Officer's report makes it apparent that there was a real increase in abundance in 1962, though not to the level of 1960 and previous years.

## Large Scale Fishery under Licence

55. There were three organizations holding large scale licences in 1962.

56. There was a rise in ring netting in the south east arm consequent upon all three organizations being in full action again, which more than off-set a slight fall in gill net activity. Catch from the south east arm rose from 2,654 short tons in 1961 to 3,686 in 1962.

57. During 1962 there was also some activity in the south west arm on the part of one of the large scale organizations. This was restricted to gill netting and the catch, in terms of yield per unit effort, was a relatively good one with respect to Labeo. For this species the catch

per 100 yards of netting was 15 fish as against 10 in the south east arm. Although the overall catch was not more than 49 tons this was from quite a small effort and, as the Fisheries Officer points out, the south west arm could clearly give a useful yield if a forthright effort were made. The lack of a good access road to facilitate marketing and distribution is no doubt a powerful deterrent to such effort.

58. Figures relating to this section of the fishery are at Appendix IV.

Small Scale Fishery not subject to licence

59. Data for this section of the fishery are shown at Appendix V. During 1962 the scope of the recording system was widened somewhat and figures were collected from several beaches in a given area instead of only one, so that the observations are not completely comparable. In Table II, therefore, the 1961 figures, where listed, have a nearly equivalent basis to those for 1961, but not an exactly equivalent one.

60. There were some interesting developments in Lake Malombe where, in the face of repeated attacks from crocodiles, gill nets used in the normal way have almost been abandoned. Instead some 1,000 yards are set in a circle about the fishing craft which then moves repeatedly round the inner circumference with the crew beating the water to drive the encircled fish into the nets. This method obviates the risk of damage from crocodiles and makes it possible to land fish in a much fresher condition than those from the ordinary night-set gill net.

61. Apart from this development there was no very marked change in the rate of progress of the small scale fishery. The general pattern remained much the same as in previous years with every gradation in type of operator from the purely subsistence fisherman to the almost full-time commercial man. There were just over a hundred men of this latter type in action during 1962 in the southern part of Lake Nyasa, Upper Shire and Lake Malombe and they produced a total of about 1,400 short tons of fish. The various grades of subsistence and semi-subsistence fishermen, who numbered many hundreds, produced a total catch estimated as being of the order of 3,000 short tons.

62. This is much as was estimated for 1961 but the 1962 estimate was based on much more comprehensive and systematic data.

63. An idea of how intermittent was the average activity in the subsistence section of the fishery may be obtained from Table I of Appendix V. This shows the frequency of use of various types of gear relative to the maximum possible frequency where maximum possible frequency is taken as one set per day of each gill net available in the area, two per day for large meshed seines and five per day for small meshed seines and chilimila. This is really below the maxima for seine nets and chilimila, but seems good enough as a basis of comparison from year to year.

64. It is clear that a considerable proportion of the individual net owners are really only using their nets very infrequently indeed. Management of a fishery made up of numbers of individuals working on these sporadic lines, and the organisation of proper marketing systems for it, are both extremely difficult.

65. If the industry and its marketing is to be properly organized and managed, what seems to be needed is a change from casual, semi-subsistence fishing to regular commercial fishing, and it is encouraging to note that this change is beginning to occur. On the other hand the limits on total catch imposed by the stock potentials make it plain that only a finite number of subsistence fishermen can make the change to full time fishing with profit to themselves and without damage to the interests of those who have already made it.

66. The above remarks apply more especially to fishing in Lake Nyasa, Upper Shire and Lake Malombe. Not enough is yet known about Lake Chilwa to know whether they yet apply there or what margin is between total catch and overall potential but certainly the total catch appears to be astonishingly large. Thus recorded landings by fishermen operating from Kachulu beach alone averaged some 4 short tons per day for fourteen sample days spread over the months of June to December. Variations from this mean were very wide and the sample may well be a misleading one but should it be a true sample it would indicate a catch of the order of 1,400 short tons per annum at this beach. With Chisi Island landings and those of the southern and eastern beaches to be added it appears that tht total landings might be of the order of 4,500 short tons per annum. This seems a great deal for some 400 square miles of water in terms of a sustained yield.

67. In particular it is to be noted that a high proportion of fish caught, namely Tilapia shirana, are very

small, possibly immature specimens. Whether, however, this is a reflection of the fact that only small meshed nets are used or whether these small meshed nets are used because there are few adult fish left to catch is not yet known. Certainly there has been a reduction in average mesh size over the last few years, since, in fact, manufactured nets became easily available. This, however, may have been the effect of the Nyasaland system of sale by the fish instead of by weight, which makes it more profitable to catch large numbers of small fish than rather fewer fully grown specimens of much greater total weight.

68. The Chilwa station has not been open long enough to be sure on these points but it seems very possible that some controls may be necessary on this water as well as in Lake Nyasa if the best return is to be received from it.

69. The general situation with regard to fishermen who have received loans remained much the same as in 1961. Payments were slow in coming in, even from those whose businesses appeared to be flourishing, and there were a depressing number of outright failures. Marketing difficulties had something to do with this but were certainly not the only cause as was made plain by the success of some of the operators.

70. The dispute between the Atonga and Anyanja fishermen at Cape Maclear, which began in 1961, showed no sign of abatement in 1962, and the valuable open-water fishery for 'utaka' collapsed as a result. A few of the Atonga chilimila fishermen have established themselves in other parts of the southern portion of Lake Nyasa but the majority have returned home.

71. In spite of the less pleasant features discussed above, some of which have more bearing on the future than the present, there was, in general, fairly steady progress in the inshore fishery. There are now some 150 plank boats and over 100 outboard engines in use in the southern part of Lake Nyasa, with more on Lake Chilwa, and investment of money in fishing is certainly increasing. In general the problem may now be to guide and control an expansion whereas, a comparatively few years ago, the problem was to stimulate one.

## The Fish Trade

72. Approximately 68 tons of fresh fish, 65 tons of smoked and 108 tons of salted fish were exported to the Rhodesias by the large scale firms during the year, corresponding to about 480 short tons in landed weight. The corresponding figure in 1961 was 765 short tons and the decline in export in spite of the considerably increased production is a welcome sign of rising consumption within the territory.

73. Some of the large scale firms re-commenced the purchase of fish from the individual operators of the inshore fishery but exact figures are not known.

74. Minor fish trading continued much as in previous years but there were signs of a rather wider distribution of fresh fish in the Central Province. The use of ice for this purpose is gaining ground and sales of ice from the Departmental plant at Fort Johnston amounted to 48,360 lbs. as against 28,710 lbs. in 1961, with a revenue of £243. The number of customers remained steady at 97 but 13 privately owned insulated boxes, of the pattern demonstrated by the Department at the close of 1960, were in use by the end of the year.

75. Price records on the beaches and at markets suggested a very slight drop in average prices for the various sizes of fish compared with 1961. Strictly comparable figures are, however, very difficult to obtain when sales are of individual fish rather than by weight and the drop, if it existed, was a very slight one. The price of a large Tilapia, i.e. about eleven inches or a little above, was generally about 4d. on the Lake Shore at Fort Johnston and often rather higher in the Central Province, especially at Kota-Kota, and about 10½d. on Limbe market and up to 1/3 on Lilongwe market. Prices for other types of fish were, size for size, generally lower.

76. Records at Kachulu beach compared with those on the east side of the lake showed an expected higher level, the east side prices being usually about two thirds of those pertaining at Kachulu. The Kachulu figures also illustrated the effect of seasons on the average price which in March, when catches were good and buyers rather scarce because of difficult road conditions, was about one third of that ruling in November when buyers could reach the lake in large numbers.

77. The price figures from Chilwa also showed how sales by individual fish instead of by weight tend to throw the emphasis on fishing for the smaller, younger specimens. Thus, taking November price figures, a Tilapia of less than 13 cm., which would weigh about a tenth of a pound, sold for about a halfpenny. Thus the rate was equivalent to fourpence halfpenny to fivepence a pound. A fish between 20 cm. and 27 cm., however, which would weigh about half a pound was selling for a penny halfpenny, equivalent to a rate of threepence per pound, while a fish over 27 cms. which would weigh just over three-quarters of a pound, sold at a rate equivalent to twopence three-farthings per pound. Since the young fish are naturally more numerous than the older, larger fish it is easier to catch a pound's weight in young fish than to catch the same weight in adults. When the pound's weight of the young fish is also worth more than the pound's weight of old fish it is quite clear where the emphasis of effort is likely to be. The situation stems, of course, from the fact that few consumers realise how rapidly the weight of a fish goes up with increasing length.

78. Happily there is a growing tendency for trade at some of the bigger beach markets to be conducted by volume instead of by individual fish. That is, a buyer will pay so much for a full basket of such and such a size, and if this practice becomes general it may tend to equalise the emphasis on old and young fish.

79. During 1962 the marketing system in the small scale fishery was reviewed by experts from the Food & Agriculture Organisation of United Nations, but their reports and recommendations have not yet been received. It was understood however that, apart from the overall problem of the limited purchasing power of the mass of the people, they considered the main problems were those of arranging for the concentration of a number of catches at a relatively few landing points, so as to make a significant total available at each, and of dealing with the wet season catches at beaches only sporadically accessible to buyers at that time.

80. Both these problems have long been recognised by the Fisheries Staff, but one of the F.A.O. experts, Mr.J. Dibbs, who preceded the main team, proposed what seemed an eminently practicable solution of the second of them.

81. He proposed the use of drying kilns of a simple

type, to economise in fuel and avoid risk of rain damage during curing, coupled with efforts to persuade one or two people at each beach to set up as fish curers to the community. They would receive fish from the fishermen, cure it and return it to its owners and be paid either in cash or by retaining a proportion of the fish cured.

82. The idea of using kilns was not new to the Department but the application of the method was. Previous efforts to introduce kilns have been unsuccessful largely because the fishermen themsleves do not want to be involved in fish curing, as a general rule, nor does the catch of one man always justify the complication of using a kiln, while the buyers, who could use a kiln with advantage, are usually not lake shore residents and do not want to be involved with structures away from their own villages. The system proposed would get over both these difficulties and would permit fishing to proceed steadily, without the risk of spoilage if no outside traders came to buy and cure the catch, and would mean that when they did succeed in getting to the beach they would not have to waste time waiting for a payload.

83. Experiments were made forthwith by Fish Ranger Fort Johnston, using a kiln constructed on the lines suggested by Mr. Dibbs, in order to work out the technical side of the operation.

## Development Work

84. Probably the two most important aspects of devdopmental work were the establishment of a mobile unit for the maintenance of engines of fishing craft and the building of a jetty at Kachulu on Lake Chilwa.

85. The Mobile Maintenance Unit, consisting of a mechanic and his assistant travelling round the Lake with a considerable range of replacement parts, went into action in April. Its task was to do ordinary simple servicing and minor repairs to the outboard engines which are coming increasingly into use in the inshore fishery, and to advise fishermen on ordinary running and maintenance procedure. During 1962 this service was provided free but engine owners had to purchase, at cost price, any spare parts supplied.

86. Fish Ranger, Fort Johnston, who established the unit as a working organization, reported that it had been welcomed everywhere by engine owners and obviously it filled a sorely felt want.

87. During the nine months it was in operation in 1962 the unit visited Lake Malombe three times, south west arm, Salima, Domira Bay and Kota-Kota twice each, and south east arm once, besides spending a considerable time dealing with engines brought in to the Fort Johnston office. In all 46 engines were serviced and 69 repaired and some £76 worth of spares were sold.

88. The Lake Chilwa jetty, built at Kachulu, was designed to facilitate the landing of fish and other produce at this beach, the main landing beach of Lake Chilwa at the end of the motor road from Zomba. Its chief benefit will probably be felt in the dry season when the fall in lake level makes it impossible to bring canoes and other craft close inshore.

89. The earthwork to form the main body of the jetty was built by the Mechanical Soil Conservation Unit of the Agricultural Department at a cost of £1,800, the work being completed in October. Unfortunately through some misreading of the plans the sides were made very much steeper than the design proposed and this, coupled with unusually early heavy rains and high winds before the soil had had time to consolidate, led to a good deal of trouble with erosion and undercutting. After the main earthwork was completed much work remained to be done in the way of stoning the lower edges against wave action, grass planting to bind the banks, etc. This later work had to be done by manual labour as funds did not permit further use of the Mechanical Soil Conservation Unit and it was not possible to open the jetty for general use by the end of the year.

90. It is, however, confidently expected that it will be possible to open it by the dry season of 1963 and it should materially assist fish trading and general water transport at this important landing.

91. Boat building, by a carpenter working on a contract basis under Departmental supervision and management, continued at Fort Johnston. Thanks to extended tours by the Fish Ranger and the activities of the Mobile Maintenance Unit and the Demonstration Unit discussed under the Training Section, there was a considerable revival of demand. Thirteen boats were completed and sold in addition to two left unsold at the end of 1961.

92. This increased demand made it possible to finance the erection of a boat-building shed separate from the

Departmental Workshops and this was nearing completion at the end of this year.

93. Two carpenters from Lake Chilwa also visited Fort Johnston to be trained in the simple boat building undertaken at the station and returned home with plans to set up their own businesses to serve Lake Chilwa fishermen.

Training and Propaganda

94. The Fish Ranger's absence from Nkata Bay to take charge of the Fort Johnston station prevented use of the small training school there but in June some staff and equipment were transferred to Fort Johnston and the Fish Ranger conducted three courses at that base.

95. Some twenty applications for places were received, not all of whom could be accommodated at the make-shift site and thirteen men completed the courses held. Most of the applicants were from the south east arm and Lake Malombe.

96. The Demonstration Unit, designed to give practical demonstrations of new or imporved methods evolved in the course of experimental work, was active during the year and toured extensively in the southern part of Lake Nyasa and in Lake Malombe. The main emphasis was on demonstration of proven improvements in gill net setting and mounting, and on showing the advantages of the new platil monofilament nets which were such a success experimentally in 1960. Some successful demonstrations of Chilimila fishing were also given at the southern end of the south east arm, where the method is still largely unknown and where its introduction might relieve the pressure of the inshore 'utaka' seines on the immature Tilapia.

97. The chilimila method also formed part of the training courses held and Fish Ranger reports that it was enthusiastically received at Malindi, where there is a moderate supply of 'utaka' and other Haplochromids available in the White Rock area not exploitable by the ordinary methods in use in the locality.

98. The staff of the Demonstration Unit was also used to demonstrate the kiln drying of fish, as suggested by Mr. Dibbs. The Fish Ranger reports, after the trials discussed in the Experimental section: "Products from the

kiln were given away to African buyers, who stated that the fish sold as well as any other on the market. The kiln was put into operation at a buyers' camp and a competition held between the buyers and the Department to see who could cure the most fish in one hour and whether the products were the same. The kiln took one gallon of palm nuts (for fuel) compared with two for the traditional method and cured sixty fish compared with forty three. The buyers worked at top speed to try to compete but failed to match our rate. It was agreed that our product was a good one."

99. It is not considered that the kiln method has much reference to these non-resident buyers who, as earlier attempts have shown, do not want to be involved with structures on the Lake Shore, but the operation certainly seems to have been a telling demonstration of the technical effectiveness of the kiln.

100. The Fisherman's Information Room at Fort Johnston was maintained as usual and was visited by some 370 people. Only 59 of these were actually fishermen but visits from the non-fishing public are, of course, not unimportant as it is clearly desirable that the general public should also know what is being done. Almost all visitors appeared to be impressed by the variety of the Fisheries Section's activities as advertised in the Information Room.

## Experimental Work

101. Experimental work dealt with a variety of fields connected with the fishery. Fish Ranger, Fort Johnston, was responsible for most of the work in the absence of the Fisheries Officer on leave, though the latter had initiated many of the gill net experiments before departing.

102. The Fish Ranger, Fort Johnston, made some trials of a mobile fish smoking kiln, on the lines of a design suggested by Mr. J. Dibbs of F.A.O.

103. The kiln consisted of a wooden frame five feet high by three feet square, covered with zinc sheeting but open top and bottom. It was designed to be stood over a shallow pit containing a slow fire and the fish were laid for smoking in shallow trays with wire mesh bottoms stacked one above the other inside the kiln. In use the order of these trays was rotated every fifteen minutes.

104. In essence the apparatus represented an elaboration of, rather than a departure from, the traditional method by which fish are laid flat on a single grill over a slow fire. The covered frame and stack of trays really represented no more than a stack of grills over the same fire. The fish were thus half grilled in the traditional way rather than smoked in the European way and in taste and appearance should be more acceptable locally than smoked fish as the European understands the term.

105. A kiln of this size and type was found to hold 60 fish of normal size and could deal with them in one hour.

106. The advantages claimed for the kiln were:-

(i) with the addition of some removable covering at the top, e.g. thatch of palm leaves, it could be used in rainy weather when the traditional method is unusable;

(ii) it achieved a 50% saving of fuel consumption.

The first advantage is obviously of general application and the second would be an important one in places such as Likoma Island, shores of Lake Chilwa, etc., where fuel for curing has to be brought from a distance.

107. Similar, less documented, kiln trials were made by Fish Ranger, Lake Chilwa.

108. Experiments were continued with delayed release buoys, as a safeguard against night thefts of gill nets. Using a method with carpenters' glue originally suggested by the late Dr. V.D. van Someren, Director of the East African Freshwater Fisheries Research Organization, the Fish Ranger, Fort Johnston, evolved a satisfactory working procedure.

109. He reported that the marker buoy was fixed one fathom below the surface by taking a bight of the buoy rope through two holes bored in a slab of glue. During the night the glue gradually dissolved and released the buoy to the surface in the early morning, by which time the rightful owner would be there to pick up his nets. Various sizes of glue slabs gave the following results, using a marker buoy with a buoyancy of 1,650 grams:-

| Size of Glue | | Release Time | |
|---|---|---|---|
| 2" x 2" x ¼" holes | ¾" apart | 9 hours | 25 mins. |
| 2" x 2" x ¼" " | 1" " | 10 " | 15 " |
| 2" x 2½" x ¼" " | 1¼" " | 11 " | 45 " |
| 2" x 3" x ¼" " | ½" " | 12 " | 0 " |
| 2" x 2½" x ¼" " | 3/8" " | 14 " | 0 " |

110. Gill net experiments included further series on comparison of catching ability of mended and unmended nets, float spacing, mounting technique and shift setting.

111. The experiment with nylon nets mended meticulously and fished against nets which were merely 'cobbled' was a repeat of similar experiments in 1959 and 1961. The results in 1962 confirmed those of previous years in which it was shown that the 'cobbled' net caught at least as much and even rather more than the net mended meticulously mesh by mesh. The figures of all three series are as follows, the 'cobbled' or 'unmended' net being No.1 and the carefully mended net being No.2:-

| Year | No. of Sets Each Net | Hours Mending Time No.1 | Hours Mending Time No.2 | Number of Fish Caught No.1 | Number of Fish Caught No.1 | Percentage of total catch in No.1 |
|---|---|---|---|---|---|---|
| 1959 | 59 | 15¼ | 51¾ | 290 | 308 | 48% |
| 1961 | 141 | 17¼ | 36 | 829 | 767 | 52% |
| 1962 | 108 | 21½ | 54¼ | 190 | 141 | 52% |
| | 308 | 54 | 142 | 1,309 | 1,216 | |

112. The 1959 series actually involved two successive mended nets because the first of the two was lost after 40 sets of the series. In this series therefore the unmended net was, at the close, fishing against a net which was not only being very carefully mended but was also half its age. But for this it seems likely that the cobbled net would have been superior, as in the later series.

113. The difference between the catches, taking all the series together, is admittedly slight, though in favour of the cobbled net. The big advantage was the economy in man hours spent on repair work.

114. Two trials, the first by the Fisheries Officer

and the second by the Fish Ranger, were made to determine the effect of varying float spacings in gill net fishing. The first was carried out from 7th December 1961 to 20th February 1962 and involved 67 sets while the second ran from 7th November to 21st December 1962 and involved 33 sets.

115. The results of the first trial, made with 3½ inch mesh nylon nets, 26 meshes in depth, were as follows:-

| Species | Numbers caught in nets with various float spacings, as indicated: 12 ft. | 10 ft. | 8 ft. | 6 ft. | 4 ft. |
|---|---|---|---|---|---|
| Tilapia squamipinnis | 85 | 60 | 78 | 63 | 53 |
| Tilapia lidole | 11 | 11 | 11 | 6 | 13 |
| Other Tilapia | 3 | - | 4 | - | - |
| Rhamphochromis spp. | - | 1 | - | 1 | - |
| Haplochromis spp. | 5 | 3 | 4 | 6 | 7 |
| Labeo mesops | 153 | 134 | 123 | 96 | 94 |
| Barbus eurystomus | 2 | 2 | - | - | - |
| Barilius microlepis | - | - | - | - | 2 |
| Clarias spp. | 16 | 12 | 12 | 2 | 11 |
| Bagrus meridionalis | 14 | 8 | 11 | 9 | 1 |
| Totals = | 289 | 231 | 243 | 183 | 181 |

116. The first trial having suggested that the wide spacing was more effective, the second was run with even wider spacings. In this trial the nets were nylong 4 inch mesh nets, 52 meshes deep, and results were as follows:-

| Species | Numbers caught in nets with various float spacings, as indicated 18ft. | 16ft. | 14ft. | 12ft. | 10ft. | 8ft. |
|---|---|---|---|---|---|---|
| Tilapia squamipinnis | 320 | 309 | 257 | 248 | 304 | 269 |
| Tilapia lidole | 205 | 201 | 310 | 302 | 269 | 224 |
| Other Tilapia | 9 | 4 | - | 3 | 3 | 1 |
| Labeo mesops | 5 | 10 | 17 | 14 | 9 | 8 |
| Barbus eurystomus | 1 | 1 | 3 | 1 | - | - |
| Clarias spp. | 4 | 4 | 4 | 3 | 3 | 2 |
| Bagrus meridionalis | 6 | 3 | 4 | 2 | 2 | 4 |
| Totals = | 550 | 532 | 595 | 573 | 590 | 508 |

117. The nets in each series were fished simultaneously in fleets, the order of the nets in the fleet being changed at each set.

118. A comparison of the two series showed a slight anomaly in the case of the net with the 10 foot spacings in the first series and with the 12 foot spacings in the second. This may be due to some inferiority of the nets themselves or their mountings. In general, however, the trials indicate that for the floats used, 2½ inch Platex, a 10 foot to 14 foot spacing is the best, results falling off above and below these limits.

119. The usual spacing of floats in the small scale inshore fishery is about 8 feet but the floats used are by no means standard and, generally speaking, have less buoyancy than those used in the experiments.

120. The main result that emerged from the trials was that it appeared that it was possible to have too many floats as well as too few. It would seem, in fact, that it would be sound practice for fishermen to standardise on a particular type of float and work out the optimum spacing for it. Clearly such a spacing exists.

121. An interesting point emerged from these sets and that is that the size selectivity of a net of a given mesh apparently varied perceptibly with float spacings. Fisheries Officer reports:- "A 4 inch mesh net with floats spaced at 8 foot intervals catches mostly Tilapia of 27 cm. with a rather steep decline of numbers of smaller and bigger fish. The 18 foot spacing, however, shows a less pronounced peak at 26 cm. and a relatively greater number of a size above 26 cm."

122. Since the lighter vertical tension which presumably resulted from the wider float spacing apparently has increased efficiency it was decided to try the effect of decreasing this tension still further by connecting head and foot rope with a series of vertical ties between the two, each tie being shorter than the normal hanging depth of the net.

123. Accordingly five nets were set up and fished together, one being used normally, and the others with cross ties between head and foot rope. The nets were identical except as regards depth, which was 54 meshes in three nets and 50 in the others. One of the 54 mesh nets was ser normally, as the standard, while one each of the 50 and 54 mesh nets had six foot cross ties and the other had seven foot cross ties. There were 159 sets in the series.

124. Results were as tabulated below and did not indicate any advantage from the fitting of corss ties, except possibly in the case of Clarias.

| Fish | Catches each net . 54 meshes normal set | 54 meshes Cross tie 6' | 54 meshes Cross tie 7' | 50 meshes Cross tie 6' | 50 meshes Cross tie 7' |
|---|---|---|---|---|---|
| Tilapia spp. | 1,323 | 1,260 | 1,300 | 1,037 | 955 |
| Labeo | 86 | 81 | 41 | 121 | 120 |
| Barbus spp. | 3 | 5 | - | - | 4 |
| Bagrus | 41 | 19 | 32 | 36 | 32 |
| Clarias | 14 | 25 | 29 | 11 | 22 |
| Totals = | 1,467 | 1,390 | 1,402 | 1,205 | 1,133 |

125. The series of trials to determine the optimum period of the night at which to set gill nets, which were begun in November 1961, was continued at intervals during 1962. In these series the catch of a fleet of nets left in place from dusk to dawn was compared with that of an identical fleet set for shorter periods at intervals during the same night. In one series the variable fleets were set from dusk to midnight and midnight to dawn while in the other the night was divided into four periods. Various phases of the moon were covered and various seasons of the year.

125. Results are tabulated below. The figures in brackets beside the totals express the catches of the various short sets as a percentage of the full night catch.

A. Two shifts of net against one left all night.

(1) Five nights in period 3-9 March. New Moon 5 March.

| Fish | 1700-0600 | 1700-2400 | 0000-0600 |
|---|---|---|---|
| Tilapia | 136 | 74 | 90 |
| Labeo | 5 | 1 | 12 |
| Others | 12 | 9 | 5 |
| totals | 153 | 84 (56%) | 107 (66%) |

(2) Seven nights in period 16-25 March. Full moon 5 March.

| Fish | 1700-0600 | 1700-2400 | 0000-0600 |
|---|---|---|---|
| Tilapia | 307 | 260 | 228 |
| Labeo | 47 | 22 | 52 |
| Others | 3 | 14 | 27 |
| Totals | 357 | 297(83%) | 307(85%) |

B. Four shifts of net against one left all night.

(1) Ten nights relating first quarters of moon.

4 nights in period May 10-15. First Quarter May 10.
4 " " July 10-13. " " July 8.
1 " October 9. " " October 4
1 " November 8. " " November 3.

| Fish | 1700-0600 | 1700-2030 | 2030-2400 | 0000-0300 | 0300-0600 |
|---|---|---|---|---|---|
| Tilapia | 97 | 65 | 63 | 70 | 54 |
| Labeo | 84 | 67 | 38 | 6 | 9 |
| Others | 12 | 4 | 8 | 16 | 18 |
| Totals | 193 | 136(70%) | 109(56%) | 92(47%) | 81(42%) |

(2) Nineteen nights relating to full moons.

6 nights in period 16-23 May. Full moon 17 May
5 " " 17-21 July " " 15 June
3 " " 10-12 Oct. " " 12 October
5 " " 9-15 Nov. " " 11 November.

| Fish | 1700-0600 | 1700-2030 | 2030-2400 | 0000-0300 | 0300-0600 |
|---|---|---|---|---|---|
| Tilapia spp. | 295 | 268 | 256 | 217 | 252 |
| Labeo | 46 | 38 | 24 | 4 | 51 |
| Others | 23 | 23 | 19 | 13 | 22 |
| Totals | 364 | 329(90%) | 299(82%) | 234(64%) | 325(89%) |

(3) Eleven nights relating to last quarters of moon

5 nights in period 26 May to 1 June. Last quarter 25 May
4 " " 24-28 July " " 24 July
2 " " 17-18 October " " 20 Oct.

| Fish | 1700-0600 | 1700-2030 | 2030-2400 | 0000-0300 | 0300-0600 |
|---|---|---|---|---|---|
| Tilapia spp. | 218 | 228 | 106 | 115 | 134 |
| Labeo | 152 | 14 | 34 | 15 | 19 |
| Others | 42 | 19 | 22 | 13 | 15 |
| Totals | 412 | 261(63%) | 162(39%) | 143(34%) | 168(40%) |

(4) Seven nights relating to new moons.

3 nights in period 3-6 July. New Moon 2 July.
4 " " 31 July to 4 Aug. " 30 July.

| Fish | 1700-0600 | 1700-2030 | 2030-2400 | 0000-0300 | 0300-0600 |
|---|---|---|---|---|---|
| Tilapia spp. | 50 | 11 | 2 | 5 | 6 |
| Labeo | - | 2 | 7 | - | 1 |
| Other | 28 | 12 | 14 | 13 | 17 |
| Totals | 78 | 25(32%) | 23(29%) | 18(23%) | 24(30%) |

127. No very clear pattern of fish activity emerged from the experiments. It appeared that, taking the year as a whole, activity is fairly uniform throughout the night and that variations from this pattern with moon phases are scarcely large enough to make it worth while trying to adjust the hour of setting to take advantage of them.

128. What the figures do suggest, however, is that either fish actually escape from the net if it is left in position for prolonged periods or that, for some reason, the catching ability of a net during a single set declines sharply with the passage of time. Thus in series dealing with four shifts per night it will be seen that the difference between the catches of individual shifts is not very great, indicating a fairly uniform availability of fish. Yet the catches of individual short sets were only below 25% of the catch of the whole night set for one shift in one moon phase, although the length of the short sets was only 25% of that of the whole night. Usually the catches of the individual short sets were above 30% of the full night catch and were sometimes up to 80% or 90% of it.

129. Clearly if a fisherman had decided to stand by his net all night it would be advantageous to haul and shoot at intervals, rather than leave the same net undisturbed all night. It might also, in practice, be worth

setting for a portion of the night only, rather than either sacrificing a whole night's sleep by standing by the nets all night or performing a double journey to and from the fishing grounds to get the comparatively few extra fish that a whole night set would produce.

## Fisheries Research

130. In previous years the work of the fishery research organization has been published in a separate report produced jointly by the Northern Rhodesian and Nyasaland sections of what used to be known as the Joint Fishery Research Organization. The report of the Department of Game, Fish & Tsetse Control, which administered the Nyasaland section of the organization, has merely outlined the main lines of work followed.

131. During 1962, however, the Government of Northern Rhodesia decided that as the two sections of the organization were now administratively separated they could no longer be regarded as part of a combined project even though they were, at a scientific level, working in consultation with one another. The Government of Northern Rhodesia therefore ruled that the Joint Fishery Research Organization must, as such, be regarded as having been dissolved and that the Northern Rhodesian section must be considered as simply a part of the Department of Game & Fisheries which, as in Nyasaland, administered it. It was further ruled that the publication of a joint report should be discontinued after the report for 1961. The work of the Nyasaland section for 1962 is therefore published as Appendix VIII herewith and there appears to be no need to summarise it, as has been the practice previously. Future reports will, as mentioned in the introduction, form part of the report of the Department of Agriculture & Fisheries.

## Trout Fishing

132. Revenue for trout licences for the season ending March 1962 amounted to £122.0.0., rather more than double the usual income from this source. Licences issued for the Mlunguzi stream totalled 104 in number while 26 were issued for Mlanje streams and 16 for the North Rumpi and Kaziwiziwi. A good proportion of fishing returns were received.

133. The Mlunguzi stream yielded 310 fish averaging

10.3 inches in length in 163 rod days with a further 563 fish returned as undersized. This is an average of 1.9 fish of "keepable" size and 3.4 undersized fish per rod day. Similar figures for the 1960/61 and 1959/60 seasons were .5 keepable fish and 2.1 undersized fish respectively, so 1961/62 appears to have shown an exceptionally good proportion of sizeable fish. It must be admitted, however, that there was probably greater emphasis on fishing the reservoir proper, as distinct from the stream, and this may have been the main factor in bringing about the rise in proportion of keepable fish. Something, however, is also attributable to the hand feeding of fingerling fish in rearing ponds and subsequent release to the stream, which has been practised for a year or so.

134. Mlanje fishing produced 128 keepable fish and 124 undersized fish in 42 rod days, or an average of 3 fish per rod day in both classes. This is slightly better than the 1959/60 figure in respect of keepable fish and not quite so good as those for 1960/61, so there appeared to be no great change in this fishery. The average size of the fish retained was 9.4 inches.

135. The North Rumpi and Kaziwiziwi produced 52 keepable fish and 4 undersized fish in 43 rod days, which is approximately the same as in previous years. It should be noted, however, that the North Rumpi catch included fish of 7 inches and 8 inches which must have been spawned in the stream. Similarly the 1959/60 catch included small fish, so that allegations that fish are not breeding in the stream at all can scarcely be well founded. Game Ranger, Rumpi, however, reports that hen fish are often caught with developed ova, irrespective of season, and that these ova often appear to be in process of re-absorption. It may be, therefore, that spawning facilities, though not absent altogether, are rather inadequate.

136. The Kaziwiziwi, moreover, yielded a very small proportion of the total catch from the two streams and an inspection carried out by the Senior Ranger (Fish) in September 1962 showed it apparently virtually bare of fish. There would appear to be some inhibiting factor at work as the stream was originally stocked no less heavily than the North Rumpi and has had no more intense fishing.

137. Trout continued to flourish in the upper portion of the Chelinda on the Nyika plateau, where, during 1962, fish were observed at intervals over the upper nine miles. There was, however, little fishing other than test fishing

during 1961/62, it having been considered wise to discourage ordinary fishing for the time being in order to permit the stock to increase. The largest fish caught in the course of what fishing there was, measured 16 inches, but fish of 20 inches have been seen during 1962/63. Trout also made their appearance in the Chire River on the Northern Rhodesian side of the plateau, a 9 inch fish having been netted from the source of the river just behind the Rest House. This will be the result of the 1954 stocking carried out by Nyasaland officers on behalf of Northern Rhodesia.

138. Details of the 1961/62 catches from various waters appear in Appendix VI.

139. The Kaziwiziwi fishing camp received thirty two visitors during the 1961/62 season, the number having risen gradually but steadily since the twenty visitors of the 1958/39 season when the camp was opened.

140. Full records of the 1962/63 season are not yet received. Mlunguzi results are likely to be depressed by the fact that the reservoir was again drained without warning by the Nyasaland Electricity Supply Commission and a number of trout were lost downstream or suffocated by the mud stirred up from the bottom of the reservoir during the closing stages of the drainage.

## Fish Farming

141. Trials were carried out by the Senior Ranger (Fish) at the Domasi station to compare the yield of pure stocks of Tilapia shirana with that of mixed stock of T. shirana and T.melanopleura. The two species occupy rather different ecological niches in the adult stages but it has been suggested that T.melanopleura might have an adverse effect on T.shirana if it were introduced to what had hitherto been a pure stock. The trials had relevance to a project to introduce T.melanopleura to Lake Chilwa, where the alternate growth and rotting away of higher plants with the seasonal drying and flooding of the margins suggests that the introduction of this species might mean the utilization of potential fish food not now usable by the present exclusively T.shirana population.

142. The trials were conducted in two series of sets of three identical ponds. In each series one pond was stocked with a pure culture of T.shirana and the others

were stocked with T.shirana of the same size plus varying numbers of T.melanopleura. The total number of fish was the same in all three ponds.

143. The results of these trials are tabulated below:-

| Pond No. | Series 1 Thirteen Months E1 | E2 | E3 | Series 2 Nine Months B2 | A1 | A3 |
|---|---|---|---|---|---|---|
| Original Stock | | | | | | |
| T.shirana No. | 600 | 300 | 500 | 300 | 250 | 150 |
| " Average length(cms) | 8.75 | 8.75 | 8.75 | 5.8 | 6.5 | 6.5 |
| T.melanopleura No. | - | 300 | 100 | - | 50 | 150 |
| " Average length(cms) | - | 7.0 | 7.0 | - | 6.0 | 6 |
| Yield | | | | | | |
| Grown Fish | | | | | | |
| T.shirana, No. | 585 | 300 | 331 | 209 | 221 | 126 |
| " Average length(cms) | 17 | 17.8 | 16.5 | 10.9 | 10.2 | 9.2 |
| T.melanopleura No. | - | 300 | 100 | - | 29 | 159 |
| " Average length(cms) | - | 13.5 | 12.6 | - | 9.1 | 8.4 |
| Half Grown Fish | | | | | | |
| T.shirana, No. | 1,380 | 515 | 360 | Not recorded | | |
| " Average length(cms) | 7.9 | 9.1 | 7.5 | " | | |
| T.melanopleura, No. | - | 483 | 504 | " | | |
| " Average length(cms) | - | 7.3 | 9.1 | " | | |
| Fish fry | | | | | | |
| Weight (lb.) | 48 | 38 | 30 | " | | |
| Percentage of growth increment in original T.shirana stock | 94% | 103% | 88% | 87% | 56% | 41% |

144. The results are obviously inconclusive. Series 2 suggests that there might have been some inhibition on the growth of the original stock of T.shirana resulting from the admixture of T.melanopleura but this is contradicted by series 1 where the highest growth rate of the T.shirana in the three ponds was in the pond with the smallest original stock of T.shirana and largest proportion of T.melanopleura. As far as fry and young fish production is concerned the production of T.shirana in ponds E2 and E3 seems disproportionately low compared with that in pond E1 considering the original stocks, particularly in the case of E3, and this might be the result of competition from T.melanopleura.

145. Clearly the experiment needs to be repeated over a longer period and with a greater multiplicity of ponds.

146. Trials were also conducted to determine the effect of a predator on T.shirana and T.melanopleura stocks, the object being to see whether fewer fry and larger individual fish could be produced by this means.

147. The predator chosen was Serranochromis thumbergii and four identical ponds were used in the trials which lasted for thirteen months. Results are tabulated below:-

| Pond No. | C1 | C3 | C4 | C2 |
|---|---|---|---|---|
| Original Stock | | | | |
| S.thumbergii, No. | 10 | - | 10 | - |
| " Average length (cms) | 14 | - | 13.7 | - |
| T.shirana, No. | - | - | 300 | 300 |
| " Average length (cms) | - | - | 8.75 | 8.75 |
| T.melanopleura, No. | 300 | 300 | - | - |
| " Average length (cms) | 7 | 7 | - | - |
| Yield | | | | |
| Grown Fish | | | | |
| S.thumbergii, No. | 6 | - | 9 | - |
| " Average length (cms) | 24.5 | - | 24.4 | - |
| T.shirana, No. | - | - | 289 | 233 |
| " Average length (cms) | - | - | 12.8 | 12.0 |
| T.melanopleura, No. | 291 | 277 | - | - |
| " Average length (cms) | 11.1 | 10.3 | - | - |
| Weight of fry & small fish (lb) | 1.5 | 9.5 | 3 | 23.75 |
| Percentage growth increment in forage fish | 58% | 47% | 46% | 37% |

148. In this trial the addition of the predator seems to have depressed fry production quite perceptibly and also to have resulted in some increases in growth rate of the original stock. The trial will be repeated with higher and varying percentages of predators.

149. Towards the end of the year a trial was started with what was hopedwould prove to be a mono-sex culture of T.shirana, selection having been made on the basis of colour differences between the sexes at a half-grown stage.

It was not possible to say for certain by the end of the year that selection had been absolutely correct but no signs of breeding had been observed and the trial looked encouraging.

150. In addition to the experiments a great deal of work was done in rearranging the inlet and outlet systems to the various ponds so as to provide each with an independent water supply. Also the two-acre pond started in 1961 was completed and stocked with a miscellany of local fish. This pond is comparable with the average farm dam in size and its progress should give useful information about the management of this sort of water, where the detailed techniques of intensive fish farming are scarcely practicable.

151. During the year a total of 4,300 young fish were distributed to various farm dams, 500 going to private estates and 3,800 to dams erected by the Agricultural Department. There was no extensive adoption of fish farming by small scale agriculturists in the Southern Province but one or two began to make attempts in this direction and the Government Fish Farm attracted much attention from the Teacher Training Centre at Domasi.

152. The Nchenachena station, under the control of the newly appointed Fish Breeder, continued to act as a source of stock for the expanding private fish farming in the Northern Province and as a base for demonstrations and propaganda.

153. By the end of the year there were 141 ponds in action in the Northern Province, 17 of which were constructed during 1962, and a further 3 were under construction. Some 760 fish were issued to stock the new ponds, and 336 lbs. of fish from the Government ponds were sold as food to local villagers as a demonstration and propaganda measure.

154. It became clear during the course of the year that cropping difficulties represent a significant obstacle in the widespread adoption of small scale fish farming. Accordingly some trials were made with fish traps of the traditional type baited with maize paste and results suggest that, for this very small scale farming, they will be a much more practical method than the draining and seining normally practised in larger farming operations. Following the trials at Nchenachena they are being increasingly adopted by local farmers.

## (d) Tsetse Control

### Surveys

155. There was little demand for survey work as an aid to settlement or trypanosomiasis control. The only area so dealt with was Toleza farm where regular observations were instituted towards the end of the year as a result of the suggestion that cattle might eventually play a more important part in the economy of the farm, which is on the edge of an area of G.morsitans infestation.

156. Observations in Port Herald District in relation to the re-occurrence of trypanosomiasis were continued in the early part of the year. The Department of Veterinary Services decided, however, to try to control the outbreak by prophylaxis and continued investigation of the source of infection became unnecessary.

### Karonga Reclamation Scheme

157. No new work was undertaken on this scheme and fly catches continued to drop on the routine patrols, only nine flies being captured during the year. The application of dieldrin in 1961 was apparently successful in eliminating these pockets of infestation and increased cultivation of the former fly areas continued. The operation of routine patrols was gradually wound up during the period October-December.

158. Full treatment, with drugs, of all cattle in the area by the Department of Veterinary Services is reported to have eliminated trypanosomiasis, at least temporarily. The intention is again to prevent re-infection by prophylaxis, so that no further information on fly challenge is likely to become available.

### Tsetse Control Posts

159. Four posts continued operation normally in Kota Kota District. The Fort Johnston post was closed in September as a result of the continued decline in catches and a number of pickets and patrols are now carried out, since these would be better able to detect the actual source of any increase of fly in the area which the post covers. In August the Kasupe post ceased to disinfest motor vehicles, since these have been found to be a virtually negligible source of carried fly in this area. Pedestrians and cyclists continue to be examined since they are most likely to show any revival of the fly population.

160. Details of traffic and fly catches for all posts in 1962 and a comparison of fly catches in recent years are shown in Appendix VII. In the Southern Province catches at Kasupe and Fort Johnston continue to be very low, fly populations in the latter area having shown a most remarkable collapse since 1960. The Central Province posts around Kota Kota continued catches at much the same, or even a slightly higher, level than recent years for the first six months, after which there was a sharp decline.

## Miscellaneous

161. Last year's experiment of protecting a game camp from G.morsitans was repeated in August in the Mwabvi Game Reserve. Tree trunks were sprayed to run off point to a height of 10 feet with 4 per cent. dieldrin to a distance of 100 yards from the camp. There was an immediate drop in fly catches from an average of 10 per day to 5 per day. Observations two months later showed an average of 8 per day flies caught in the camp area or attracted to screens. Flies are believed to reach the camp mainly by carriage or their own movement, that is, there are not any 'resident' tsetse, so that this degree of reduction is perhaps not disappointing, although it is not of very practical value.

162. In April, the Tsetse section of the Department was transferred to the Department of Agriculture & Fisheries and future reports will emanate from that Department. The officers of the tsetse section are now with the Agricultural Research Services, P.O.Box 87, Zomba.

H. J. H. Borley

## A P P E N D I X  I

## DIVISION I STAFF 1962

| | |
|---|---|
| Director | H. J. H. Borley, C.B.E., M.A. |
| Tsetse Botanist | B. Steele, B.Sc., Ph.D. * |
| Fisheries Officer | E. C. L. Birkenmeier, D.Phil. |
| Senior Ranger (Game) | E. T. Llewellyn |
| Senior Ranger (Fish) | A. V. Gifkins |
| Fish Rangers | K. T. Howard |
| | B. W. Morris |
| Game Rangers | O. J. Carey |
| | L. T. Kettle |
| Fish Breeder | C. M. Chisala ** |

Fishery Research Organization

| | |
|---|---|
| Fishery Research Officers | D. H. Eccles, B.Sc. |
| | R. B. Williamson, B.Sc. |
| | Mrs. S.I.B. Williamson, B.Sc. (part time) |
| Technical Officer | A. A. Hyde |

* = Transferred to Department of Agriculture w.e.f. 1.vii.62

** = Appointed w.e.f. 1.ix.62

## A P P E N D I X  I I

### Table I

Crop Protection

Animals killed & staff employed 1st Jan. to 31st Dec. 1962

| | Totals 1961 | Northern Province | Central Province | Southern Province | Totals 1962 |
|---|---|---|---|---|---|
| Average No. hunters | 26 | 5 | 16 | 7 | 28 |
| ANIMALS KILLED | | | | | |
| Elephants | 67 | - | 41 | 6 | 47 |
| Hippo | 73 | 5 | 28 | 5 | 38 |
| Buffalo | - | 2 | - | - | 2 |
| Carnivora | 22 | 6 | 4 | 48 | 57 |
| Antelope | 2 | - | - | 1 | 1 |
| Baboon | 175 | 21 | - | - | 21 |
| Pig | 5 | 9 | - | 1 | 10 |

### Table II

Revenue accuring from Crop Protection Activities

| | |
|---|---|
| Value of Ivory (estimated) | £739 |
| Value of meat & skin sales | £227 |
| | Total = £966 |

## APPENDIX III

Average number of Game seen per 10 Patrol Days

| Type | Table IA - MWABVI | | | | Table 1B - LENGWE | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. |
| Elephant | - | - | - | - | - | - | - | - |
| Rhinoceros | .1 | .3 | .4 | 1.4 | - | - | - | - |
| Hippopotamus | - | - | - | - | - | - | - | - |
| Zebra | 2.2 | - | .9 | - | - | - | - | - |
| Lion | - | - | - | - | - | - | - | - |
| Leopard | - | - | - | - | seen | - | - | - |
| Buffalo | 5.6 | 12.3 | 6.5 | 17.1 | 2.2 | 1.1 | 9.0 | 5.1 |
| Sable | 21.7 | 16.2 | 15.3 | 25.5 | - | - | - | - |
| Roan | - | - | - | - | - | - | - | - |
| Kudu | 17.7 | 15.1 | 12.2 | 27.1 | 4.7 | 4.9 | 5.9 | 6.1 |
| Eland | - | - | - | - | - | - | - | - |
| Hartebeeste | - | - | - | - | 3.0 | 4.0 | 2.5 | 2.3 |
| Waterbuck | - | - | - | - | - | seen | - | - |
| Nyala | - | - | - | - | .3 | .9 | .5 | 2.3 |
| Impala | 17.6 | 6.3 | 6.9 | 11.2 | 2.5 | 3.5 | 1.1 | 1.1 |
| Reedbuck | 1.3 | - | .8 | 1.6 | .9 | 1.3 | 1.2 | 1.3 |
| Bushbuck | 2.7 | 5.3 | 1.7 | 3.3 | 1.7 | 1.6 | 1.4 | 1.3 |
| Duiker | 4.2 | 3.3 | 2.3 | 4.0 | 1.1 | 1.3 | 1.4 | 1.1 |
| Klipspringer | 2.7 | .7 | .7 | 2.6 | - | - | - | - |
| Oribi | - | - | - | - | - | - | - | - |
| L. Suni | - | - | - | - | seen | seen | seen | .4 |
| S. Steinbuck | .1 | - | .1 | .1 | seen | - | - | - |
| Pig | 3.6 | .8 | 3.9 | 2.2 | 2.4 | 4.0 | 1.8 | 1.6 |
| Warthog | 12.7 | 14.1 | 9.3 | 12.2 | 1.2 | 1.3 | 1.1 | .5 |
| Wild Dog | - | - | - | - | - | - | - | - |
| Red Duiker | .2 | .1 | .1 | - | - | seen | .1 | - |
| TOTAL PATROL DAYS | 224 | 186 | 224 | 193 | 175 | 179 | 201 | 197 |
| TOTAL DAYS NO GAME SEEN | 52 | 41 | 47 | 31 | 53 | 50 | 61 | 48 |

APPENDIX III (contd)

| Type | Table 1C - MAJETE | | | | Table 1D - NYIKA | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. |
| Elephant | 8.1 | 5.1 | 6.3 | 2.1 | - | - | - | - |
| Rhinoceros | - | - | - | - | - | - | - | - |
| Hippopotamus | - | - | - | - | - | - | - | - |
| Zebra | 11.9 | 4.3 | 1.0 | 2.6 | 81.8 | 82.5 | 112.5 | 146.3 |
| Lion | - | .3 | .2 | - | - | .1 | .4 | .3 |
| Leopard | seen | .1 | - | - | - | - | .1 | .1 |
| Cheetah | - | - | - | - | - | - | - | seen |
| Buffalo | - | - | - | - | .2 | .2 | .5 | seen |
| Sable | 3.2 | 1.4 | 1.8 | 2.5 | - | - | - | - |
| Roan | - | - | - | - | 43.5 | 37.9 | 34.8 | 55.1 |
| Kudu | 4.8 | 3.7 | .7 | 3.1 | - | - | - | - |
| Eland | 4.3 | 1.2 | 1.1 | 2.2 | 158.6 | 101.8 | 90.8 | 218.6 |
| Hartebeeste | 1.1 | - | - | - | .1 | - | .2 | seen |
| Waterbuck | - | - | - | - | - | - | - | seen |
| Nyala | - | - | - | - | - | - | - | - |
| Impala | - | - | - | - | ?seen | - | ?seen | ?seen |
| Reedbuck | 1.2 | .7 | - | .4 | 24.9 | 28.7 | 48.2 | 46.8 |
| Bushbuck | .8 | .5 | 1.5 | 2.9 | 1.8 | 1.5 | 2.6 | 3.0 |
| Duiker | 1.9 | 1.5 | 1.2 | 1.6 | 8.1 | 9.5 | 11.6 | 14.8 |
| Klipspringer | 1.9 | 1.1 | 1.5 | 3.3 | - | - | - | seen |
| Oribi | - | - | - | - | - | - | - | - |
| L. Suni | - | - | - | - | - | - | - | - |
| S. Steinbuck | - | .3 | - | seen | - | - | - | - |
| Pig | 7.8 | 3.9 | .1 | - | 11.6 | 11.8 | 10.2 | 6.9 |
| Warthog | 3.4 | .2 | .7 | 4.5 | 5.6 | 3.8 | 8.3 | 11.0 |
| Wild Dog | - | - | - | - | - | - | - | - |
| Red Duiker | - | ?seen | - | - | - | - | - | - |
| TOTAL PATROL DAYS | 171 | 188 | 229 | 120 | 375 | 375 | 444 | 490 |
| TOTAL DAYS NO GAME SEEN | 57 | 66 | 126 | 48 | nil | nil | nil | nil |

## APPENDIX III (contd)

| Type | Table 1E - KOTA KOTA | | | | Table 1F - KASUNGU | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. |
| Elephant | 35.6 | 35.1 | 31.4 | 34.2 | 58.9 | 59.1 | 52.4 | 67.5 |
| Rhinoceros | 1.6 | 1.2 | 1.0 | .6 | 3.5 | 3.6 | 1.0 | 1.1 |
| Hippopotamus | - | - | - | - | - | - | - | - |
| Zebra | 12.0 | 13.0 | 10.2 | 13.3 | 12.7 | 14.1 | 10.4 | 15.9 |
| Lion | .5 | .3 | .2 | .4 | .8 | .9 | .6 | .4 |
| Leopard | seen | - | seen | seen | .1 | .3 | .2 | .1 |
| Buffalo | 37.5 | 27.4 | 26.4 | 25.0 | 21.5 | 40.6 | 27.1 | 28.0 |
| Sable | 12.4 | 10.9 | 8.6 | 7.3 | 10.4 | 12.3 | 11.5 | 9.7 |
| Roan | 10.6 | 7.8 | 6.4 | 5.9 | 9.4 | 10.3 | 11.8 | 9.4 |
| Kudu | 7.2 | 9.4 | 6.8 | 7.6 | 5.8 | 6.6 | 4.9 | 4.9 |
| Eland | 22.4 | 17.5 | 17.0 | 17.9 | 23.3 | 19.4 | 17.2 | 20.4 |
| Hartebeest | 11.0 | 9.5 | 10.4 | 12.9 | 15.9 | 13.3 | 12.7 | 12.9 |
| Waterbuck | 7.6 | 9.5 | 8.5 | 6.7 | 2.5 | 2.4 | 2.4 | 1.6 |
| Nyala | - | - | - | - | - | - | - | - |
| Impala | - | - | - | - | - | - | - | - |
| Reedbuck | 4.4 | 5.1 | 2.2 | 2.9 | 5.6 | 4.1 | 4.2 | 4.8 |
| Bushbuck | 6.8 | 6.4 | 3.4 | 3.1 | 1.3 | 1.3 | 1.0 | .9 |
| Duiker | 5.2 | 6.0 | 1.9 | 2.3 | 1.1 | 1.4 | 1.5 | 1.5 |
| Klipspringer | 2.1 | 3.0 | seen | 1.5 | - | - | - | - |
| Oribi | - | - | ?seen | ?seen | .2 | .3 | 1.7 | 1.6 |
| L. Suni | - | - | - | - | - | - | - | - |
| S. Steinbuck | .9 | .9 | 1.1 | .6 | .2 | .5 | .3 | .7 |
| Pig | 15.5 | 11.2 | 11.7 | 8.7 | 4.1 | 4.4 | 4.3 | 5.6 |
| Warthog | 11.6 | 10.0 | 4.4 | 7.1 | 4.6 | 4.0 | 6.0 | 6.8 |
| Wild Dog | - | - | - | - | - | - | 1.1 | .3 |
| TOTAL PATROL DAYS | 680 | 752 | 685 | 658 | 740 | 750 | 760 | 643 |
| TOTAL DAYS NO GAME SEEN | 128 | 108 | 191 | 93 | 112 | 118 | 116 | 55 |

APPENDIX III (contd)

| Type | Table 1G - VWAZA MARSH | | | |
|---|---|---|---|---|
| | 1st qtr. | 2nd qtr. | 3rd qtr. | 4th qtr. |
| Elephant | 4.9 | 30.7 | 60.5 | 33.1 |
| Rhinoceros | - | - | - | - |
| Hippopotamus | 1.4 | 1.8 | 4.8 | 1.3 |
| Zebra | 1.8 | - | 5.4 | 1.8 |
| Lion | .4 | .2 | .4 | .3 |
| Leopard | - | .2 | seen | - |
| Buffalo | 16.5 | 41.3 | 50.7 | 50.2 |
| Sable | 2.4 | 4.7 | 10.4 | 5.0 |
| Roan | 34.9 | 25.1 | 63.2 | 59.0 |
| Kudu | - | 3.2 | 9.4 | 5.1 |
| Eland | 18.1 | 33.7 | 54.0 | 55.6 |
| Hartebeeste | 4.1 | 5.8 | 11.6 | 12.9 |
| Waterbuck | .7 | .2 | - | - |
| Nyala | - | - | - | - |
| Impala | .6 | 3.6 | 3.5 | - |
| Reedbuck | 11.1 | 16.8 | 15.5 | 19.0 |
| Bushbuck | 8.5 | 6.5 | 11.5 | 13.3 |
| Duiker | 12.0 | 9.0 | 16.7 | 21.6 |
| Klipspringer | - | - | - | - |
| Oribi | - | - | - | - |
| L. Suni | - | - | - | - |
| S. Steinbuck | 4.4 | 3.6 | 5.5 | 8.9 |
| Pig | 6.1 | 5.9 | 10.7 | 9.9 |
| Warthog | 4.3 | 10.0 | 19.1 | 24.5 |
| Wild Dog | - | - | - | - |
| TOTAL PATROL DAYS | 225 | 225 | 198 | 280 |
| TOTAL DAYS NO GAME SEEN | nil | nil | nil | nil |

# APPENDIX IV

## Large Scale Fishery under Licence

### Table I. Total use of each type of net per annum

| Type of Net | 1958 | 1959 | 1960 | 1961 | 1962 |
|---|---|---|---|---|---|
| S. E. Arm | | | | | |
| Ring Net (Hauls) | 9,325 | 12,412 | 9,607 | 5,995 | 7,649 |
| Gill Net (Yds. set) | 3,271,760 | 3,040,220 | 3,792,400 | 1,788,000 | 1,477,700 |
| S. W. Arm | | | | | |
| Ring Net (Hauls) | Not used in this area | | | | 265,300 |
| Gill Net (Yds.set) | - | - | - | - | |

### Table II. Average catch per single haul of ring net
(Numbers represent dozens)

| Net | Fish | 1958 | 1959 | 1960 | 1961 | 1962 |
|---|---|---|---|---|---|---|
| No.1 Ring Net | Tilapia | 59 | 42 | 36 | 59 | 73 |
| No.2 Ring Net | Tilapia | 55 | 22 | 27 | 45 | 55 |
| No.3 Ring Net | Tilapia | 38 | 42 | 38 | 43 | 41 |

### Table III. Total catches of more important species
(Numbers represent dozens. Weight estimated in short tons

| Year | Tilapia | Labeo | Bagrus & Clarias | Others | Weight |
|---|---|---|---|---|---|
| S.E.Arm | | | | | |
| 1958 | 479,675 | 41,229 | 10,654 | 1,226 | 4,311 |
| 1959 | 482,730 | 35,207 | 8,886 | 659 | 3,953 |
| 1960 | 383,519 | 34,012 | 6,160 | 283 | 3,391 |
| 1961 | 321,252 | 12,062 | 3,093 | 31 | 2,654 |
| 1962 | 465,572 | 14,038 | 1,184 | 40 | |
| 1962(Wt.) | 3538.4 | 126.3 | 21.3 | .2 | 3,686 |
| S.W.Arm | | | | | |
| 1958 | 4,730 | 10,836 | 5,568 | 10,034 | 297 |
| 1959 | 12,155 | 2,357 | 555 | 2,101 | 145 |
| 1960 | - | - | - | - | - |
| 1961 | 283 | 9 | 16 | 2 | 29 |
| 1962 | 2,111 | 3,345 | 176 | 11 | |
| 1962(Wt.) | 16.4 | 30.1 | 3.1 | 0.1. | 49 |

### Table IV. Number of nets registered by licensed firms

| Type of net | Number | Fees Paid |
|---|---|---|
| Ring nets | 6 | £60 |
| Gill nets | 130 | £130 |

## A P P E N D I X  I V (contd)

### Table V. Fish Exports

| Month | Weight Fresh Fish (lbs) | Weight Smoked Fish (lb) | Weight Salted Fish (lb) |
|---|---|---|---|
| January | 6,044 | 22,690 | 18,348 |
| February | 10,531 | 7,935 | 14,760 |
| March | 28,110 | 28,377 | 40,287 |
| April | 26,022 | 29,520 | 40,256 |
| May | 32,504 | 15,343 | 31,094 |
| June | - | 7,082 | 28,716 |
| July | - | 470 | 17,220 |
| August | - | 1,189 | 10,496 |
| September | 14,331 | 10,268 | 5,935 |
| October | 11,740 | 2,115 | 4,317 |
| November | - | 5,718 | 3,087 |
| December | 6,806 | - | 1,553 |
| Totals = | 136,088 | 130,707 | 216,069 |
| Estimated landed weight | 136,088 | 392,121 | 432,138 |

Combined landed weight = 480 short tons

# APPENDIX V

## Small scale fishery not subject to licence

Table I. Quantities of nets owned and frequency of their use Subsistence fishery.

| Area | Average number of nets available for use per month on regularly recorded beaches | | | | Average frequency of actual use of nets per month on regularly recorded beaches expressed as percentage of maximum reasonable use | | | | Average actual frequency of use of nets per month in area as a whole, including irregularly recorded beaches | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *LMS | SMS | GN | C | LMS | SMS | GN | C | LMS | SMS | GN | C |
| Lake Malombe | 27 | - | 357 | - | 2% | - | 7% | - | 125 | - | 1460 | - |
| River Shire | 111 | 6 | 2 | - | 6% | 17% | 72% | - | 374 | 183 | 41 | - |
| S.E.Arm East | 2 | 43 | 410 | - | 12% | 2% | 4% | - | 19 | 269 | 1258 | - |
| S.E.Arm West | - | 16 | 420 | 23 | - | 6% | 7% | 10% | - | 309 | 1528 | 495 |
| S.W.Arm East | - | 4 | 111 | **1 | - | 2% | 11% | 9% | - | 20 | 465 | 15 |
| S.W.Arm West*** | 2 | 14 | 190 | - | 10% | 2% | 4% | - | 13 | 75 | 325 | - |
| Salima - Domira Bay*** | - | 14 | 399 | - | - | 5% | 4% | - | - | 123 | 493 | - |
| Kota Kota*** | 9 | 32 | 643 | - | 8% | 4% | 6% | - | 44 | 417 | 1315 | - |
| Chia Lagoon*** | 5 | 1 | 141 | - | 100% | 27% | 8% | - | 535 | 53 | 329 | - |
| TOTALS | 155 | 130 | 2573 | 24 | | | | | 1115 | 1449 | 7214 | 510 |

*LMS = Large meshed seine
SMS = Small meshed seine
GN = Gill net
C = Chilimila

** 13 nets were available for 1 month during the recording period

*** Records of gear used and available collected over latter half of the year only.

## A P P E N D I X V (contd)

Table II. Average catch per single haul in various areas as observed at recorded beaches

(Figures represent actual numbers of fish)

A. Large meshed seines

| Area | Year | Tilapia (adult) | Tilapia (immature) | Labeo | Bagrus & Clarias | Haplochromids |
|---|---|---|---|---|---|---|
| Lake Malombe (W) | 1961 | 892.33 | - | 1.53 | 2.05 | - |
| | 1962 | 354.81 | 5 | 5.93 | 3.62 | - |
| River Shire (S) | 1961 | 214.96 | - | 1.28 | 0.19 | - |
| | 1962 | 106.54 | - | 1.43 | 0.71 | - |
| River Shire (N) | 1961 | 142.6 | - | 8.36 | 0.14 | - |
| | 1962 | 78.65 | - | 10.17 | 0.14 | - |
| S.E. Arm (SW) | 1961 | 57.73 | - | 1.81 | 8.05 | - |
| | 1962 | Not used during 1962 in this area | | | | |
| S.E. Arm (E) | 1961 | Not used during 1961 in this area | | | | |
| | 1962 | 18.16 | - | 0.16 | 0.16 | - |
| S.E. Arm (NW) | 1961 | Not used during 1961 in this area | | | | |
| | 1962 | 25.34 | - | 5.34 | 1.34 | 83.0 |
| S.W. Arm (W) | 1962 | 67.51 | - | 49.16 | 9.86 | - |
| Salima-Domira Bay * | 1961 | 51.75 | 2 | 11.86 | 14.07 | - |
| | 1962 | 25.5 | - | 5.5 | 4.5 | - |
| Kota-Kota (N) | 1962 | 30.66 | 133 | 8.66 | 5.26 | 100 |
| Chia Lagoon | 1962 | 3.81 | - | 0.04 | 0.28 | - |
| Lake Chilwa | 1962 | 19.61 | 47 | - | 1.33 | - |

B. Small meshed seines

| | | | | | | |
|---|---|---|---|---|---|---|
| River Shire (S) | 1961 | - | - | 0.66 | - | 630 |
| | 1962 | 1.25 | - | - | 0.06 | 61 |
| River Shire (N) | 1961 | 8.02 | - | 0.09 | 0.05 | 1,955 |
| | 1962 | 2.35 | - | - | - | 584 |
| S.E. Arm (E) | 1961 | 0.14 | 75 | 0.01 | 0.04 | 452 |
| | 1962 | 1.48 | 6 | 1 ?9 | 0.14 | 12,601 |
| S.E. Arm (SW) | 1961 | 84.40 | - | 4.55 | 0.16 | 109 |
| | 1962 | 4.54 | - | 15.72 | 1.81 | 1,002 |
| S.E. Arm (Central W) | 1961 | 0.10 | - | 0.005 | 0.002 | 606 |
| | 1962 | 0.70 | - | 0.003 | 0.15 | 15,579 |

| Area | Year | Tilapia (adult) | Tilapia (immature) | Labeo | Bagrus & Clarias | Haplochromids |
|---|---|---|---|---|---|---|
| S.E.Arm (NW) | 1962 | 37.11 | 222 | 9.33 | 1.99 | 155 |
| S.W.Arm (E) | 1962 | 7.44 | 277 | - | - | 1,427 |
| S.W.Arm (W) | 1962 | 13.27 | 367 | 12.07 | 3.35 | 330 |
| Salima-Domira Bay * | 1961 | 60.23 | 95 | 30.9 | 5.15 | 1,548 |
| | 1962 | 93.34 | 132 | 16.79 | 16.08 | 639 |
| Kota-Kota (N) | 1962 | 3.45 | - | 7.33 | 3.45 | 354 |
| " (Central) | 1962 | 15.34 | - | 11.15 | 5.22 | 565 |
| " (S) | 1962 | 4.32 | - | 0.26 | 0.37 | 364 |
| Chia Lagoon | 1961 | 124.25 | - | 31.25 | 11.0 | - |
| | 1962 | 29.5 | - | - | 5.7 | 315 |
| Lake Chilwa | 1962 | 282.04 | - | - | 37.75 | - |
| C. Chilimila | | | | | | |
| S.E.Arm (Cent.W) | 1961 | 0.01 | - | - | - | 3,054 |
| | 1962 | 0.01 | - | - | - | 5,832 |
| S.E.Arm (NW) | 1961 | - | - | - | - | 1,217 |
| | 1962 | - | - | 0.001 | 0.001 | 358 |
| S.W.Arm (E) | 1962 | - | - | - | - | 333 |
| Salima-Domira Bay | 1962 | - | - | - | - | 1,028 |
| D. Gill nets (Catch per 100 yds of netting per set) | | | | | | |
| Lake Malombe(E) | 1962 | 90.82 | - | 1.47 | 2.17 | |
| Lake Malombe(W) | " | 74.90 | - | 1.67 | 2.25 | |
| River Shire (N) | " | 8.90 | - | 0.06 | 3.39 | |
| S.E.Arm (E) | " | 7.74 | - | 2.87 | 0.35 | |
| S.E.Arm (SW) | " | 11.15 | - | 19.02 | 1.67 | |
| S.E.Arm (Cent.W) | " | 6.55 | - | 6.04 | 1.67 | |
| S.E.Arm (NW) | " | 4.82 | - | 2.24 | 3.47 | |
| S.W.Arm (E) | " | 3.79 | - | 7.53 | 2.79 | |
| S.W.Arm (W) | " | 1.22 | - | 6.02 | 1.90 | |
| Salima-Domira Bay | " | 1.16 | - | 15.30 | 2.91 | |
| Kota-Kota (N) | " | 0.52 | - | 5.12 | 7.42 | |
| " (Central) | " | 1.80 | - | 4.88 | 2.17 | |
| " (S) | " | 4.99 | - | 5.40 | 1.62 | |
| Chia Lagoon | " | 16.69 | - | 1.64 | 2.59 | |
| Nkata Bay | " | - | - | .01 | 2.28 | |
| Lake Chilwa | " | 21.21 | - | - | 3.67 | |

* 1961 figures represent average of what were listed as two stations.

Table III. Catches of more important species by small scale opmmercial operators in the various recorded areas of Lake Nyasa

(Numbers represent dozens. Wt. estimated in short tons)

| Area | Tilapia (Adult) | Tilapia (Immature) | Labeo | Bagrus & Clarias | Others | Weight (St.tons) |
|---|---|---|---|---|---|---|
| Lake Malombe | 171,227 | - | 1,511 | 999 | 734 | 899 |
| River Shire | | | | | | |
| S. E. Arm | 16,951 | - | 7,917 | 2,624 | 1,873 | 340 |
| S.W.Arm | 1,913 | - | 3,466 | 688 | 74 | 59 |
| Salima-Domira Bay | 350 | - | 2,616 | 1,243 | 588 | 54 |
| Kota Kota & Chia | 2,288 | - | 2,409 | 1,586 | 6,713 | 101 |
| Totals (dozens) | 192,729 | - | 17,919 | 7,140 | 9,982 | |
| " (short tons) | 963 | - | 161 | 128 | 201 | 1,453 |

Table IV. Estimated catches of more important species by small scale subsistence fishermen in the various recorded areas of Lake Nyasa

(Figures represent weight in lbs. Totals in short tons)

| Area | Tilapia (All sizes) | Labeo | Bagrus & Clarias | Haplochromids | Others | Total (St.tons) |
|---|---|---|---|---|---|---|
| Lake Malombe | 1,355,000 | 70,000 | 146,000 | - | 30,000 | 800 |
| River Shire | 481,000 | 188,000 | 21,000 | 33,000 | 47,000 | 385 |
| S.A.Arm | 348,000 | 757,000 | 157,000 | 1,566,000 | 220,000 | 1,524 |
| S.W.Arm | 31,000 | 86,000 | 60,000 | 34,000 | 17,000 | 114 |
| Salima-Domira Bay | 31,000 | 181,000 | 68,000 | 54,000 | 55,000 | 194 |
| Kota-Kota & Chia | 155,000 | 170,000 | 153,000 | 121,000 | 117,000 | 358 |
| Totals (St.tons) | 1,200 | 726 | 302 | 904 | 243 | 3,375 |

# APPENDIX VI

## Trout Fishing

| Stream | N. Rumpi River | Kaziwizi wi River | Mlunguzi River | Mlanje Streams |
|---|---|---|---|---|
| No. Rod Days | 39 | 4 | 163 | 42 |
| No. Fish Killed | 47 | 5 | 310 | 128 |
| Average of sizes | 13.8 | 14.7 | 10.4 | 9.4 |
| No. of fish at 8" | - | - | 26 | 19 |
| 8½" | - | - | 8 | 18 |
| 9" | - | - | 74 | 39 |
| 9½" | - | - | 24 | 6 |
| 10" | - | - | 66 | 31 |
| 10½" | - | - | 8 | 4 |
| 11" | - | - | 22 | - |
| 11½" | - | - | 7 | - |
| 12" | 9 | 1 | 27 | 2 |
| 12½" | 2 | - | 5 | 1 |
| 13" | 7 | 1 | 11 | 8 |
| 13½" | 5 | - | 1 | - |
| 14" | 3 | - | 15 | - |
| 14½" | 6 | - | 3 | - |
| 15" | 5 | - | 5 | - |
| 15½" | 4 | - | 1 | - |
| 16" | 5 | 2 | 2 | - |
| 16½" | 1 | 1 | 2 | - |
| 17" | - | - | - | - |
| 17½" | - | - | 1 | - |
| 18" | - | - | 2 | - |
| No. fish returned as undersized | 4 | nil | 563 | 126 |
| No. Licences | 16 | | 104 | 26 |
| Revenue | £8.15.0 | | £103 | £10.10. |

## APPENDIX VII

Summary of Traffic and Flies (G. morsitants) caught at Decontamination Posts, 1962

| Post | Position | Number of Vehicles | Flies caught | Number of cycles | Flies caught | Number of Pedestrians | Flies caught | Total flies |
|---|---|---|---|---|---|---|---|---|
| Kota Kota | Outskirts of Kota Kota Town (N) | 5,317 | 98 | 7,069 | 10 | 25,398 | 0 | 108 |
| Chota | Outskirts of Kota Kota Town (S) | 1 | 0 | 170,732 | 12 | 289,896 | 10 | 22 |
| Mbobo | Approach to C.P.Highlands, Kota Kota Road | 2,566 | 168 | 1,939 | 27 | 4,082 | 19 | 214 |
| Fort Johnston | East of ferry crossing, Fort Johnston Town | 3,881 | 2 | 81,729 | 7 | 146,865 | 3 | 12 |
| Kasupe | Approach to Zomba Highlands, Zomba-Liwonde road | 11,580 | 0 | 71,294 | 5 | 99,697 | 0 | 5 |
| Fungo | Approach to Malomo area, Kota Kota road | 458 | 11 | 1,182 | 24 | 1,941 | 9 | 44 |

Long term Records from Deflying Posts
Total flies (G. morsitans)

| Post | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Kota Kota | 47 | 34 | 16 | 28 | 105 | 181 | 136 | 113 | 194 | 135 | 108 |
| Chota | 12 | 16 | 12 | 7 | 5 | 10 | 13 | 12 | 10 | 23 | 22 |
| Mbobo | 26 | 45 | 24 | 50 | 205 | 266 | 164 | 203 | 358 | 265 | 214 |
| Fort Johnston | 7,557 | 11,750 | 9,591 | 2,652 | 1,589 | 3,736 | 3,849 | 1,787 | 812 | 47 | 12 |
| Kasupe | 84 | 88 | 96 | 46 | 63 | 104 | 22 | 26 | 18 | 6 | 5 |
| Fungo | - | - | - | - | - | - | 29 | 34 | 91 | 62 | 44 |

# APPENDIX VIII

## Fishery Research Work:

### STAFF AND GENERAL

There were no changes in Senior Research Staff during the year, the vacancy for a third Research Officer still not being filled. The appointment of Mrs. Gange-Harris as temporary Librarian cum Secretary was terminated at the end of July. Her help in the classification of the library has been most useful. Mrs. Williamson, after a break from April to November, continued part time work on the phytoplankton.

The year has seen the move of the headquarters of the Research Unit from Nkata Bay to Monkey Bay at the south end of the lake where a new laboratory and staff housing have been built. The long awaited move took place in July and August, the scheduled date for completion of the buildings, and the fact that in the event they were not completed till December disrupted much of the year's scientific work. Both Research Officers and most of the ancilliary staff and equipment moved to Monkey Bay. The Nkata Bay Laboratory is being maintained as a sub-station, at present under the charge of a Senior Fisheries Assistant.

The new launch "Ethelwynn Trewavas" arrived from England and was put on the lake in November. Her fitting out was completed at the Railways Dockyard, Monkey Bay, in December. Due to some minor snags she was not in commission by the end of the year.

The "Edmund Rhoades" went in to the Launch Repair base at the end of August for refit and engine overhaul and is not yet back in commission.

In September the Laboratory at Monkey Bay was visited by Professor C.M.Yonge, Chairman of the Fisheries Committee of the Department of Technical Co-operation. In November the Director of Game & Fisheries from Northern Rhodesia and his Chief Fisheries Research Officer came for an informal Meeting. The annual meeting of Fisheries Scientists from Northern Rhodesia and Nyasaland did not take place during the year, two of the Rhodesian officers being on long leave. It has been arranged that the meeting will take place early in 1963 at Monkey Bay.

## RESEARCH LAKE NYASA

### 1. LABEO MESOPS

#### Breeding Migration

Due to local difficulties little work was done on the spawning migration and breeding of Labeo in the 1961/62 rains. These difficulties were resolved, however, and a small sample was taken from the fishing weirs on the Limpasa River at the beginning of March. This is the tail end of the breeding season in the Northern Province and the sample may well not be representative of the spawning run as a whole. The length frequency distribution of the females had a mode at 37 cm. and that of the males at 33.5 cm. The sex ratio did not differ significantly from 1:1. It was interesting to note in this sample the lack of "Running Ripe" females. Only two of the thirty two females could be so described and both these were already dead before being removed from the trap. In a species that makes use of a single rise and fall of the river to move upstream and spawn, as does L.mesops, this would seem to indicate that Running Ripe is a very short stage in this fish if indeed it exists at all. It may well be that the females are only Running Ripe when they are actually spawning. If this is so it would make more difficult any attempt at artificial stripping and fertilization of eggs. The males, as is the case with many species of fish, are Running Ripe over a long period and were found in this condition in the Lake in November.

#### Juvenile Growth

From the end of March through to November young fish were caught at regular intervals with small meshed seine nets in the lake at Nkata Bay. These are the youngest stages of Labeo mesops that have so far been found, the riverine stage being unknown.* Altogether some 13,000 fish were measured. During the period the fish apparently grew from a length of 7.8 cm. in March to about 10.5 cm. in November. It is, however, extremely unlikely that this is the true growth rate due partly to the selectivity of the gear used and partly to the continual recruitment of small fish to the population resulting from the long breeding season in the North (November or December to March). Another factor influencing the apparent growth rate is the

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* March 1963.
The riverine stage from hatching to migration into the lake is now known.

movement of young fish off the shallow beaches as they grow larger. This seems to occur from about 10 or 11 cm. of length upwards, and probably starts in July. It is hoped to get a better ides of juvenile growth from Monkey Bay where the breeding season is shorter.

## Adult Growth

From the gill net experiments of July and August 1959, 1960, 1961 (see J.F.R.O. reports 1960 and 1961) and a similar experiment conducted in July and August this year, growth curves for fish from 20 cm. upwards have been derived. These differ slightly from the curves given in J.F.R.O. Report for 1960, which curves were based on the 1959 results only. The curves closely approximate to the von Bertalanffy equation of growth, a theoretical equation which has been found to fit many fish populations. The regular samples now being taken at Monkey Bay agree well with the curves obtained. If these curves are extrapolated to infinity they give values for the length of females of about 46 cm. and for males of about 38 cm. which values correspond with the maximum size of the respective sexes caught in the lake. Due to the uncertainty over juvenile growth rate it is not possible to define the origin of the curves at present and therefore figures for length at any particular age cannot be given with certainty.

## Maturation

The length at which 50% of the fish are mature at Monkey Bay in November was 34 cm. for females and 28 cm. for males. If these figures are examined in conjunction with the curves for growth that have been derived it would appear that maturation of the gonads, and therefore spawning, is delayed by a year in many females as compared with the males. That this is so was tentatively put forward by Lowe * as an alternative explanation of the larger size of breeding females, the other possibility being that the sexes had differing growth rates. It would now seem that both these factors are involved.

## Fecundity

The ovaries and eggs of a number of fish from Monkey Bay have been examined. The number of eggs varied with

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* Lowe, R.H. 1952 Report on Tilapia and other fish and Fisheries of Lake Nyasa 1945-47. Colonial Office Fisheries Publications, Volume 1, No.2.

the size of fish being between about 85,000 (fish 35 cm. long) and 140,000 (fish 40 cm. long). The size frequency distribution of the eggs in any one fish follows a normal unimodal curve as might be expected in species with a single fairly well defined breeding season.

Food and Feeding

In the course of collection of data on the degree of fullness of the gut it was noticed that there seemed to be a correlation between degree of fullness and length of fish especially among the females. The figures for November, for example, show that the majority of females between 20 and 29.5 cm. had a full gut whereas in the majority of those between 30 and 45 cm. the gut was empty. The latter group of fish consists largely of mature or maturing individuals and the comparative emptiness of the gut may be connected with this, a prebreeding tendency to fast being found in some other fish species. It must be emphasised that this apparent correlation has not yet been rigorously examined and any conclusions based on it must be regarded as extremely tentative.

A start has been made on the analysis of the phytoplankton and other elements of the gut contents of fish at different stages.

## 2. HYDROLOGY

Routine observations at the deep station off Nkata Bay were continued during 1962 in the months when a launch was available (January to August). Temperature and Oxygen readings were plotted and isotherms and oxygen isopleth depths obtained graphically. The results are shown in Tables 1 and 2.

## 3. PHYTOPLANKTON

Plankton samples were taken regularly from various depths at the Deep Station, Nkata Bay, until the end of March. Analysis of these samples has given some information on the vertical distribution of the more abundant (Lyngbya nyassae, Nitschia nyassensis, Oedogonium sp.). A slight bloom of Anabaena was noted in early March.

Regular sampling was started at Monkey Bay in November. Compared with Nkata Bay this is a shallow area of the lake

and the phytoplankton is, as might be expected, present in greater quantity. There are also considerable qualitative differences. Filaments of Melosira spp. have been found in all samples from Monkey Bay whereas these were rarely seen in the North and species of Peridionales not noted at Nkata Bay have been found in abundance in samples from Monkey Bay.

In this work much help has been received from Dr. J.F.Talling of the Freshwater Biological Association of United Kingdom, both with advice on technique and in the analysis of a number of samples.

## PUBLICATIONS

The following paper was published during the year:

ECCLES, D.H. 1962. An internal wave in Lake Nyasa and its probable significance in the nutrient cycle. Nature. Vol.194, No.4831, pp.832-833.

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Table I

Deep Station, Nkata Bay

Depth in metres of isotherms 1962

| Date | 13.1 | 12.2 | 20.2 | 6.3 | 14.3 | 19.3 | 30.3 | 4.4 | 26.4 | 5.6 | 20.6 | 9.7 | 9.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature °C | | | | | | | | | | | | | |
| 28.00 | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| 27.75 | - | - | - | - | 1 | 12 | 21 | - | - | - | - | - | - |
| 27.50 | - | 3 | - | - | 0 | 28 | 40 | 38 | - | - | - | - | - |
| 27.25 | - | 10 | 23 | - | 25 | 38 | 45 | 42 | 5 | - | - | - | - |
| 26.75 | - | 32 | 30 | 44 | 31 | 44 | 49 | 45 | 13 | - | - | - | - |
| 26.50 | 21 | 38 | 36 | 62 | 35 | 49 | 51 | 47 | 47 | - | - | - | - |
| 26.25 | 26 | 42 | 41 | 68 | 38 | 51 | 53 | 50 | 51 | - | - | - | - |
| 26.00 | 28 | 47 | 45 | 75 | 45 | 54 | 56 | 53 | 55 | - | - | - | - |
| 25.75 | 29 | 49 | 46 | 75 | 46 | 55 | 58 | 55 | 56 | - | - | - | - |
| 25.50 | 31 | 51 | 48 | 76 | 47 | 56 | 60 | 56 | 58 | - | - | - | - |
| 25.25 | 37 | 53 | 50 | 77 | 48 | 57 | 61 | 58 | 60 | - | - | - | - |
| 25.00 | 41 | 54 | 60 | 78 | 49 | 59 | 63 | 60 | 62 | 0.5 | 43 | - | - |
| 24.75 | 44 | 57 | 64 | 78 | 50 | 60 | 65 | 62 | 64 | 71 | 53 | - | - |
| 24.50 | 47 | 61 | 68 | 79 | 53 | 62 | 67 | 65 | 66 | 86 | 61 | 60 | - |
| 24.25 | 51 | 64 | 71 | 80 | 55 | 65 | 68 | 67 | 68 | 92 | 76 | 88 | - |
| 24.00 | 57 | 67 | 76 | 85 | 58 | 67 | 70 | 70 | 70 | 95 | 87 | 95 | 34 |
| 23.75 | 62 | 72 | 82 | 90 | 60 | 70 | 76 | 79 | 75 | 97 | 95 | 106 | 73 |
| 23.50 | 68 | 83 | 90 | 95 | 71 | 78 | 84 | 87 | 90 | 100 | 104 | 124 | 94 |
| 23.25 | 84 | 100 | 105 | 103 | 80 | 88 | 98 | 106 | 103 | 115 | 121 | 138 | 111 |
| 23.00 | 111 | 124 | 129 | 129 | 115 | 130 | 125 | 134 | 129 | 135 | 150 | 146 | 145 |
| 22.75 | 150 | 194 | 187 | 180 | 190 | 203 | 195 | 178 | 210 | 188 | 205 | 190 | 204 |
| 22.00 | - | 346 | - | 268 | - | - | 300 | 300 | - | 300 | 300 | 275 | 350 |

Table 2

Deep Station, Nkata Bay

Depth in metres of oxygen isopleths 1962

| Date | 13.1 | 12.2 | 20.2 | 6.3 | 14.3 | 19.3 | 30.3 | 4.4 | 56. | 20.6 | 9.7 | 9.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oxygen. Parts per million | | | | | | | | | | | | |
| 8 | 28 | - | - | - | 20 | - | - | - | - | 18 | - | 28 |
| | | | | | | | | | | 24 | | 32 |
| 7 | 55 | 35 | 10 | 23 | 30 | 34 | - | 41 | 33 | 40 | 80 | 60 |
| | | | 22 | | | | | | | | | |
| 6 | 83 | 89 | 59 | 73 | 69 | 66 | 53 | 56 | 77 | 75 | 96 | 83 |
| 5 | 105 | 114 | 102 | 105 | 84 | 88 | 81 | 87 | 96 | 99 | 120 | 100 |
| 4 | 112 | 135 | 128 | 126 | 113 | 113 | 114 | 118 | 110 | 128 | 139 | 117 |
| 3 | 119 | 154 | 146 | 140 | 133 | 138 | 139 | 141 | 137 | 154 | 156 | 150 |
| 2 | 132 | 167 | 166 | 168 | 150 | 162 | 161 | 162 | 160 | 174 | 176 | 167 |
| 1 | 147 | 175 | 185 | 174 | 170 | 192 | 181 | 182 | 180 | 192 | 191 | 189 |
| 0 | 244 | 300 | 225 | 250 | 250 | 250 | 225 | 300 | ? | ? | ? | 275 |