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THE POTENTIAL FOR CLUPEID FISHERY IN LAKE KAINJI, NIGERIA

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ABSTRACT
The potential for a clupeid fishery in Lake Kainji has been examined using both experimental fishing samples and the results obtained from those of the commercial fishermen. A total annual production of 1,400 tons has been estimated. In money terms, this amounts to N198.800 (£99,400) per annum. This production has been sustained by the abundant zooplankton food available the year round on the lake.

Recommendations for the effective methods of cropping clupeids were made, bearing in mind the need to maintain the fishery on a sustained yield basis.

The place of clupeids in the ecology of the lake was examined and on the basis of the evidence available it was recommended that *Pellonula afzeluisi* could be exploited on a large commercial scale without any adverse effects on the fishery in the lake.

INTRODUCTION

The need for increased fish production in Nigeria is evident and various attempts are now being made to increase production from coastal and inland waters. However, the reports on the fish yield from Kainji Lake have been based entirely on gill net catches. BAZIGOS (1972), put the total gill net fish production as 17,000 metric tons for 1969, 28,000 metric tons for June 1970-July 1971 and 11,000 metric tons for 1972; none of these estimates takes account of the clupeid fishery. The reason for this is quite obvious. The clupeids (20-75 mm standard length) are not sampled by the graded fleet of nets which has a minimum mesh size of 50 mm. Yet there is a clupeid fishery in the lake which is worthwhile and which was anticipated in view of the occurrence of clupeids in the River Niger system (REED 1969).

The occurrence of clupeids in the Kainji Lake was first reported by TURNER (1970) who recorded the widespread distribution of large numbers of *Potamothrissa miri.* Later LELEK (1972) reported the presence of two species, namely *Sierrathrissa leonensis* and *P. afzeliusi.* WHITEHEAD and POLL (personal communication) have confirmed that *S. leonensis* and *P. afzeliusi* are the only species known in Kainji area.

JOHNSON (1973) has drawn attention to

the importance of the clupeid fishery in the lake. In his opinion the harvest of clupeids is the only possible remaining area for the major expansion of fish harvest left in Kainji Lake and he has recommended that the efforts of the gear technologist should be concentrated on harvesting clupeids. While this statement can be questioned in view of the fact that *Tilapia* and *Lates* fishery of the lake are yet to be fully exploited, it does highlight the importance of clupeid harvest in Kainji Lake. This article draws attention to a potential clupeid fishery in Kainji Lake.

METHODS

Samples were collected between September 1972 and April 1973. The specimens were attracted at night to a stationary light source (100 w electric bulb powered by a generator) with the bulb floating on the surface of the water. The fish so attracted were captured using a lift net (2 m × 4 m) of 2.5 mm bar (5 mm stretched). The net was lowered to about 10 m depth before beaming the light from the surface. Each haul lasted one hour and three hauls were taken in each station between 18.00 and 22.00 hours. The specimens collected were immediately preserved in 5% formalin and examined later after washing in water. Where samples were large sub-samples were taken but in other cases all specimens caught were counted after they were identified. The number and weight of sub-samples were taken and the total number and weight estimated.

In view of the relevance of light penetration to the method of harvest, water transparency was determined at about 17.30 hours each evening by means of a Secchi disc.

In addition three villages Awuru, Faku and "Cover" dam were visited weekly for purposes of taking records of the commercial fishery. Estimates of their catches were made both by dry weight and fresh weight.

The local fishermen use the atalla lift net as the main gear for the harvest of clupeids. The gear (see Figs. 1-3) is made up of a 5 meter square frame made from four raffia palm (*Raphia vinifera* P. Beauv.) poles. Two of the four corners of the frame are fitted to the sides of the boat in such a way as to enable the frame to be dipped and lifted in and out of the water. There is a devise for depressing the net during operation. The ropes tied to the outer corners of the poles and the centre of the net are used to raise the net vertically and to shake the fish into the canoe. The net is operated by dipping it for a minute or two into water then raising it up. By doing this the atalla net transverses the upper layers of the water thus harvesting the pelagic clupeids.

RESULTS

P. afzeliusi and *S. leonensis* were present in all the stations sampled (Fig. 4). *Microthrissa miri* which was reported by McCONNELL (1965) in the area has not been captured in the lake and it would appear that *P. miri* reported by TURNER (1970) was in fact a mistaken identity for *P. afzeliusi*. Also in all cases *P. afzeliusi* dominated the catches in the open water while *S. leonensis* was more numerous in the shallow water near the edge. The abundance of both species varied from station to station and from month to month (Figs. 5 and 6) but on the whole abundance of *P. afzeliusi* was more correlated with water transparency than that of *S. leonensis*. Table 1 shows the estimated total number and weight of clupeids caught during the sampling period.

During the study the fishermen in Amuru, Faku and "Cover" dam sold approximately 60,600 kg fresh weight (or 18,625 kg dry weight) of clupeids. This gives a yield of about 56 tons fresh weight.

DISCUSSION

The results show that there is a good stock of clupeids in the lake. The two species *P. afzeliusi* and *S. leonensis* seem to be

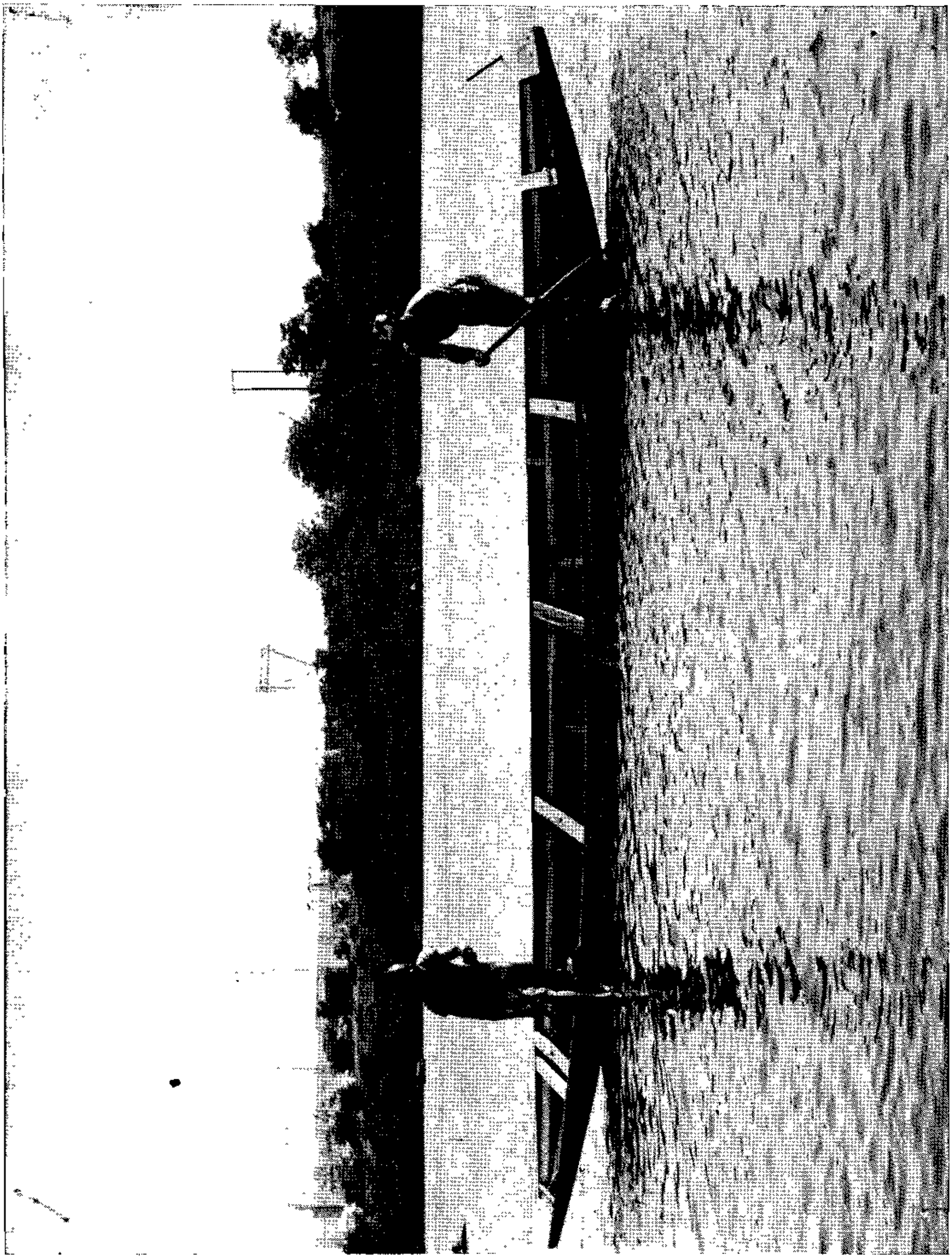

Fig. 1: The atalla net dipped in the water

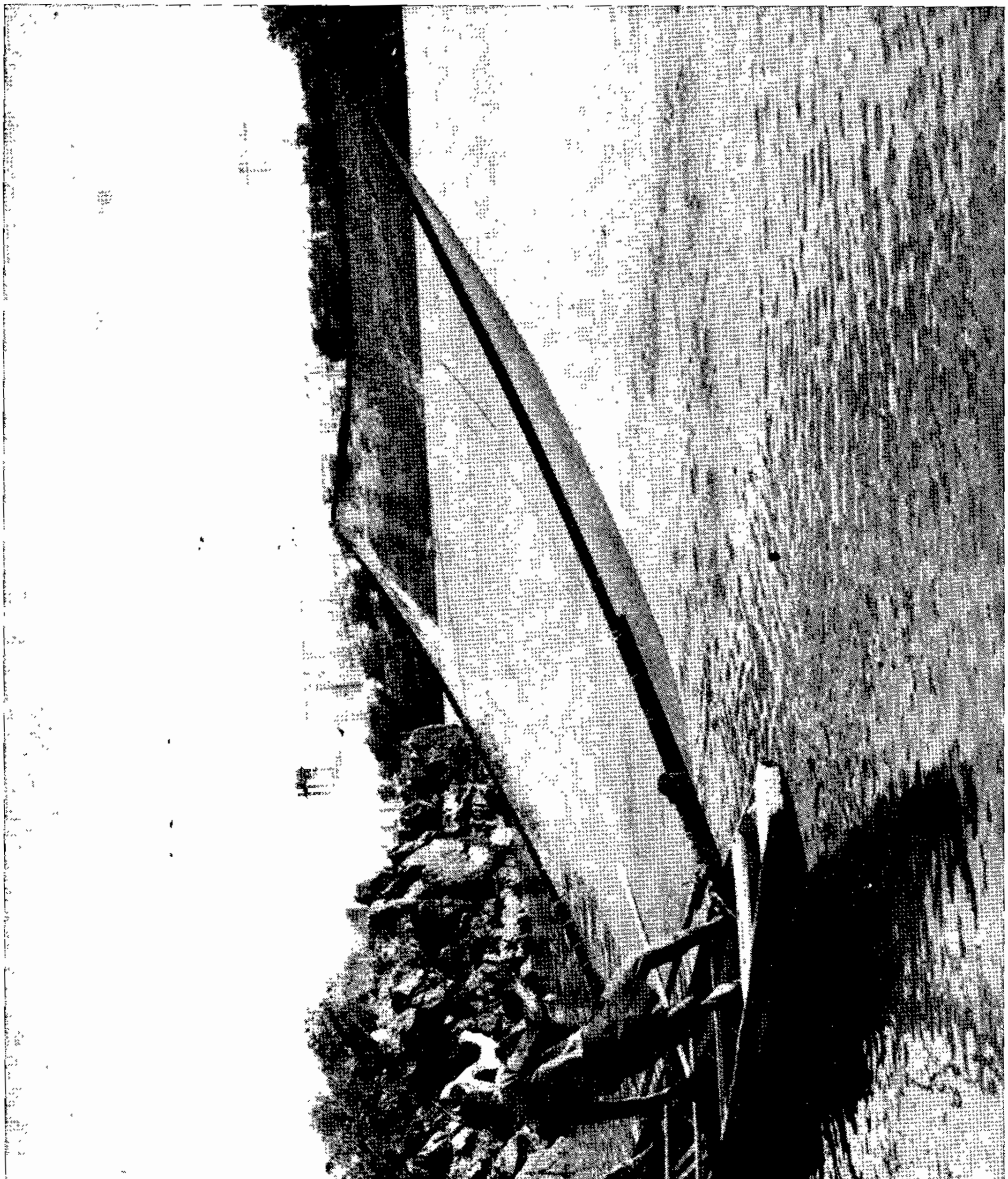

Fig. 2: The atalla net being lifted

Fig. 3: Atalla nets laid out for drying

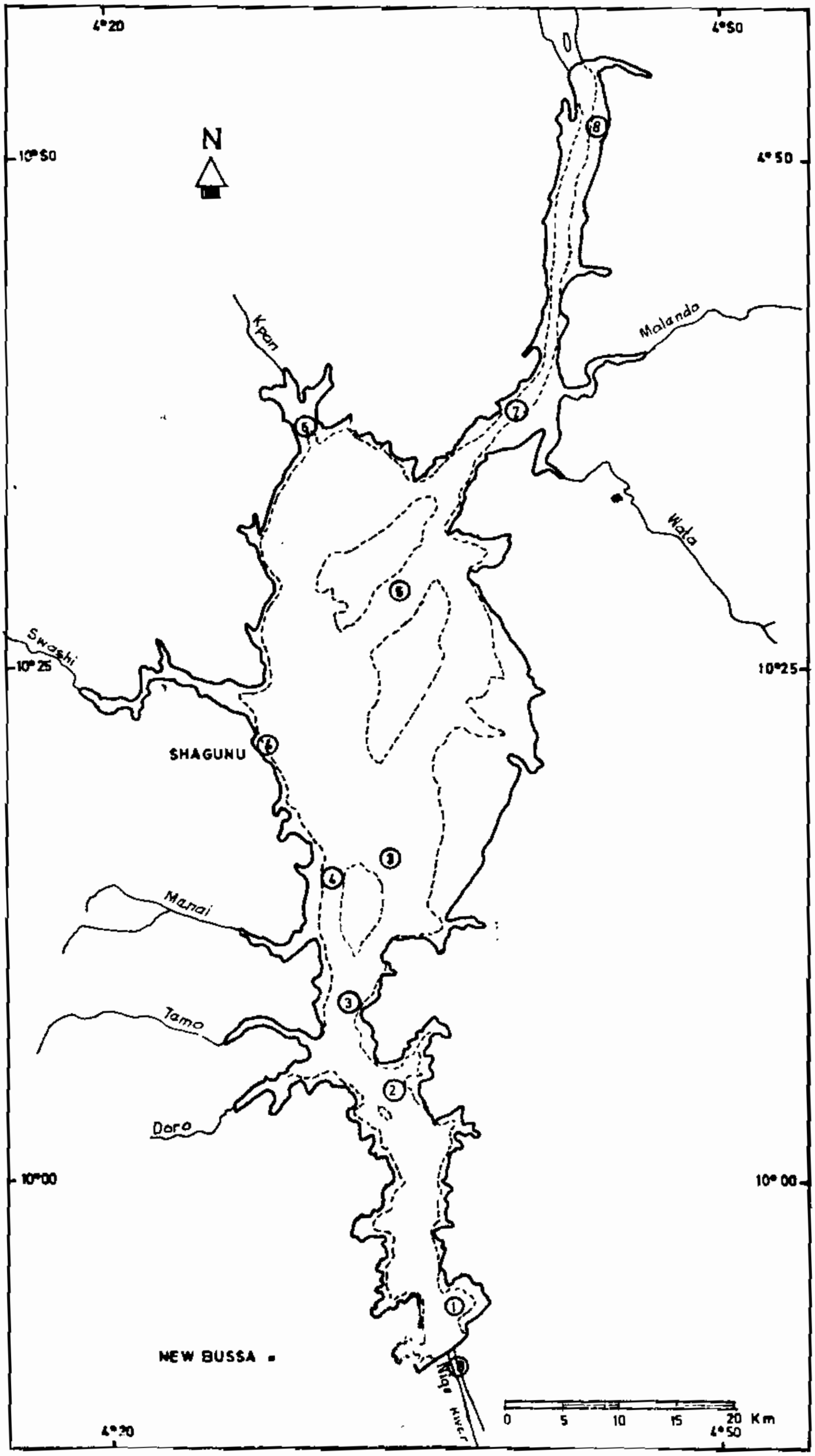

Fig. 4: Map of Kainji Lake Clupeid Sampling Stations

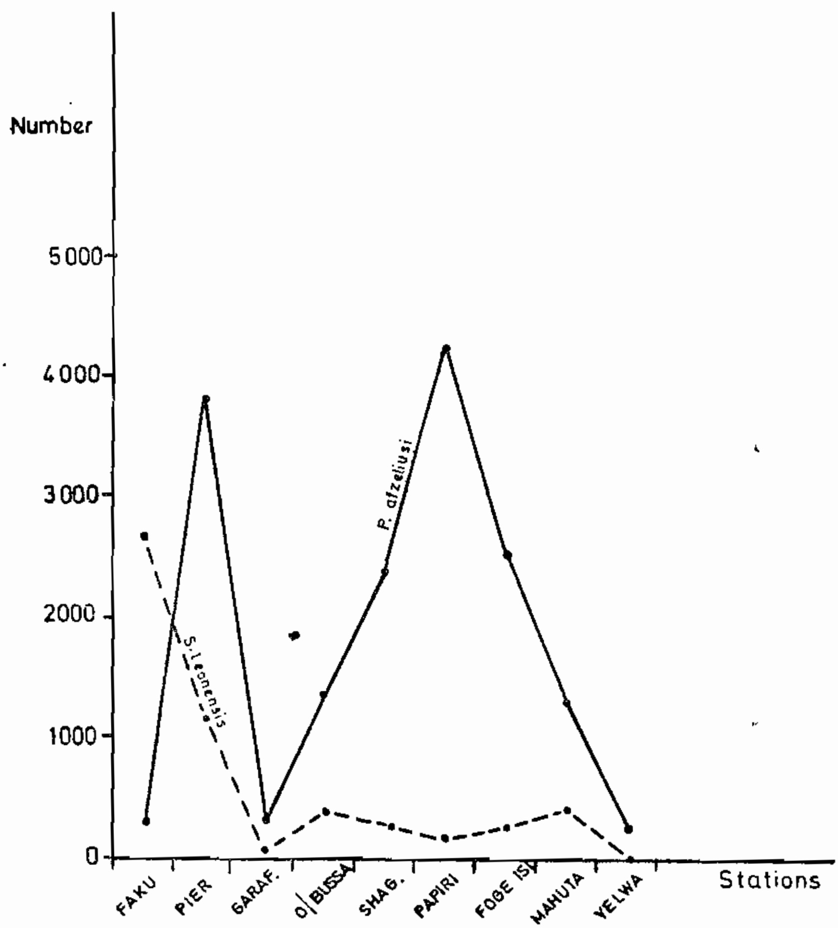

Figure. 5. Variation of Clupeid catches from station to station

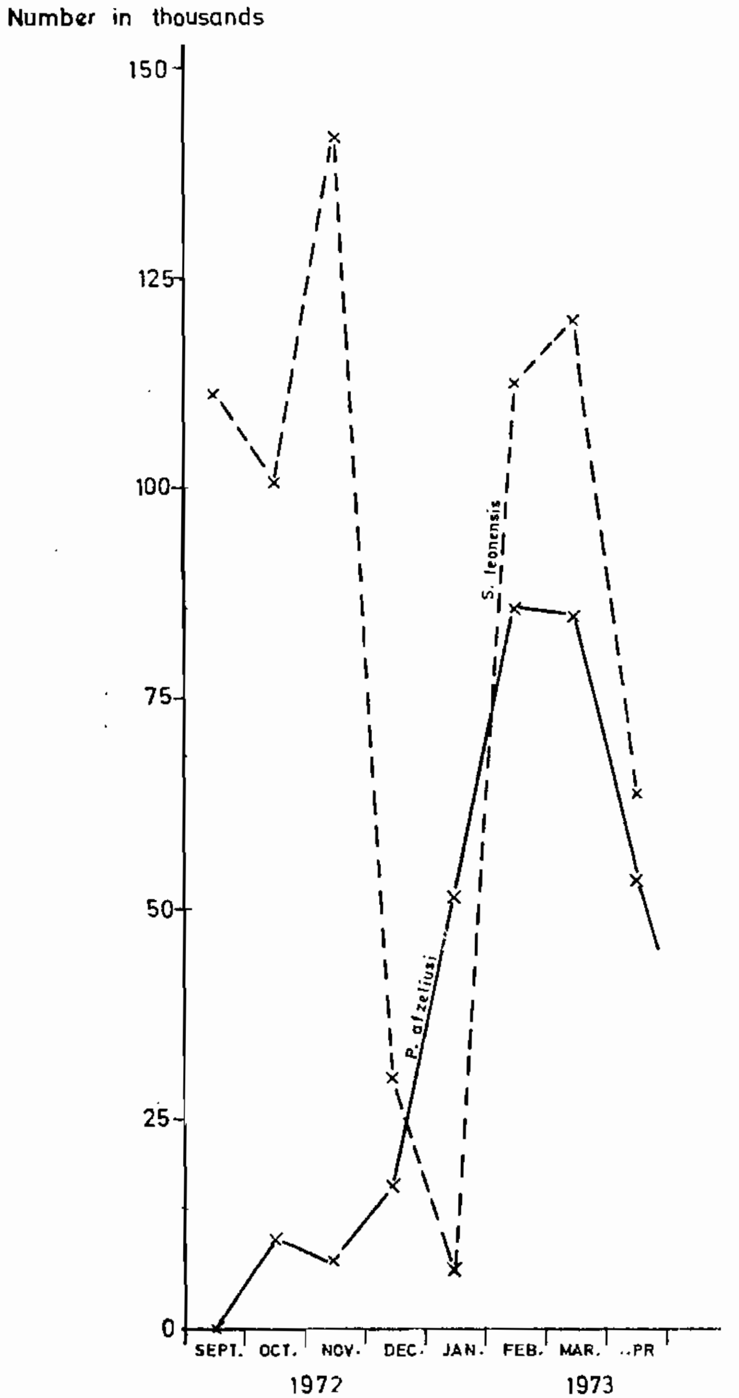

Figure 6 Monthly clupeid catches

species (SCHOONBEE 1969) particularly in larger specimens (MUNRO 1967). Enzymatic analysis of the digestive tract of *C. mossambicus* has shown high pepsin activity in the stomach, with lower activity in the intestine where amylase activity was also recorded which indicated that the species should be capable of utilising a varied diet (COCKSON and BOURN 1972).

In this study *C. mossambicus* was found to feed throughout the day and night and to have a highly varied diet. Small fish fed predominately on zooplankton, but with increasing size fish became a major item. This latter observation conflicts with that of MUNRO (1967) on Lake McIlwaine (Rhodesia) and may in part be due to the relatively small size of specimens that were caught in Lake Chilwa. However, there was a clear progressive increase of the proportion of fish in the diet of larger individuals in Lake Chilwa. This discrepancy may have arisen because, in contrast to Lake McIlwaine, there are no other predatory fish species in Lake Chilwa.

In common with a number of other species of *Tilapia* (*T. esculanta, T. nilotica* and *T. variabalis* (FISH 1955); *T. mortimeri* (syn. *T. mossambica)* (MATTHES 1965); *T. zilli, T. melanopleura* and *T. galilaea* (PETR 1967); *T. mossambica* and *T. melanopleura* (MUNRO 1967) this study showed that *T. shirana chilwae* had a mainly herbivorous diet of higher plant material and algae, although zooplankton was also consumed, mainly by smaller fish. LE ROUX (1956) has also reported the importance of zooplankton in the diet of young. *T. mossambica, T. melanopleura, T. sparmanii* and *T. andersoni.* KIRK (1970) found that *T. shirana chilwae* caught in Lake Chilwa in the period prior to the drying of the lake fed almost exclusively on blue-green algae. In this study the proportion of blue-green algae in the diet was found to be relatively small (12% and 1%). The discrepancy is possibly due to the prevailing environmental conditions before and after the drying of the lake. The conductivity of the water in the central region of the lake was well in excess of 4,000 μmho/cm for most of the period of KIRK's study.

Enzymatic studies of the alimentary canal of *T. shirana chilwae* (COCKSON and BOURN, 1972) showed that there was no protease activity in the stomach, while in the intestine both pepsin and trypsin activity was present. Amylase was found in all regions of the gut. These observations indicate that the species is adapted to a herbivorous diet.

Analysis of data to reveal seasonal changes in the diet of the three fish species was inconclusive. However some differences were found in the feeding patterns of fish caught in waters of different conductivity. The seasonal changes in the conductivity of Lake Chilwa are complex (McLACHLAN *et al.* 1972); but in general terms during the dry season, from about April to October, conductivity values gradually increase and exceed 1,500 μmho/cm; while during the wet season, from about November to March, the waters are diluted by increased river inflow. Thus to some extent seasonal changes in diet are reflected by the different feeding patterns of fish caught in waters with a conductivity greater or less than 1,500 μmho/cm.

The changes in the diet that were observed with the size of each species is of interest. It is uncertain whether or not these changes are due to differences in the selectivity, or the efficiency of feeding in each size group of fish. Not surprisingly fish in the smallest size group of each species had feeding patterns similar to those in the immature stage of sexual maturity. It might therefore have been useful to have had a more refined breakdown of the early stages of maturation so that changes in feeding with growth and gonad development could have been examined more closely.

Fig 7: Clupeids spread out for sundrying

Tanganyika (COULTER 1968). There the species harvested are *Stolothrissa tanganicae* and *Limnothrissa miodon* which are in fact bigger than the Lake Kainji species. The annual yield there was only 2,000 tons in 1966 so that their small size at Kainji seems to be compensated by their vast numbers.

A high production of clupeids also exists in Lake Volta. Present estimates show a yield of 1482.3 kg of clupeids per sampling round (VANDERPUYE 1971). It seems therefore that many African lakes can support a flourishing clupeid fishery.

The problem however is how best to harvest clupeids. In Lake Volta, REYNOLDS (1966) recommended the "Lusenga" net, Banbo "Chiurn" net, cast net, and "Chirimila" net (a type of modified seine net used originally on Lake Nyasa for *Hemichromis* spp.) for clupeid exploitation. More recently VANDERPUYE (1971) has added gill nets to the list and suggested that gill nets 13 mm ($\frac{1}{2}''$) and 25 mm ($1''$) with thin twines are the best. While most of the methods outlined above may be suitable for catching *Pellonula* (maximum size 9.9 cm standard length with a weight of 13.5 g) and *Cynothrissa* (maximum size 150 mm standard length for a weight of 47 g) in Volta Lake they are not likely to be appropriate in Kainji Lake because of the small size of the clupeids here. *Cynothrissa* has not been recorded so far in Lake Kainji and it has been observed that the average size of *P. afzeliusi* in Lake Kainji (4-5 cm standard length maximum size 7.5 cm standard length) is smaller than the average from the other African lakes. The methods will be particularly unsuitable for catching *S. leonensis* (maximum size 3.4 cm). VANDERPUYE (1971) also stated that *Sierrathrissa* does not grow to a size which can be captured with even a 13 mm mesh size net in Lake Volta.

In Kainji Lake the atalla holds the greatest promise. But its use in the lake is faced with some difficulties. This gear requires calm water for an effective fish harvest and safety of the operations. Furthermore it cannot be used when the clupeids move into deeper water such as during rough weather when there are waves. Then the fish will be out of reach of the atalla net. At such times it is useless to try to fish clupeids. The atalla net may be supplemented with the light attraction technique during calm weather and when the transparency of the water is high.

It is suggested therefore that until a more efficient method is devised, the atalla gear should be used in combination with the light attraction technique. The results to be obtained are encouraging enough to create a flourishing clupeid fishery in Lake Kainji.

SUMMARY

During light attraction sampling for clupeids on Kainji Lake it was observed that the two species of clupeids *P. afzeliusi* and *S. leonensis* said to be present in the area have a lakewide distribution. *P. afzeliusi* dominated the catch in the open water while *S. leonensis* were more numerous in the shallow water.

Catches especially of *P. afzeliusi* were correlated with season. The light attraction was observed to be more effective during the period of the black flood whereas the atalla method was the reverse; higher catches being recorded during the period of high turbidity (White Flood). Both methods seem to require calm weather for efficiency in the operation.

An estimated production of 1,400 tons yielding about 198,800 Naira (£99,400) was made based on the results obtained for the work.

The future of the fishery was considered on the basis of ecological parameters and conclusions reached that the superabundant zooplankton food in the lake would enhance the growth and production of clupeids. It was also suggested that the expanded com

Table 1. Estimated total number and weight of Clupeids caught and average water transparency of all stations sampled

Month		*Pellonula afzeliusi*		*Sierrathrissa leonensis*		Average
		Number	Weight (gms.)	Number	Weight (gms.)	water transparency in M.
September	1972	15146	11052	92938	13225	0.3
October	1972	22584	12884	85286	13404	0.4
November	2972	20690	11140	114389	15480	0.4
December	1972	27233	16306	41279	5298	0.5
January	1973	51074	36803	19299	3996	0.6
February	1973	74993	48561	93799	18858	0.7
March	1973	74536	43877	99085	18686	0.7
April	1973	52609	33749	59576	13644	0.6
Total		338865	214372	605651	102591	

mercial clupeid fishery will not adversely affect forage for the piscivores because other food substitutes are available.

It was concluded that until a more effective gear is developed a combination of both the atalla and light attraction methods should be used.

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