THE REPUBLIC OF UGANDA

MINISTRY OF
ANIMAL INDUSTRY, GAME AND FISHERIES

FISHERIES DEPARTMENT

OCCASIONAL PAPERS

No. 3—1970

Published by Authority

PRINTED BY THE GOVERNMENT PRINTER, ENTEBBE, UGANDA

CONTENTS

OBSERVATIONS ON THE TAXONOMY AND BIOLOGY OF LATES (CUVIER 1828) IN LAKE ALBERT

by

J. B. HUNTER

INTRODUCTION

BOTH in terms of commercial landings and biological importance, the Nile Perch is one of the most prominent fish in Lake Albert. It can bear considerable further exploitation, is the source of stockings elsewhere, and it is, therefore, important to know whether more than one species is being dealt with, and, if so, what differences there are in the ecology of the different species.

Considerable controversy has surrounded the systematics of the genus *Lates* (Cuvier 1828) in Lake Albert. Worthington distinguished the Albert *Lates* from *L. niloticus,* the form occurring in the River Nile. He proposed two species: (1) *L. albertianus,* and (2) *L. macrophthalmus,* recognising *L. macrophthalmus* as a separate species from the fact that it matured at a smaller size and occupied deeper regions of the lake than did *L. albertianus.* Worthington further separated *L. albertianus* from *L. niloticus* on the basis of a larger eye, longer caudal peduncle and different head measurements, and suggested that it be given full specific status.

David and Poll considered that the two Lake Albert forms should be considered as sub-specifically different, and designated them as *L. n. albertianus* and *L. n. macrophthalmus.* Hamblyn suggested that there was only one species, the fry of which were spawned in shallow water. Some fry developed in the inshore areas while others drifted into deeper water, and developing in a different environment, became a separate ecotype.

Holden examined preserved material mostly brought back by the Worthington expedition in 1928, and made a statistical analysis of certain morphological characteristics between *L. n. albertianus, L. n. macrophthalmus* and *L. niloticus* from the River Nile. From this he concluded that *L. n. albertianus* was not significantly different from, but should be considered synonymous with, *L. niloticus,* and that *L. n. macrophthalmus* was significantly different from *L. niloticus* and should be given full specific status. This assumption is accepted by the author and the species, *L. niloticus* and *L. macrophthalmus,* are considered valid for the rest of this study.

EXPERIMENTAL FISHING

Experimental fishing was carried out by the author in 1968 during the course of his duties as Regional Fisheries Officer. A completely exhaustive series of experiments was not possible, but throughout the author's time on Lake Albert, data on length, sex and maturity of *Lates* from experimental fishing were recorded. During a period of more intensive fishing, towards the end of the observations, morphometric data was collected. A fleet of gill-nets from 2½ inches to 8 inches was used, and the composition of the fleet has been kept fairly constant. Most fishing was done in the Butiaba area where there are areas of deep and shallow water within easy reach.

MORPHOLOGICAL DIFFERENCES

The most obvious difference between the two species is the shape of the caudal peduncle, as can be seen from Plate 1. The ratio of length to depth of the caudal peduncle varies between 1·2 and 1·6 for *L. niloticus* and 1·5 and 2·1 for *L. macrophthalmus*. As can be seen for the frequency distribution of this characteristic (fig. 1), there is an overlap zone between 1·5 and 1·6, and in this zone the state of maturity relative to length, as well as other morphological characteristics, was used to separate the species.

The orbital diameter is greater compared with length in *L. macrophthalmus* than in *L. nilotics* as the specific name implies. This character was not measured in a sufficient number of specimens to enable comparison over a wide range of lengths.

TABLE 1: COMPARISON OF VERTICAL AND HORIZONTAL ORBITAL DIAMETERS BETWEEN *L. niloticus* AND *L. macrophthalmus* (108 SPECIMENS MEASURED)

	Vertical diameter (mm)		*Horizontal diameter (mm)*	
Length (cm)	*L. niloticus*	*L. macrophthalmus*	*L. niloticus*	*L. macrophthalmus*
15·0–19·9 ...	11·7	13·4	15·3	15·8
20·0–24·9 ...	15·1	16·3	18·0	19·0
25·0–29·9 ...	17·3	17·8	20·1	21·3

Another specific difference is the number of spines in the first dorsal fin. In *L. macrophthalmus* the number is invariably 7, while in *L. niloticus* the number is more variable: 86 per cent of the specimens examined having 8 spines, and 14 per cent having 7 spines (135 fish examined).

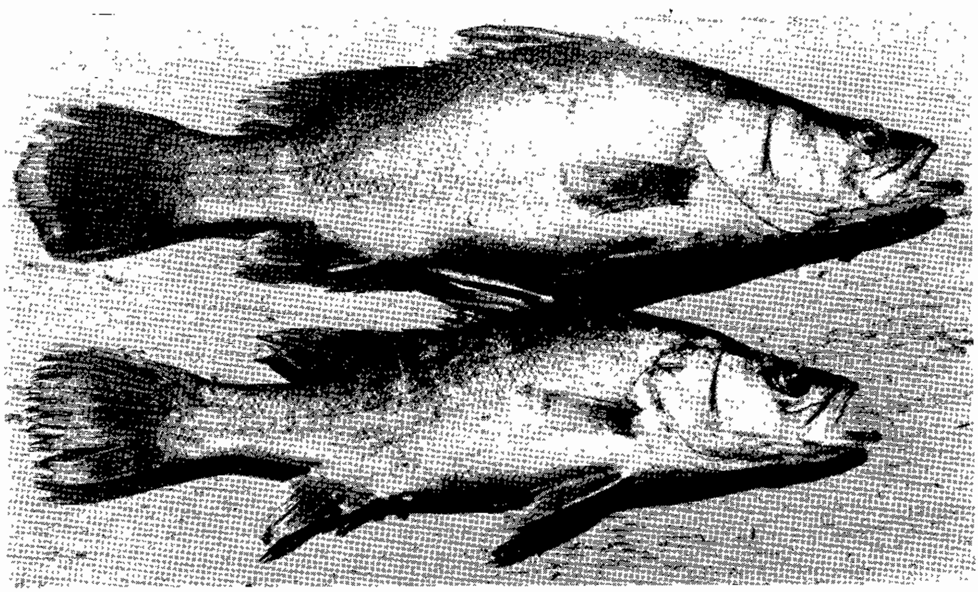

Plate 1 (a)—Lates niloticus (Upper). Lates macrophthalmus (Lower)

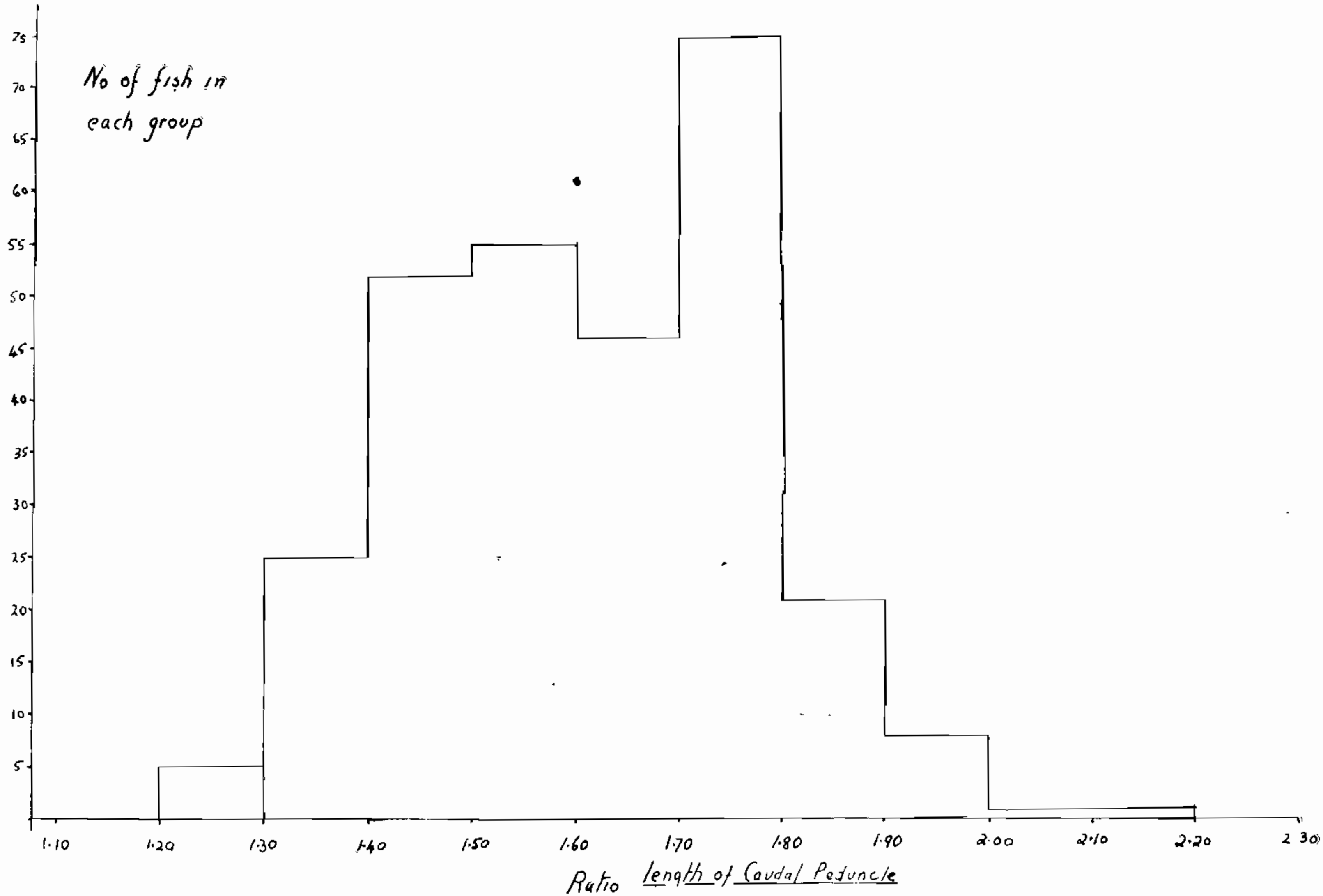

Figure 1. Frequency polygon of caudal peduncle ratios of 289 specimens of *Lates* caught at all depths fished in Lake Albert.

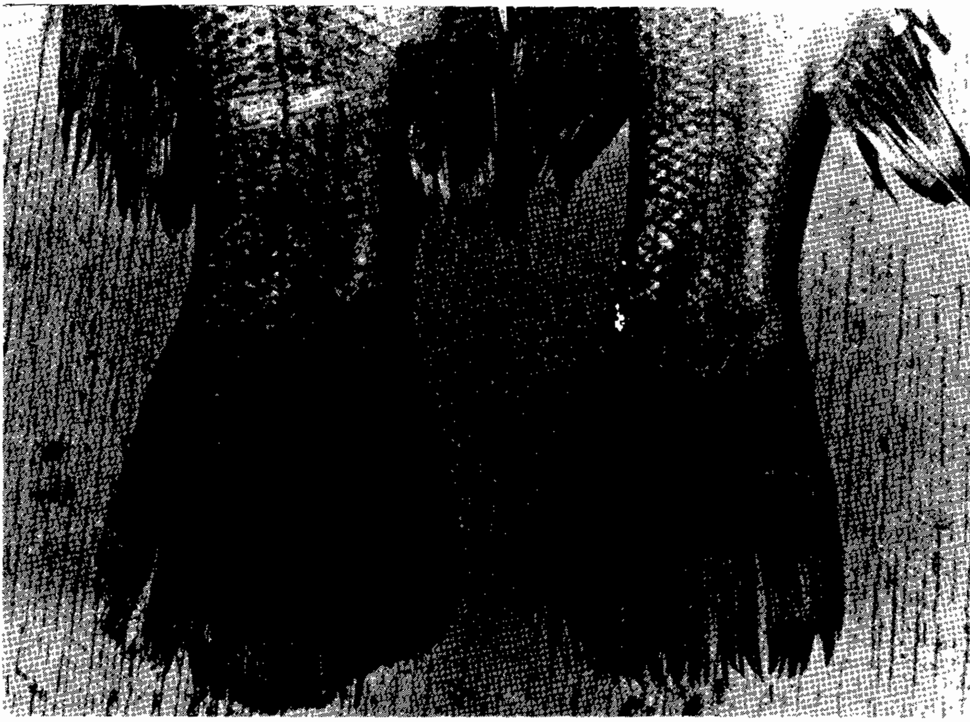

Plate 1 (b)—Lates niloticus (Left). Lates macrophthalmus (Right)

It appeared that the maxilla was longer in *L. niloticus* than in *L. macrophthalmus,* and for the convenience the position of the posterior extremety of the maxilla was noted in relation to the eye. For the 65 specimens of *L. macrophthalmus* measured, the average extremety was level with a point on the eye 0·14 diameters from the anterior end, while in *L. niloticus* the average maxilla reached a point 1·0 diameters from the anterior end of the eye, *i.e.* directly ventral to the posterior end of the eye (17 specimens examined). This method was found to be quick and simple under field conditions, although a comparison of maxillary length with head length may be more valuable. The difference in length, and therefore gape, of the jaws between the two species seems explicable as a consequence of their dietary preferences.

HABITAT

Basically *L. macrophthalmus* occupies the deeper waters of the lake from depths of 8 metres to at least 50 metres, which is the greatest depth fished. The population density as reflected in catch per net figures certainly increases with depth as far as the 33-metre mark and apparently beyond. Worthington caught specimens in water of 23 metres in depth and beyond, but it would seem to be more common in shallow water than has been supposed. It is more likely to occur in areas where deep water occurs close inshore, and the movement into shallow water does not involve great distances, but nevertheless considerable numbers have been caught in the gently shelving and truly shallow water areas.

L. niloticus occupies the shallower areas of the lake, although it occurs in large numbers where deep water encroaches near the shore. Even in truly off-shore waters, more than six miles from shore, occasional specimens are found at depths of 50 metres.

Fish showed that an oxygen tension of only 5 mm Hg was sufficient to oxygenate the haemoglobin of *Mormyrus kannume* and *Bagrus docmac,* and presumably this would also apply to *L. macrophthalmus*. He further demonstrated that a partial pressure of 75 mm Hg was necessary to oxygenate the haemoglobin of *L. niloticus* (his specimens were taken inshore in shallow water). It appears that generally deeper off-shore waters have much lower oxygen tension in Lake Albert than in the upper layers. It might, therefore, be surprising to find *L. niloticus* in deeper waters unless there is a separate ecological type adapted to a lower oxygen tension than 75 mm of Hg.

Possibly, then, the *L. niloticus* found in the deep off-shore waters are a separate ecotype adapted to live in these conditions. On the other hand, Holden considers that water of high oxygen tension may at times occur off-shore, and that when subsequent lowering of oxygen occurs, any specimens of *L. niloticus* which have migrated from shallow waters must either return or perish. This appears the more likely possibility.

FOOD PREFERENCES

An exhaustive study of stomach contents was not made, and stomachs of fish hauled from deep water were often found to be everted. In specimens of *L. macrophthalmus,* up to 20 cm in length, the prawn, *Caridina nilotica,* was the only identifiable food. In larger specimens, fish prey also occurred, and of the fish prey, *Lates* was the most abundant, although its bony nature and its indigestibility may have led to its exaggeration as a prey species. Even in the largest specimens recorded, *Caridina* still formed the bulk of the stomach contents, and the large concentrations of *Caridina* in the deeper regions of the lake are probably responsible for the great density of this species in these regions.

Where *L. niloticus* of less than 20 cm in length occurred in shallow water and in lagoons, Odonate nymphs formed the bulk of the stomach contents. Where the young fish occur further off-shore, *Caridina* forms the bulk of the diet. For specimens over 20 cm in length, fish becomes the most important item of the diet. *Lates* and *Cichlids* appear to be the most common. Hamblyn gives a most comprehensive account of the diet of Nile Perch, with detailed observations of the method of prey capture made in aquaria. Thus, although there is an overlap in the diet of the two species, *L. macrophthalmus* has a definite preference for the prawn *Caridina,* while *L. niloticus* is basically piscivorous. Holden suggests that the type of caudal peduncle and fin possessed by *L. niloticus* gives it some evolutionary advantage over *L. macrophthalmus* in piscivorous feeding.

ATTAINMENT OF MATURITY

Holden states that female *L. macrophthalmus* spawn at about 30 cm (fork). The smallest spent female observed by the author had a length of 18·6 cm (standard), and several others were between 20 and 24 cm. The ovaries of a mature female of 25 cm had a volume of 3·5 cc, and the eggs were extremely small, having an average diameter of 0·45 mm. The final maturation stages take place without any great increase in the size of the ovary, but the organ becomes smoother in outline, and takes on a yellowish colour. Hamblyn found that the intermediate stages in ripening were difficult to distinguish in this species.

Of the 310 specimens of *L. macrophthalmus,* from all depths of water, examined during the survey, 55 per cent were male and 45 per cent female. Of these 310 fish, 54 per cent were mature. 30 fish of this species were caught in water less than 10 metres deep, and of these 85 per cent were mature and 85 per cent were females. Although this latter sample is small, it does suggest that mature fish, particularly females, come into shallow water to breed. The fact that Holden identifies one collection of very small fish (10·4–54·5 mm (fork)) from Butiaba Lagoon as *L. macrophthalmus,* supports this theory. On the other hand, fry of 4·0–9·0 cm were trawled from a depth of 40 metres off Buhuka by Worthington, and fish of this size have been found by the author in stomachs of larger

Lates caught in deep water. It seems that *L. macrophthalmus* can grow to a length of at least one metre as a fish of that size was caught by Holden off Wansekó, but fish of more than 40 cm are uncommon.

According to Holden, the males of *L. niloticus* begin to mature at a fork length of about 60 cm and the females at about 85 cm, and Worthington thought that the minimum breeding size for females was probably about 124 cm (total) though he examined none under 78 cm. Ripe males of 52 and 54·5 cm (standard) and spent females of 46·5 and 50 cm (standard) length have been caught by the author and Mr. R. Chilvers of the East African Freshwater Fisheries Research Organisation, off Kibiro, and morphometric details showed that the fish were indisputably *L. niloticus*. In Lake Victoria, Gee suggests that *L. niloticus* starts maturing for the first time at 20 cm, and that the smallest fish with near-ripe gonads measured approximately 23·5 cm, standard length (these were presumably males, although Gee does not so specify). On Lake Tchad, Hopson reports that 50 per cent of the males of this species are mature at a length of 50 cm, and 50 per cent of females at 57 cm. The eggs are spawned in sheltered water on that lake, and contain a large single oil globule. They are pelagic and hatch at a size of 1·2 mm.

On the subject of spawning, Kenchington says of *L. niloticus* in the Nile River, Sudan:

"The species, unlike the salmon, does not spawn fasting and the process seems a protracted one, broken by intervals for feeding. The season for breeding has been quite definitely determined as from late December to mid-May, during the whole of which period individuals are regularly taken both dead, ripe and newly spent . . . A migration upstream to the spawning beds appears on first principles, and having regard to the life histories of related species, biologically improbable . . . It is probable that the ova are deposited in deep or in fast-moving water, possibly in holes or pans of the rocky bottom. A type of damage to the stoutly webbed fins, and to those fins most in contact with the bottom (caudal and pelvic) was observed from time to time in the spawning season in dead, ripe, in actually extruding, and in spent fish which suggests attrition by rocks or sharp gravel, probably in strong water, so as to damage the stout fin spines and membranes, postulates considerable force. Three years of close observations have failed to reveal *aigle* in their spawning activities in waters near the shore or in the probably shallows . . . The ripe ova measure 0·4–0·7 mm in diameter, and are spherical with a thin but tough envelope. They are white owing to their creamy yolk contents, and contain much oil in creamy globules. They are of such a type and density as probably to sink after fertilisation, if not actually heavier than water. The appearance of the ripe ovary suggests the arrangement in orderly rows and skeins, and may mean that they are laid in strings about submerged objects, as with the common perch. They seem small in relation to the scale of the adult fish. Rough spawn counts were made and gave an average of about 3¼ thousand ova per gram of ripe ovary, and also 26 gm of ovary per kilogram live weight. Fish spawn first at 7–8 pounds."

CONCLUSIONS

Existing data recorded by Worthington and Holden suggests that two species of *Lates* occur in Lake Albert and morphometric data collected by the author support this theory. The two species are not confined to deep or shallow water quite as much as was thought previously, *L. niloticus* having been caught in truly deep water some miles from shore and *L. macrophthalmus* having been caught in considerable numbers in water of less than 10 metres in depth. Both species have been found to mature and breed at a considerably smaller size than was previously believed.

REFERENCES

WORTHINGTON, E. B. (1929)—A Report on the Fisheries of Lake Albert and Kioga. Crown Agents for the Colonies, London.

DAVID AND POLL (1937)—Contribution a la faune ichthyologique du Congo Belge—in Annals. Mus. du Congo Belge (Zool.) 3. (5).

HAMBLYN, E. I. (1966)—The Food Habits of the Nile Perch. *Lates niloticus* fam. *centropomidae*. Rev. Zool. Bot. Afr. LXXIV (1–2) (1–28).

HOLDEN, M. J. (1967)—The systematics of the genus *Lates* (*Teleosti; Centropomidae*) in Lake Albert, East Africa. J. Zool. London., 151 (3) 329–342.

FISH, G. R. (1956)—Some aspects of the Respiration of six species of fish from Uganda. J. Exp. Biol. 33, 186–195.

HOLDEN, M. J. (1963)—Report on the Fishery of Lake Albert. Cyclostyled Report. Fisheries Laboratory, Lowestoft.

GEE, J. M. (1969)—A comparison of certain aspects of the biology of *Lates niloticus* (Linn) in some East African lakes. Rev. Zool. Bot. LXXX (3–4) (244–262).

HOPSON, A.—Fisheries Officer, Lake Tchad, Nigeria. Personal letter.

KENCHINGTON, F. E. (1933)—Studies on the Nile Perch or *Aigle* (*Lates niloticus*) at Sennar. Sudan Notes and Records, 16, Khartoum.