



# The Jubb Papers

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LONG ISLAND KILLIFISH ASSOCIATION

# The Identification of *Nothobranchius orthonotus* (Peters, 1844)

R. A. Jubb

During the years 1842 to 1848, Dr. Wilhelm Peters of Berlin, Germany, explored the Zambezi River, the largest in southern Africa, from its mouth to as far as Tete, a small town some 400 kilometers upstream which was established by Portuguese Dominican Fathers as far back as 1531. In addition to birds and reptiles Peters collected many fishes, most of them new to science, from fresh and estuarine waters of the Zambezi.

The Zambezi River empties into the Indian Ocean via an extensive delta of ever-changing channels and flood-plains subject to seasonal flooding. One of the most stable of these channels is the Kwakwa or River of Quelimane which enters the sea about 95 kilometers north of the other mouths of the Zambezi. West of Quelimane there are low-lying, seasonal swamps and it was from these that Peters obtained the first specimens of a fish species which, today, we refer to as *Nothobranchius orthonotus*. He would have landed at Quelimane and must have obtained his specimens soon after this as in 1844 he published a short description of this material under the name *Cyprinodon orthonotus*.

In 1855 Peters, for reasons not stated, listed his material in another scientific journal as *Hydrargyra maculata*. The specific name *maculata*, meaning spotted, is, as will be seen later, of great significance. In 1866, A. Günther, of the British Museum, in his *Catalogue of the fishes in the British Museum*, transferred Peters' *Cyprinodon orthonotus* to the genus *Fundulus*. That same year Günther and Playfair, in their publication *Fishes of Zanzibar* referred some specimens of *Nothobranchius* from Zanzibar to the species *orthonotus*, but in 1893 these were described by G. J. Pfeffer as a new species with the name *Fundulus guentheri*.

In 1868 Peters published his *Reise nach Mossambique* in which, with meticulous care and thoroughness, he described and illustrated the fishes he collected in Mocambique waters. To accept his species *orthonotus*, he erected a new genus which he named *Nothobranchius*. In his emended description of *Nothobranchius orthonotus*, Peters gave the distribution as from the freshwater swamps near Quelimane to Quisanga some 850 kilometers northwards up the coast of Mocambique. Peters also included the record of Günther and Playfair of *orthonotus* from Zanzibar. In his discussion, he records that the local name is *anamolugo* and adds: "Gebacken gibt er ein vortreffliches Gericht"—the translation of which will horrify *Nothobranchius* enthusiasts as it means "when baked they provide an excellent dish."

For some unknown reason ichthyologists referred their material to the genus *Fundulus* instead of using Peters' *Nothobranchius*. However, in 1924 George S. Myers, who needs no introduction to aquarists, recognized the genus *Nothobranchius* but erected a new genus *Adioniops* with *guentheri* as the type species to accept *guentheri*, *neumanni* and other related species. But in 1933 Myers, in a paper with the title "The genera of the Indo-Malayan and African cyprinodont fishes allied to *Panchax* and *Nothobranchius*", published in *Copeia*, wrote as follows:

"Recent study has convinced me that Ahl was perfectly correct in referring *Fundulus neumanni*, *Fundulus guentheri* and other related forms to *Nothobranchius*. *Fundulus kubntae* Ahl and *Adioniops troemneri* Myers, both from Beira, appear to be identical with *Nothobranchius orthonotus*. Peters' types of *orthonotus*, one of which I have examined, were in poor condition and the lips are flabby and stretched. This makes the specimen I have examined (just as in Peters' figure) seem to have a great lateral gape. I find that the lips when placed in their original position are like those of *guentheri*. *Nothobranchius orthonotus* has, however, longer jaws than any other *Nothobranchius* but I cannot separate it generically on this character alone."

Thus the genus *Nothobranchius* Peters came into general use, but live *Nothobranchius* specimens remained a relative rarity amongst aquarists. The development of faster and faster transport by air during the past two decades opened up a new era for aquarists in many parts of the world. Today live aquarium fishes reach their destination in as many hours as it took days, or sometimes weeks previously. Coupled with this the development of color photography provided aquarists, as well as naturalists and ichthyologists, with a number of magnificently illustrated books to choose from for the identification of tropical fishes in their natural colors. On paper it would appear that the aquarist and ichthyologist were well provided for but, when the two got together and compared notes, it became apparent that a great deal of confusion existed as to the identification of some of the species.

Colonel J. J. Scheel's classic *Rivulins of the Old World*, published in 1968, left no doubt about the confusion that existed in the common and scientific nomenclature of *Nothobranchius* species. It was decided, therefore, in the first instance, to try and establish the identity of Peters' *Nothobranchius orthonotus*—a decision which met with immediate collaboration from members of the American Killifish Association and the British Killifish Association, and which now has resulted in the honor the Long Island Killifish Association has bestowed on me in the form of "The R. A. Jubb Award", a trophy for the best *Nothobranchius* in the 1975 American Killifish Association Convention and Show.

Apart from the emended description of *Nothobranchius orthonotus* published by Peters in 1868, available literature, both popular and scientific, has provided little additional evidence as to the identity of this species—in fact, three popular publications on aquarium fishes have used an illustration

of a fish which does not belong to this genus. A type specimen, obtained on loan by courtesy of the Berlin Museum, confirmed the thoroughness of Peters' emended description but added little to our knowledge of the appearance and color pattern of the living fish.

Attention had to be turned to the type locality Quelimane and the possibility of obtaining fresh material from that part of Mocambique. However, the first live specimens of *Nothobranchius* that could be identified as representing *orthonotus* came from isolated pans in the northern parts of the Kruger National Park, near the Mocambique border. These were discovered by Dr. U. de V. Pienaar. This was followed by specimens of *Nothobranchius orthonotus* from elephant drinking pans in the Gona re Zhou Game Reserve in the low-veld near the Rhodesia-Mocambique border. Mr. B. Donnelly, a Rhodesian Fish Research Officer on vacation, collected specimens from pans on the flood-plains of the Pungwe River near Vila Machado. Then final confirmation of this research work came from a large collection of *Nothobranchius* from the Lower Zambezi River system made by Mr. S. M. Grant, Guest-speaker at the 1975 American Killifish Association Convention.

Grant's collection was made near Chiromo on the flood-plains of the Shire River, a tributary of the Zambezi which is the only exit of Lake Malawi, Africa's third largest and most beautiful lake. From an ecological point of view, the Lower Shire and Lower Zambezi areas, including Quelimane, all belong to one large eco-system subject to seasonal flooding during the summer months, and dry spells extending from autumn to early spring.

Meristic and morphological studies have shown that Grant's specimens, like those of the other collectors mentioned above, represent Peters' *Nothobranchius orthonotus*. Grant's collection is particularly valuable as it is supported by color photographs and notes on the living fishes in their natural habitat. As far as vivid coloring is concerned, *Nothobranchius orthonotus* is the least attractive of the known *Nothobranchius* species. The maximum size attained by mature males varies with the habitat and population density, but, under optimum conditions male specimens of up to 100mm in total length have been recorded.

Mr. Grant's slides will be shown at the Convention but for the benefit of readers a general description of the color pattern of mature male *Nothobranchius orthonotus* follows:

- Scales: Edged with maroon or reddish-brown; scale centers iridescent sky-blue, turquoise or sea-green, the intensity of body coloration depending largely on circumstances as wild fish under stress are often quite pale.
- Dorsal fin: Membrane olive with numerous small red or reddish-brown spots and transverse bands; extremity of fin darkish and often edged with white.
- Caudal fin: Membrane dark olive with red or reddish-brown spots. In some specimens the fin rays near the base of the caudal are also red or reddish-brown.

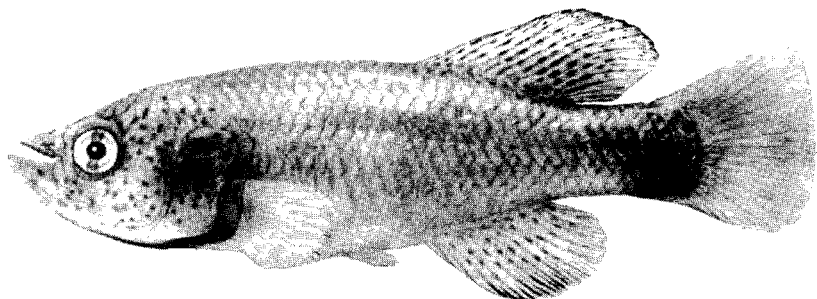


Fig. 1 *Nothobranchius orthonotus* (Peters, 1844). Male, total length 75 mm.

**Anal fin:** Membrane pale olive with numerous small magenta or reddish-brown spots and transverse bands. Extremity of fin mauve or black with white border.

**Ventral fin:** Small with red or reddish-brown spots and blotches.

**Pectoral fin:** Transparent pale olive membrane with extremity of fin streaked with red or reddish-brown.

**Ventral surface:** Golden with numerous small red or reddish-brown spots toward the caudal region.

**Eye:** Iris golden with dark vertical band through eye. In adult males eye small, the diameter going about 5 times into length of head.

**Operculum and preoperculum:** Iridescent sky-blue or sea-green with scattered, prominent red or reddish-brown spots on cheeks and operculum, the ventral border of the operculum being jet black. The spots mentioned above are a prominent feature and remain so for quite a long time after all other body color features have faded. This color pattern may have prompted Peters to use the specific name *maculata* in 1855.

**Female coloration:** Females of *Nothobranchius orthonotus* are usually smaller than the males. They are a uniform pale olive color without any dark spots on the posterior part of the body. This is very important to remember as in the vicinity of Beira another species of *Nothobranchius* has been collected, more vividly colored in the case of males but the females are distinctly spotted towards the caudal region. This species has been assigned provisionally to *Nothobranchius kubntae* (Ahl, 1926).

**Scale counts:** Lateral line series 28–30, 24–28 around the body in front of the ventrals; 4 rows of scales on cheeks below orbit, 4–5 rows on head between orbits.

**Fin counts:** Dorsal fin, 15–16 rays; anal fin, 14–17; ctenoid spines on rays. Origin of dorsal fin over origin of anal fin. Insertion of dorsal fin midway between origin of middle rays of caudal and posterior edge of preoperculum.

**Teeth:** As illustrated by Peters, upper and lower jaws with outer and inner rows of spaced, relatively large, sharp, hooked teeth, with

numerous scattered, small pointed teeth between these rows. Mouth large, directed upward.

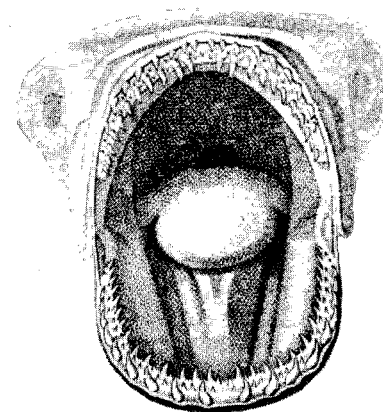


Fig. 2 Dentition of *Nothobranchius orthonotus* after Peters. Enlarged view.

**Distribution:** From the material available it can be stated that specimens of wild *Nothobranchius* which can be referred to the species *Nothobranchius orthonotus* (Peters, 1844) have been collected from the flood-plains of the Lower Zambezi River system, the flood-plains of the Pungwe River, isolated pans in the Gona re Zhou Game Reserve, isolated pans in the northern sections of the Kruger National Park, and the flood-plains of the Pongolo and Mkuze rivers in northern Zululand. The distribution of *Nothobranchius orthonotus*, in its wild state, north of the Lower Zambezi River system still has to be investigated.

Literature Cited:

- Günther, A. 1866. Cat. Fish. Brit. Mus., 6, p.326.
- Myers, G. S. 1824. A new Poeciliid fish from the Congo, with remarks on Funduline genera. Amer. Mus. Novit. 116:1-9.
- 1933. The genera of Indo-Malayan and African Cyprinodont fishes related to *Panchax* and *Nothobranchius*. Coepia: 180-185.
- Peters, W. 1844. Mon. Berl. Ac., p.35.
- 1855. Arch. f. Nat., 1, p.269.
- 1868. *Reise nach Mossamb.*, 4, p.61, pl. XII.
- Pfeffer, G. 1893. Ostafrikanische Fische gesammelt von Herrn Dr. F. Stuhlmann im Jahre 1888 und 1889. Jahrb. Hamburg Wiss. Anst., 10:131-177.
- Playfair, R. L. and Günther, A. 1866. *Fishes of Zanzibar*. John van Voorst, London, p. 118.

# Preliminary Note on the Identification of *Nothobranchius kuhntae* (Ahl, 1926) and *Nothobranchius guentheri* (Pfeffer, 1893)

R. A. Jubb

The following conclusions are based on records relating to wild fishes and preserved material, and particular attention has been paid to the coloration of mature males and females.

Writing on the coloration of mature Cichlids of the Great Lakes of Africa, Fryer and Iles (1972) have this to say: "Conspicuous colors appear to have two main functions. Like color patterns they serve as recognition marks, identity cards as it were, which inform members of their own species—and other species—of their kinship or lack of it. The ability to recognize members of one's own species is of tremendous importance in nature, and the ways in which this is achieved are various and by no means always understood. Thus when we say that colors are used by Cichlids as an aid to recognition we are only drawing inferences from the evidence we see in nature. The evidence, however, is reasonably convincing. Cichlids often occur in complex communities in which many species, some of which are closely related, find themselves in more or less intimate contact. While there are exceptions, in general it is among the Cichlids of the most complex and densely crowded communities, where the problems of recognition are likely to be most acute, that most brilliant colors are to be found. It is at the time of mating that specific recognition is particularly important for should the system of recognition break down interspecific hybridization becomes possible in nature."

In discussing the evolution and speciation in the species flock of Cichlid fishes of Lake Victoria, Greenwood (1959) has this to say: "In many cases it was found that morphologically identical species had distinctive male breeding coloration."

In attempting to identify the described *Nothobranchius* species, the above characteristics have been applied to this group of fishes as well. The species of *Nothobranchius* fall into two groups of morphologically closely related species. To mention some of the better known species, these are:

- Group 1. *Nothobranchius orthonotus* (Peters, 1844).  
*Nothobranchius kubntae* (Ahl, 1926).  
*Nothobranchius guentheri* (Pfeffer, 1893) with which must be included *N. melanospilus* (Pfeffer, 1896).  
*Nothobranchius neumanni* (Hilgendorf, 1905).  
*Nothobranchius palmquisti* (Lonnberg, 1907).
- Group 2. *Nothobranchius taeniopygus* (Hilgendorf, 1888).  
*Nothobranchius brieni* (Poll, 1938).  
*Nothobranchius rachovii* (Ahl, 1926).  
*Nothobranchius kirki* (Jubb, 1969).  
*Nothobranchius furzeri* (Jubb, 1971).

In their wild state, mature males—and indeed in some cases mature females—all have a distinctive color pattern. Future and current research may indicate a rearrangement of these species but, it is of interest to note that the males of Group 1 tend to grow to a larger size in nature than those of Group 2. The maximum size attained by mature males in nature is variable as it depends on the duration of the habitat which is usually a temporary, inundated pan; the population density in relation to the size of the habitat; the amount of natural food available; the changing chemical condition of the water and prevailing weather conditions. It is also of interest to note that Scheel (1968) found the haploid chromosome number of *N. rachovii*, Group 2, to be 9, and that of what he considered to be *N. orthonotus* to be 18, *N. palmquisti* 18 and *N. guentheri* 19.

## *Nothobranchius kuhntae* (Ahl, 1926)

Apart from the original description of specimens from Mocambique (Ahl, 1926) the first indication of the identity of *N. kubntae* and its locality came from the writings of Roloff (1959) and Turner (1964) who described specimens of *Nothobranchius* collected near Beira, Mocambique. These specimens were, at that time, identified as representing *Nothobranchius rachovii* and *Nothobranchius orthonotus*. However, the descriptions of those assigned to *N. orthonotus* were of a far more attractive species than what is now recognized as representing *N. orthonotus*, the male being particularly attractive with brilliant red markings on the scales, fins, and spots on the cheeks. In addition to this, the female was decorated with red spots on the body and fins, quite unlike the plain dress of the female of *N. orthonotus*. Later the distinctive color pattern of *N. kuhntae* was confirmed by color slides sent to me by Steve Sellers of a *Nothobranchius*, designated U-4, which came from Vila Machado, Mocambique. More recently Darel Plowes of Umtali, Rhodesia, sent me slides of specimens of *N. kubntae* collected from pans on the Pungwe River flood-plains between Muda and Tika which are on the main road between Vila Machado and Beira. Plowes collected his material in 1970. In fact an excellent illustration of a mature male and fe-

male *N. kubntae* appears on page 781 of the 1871 edition of the *Encyclopedia of Tropical Fishes* by Axelrod and Vorderwinkler, published by T. F. H. Publications. This illustration from a color slide taken by Roloff shows up the brilliant markings of the male and also the red spots on the body and fins of the female. The caption reads *Nothobranchius melanospilus* but this is a misidentification.

*N. kubntae* occurs in pans and inundated areas along the seasonal flood-plains of the Pungwe River between Vila Machado and Beira in Mocimboa do Batuque. Future collecting may extend this distribution. It occurs together with *N. orthonotus* in some places and is also found together with *N. rachovii*. Beauty is in the eye of the beholder I admit, but *N. kubntae* and *N. rachovii* of the Pungwe River flood-plains are, to me, the most colorful of the *Nothobranchius* species—even more attractive than that remarkable species *Nothobranchius korthausae* Meinken, 1973, described from Mafia Island which lies off the coast of Tanzania.

The fact that *N. orthonotus* and *N. kubntae* are sympatric in the vicinity of Beira may account for the confusion of the two species when dealing with preserved material, but living specimens from their native habitat can hardly be confused. Confusion with *N. melanospilus* may be due to the fact that when preserved, especially in 5% formalin, the red spots on the body of the females tend to turn black.

### *Nothobranchius guentheri* (Pfeffer, 1893)

For three successive years Dr. R. G. Bailey of the Fisheries Laboratory, Central Agricultural Research Centre, Ilonga, Kilosa, Tanzania, studied populations of wild *Nothobranchius*, later determined as *N. guentheri*, in seasonal ponds near Ilonga. His intensive field observations on the biology of these fishes, subsequently added to by a taxonomic study of preserved material from Ilonga and material housed in the British Museum, London, enabled him to publish a valuable paper on the biology of *Nothobranchius guentheri*, and to conclude that *Nothobranchius melanospilus* (Pfeffer, 1896) is a synonym of *N. guentheri* (Bailey, 1972). I have personally examined typed material in the British Museum and I agree with Bailey. Dr. Bailey's paper should be read by all aquarists.

The type specimens of *N. guentheri* were collected by Sir Lambert Playfair in 1864 and were recorded as coming from Zanzibar. In those days Zanzibar included the island of Zanzibar and a strip of the African mainland opposite it. On referring to the map of Tanzania it will be seen that Kilosa is opposite Zanzibar and can be considered to be within the type locality of *N. guentheri*.

There is some confusion about the type specimens of *Nothobranchius melanospilus*. Boulenger (1915) records five type specimens, all females, also collected by Playfair, as coming from the Seychelles. Pfeffer (1896) based his description of *N. melanospilus* on four specimens from

Longa Bay, Tanzania, which is also within the type locality of *N. guentheri*. At the same time Pfeffer considered that Playfair's specimens, recorded as coming from the Seychelles, represented a different species. This was followed much later by Ahl who, in 1935, described Playfair's specimens as a new species, *Nothobranchius seychellensis*. Professor J. L. B. Smith carried out an intensive survey of the fish fauna of the Seychelles in 1954 and failed to find *Nothobranchius* on the islands (Smith, 1963). This confusion is best resolved by considering Playfair's *Nothobranchius* from the Seychelles as being incorrectly labelled as far as locality is concerned, and that *N. seychellensis* is a synonym of *N. melanospilus*.

From Bailey's work it is now possible to identify *N. guentheri* from its morphology, color pattern, and the fact that mature females have scattered black spots, especially towards the posterior part of the body. Here in South Africa, Mr. N. Nathan of Bloemfontein, an experienced *Nothobranchius* enthusiast, has been raising fish from commercially obtained eggs labelled as *N. melanospilus*. From his detailed descriptions, color slides and preserved material it has been possible to obtain mature specimens which agree with Bailey's findings. An excellent illustration of *Nothobranchius guentheri* (Pfeffer, 1893), as we should recognize it today, will be found on page 300 of Scheel's classic *Rivulins of the Old World* (Scheel, 1968).

By accepting Bailey's diagnosis of the identity of *N. guentheri* and *N. melanospilus* we raise the question of the identity of the species that have been regarded as representing *N. guentheri* by most aquarists for many years. Scheel (1968) in discussing *N. guentheri* states: "The *guentheri* name frequently has been used for aquarium strains of *Nothobranchius*. It is, however, highly doubtful whether most of these strains are Pfeffer's *guentheri*. It seems that three distinct species of *Nothobranchius* have been known under the *guentheri* name amongst aquarists." From Scheel's remarks it will be realized that a great deal of work still has to be carried out on the taxonomy of the *Nothobranchius* previously considered to represent Pfeffer's *guentheri*. In this work I am fortunate in having the collaboration of Mr. N. Nathan of Bloemfontein, and the collaboration of Dr. R. J. Lesseps, S.J., of the Katholieke Universiteit, Toernooiveld, Nijmegen, Holland. Dr. Lesseps has been working on the biology of *Nothobranchius neumanni* and I have been able to compare his preserved material with the type specimens in the British Museum. I have been able to compare his photographs in color with numerous illustrations of species referred to as *N. guentheri* and it may well be that *N. neumanni* has been overlooked. This does not, however, account for all the species going under the name of *N. guentheri*.

The species *Nothobranchius palmquisti* is still being studied. In so far as the color pattern goes, a good illustration of a mature male will be found on page 345 of Scheel's *Rivulins of the Old World*, and on page 94 of *The Complete Aquarist's Guide to Freshwater Tropical Fishes* by Gilbert & Legge, published by Ward Lock Ltd., London. These agree with slides by Dr. R. Haas taken in America.

Note on Color Photography

Modern color photography can usually give an extremely pretty picture, but this does not mean that the colors are quite correct—different effects can be obtained using different lighting. At the same time no two males in their mature dress are identical. Variation in photography and male plumage of *N. rachovii* is shown clearly on pages 360 and 361 of Scheel's *Rivulins of the Old World*. At the same time variations can occur in the actual printing so that careful study of printing proofs must be made in the proof stage. To enable the photographer to correct for any errors in film processing, Mr. Nathan places a small red plastic disc or strip on the extreme left of the field of focus. This enables any correction to be made when studying the slide.

Literature Cited:

- Ahl, E. 1926. Neue oder selten importierte Fische, III. Bl. Aquarienkunde Stuttgart 37: 346.
- 1935. Über neue oder seltene afrikanische Zahnkarpfen der Gattungen *Aphyosemion* und *Nothobranchius*. Zoo. Anz., Leipzig 112:123-129.
- Bailey, R. G. 1972. Observations on the Biology of *Nothobranchius guentheri* (Pfeffer) (Cyprinodontidae), an annual fish from the coastal region of East Africa. Afr. J. Trop. Hydrobiol. Fish. 2(1): 33-43.
- Boulenger, G. A. 1915. *Catalogue of the Freshwater fishes of Africa*, 3, 526 pg.
- Fryer, G. and Iles, T. D. 1972. *The Cichlid Fishes of the Great Lakes of Africa*. T. F. H. Publications.
- Greenwood, P. H. 1959. Evolution and speciation in the *Haplochromis* fauna (Pisces: Cichlidae) of Lake Victoria. Proc. int. Congr. Zool. 15:147-150.
- Hilgendorf, F. M. 1888. Fische aus dem Victoria-Nyanza, gesammelt von dem verstorbenen Dr. G. A. Fischer. Sitzber. ges. natf. Fr., Berlin, 75-78.
- 1905. Fische von Deutsch und Englisch Ost-Africa. Zool. Jarhb. Syst. 22:405-420.
- Jubb, R. A. 1969. The *Nothobranchius* (Pisces; Cyprinodontidae) of Southern Africa and a new species from Lake Chilwa, Malawi. Ann. Cape Prov. Mus. (Nat. Hist.) 8(1):1-11.
- 1972. A new *Nothobranchius* (Pisces, Cyprinodontidae) from Southeastern Rhodesia. J. Amer. Killifish Assn. 8(1):12-19.
- Lönnberg, E. 1907. *Sjostedts Kilimandjaro-Meru Expedition*, 5, Upsala.

- Peters, W. 1844. Monatschr. Akad. Wiss., Berlin.
- Pfeffer, G. 1893. Ostafrikanische Fische gesammelt von Herrn Dr. F. Stuhlmann im Jahre 1888 und 1889. Jahrb. Hamburg. Anst. 10:131-177.
- 1896. *Deutsch Ost Afrikas. Die Fische Ost Afrikas*, III. Dietrich Reimer, Berlin.
- Playfair, R. L. and Günther, A. 1866. *Fishes of Zanzibar*. John van Voorst, London, p.118.
- Poll, M. 1938. Poissons du Katanga (bassin du Congo) recoltés par le professeur Paul Brien. Rev. Zool. Bot. Afr. 30:389-423.
- Roloff, E. 1959. Collecting and breeding the *Nothobranchius* species. Trop. Fish Hobbyist 7(10):12-19.
- Scheel, J. J. 1968. *Rivulins of the Old World*. T. F. H. Publication, 473 pp.
- Smith, J. L. B. 1963. *The Fishes of the Seychelles*. Dept. Ichthyology, Rhodes University, Grahamstown.
- Turner, B. J. 1964. An introduction to the fishes of the genus *Nothobranchius*. I. African Wild Life 18(2):117-124.

# The *Nothobranchius* Species of Malawi, Africa

R. A. Jubb

Lake Malawi, which appears on older maps as Lake Nyasa, the third largest of the great lakes of central Africa, is about 320 miles long and has a maximum width of approximately 50 miles. Its computed area is 11,600 square miles. The mean water surface is in the order of 1,500 feet above sea level, and in the deepest part near the northern end its floor descends to about 700 feet below sea level; that is to say the greatest depth is in the order of 2,200 feet. The Lake occupies the greater part of a deep trough of a southern portion of the Great Rift Valley system. The sides of the trough, in the north, rise high above the Lake water level and here amidst magnificent scenery the Livingstone Mountains rise steeply to a height of 7,000 feet above the Lake. The southern portion of the Lake is much shallower and here there are coastal plains of varying widths where seasonally inundated pans and marshes provide habitats for *Nothobranchius*.

The Lake has only one outlet, the Shire River. The upper portion of the Shire for at least 50 miles is a continuation southwards of the Great Rift Valley. Here the gradient of the river is very low but once past Liwonde the gradient increases and via a series of cataracts and rapids the Shire drops some 1,200 feet to the Lower Shire Valley to join the Lower Zambezi near Sena. The flood-plains of the Shire River between Chiromo and Port Herald also provide suitable habitats for *Nothobranchius* and it is here that Mr. S. M. Grant has been able to collect a fine series of *Nothobranchius orthonotus* and study living material in the field.

As far as the fish fauna is concerned Lake Malawi, including its catchment, is a compact zoogeographical entity. While there are a number of strictly fluviatile species, the fish fauna is dominated by the host of Lake Malawi endemics. Of the 242 species listed by P. B. N. Jackson (Jackson, 1961) 220 occur only in the Lake and affluent rivers and nowhere else in the world. These have evolved within the Lake and form one of the most interesting assemblages of fishes in the world, many of them being beautifully colored and of considerable interest to the aquarist. Many of them are closely related and rather difficult to distinguish from one another. Each species, however, is adapted to a certain habitat and way of life for which the fish has been wonderfully modified, especially, for example, in the dentition among Cichlids, which is much the largest family present.

Jackson's checklist of the fishes of Malawi (Jackson, 1961) mentions two sites from which *Nothobranchius* were collected. These were marshy

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Albany Museum, Grahamstown, South Africa

areas near Monkey Bay and Mangochi (Fort Johnstone), both at the southern end of the Lake. These specimens, collected as far back as 1925, were assigned to the species *Nothobranchius orthonotus* Peters, but, as will be discussed below, this may probably prove to be incorrect.

Within the Lake basin, collections by S. M. Grant covered sites between Salima and Liwonde, and a good series of specimens, together with color slides of the habitats and living fishes, were sent to the Albany Museum, Grahamstown, for identification. Three distinct species appear to be represented:

1. From near Salima a species closely resembling *Nothobranchius kirki* Jubb, which was described from a site near Lake Chilwa (Jubb, 1969). This species has been designated *Nothobranchius cf. kirki*.
2. From near Mangochi a small species, as yet not positively identified, belonging to the *Nothobranchius taeniopygus/Nothobranchius palmquisti* group.
3. From near Liwonde, which is on the Shire River above the Murchison Cataracts, a large species morphologically identical with *Nothobranchius orthonotus* Peters, but differing in that mature males lack the red or brick-brown spots on the cheeks and their overall coloring is not as attractive as that of true *Nothobranchius orthonotus* from most sites along the Lower Zambezi or south of this. This species, pending further investigation, has been designated *Nothobranchius cf. orthonotus*.

From investigation carried out by Dixey (Dixey, 1926) there is evidence that changes have taken place in the Lake Malawi drainage during its evolution. Dixey postulated a link during the Pleistocene between the north of Lake Chilwa and the Upper Shire River, the principal drainage of Lake Chilwa at that time being into the Ruo River and thence into the Lower Shire River which flows into the Lower Zambezi River drainage system. Evidence in favor of this hypothetical link between the evolving Lake Malawi and the Lower Zambezi River in past geological times can be found by examining the distribution of the non-endemic fish species which occur in the Lake today. The majority of these are widely distributed in the Zambezi River system and rivers south of it. At the same time the large number of endemic fish species which have evolved in the Lake, and which are found nowhere else in the world, indicate that Lake Malawi has been isolated from the Lower Zambezi River or any other drainage system for a long period of geological time. This isolation could account for the morphological differences, which are chiefly to be found in the color pattern of mature males, between *Nothobranchius kirki* of the type locality near Lake Chilwa and those of *Nothobranchius cf. kirki* from the Salinga area. The same explanation could be used for the differences between *Nothobranchius orthonotus* from the Lower Shire flood-plains and those, designated *Nothobranchius cf. orthonotus*, collected by Grant in the vicinity of Liwonde.



The specimens from the Mangochi area, as yet not positively identified, are also of great interest in this discussion as they resemble an unidentified *Nothobranchius* from the Pungwe River flood-plains north-east of Vila Pery in Mocambique. Sufficient material from this latter site is not available yet for direct taxonomical comparison with material from Mangochi. At this stage little more can be said about the Mangochi *Nothobranchius* beyond that it is a small species of the *taeniopygus* / *palmquisti* group. In coloration mature females are unspotted with an overall silvery olive color. Mature males could be mistaken for *Nothobranchius palmquisti* as illustrated in Scheel, page 344 of his *Rivulins of the Old World*, and this line of research will be followed up when more material from Mocambique becomes available. The specimens in the British Museum, collected near Mangochi, then known as Fort Johnstone, by Christy in 1925 will have to be examined as they probably belong to this unidentified species.

#### Literature Cited:

- Dixey, F. 1926. "The Nyasa section of the Great Rift Valley." *Geogr. J.* 68:131-133.
- Jackson, P. B. N. 1961. "Checklist of the fishes of Nyasaland." *Occasional Papers of the National Museum of Southern Rhodesia*, No. 25B.
- Jubb, R. A. 1969. "The *Nothobranchius* (Pisces, Cyprinodontidae) of Southern Africa and a new species from Lake Chilwa, Malawi." *Ann. Cape Prov. Mus.*, 8 (1):1-11.
- Kirk, R. G. 1967. "The zoogeographical affinities of the fishes of the Chilwa-Chiuta Depression in Malawi." *Rev. Zool. Bot. Afr.* 76 (3-4):295-312.
- Scheel, J. J. 1968. *Rivulins of the Old World*. T. F. H. Publications, Jersey City, U.S.A. 473 pp.

## Appendix

### Checklist of Known *Nothobranchius* Species

- Nothobranchius brienii* Poll, 1938. Congo and Upper Zambezi River systems.
- Nothobranchius eiminki* Ahl, 1935. Tanzania. Females spotted. Probably synonym of *N. guentheri*.
- Nothobranchius furzeri* Jubb, 1971. Southeast Rhodesia near the Mocambique border.
- Nothobranchius gambiensis* (Svennson, 1933). Gambia. According to Scheel belongs to genus *Fundulosoma*.
- Nothobranchius guentheri* (Pfeffer, 1893). Tanzania. Females spotted.
- Nothobranchius kirki* Jubb, 1969. Lake Chilwa, Malawi.
- Nothobranchius kiyawensis* Ahl, 1928. Nigeria. According to Scheel belongs to genus *Aphyosemion*.
- Nothobranchius korthausae* Meinken, 1973. Mafia Island off coast of Tanzania.
- Nothobranchius kubntae* Ahl, 1926. Beira, Mocambique. Females spotted, males spotted red on cheeks.
- Nothobranchius mayeri* Ahl, 1935. Beira, Mocambique. From description this is a synonym of *N. kubntae*.
- Nothobranchius melanospilus* (Pfeffer, 1896). Tanzania. Females spotted. Synonym of *N. guentheri*.
- Nothobranchius microlepis* (Vinciguerra, 1897). Somalia. No other material known.
- Nothobranchius mkuziensis* (Fowler, 1934). Mkuzi River, Zululand. Synonym of *N. orthonotus*.
- Nothobranchius neumanni* (Hilgendorf, 1905). Tanzania. Females not spotted.
- Nothobranchius orthonotus* (Peters, 1844). Quelimane, Central and Southern Mocambique, Southern Malawi.
- Nothobranchius palmquisti* (Lonnberg, 1907). Tanzania.
- Nothobranchius patrizii* (Vinciguerra, 1927). Somalia. No other material known.
- Nothobranchius rachovii* Ahl, 1926. Beira. Central Mocambique southwards to Eastern Transvaal.

- Nothobranchius robustus* Ahl, 1935. Tanzania. Probably a synonym of *N. neumanni*.
- Nothobranchius rubroreticulatus* Blache & Miton, 1960. Republic of Chad.
- Nothobranchius seychellensis* Ahl, 1935. Described from incorrectly labelled specimens originally collected by Playfair and described as *Fundulus melanospilus* by Pfeffer in 1896. These were females of *N. guentheri*. The genus *Nothobranchius* is not represented in the Seychelles.
- Nothobranchius taeniopygus* (Hilgendorf, 1888). Uganda south to Zambia.
- Nothobranchius troemneri* (Myers, 1926). No locality. Synonym of *N. orthonotus*.
- Nothobranchius vosseleri* Ahl, 1924. Tanzania. Not a valid species. See Scheel, page 433.