

FISHES OF THE CYPRINID GENUS *TOR* IN THE NAM THEUN WATERSHED (MEKONG BASIN) OF LAOS, WITH DESCRIPTION OF A NEW SPECIES

Tyson R. Roberts

Research Associate, Smithsonian Tropical Research Institute.

Corresponding address: Capital Mansion, 1371 Phaholyotin Road, Sapankhwai, Bangkok 10400, Thailand.

ABSTRACT. - Three species of *Tor* are reported from the Nam Theun watershed in central Laos: *Tor tambra*, *T. sinensis*, and *T. ater* new species. They are distinguished by differences in scale counts, length of mental lobe, and coloration of body and fins (particularly the pelvic, anal and caudal fins). Adults and subadults of all three species have striking coloration, *T. tambra* predominantly yellowish-green, *T. sinensis* red, and *T. ater* black. In the Nam Theun and elsewhere in the Mekong basin, the juveniles of *T. tambra* are silvery with yellow or yellowish-orange fins, while juveniles of *T. sinensis* are silvery with red or pink fins. Juveniles of *T. ater* are unknown. *T. tambra* and *T. sinensis* have large scales, while *T. ater* has relatively small scales; *T. tambra* in the Nam Theun and *T. ater* have short mental lobes, *T. sinensis* a long mental lobe. Further study is needed to determine the identification of *Tor* species in the upper Mekong within the Yunnan Province of China, and in the lower Mekong of southern Laos and Cambodia. *T. laterivittatus*, recently described from the Mekong basin in Yunnan, is identified as a synonym of *T. sinensis*.

Systematics of *Tor* in the Malay Peninsula, Sumatra, Borneo and Java is confusing. All of the specimens have large scales. For the time being, two species are recognised, *T. tambra* (with a short mental lobe) and *T. tambroides* (with a long mental lobe), but there may actually be only a single species, highly variable in length of mental lobe and size at sexual maturity. Juveniles and adults sexually mature at small sizes (150-200 mm) are silvery with yellow, orange, pink or pale red fins irrespective of the length of the mental lobe. Coloration of large adults is poorly known (especially with regard to length of mental lobe).

INTRODUCTION

Fishes of the tropical and subtropical Asian cyprinid genus *Tor* live in large, relatively cool mountain tributaries of the Mekong River in north-eastern Cambodia, Laos, and the Yunnan Province of China. They are rare or absent in the Mekong mainstream, and in Mekong

tributaries in Thailand. Two large-scaled species are common in the Mekong tributaries of Laos, known as 'pba daeng' and 'pba tohn' in the Lao language, but have not been scientifically reported previously. These are now identified as *Tor tambra* and *T. sinensis*. Both occur in the Nam Theun basin of central Laos. A third species from the Nam Theun, with small scales and distinctive coloration, apparently very rare and with no Lao name reported, is described as *T. ater*, new species.

Knowledge of Mekong *Tor* was very limited until publication of the paper on the species in Yunnan by Zhou & Cui (1996). These authors recognized five species: *Tor douronensis* and *T. tambroides*, both described from Java; and *T. tor sinensis*, *T. laterivittatus* and *T. polylepis*, described from the Mekong basin in Yunnan. They did not compare their Yunnanese material identified as *T. douronensis* and *T. tambroides* with Javanese material, and as they noted, their identifications of these species are doubtful.

In this paper, *Tor sinensis* is regarded as a distinct species, not a subspecies of *T. tor*. The holotype is based on a juvenile of the nominal species *T. laterivittatus* which Zhou & Cui (1996) based on three large specimens. *T. polylepis* appears to be a valid species known only from two large specimens collected in Yunnan in 1959 and 1986.

In a recent review of the early *Tor* material collected in Java by Kuhl and van Hasselt, I treated *Tor douronensis* and *T. tambroides* as junior synonyms of *T. tambra* (Roberts, 1993). This paper was not cited by Zhou & Cui. The specimens from Yunnan reported by them as *T. douronensis*, all juveniles, are tentatively identified here as *T. tambra*. Identification of the large specimen they reported as *T. tambroides* is uncertain, but might be *T. sinensis*.

Three species are reported here from the Nam Theun watershed of Laos: *Tor tambra*, *T. sinensis*, and *T. ater*, new species. The specimens were collected during environmental impact assessment for various hydropower projects.

Systematic status of *Tor* species from the Malay Peninsula and Indonesia is discussed in the light of knowledge of the Mekong species and of specimens in the Zoological Reference Collection of the Department of Biological Sciences, National University of Singapore (ZRC). Sizes of specimens are given as standard length.

***Tor* Gray, 1834**

Tor Gray, 1834: pl. 96. Type species *Cyprinus tor* Hamilton, 1822, by absolute tautonymy. Gender masculine.

Diagnosis. - Distinguished from most other barbine cyprinid genera by having a fleshy median mental lobe. Last simple dorsal fin ray non-serrate. Scales large, lateral scale series 22-35, predorsal scales 7-14, and transverse scales 4-5/1/2-3. Vertebrae 24-27+14-16=39-43.

***Tor tambra* (Valenciennes, 1842)**

(Fig. 1)

Barbus tambra Valenciennes, in Cuvier and Valenciennes, 1842: 190 (type locality: Buitenzorg, western Java).

Tor douronensis - Zhou & Cui, 1996: 134, figs. 4-6 (Yunnan).

Material examined. - From Nam Theun watershed: ZRC 40349, 101 mm, Nam Theun at Ban Talang (=Ban Signo), P. Vongsay, Jul.1995; ZRC 40347, 98 mm, Nam Theun above Theun-Hinboun dam site, N. A. Hvidsten & P. Vongsay, 14 Feb.1995; ZRC 40348, 97.4 mm, Nam On at Ban Sop On, Nam Theun 2 project area, P. Vongsay, Oct.1995. In addition to catalogued material examined, large numbers of this species representing all sizes from very small to 1 m were observed in fresh condition in the Se Kong as well as the Nam Theun watershed in Laos.

Diagnosis. - Mentum short. Scales in lateral series 21-24; predorsal scales 7-10; transverse scale rows 4/1/2. Total gill rakers on external face of first gill arch 16-22. Juveniles (in Mekong basin) silvery, pelvic fins yellow with white lateral margin. Adults without lateral stripe, predominantly yellowish-green in color. Vertebrae 25-17+14-16=39-43 in Nam Theun watershed, 24-25+14-16=39-41 in the Malay Peninsula, Borneo and Java (see Table 1).



Fig. 1. *Tor tambra*. Tuberculate male about 1 m long (not preserved) landed at Tha Bac, Nam Theun, 50 km south of Laksao on 5 June 1995.

Table 1. Counts of gill rakers and vertebrae in Southeast Asian *Tor*.

| | gill rakers | | | | | | | | | | vertebrae | | | | |
|-----------------------|-------------|----|----|----|----|----|----|----|----|----|-----------|----|----|----|----|
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 39 | 40 | 41 | 42 | 43 |
| <i>Tor ater</i> | | | | | | | | | | | | | | | |
| Nam Theun | 1 | | 1 | 1 | | | | | | | | | | | 3 |
| <i>Tor sinensis</i> | | | | | | | | | | | | | | | |
| Nam Theun | | | | | | 2 | 4 | 2 | 1 | 1 | | | 2 | 6 | 2 |
| Houai Mor | | | | | | | | | | 1 | | | | 1 | |
| <i>Tor tambra</i> | | | | | | | | | | | | | | | |
| Nam Theun | | | 2 | | 1 | | | | | | 1 | 1 | | | 1 |
| Java* | | | | | 1 | 1 | | | | | | 1 | 1 | | |
| Pahang | | 1 | 2 | 6 | 5 | 1 | | | | | 1 | 11 | 3 | | |
| Danum | | | 2 | 2 | 1 | 1 | | | | | 6 | 9 | 1 | | |
| Brunei | | 1 | | | | | | | | | | | | 1 | |
| Sarawak | | | | | | | | 1 | 1 | | | 2 | | | |
| <i>Tor tambroides</i> | | | | | | | | | | | | | | | |
| Pahang | | | | | | | 3 | 2 | 3 | 1 | 3 | 6 | | | |
| Endau | | | | | | | | 1 | 1 | | | | | 2 | |
| Danum | | | | | 1 | | | | | | | | | | |
| Brunei | | | 1 | | | | | | | | 1 | | | | |
| Long Padas | | | 2 | 1 | | 1 | | | | | 2 | 2 | | | |

* data from Roberts, 1993.

Tuberculation. - The large *T. tambra* photographed at Tha Bac in November, 1995 (Fig. 1), presumably a male, has extremely numerous parallel or nearly parallel longitudinal rows of close-set fine tubercles covering virtually the entire side of the face. A 485 mm presumed male from Peninsular Malaysia (ZRC 9554) has similar tuberculation, except that the rows of tubercles and number of tubercles are fewer.

Vertebral counts, length of mental lobe, and fin coloration. - The range of vertebral counts for *T. tambra* from the Nam Theun watershed, although based on only three specimens, is as great as that known for all *Tor* species in Southeast Asia, and is greater than that known for *T. tambra* from Malaysia and Indonesia. As indicated in Table 1, two Nam Theun specimens with 39 and 40 are typical of the species throughout its range, but one has the highest known count of 43. This specimen and its radiograph have been examined to verify the vertebral count ($27+16=43$) and identification as *T. tambra*. It does have a very short mental lobe. Unfortunately the fin coloration of this 97.5 mm specimen from Nam On was not noted in life. It is possible that it is a specimen of *T. sinensis* with an unusually short mental lobe. During my fieldwork in Laos, I have checked the fin color of hundreds of large-scaled *Tor* with short mental lobes. Without exception, these specimens had yellow or yellowish-orange (not pink or reddish) pelvic fins. All Laotian large-scaled *Tor* with long mental lobes examined for fin color had pinkish or red pelvic fins.

Comments. - Identification of Mekong *Tor* with species originally described from Java by Zhou & Cui (1996) is problematic because these authors did not have access to the types or other Javanese material, or even data from Javanese material. The Mekong specimens identified here with the species originally described as *T. tambra* from Java have ranges of gill raker, scale and vertebral counts identical or very similar with Javanese *T. tambra*. The species is apparently widely and continuously distributed in suitable large mountain streams

in Java, Borneo, the Malay Peninsula, and the Mekong basin. Although adequate information on coloration of living juveniles and adults is available only from the Mekong basin, counts of gill rakers, scales, and vertebrae fit well with the hypothesis of a single species throughout this range. It may be noted that *T. douronensis* (Valenciennes) has been identified as a junior synonym of *T. tambra* (see Roberts, 1993: 22).

***Tor sinensis* Wu, 1977**

(Fig. 2)

Tor tor sinensis Wu, 1977: 325 (type locality: Lancanjiang [= Mekong] basin, Yunnan Province, China).

Tor laterivittatus Zhou & Cui, 1996: 138, figs. 10-11 (type locality: Nanla River near Mengla, Mekong basin, Yunnan Province, China).

? *Tor tambroides* - Zhou & Cui, 1996: 139, figs. 12-13 (Mengla County, Yunnan Province, China).

Material examined (all specimens from Mekong basin in Laos). - Nam Theun watershed: ZRC 40354, 6: 83.5-118 mm, Nam Theun below Geng Wang Fang (near Mekong mainstream), N. A. Hvidsten & P. Vongsay, 18 Feb.1995; ZRC 40355, 2: 107-141 mm, Nam Theun at Theun-Hinboun hydropower project dam site, N. A. Hvidsten & P. Vongsay, 8 Feb.1995; ZRC 40351, 85.7 mm, Nam Theun above Theun-Hinboun hydropower project dam site, N. A. Hvidsten & P. Vongsay, 14 Feb.1995; ZRC 40352, 108 mm, Houai Kor near Ban Nan Nien, T. R. Roberts & P. Vongsay, 18 Nov.1995; ZRC 40353, 111 mm, Nam On at Ban Sop On, P. Vongsay, Oct.1995. Houai Mor watershed: ZRC 40358, 465 mm, Nam Houai Mor near Ban Houai Mor, Wang Wien Road, 100 km north of Vientiane (purchased in Vientiane market), T. R. Roberts, 20 Apr.1995. In addition to catalogued material, specimens of various sizes were examined in fresh condition in the Se Kong as well as Nam Theun watersheds in Laos.

Diagnosis. - Mentum long, usually reaching posteriorly to or beyond junction of upper and lower lips; soft oral structures tend to be more hypertrophied than in other *Tor* species (rostral cap larger, and more overhanging; small fleshy flap often extending posteriorly from junction of upper and lower lips; lips often moderately to greatly thickened) especially in larger individuals. Gill rakers on lateral face of first gill arch 20-22. Scales in lateral series 23-24; predorsal scales 8-10 (usually 9); transverse scale rows 4/1/2. Juveniles overall silvery; pectoral, pelvic, anal, and caudal fins rosy to reddish; adults and subadults with a deep, dark midlateral stripe, body darkish above and brownish or bronzy beneath; pectoral, pelvic, anal, and caudal fins deep red. Vertebrae 25-27+15-16=41-43.

Comments. - The types of *Tor tor sinensis* originally described by Wu and the additional material reported from the Mekong basin in Yunnan by Zhou & Cui are all juveniles apparently with uniform body coloration, ranging from 56 to 298 mm. *Tor laterivittatus* is based only on three fairly large adults or subadults of 280, 410, and 475 mm. At about 250 to 400 mm the silvery juvenile body coloration changes over to the more pronounced and highly distinctive coloration of adults. A fresh 291 mm specimen of *T. sinensis* from Yunnan appears to have a faint stripe (Zhou & Cui, 1996: fig. 14). A 380 mm specimen reported as *T. tambroides* (Zhou & Cui, 1996: fig. 12) also appears to have a faint stripe (possibly faint because of long storage in formalin). Adults of both sexes similarly colored. Vertebral counts in the material I have seen of this species are nearly all slightly higher than those of *Tor* from Malaysia and Indonesia.

The holotype of *Tor sinensis* (in the Institute of Hydrobiology, Wuhan, China) has not been examined by me, but was examined by Zhou (Zhou & Cui, 1996: 142). In placing *T. laterivittatus* as a synonym of *T. sinensis*, I have relied on the account of *T. sinensis* in Zhou

& Cui (1996); there seems no reason to doubt that their identification of this material as correct.

True *Tor tambroides* evidently do not occur in the Mekong basin. The report from the Mekong basin in Yunnan by Zhou & Cui is based on a single 380 mm specimen identified here as *T. sinensis*. By true *T. tambroides*, it is meant a large-scaled *Tor* with a long mentum and no lateral stripe in large adults. *Tor tambroides* is tentatively regarded by me as a variety or morph of *T. tambra*.

Tor sinensis is known throughout Laos by the Lao Loom name 'pba daeng' (literally: red fish). Native villagers report that it undergoes upstream reproductive migrations in the mainstream and larger tributaries of the Nam Theun in such large numbers that "the rivers turn red". In addition to the Nam Theun, Nam Hinboun, and Xe Bang Fai (see material examined), this species occurs in the Se Kong and upper Nam Ngum in Laos. In the Se



Fig. 2. *Tor sinensis*. ZRC 40358, 465 mm. Nam Houai Mor at Ban Houai Mor, on Wong Wien Road about 100 km north of Vientiane. Purchased in Vientiane market on 20 April 1995.

Kong, as elsewhere in Laos, juveniles often occur sympatrically with *T. tambra*. As in Nam Theun, they are readily distinguished by differences in fin color and length of the mental lobe.

***Tor ater*, new species**

(Fig. 3)

Material examined. - Holotype, ZRC 40356, 308 mm, Nam Theun at Ban Talang, T. R. Roberts & P. Vongsay, Sep.1995.

Paratypes - ZRC 40357, 2: 269-332 mm, collected with holotype.

Diagnosis. - A relatively small-scaled species, scales in lateral series 30-31, predorsal scales 11-12, and transverse scales 5/1/2. Mental lobe well-developed but very short, shorter even than in *T. tambra*. Adults or subadults with a dark midlateral stripe on body and all fins very dark, almost black (fin coloration of juveniles unknown, but presumably not red or yellow, because these colors persist through life in other *Tor*). Vertebrae 28+15=43 (3).

Coloration. - All three specimens were retrieved only a few days after they had been caught and put in formalin by a local fisherman at Ban Talang. The coloration, identical in the three specimens, appeared very fresh. Eyes with red iris. Body with a dark midlateral stripe. Dorsolateral surface of head and body above lateral stripe dark, almost black; ventrolateral surface below stripe much paler, scales below lateral line with white centers and broad grey margins; abdomen milk white. All fins uniformly dark, almost black, except for pale areas distally on dorsal, anal, and caudal fins.

Comments. - This species is known only from the three type specimens collected at Ban Talang. Local fishermen familiar with 'pba daeng' and 'pba tohn' did not have a name for this species, which presumably is relatively rare.

Tor ater is similar to *T. polylepis* Zhou & Cui, 1996, the only other small-scaled *Tor* known from the Mekong basin, with which it agrees in having a very short mentum and a dark midlateral stripe, but differs in having slightly larger (and therefore less numerous) scales, fewer gill rakers, and a more elongate head with a regularly convex dorsal profile. Scales in lateral series 30-31, predorsal scales 11-12, transverse scales 5/1/2 (vs. 34-35, 14, and 4-5/1/3 in *T. polylepis*). Total gill rakers on outer face of first gill arch 15, 17, 18 (vs. 19 or 22). Data on vertebral counts is not available for *T. polylepis*.

In describing *Tor ater* as new, I have been influenced by the very short head and strongly concave shape of the snout observable in Zhou & Cui's (1996) illustrations of the holotype of *T. polylepis*. The concave snout, not mentioned in their text, may be unique among species of *Tor*. Because there is no mention to the contrary, the condition of the snout presumably is the same or similar in the paratype (the only other known specimen of *T. polylepis*). *T. ater* has a proportionately much longer and dorsoanteriorly convex snout.

Distribution. - Presently known only from the Nam Theun watershed at Ban Talang in central Laos.

Etymology. - Named after the generally dark coloration of the species.

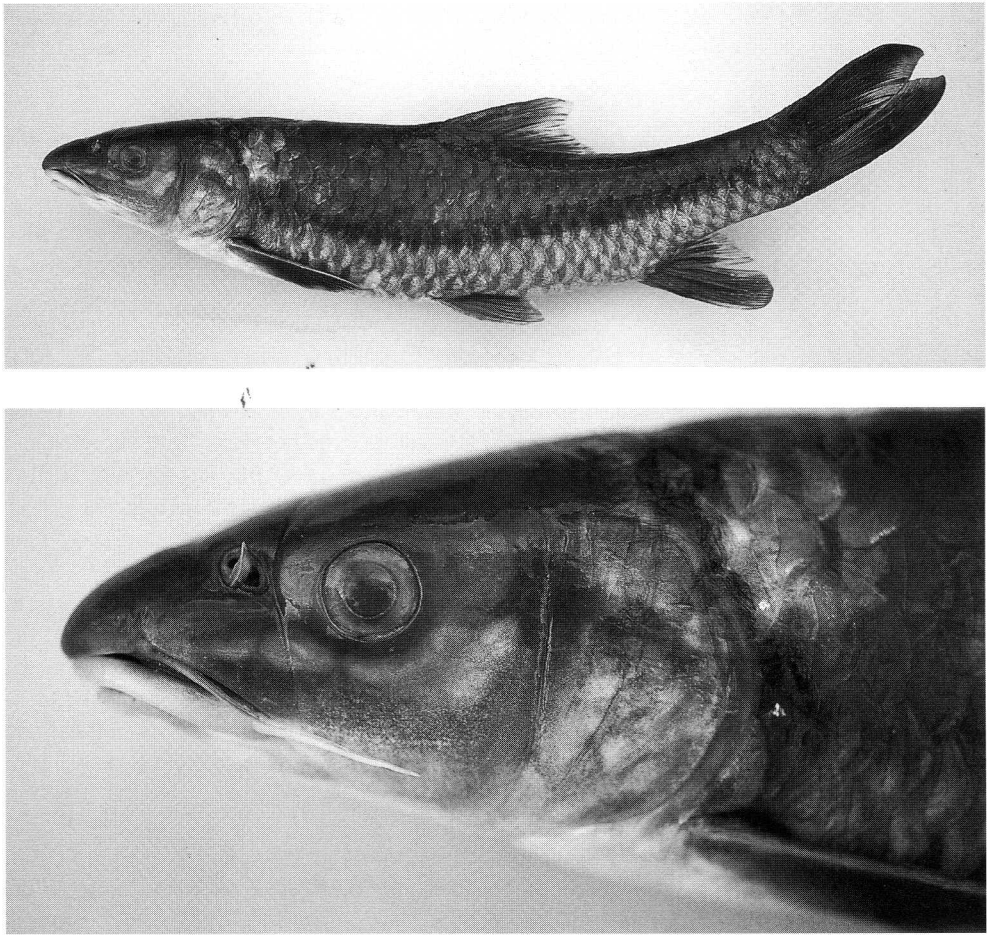


Fig. 3. *Tor ater*. ZRC 40356, 308 mm holotype. Nam Theun at Ban Talang in November 1995.

DISCUSSION

Large-scaled *Tor* are widespread in mountain streams throughout the Malay Peninsula and the larger Indonesian islands including Sumatra, Borneo and Java. As in the Mekong basin, they differ greatly in development of the mental lobe, some having a very short mental lobe and others a very long one. As in the Mekong, short mental lobes are often associated with relatively thin lips and long ones with greatly thickened lips. Greatly thickened lips and long mental lobes tend to be associated with sharp or pointed heads, thin lips and short lobes with blunter or rounded heads. Kuhl and van Hasselt, Valenciennes (see Roberts, 1993: 22-23), Bleeker (1863), Weber and de Beaufort (1916: 150-152), and other ichthyologists who have worked with Malaysian and Indonesian large-scaled *Tor* have all recognized at least two species. When comparing two very large specimens from a single locality or area, one with a very long mentum and the other with a very short mentum, and looking different in other respects as well, one is inclined to think they must be different species.

The problem, however, is that often the only difference between smaller specimens from a given Malaysian or Indonesian locality seems to be in the length of the mental lobe, which often varies continuously. Differences that distinguish the two large-scaled Mekong species

- coloration of juveniles and adults and vertebral counts - either do not distinguish them or have not been discovered. All Malaysian and Indonesian specimens of which I have seen radiographs have total vertebrae of 39-41.

A large series of *Tor* with short mental lobes collected in the Danum valley, Segama basin, Sabah (ZRC 40338, 40339, 40342), was examined by me only days after the specimens had been fixed in formalin. The collectors said the fin colors in particular had been the same in life. I found that almost all of them had the outer ray of the pelvic fin white. The pelvic fin was otherwise either colorless, slightly dusky, faintly yellowish, or faintly reddish. The anal fin was similarly colorless, dusky, faintly yellowish, or faintly reddish. Dorsal and caudal fins were dusky or yellowish (not clear or reddish). Thus the fundamental dichotomy of juveniles with fin colors all predominantly either rosy or red versus yellowish, which readily separates two species of large-scaled *Tor* in the Mekong basin, will not work in Sabah. This has yet to be verified, but it appears that *Tor* from Sabah with long mental lobes have fin coloration very similar to those with short mental lobes. I suspect that the same may hold for both kinds of *Tor* from throughout Malaysia and Indonesia, but we are very far from knowing this.

Observations on the mental lobe in various samples, but particularly in a recent sample of juveniles with long mental lobes from Long Padas in Sabah (ZRC 40346) and Lanjak-Entimau in Sarawak (ZRC 37713) have revealed a number of points. As in *Tor* generally, the posterior border may be truncate, broadly rounded or elongate. Specimens with a truncate lobe usually (but not always) have the distal portion of the lobe folded underneath. The fold is what gives the lobe a truncate appearance. When unfolded, the distal end of the lobe is seen to be rounded or elongate, and the lobe itself to be substantially longer.

Not only is the lobe folded over distally, but the lateral parts are also often strongly folded underneath the main body of the lobe. Thus when the lobe is lifted to reveal its hidden dorsal surface, one often sees three strong folds occupying much or all of the dorsal surface. When the jaws are fully opened and protracted, especially if they are also laterally expanded, the lobe presumably becomes unfolded and fully extended.

Some samples, notably the one from Long Padas (in which the lips are also greatly thickened) show considerable amounts of injury, superficial tissue shedding and replacement, and wound healing, which also alters the shape and appearance of the lobe. It appears that the very elongate lobes are more susceptible to injury than short truncate or folded lobes. It may also be that the damaged tips of elongate lobes may be folded over, and/or shed and/or regenerated.

It should be noted that observations on the use of the mental lobe during feeding are unavailable, as are observations on its histology and surface morphology.

Species of *Tor* in Java

As part of an overview of the early material of freshwater fishes collected in Java by Kuhl and van Hasselt, I reviewed their material of *Tor* which has been located in the Nationaal Natuurhistorisch Museum in Leiden, the Netherlands (RMNH) and the Museum National d'Histoire Naturelle in Paris, France (MNHN) (Roberts, 1993: 22-23, figs. 21-24). This material is essential to any understanding of the Southeast Asian species, because it includes or included all of the drawings and specimens upon which Valenciennes (in Cuvier &

Valenciennes, 1842) based the original descriptions of *Barbus tambra*, *B. douronensis* and *B. soro*.

On that occasion, I also looked briefly at Bleeker's Javanese and other material of *Barbus* or *Labeobarbus tambroides*, but time constraints prevented a thorough investigation. In particular, it was not possible to obtain radiographs for vertebral counts or to count gill rakers on the Bleeker material. Furthermore, all of Bleeker's *Tor tambroides* material (type as well as non-type) is combined in one large jar, with their localities badly and perhaps irretrievably mixed.

In the review published in 1993, I concluded that *Tor tambra*, *T. douronensis*, *T. tambroides* and possibly *T. soro* represented a single species. Differences in length of the mental lobe or median barbel of the lower jaw were attributed to the state of preservation or to individual variation. No characters were found which would distinguish a species with thickened lips and a long mental lobe from one with more normal lips and a short lobe. No significant or consistent differences were found in counts of scales, gill rakers, or vertebrae. These conclusions may now be reviewed in light of the definite information that the Mekong basin harbors two similar large-scaled species of *Tor*, one with typically thickened or thicker lips and a long mental lobe, and the other with less thickened lips and a short lobe, and that (as reported below) *Tor* with mental lobes of different lengths occur, separately or together, at many localities in peninsular Malaysia and Borneo.

The present review is greatly hindered by lack of any fresh specimens of adult or juvenile *Tor* from Java, and of any reliable information on their coloration. I have not examined any additional Javanese material, but am now inclined to the view that the 525 mm holotype of *T. tambra* (RMNH 2289; a dried, stuffed, painted and mounted specimen) represents the species or form with a short mental lobe. The very short mental lobe is illustrated in Roberts (1993: fig. 24). This specimen is peculiar in having an extremely small dorsal fin.

In his final review of Indonesian *Labeobarbus* (now *Tor*), Bleeker (1863: 77-80) recognized four species: *L. tambra*, *L. douronensis*, *L. soro* and *L. tambroides*. Bleeker's text and figures have been re-examined to see if they can shed any light on possible differences between Javanese species. In particular, I have looked for clear indications of differences in juvenile and/or adult coloration.

In describing coloration of Javanese *Tor*, Bleeker did not indicate whether he was dealing with juveniles or adults. The impression gained is that in Java, the difference between coloration of juveniles and adults may not be so pronounced as it is in the Mekong species of *Tor*. I was particularly interested to see if differences in the coloration of the fins had been observed, as these differences hold for juveniles as well as adults and differ between species in the Mekong. Bleeker's (1863) colored figures of *Labeobarbus tambra*, *L. douronensis* and *L. tambroides* have all of the fins rosy or red colored. Only the figure of *L. soro* shows yellow fins. Although tentatively regarded previously as a junior synonym of *Tor tambra*, *Labeobarbus soro* (which does not have a mental lobe) may belong instead, in the genus *Neolissochilus* Rainboth. As the holotype of *L. soro* is most likely lost (Roberts, 1993: 23), the species cannot for the moment be identified and will not be considered further. Bleeker's text indicates that fin color in all of the Javanese species of *Tor* recognized by him is variable, and may be either reddish, rosy or yellow. Adults apparently do not differ radically from juveniles in coloration, or at least not as much as in the Mekong species. Bleeker did not report any striped *Tor* from Java.

Bleeker (1863) did try to differentiate the species on the basis of scale counts and other characters. But it should be noted that his species concept of the Javanese *Tor* does not agree with the type specimens of the species described by Valenciennes, which he did not examine. In the key to species, he gives 26-28 scales in lateral series for *T. tambra*. The holotype has only 21 or 22.

There evidently are two kinds of *Tor* in Java, but whether they represent two species, discrete morphs or ecophenotypes of a single species, or simply individual variation remains undecided. So far as known they have similar or identical counts of gill rakers, scales, and vertebrae. For convenience, the forms with short mental lobe may be referred to as *Tor tambra* (Valenciennes, 1842) and those with long mental lobe as *T. tambroides* (Bleeker, 1854). They are not distinguished by any other known characters.

Species of *Tor* in the Malay Peninsula, Sumatra, Borneo and Java

Large-scaled *Tor* probably occur in large mountain streams throughout the Malay peninsula and the larger Sundaic islands of Borneo, Sumatra and Java. Bleeker (1863) did not record any Bornean *Tor*, but most of his fish collections from there were obtained in lowland areas where the genus generally does not occur. The best holdings of Indonesian *Tor* presumably are in the Zoological Museum in Bogor, Indonesia. Additional Malaysian and Bornean material is in various museums but many of the most likely localities have not been collected for *Tor*. Large adult specimens need not be collected, but good photographs are needed to show their coloration in life. Preserved specimens as well as photographs of freshly collected specimens are required of juveniles.

My observations and remarks here are based mainly on specimens in the ZRC. The collection includes two kinds of large-scaled *Tor*, one with a short mental lobe and the other with a long mental lobe. Some specimens have lobes of intermediate length. At some localities, all specimens have mental lobes of the same length, but at other localities, the specimens form two easily separated groups, one with short, the other with long mental lobes. Except for recent samples from Sabah described earlier, information of coloration in life is almost entirely lacking, and I have not been able to find any other characters that will consistently distinguish two species. The situation is nearly the same as in Java, except that more data is available from specimens with definite locality data (Table 1).

As in Java, Malaysian, Bornean and Sumatran fish with short mental lobes may be tentatively identified as *Tor tambra* and those with long lobes as *T. tambroides*. But there are problematic specimens such as those from Ulu Endau, Johor, Malaysia (ZRC 21442) with intermediate size mental lobes. If there is only one species of *Tor* in Malaysia and Indonesia (including Java), its name is *T. tambra*.

Material examined of Sundanian *Tor tambra* (unless stated otherwise). - PENINSULAR MALAYSIA - ZRC 733, 1: 95.7 mm, Perak: Jor, C. C. Chua, 24 Aug. 1969; ZRC 1946, 9 (of *T. tambroides*): 102.4-175 mm, Pahang: Taman Negara, C. S. Ogilvie, 1950; ZRC 8322, 15: 82.4-115.2 mm, Pahang: Cameron Highlands, 1960's; ZRC 9554, 1: 485 mm, no exact locality data, C. F. Lim, no date; ZRC 21442, 3 (2 of *T. tambroides*): 86.8-99.8 mm, Johor: Ulu Endau, Sungai Jasin, T. H. T. Tan & J. B. Tay, 4-5 Apr. 1992; ZRC 41954, 1: 700 mm, Trengganu, Sungai Kemaman, C. F. Lim, 1970's. BORNEO (East Malaysia) - ZRC 37713, 3 (1 of *T. tambroides*): 105-136 mm, Sarawak: Lanjak-Entimau, C. H. Diong, 17-23 May. 1994; ZRC 39721, 1: 123.2 mm, Sarawak: Bintulu, Sungai Sopan, R. Stuebing et al., 5 Nov. 1994; ZRC 40338, 8: 76.8-130 mm, Sabah: Danum Valley, H. H. Tan et al., 1 Oct. 1996; ZRC 40339, 3: 92.3-106 mm, Sabah: Danum Valley, H. H. Tan et al., 2 Oct. 1996; ZRC 40342, 6:

126-174 mm, Sabah: Danum Valley, H. H. Tan et al., 3 Oct.1996; ZRC 40344, 1 (of *T. tambroides*): 121.2 mm, Sabah: Danum Valley, H. H. Tan et al., 3 Oct.1996; ZRC 40346, 5 (of *T. tambroides*): 104-146 mm, Sabah: Long Padas, K. M. Martin-Smith, 1996; ZRC 38773, 2 (1 of *T. tambroides*): 107.8-216.3 mm, Brunei: Temburong, Sungai Temburong, K. Lim et al., 14 & 16 Jun.1995. SUMATRA - ZRC 41946, 2: 61.9-63.8 mm, West Sumatra: Padang, H. H. Tan et al., Nov.1996. JAVA - RMNH 2289, 525 mm holotype of *Barbus tambra*, Java: Buitenzorg; MNHN 3826, 93.4 mm holotype of *Barbus douronensis*, Java.

ACKNOWLEDGEMENTS

Special thanks to Phouthalom Vongsay, my Laotian counterpart during fieldwork in the Nam Theun for his invaluable help in the field and in gathering specimens. This paper was written at the National University of Singapore, with support from the School of Biological Sciences. The author thanks Prof. T. J. Lam, Peter K. L. Ng and Mrs. C. M. Yang for arranging access to collections, facilities and financial support (research grant 6390 to Dr. Peter Ng). Kelvin Lim and Tan Swee Hee assisted in locating specimens and preparing radiographs. The author's fieldwork in Nam Theun has been supported in part by grants from the Smithsonian Tropical Research Institute and the Committee for Research and Exploration of the National Geographic Society (grant 5141-93).

LITERATURE CITED

- Bleeker, P., 1863. *Atlas ichthyologique des Indes Orientales Néerlandaises. Tome III. Cyprins*. Frederic Muller, Amsterdam. 150 pp., tabs. CII-CXLIV.
- Cuvier, G. & A. Valenciennes, 1842. *Histoire naturelle des Poissons. Vol. 16*. Paris. xx+472 pp., pls. 456-487.
- Gray, J. E., 1830-1835. *Illustrations of Indian zoology; chiefly selected from the collection of Major-General Hardwicke*. 20 parts in 2 vols., pls. 1-202.
- Hamilton, F., 1822. *An account of the fishes found in the river Ganges and its branches*. Edinburgh and London. i-vii+1-405, pls. 1-39.
- Roberts, T. R., 1993. The freshwater fishes of Java, as observed by Kuhl and van Hasselt in 1823. *Zool. Verh. (Leiden)*, 285: 1-94.
- Weber, M. & L. F. de Beaufort, 1916. *The fishes of the Indo-Australian Archipelago. III. Ostariophysi: II Cyprinoidea, Apodes, Synbranchi*. E. J. Brill, Leiden. xv+455 pp.
- Wu, X.-W. (Ed.), 1977. *Cyprinid fishes of China, Vol. 2*. Science and Technology Publishing House, Shanghai. p. 209-598, 109 pls. (In Chinese)
- Zhou, W. & G.-H. Cui, 1996. A review of *Tor* species from the upper Lancangjiang River (upper Mekong River), China (Teleostei, Cyprinidae). *Ichthyol. Explor. Freshwaters*, 7(2): 131-142, 16 figs., 1 tab.