

## A Preliminary Survey of the Fishes of Lake Tonle Sap Near Siem Reap, Cambodia

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**Abstract** A preliminary survey of the freshwater fishes of Lake Tonle Sap and adjacent waters, Cambodia, recorded 56 species in 38 genera and 22 families from the lake. The fish fauna was dominated by the family Cyprinidae, which comprised 35.7% of the total number of confirmed species. Sixteen species in 11 genera were recorded from the lake for the first time on the basis of specimens collected. All of the species collected are listed and photographs provided. Morphological variations between populations of the Mekong River and Lake Tonle Sap, and speciation of fishes in the lake are discussed.

**Key words:** Fishes, freshwater, Lake Tonle Sap, Cambodia.

The freshwater ichthyofauna of Cambodia is still relatively poorly known, in large part due to the political instability which has prevailed in that country until recently. Although many researchers (e.g., Chabanaud, 1926a–b; Chevey, 1932, 1936) investigated the ichthyofauna of the area when Cambodia was under the jurisdiction of France, they provided only lists without supporting voucher specimens. Because there are many probable misidentifications in the lists (Kottelat, 1985), the identity of many of the species is now problematic. After Cambodia achieved independence from France, Mr. F. d'Aubenton collected many fishes from 178 Cambodian localities from 1960 to 1964, under the auspices of the UNO Mekong Committee (d'Aubenton, 1965a). However, the bulk of that collection remained unidentified, with the exception of several species (e.g., d'Aubenton, 1965b; d'Aubenton & Blanc, 1965, 1966), until undertaken by Kottelat (1985) who recognized 215 species in 127 genera on the basis of d'Auben-

ton's collection and previous reports published during the French colonial period.

Improving political stability in Cambodia in recent years has encouraged new investigations of the freshwater ichthyofauna of that region, a comprehensive report published by Rainboth (1996) including approximately 500 species. However, numerous species "expected to occur in Cambodia" were included, in addition to all species previously reported from Cambodia. In fact, most of the former have at no time been recorded from Cambodian waters on the basis of collected specimens. Furthermore, accurate determinations of species listed without voucher specimens are difficult. Accordingly, a list of the freshwater fishes supported by voucher specimens is now seen as an essential precursor to any detailed studies of, for example, species' diversity in the area.

The ichthyofauna of Lake Tonle Sap has not received any special attention in the past, although the lake has a unique geological history

(see below) and vast floodplain. Recently, Lim *et al.* (1999) discussed the diversity and spatial distribution of fishes in Lake Tonle Sap (89 species) and Tonle Sap River (112 species). However, they also gave no indication of voucher specimens.

The need for ichthyofauna surveys in Lake Tonle Sap is now urgent due to accelerated habitat destruction caused by the urbanization of settlements around the lake and the Mekong River system. As the first step, this paper includes a preliminary fish list on the basis of specimens collected from Lake Tonle Sap at near Siem Reap and adjacent areas during 11–13 May 2002 (end of dry season). Photographs of all species

listed are also provided. Morphological variations between populations of the Mekong River and Lake Tonle Sap, and speciation of fishes in the lake are discussed.

### Lake Tonle Sap

Lake Tonle Sap, the largest freshwater lake in Southeast Asia, lies in central Cambodia (Fig. 1). The lake is known as “elastic water world” because its water area expands very extensively in the rainy season (May to November). In the dry season (November to May), the lake has a NW-SE longitudinal axis of 120 km, a maximum width of 40 km and a water area of approximate-

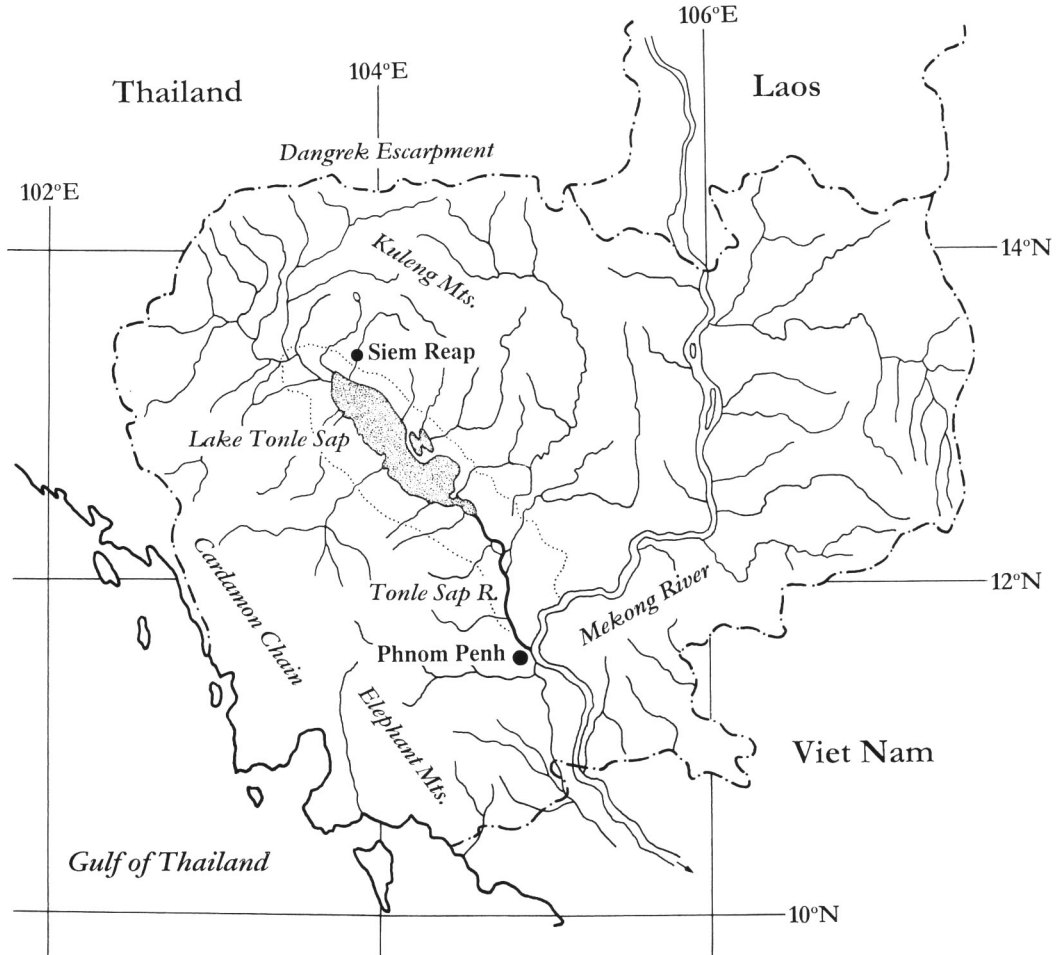


Fig. 1. Lake Tonle Sap and topographic features of Cambodia. Dotted line around lake indicates limit of wet season flood plain (from Tsukawaki *et al.*, 1994: fig. 1).

ly 3000 km<sup>2</sup>, which swells more than five-fold (to approximately 15000 km<sup>2</sup>) in the rainy season (Ministry of Public Works and Transport, Kingdom of Cambodia, 1999; Okawara and Tsukawaki, 2002). The water depth is less than 1 m during the dry season and no more than 10 m during the rainy season (Ministry of Public Works and Transport, Kingdom of Cambodia, 1999; Okawara and Tsukawaki, 2002). Accordingly, the lake lacks a fixed coastline (Fig. 1). An additional widely known name “mud ocean” refers to the deep brown color of the water throughout the year (extremely low transparency, 50–100 cm; Mitusio *et al.*, 1970), due to a large amount of suspended muddy sediments.

Lake Tonle Sap is presently connected to the Mekong River through the Tonle Sap River (Fig. 1), a great amount of water being supplied to the lake from the Mekong River in each rainy season. However, Tsukawaki (1997, 1998, 2000) and Tsukawaki *et al.* (1997) suggested that the lake was isolated from the Mekong River up to 5000 to 5600 years BP, on the basis of sedimentological and micropalaeontological analyses and a number of AMS radiocarbon datings of cored sediments from the northern part of the lake. In spite of the actual size (probably smaller than at present) and shape of the lake at that time being unknown, it was inferred that the lake was situated along the longitudinal axis of Tonle Sap Basin, isolated from the Mekong River during the Holocene Optimum, but connected probably via a river leading directly to the sea (Tsukawaki, 2000).

### Materials and Methods

Most fish specimens were either purchased in the markets of Siem Reap and Roluos or collected from the northern marginal part of Lake Tonle Sap (Fig. 2). A few additional specimens were collected from small streams flowing into Lake Tonle Sap and small ponds in and around Siem Reap Province, during 11–13 May 2002 (Fig. 2). The identification of each species generally followed Rainboth (1996) and Kottelat (2001), with

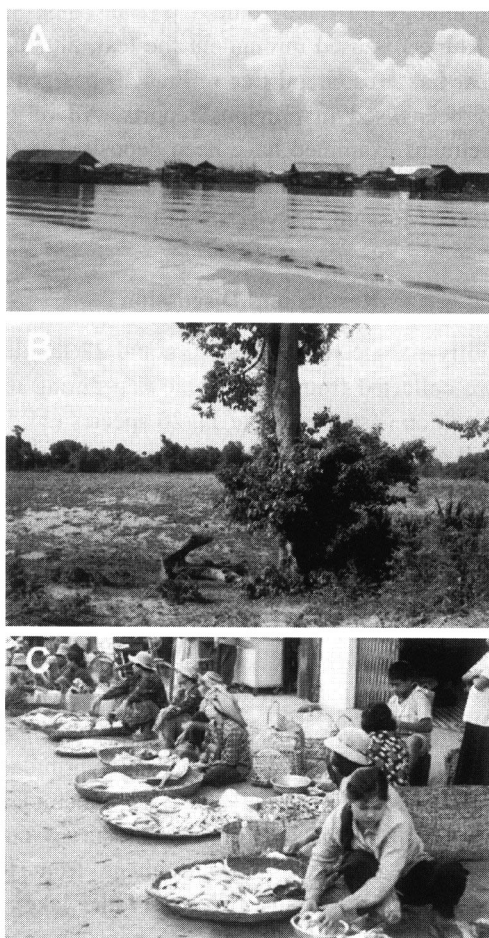


Fig. 2. Sampling sites during the present study. A, Lake Tonle Sap (with floating houses) near Siem Reap, Cambodia; B, pond near Siem Reap; C, local fish market at Siem Reap.

that of some groups following recent revisional reports (Akihito & Meguro, 1975 for Gobiidae; Allen, 1978 for Toxotidae; Roberts, 1980, 1986 for Mastacembelidae; Whitehead *et al.*, 1988 for Engraulidae and Clupeidae; Roberts, 1992a for Notopteridae; Roberts, 1992b, 1994 for Bagridae; Roberts, 1998 for Tetraodontidae). In the present list, the following data are given for each species: scientific name, author, date of publication, material examined (including registration number), standard length (abbreviated as SL-measured from the anterior tip of the snout to the caudal fin base) and comments, if any. English

terminology for Lake Tonle Sap (Ban Tonle Sap in Khmer) is used throughout the text, although Great Lake (or Grand Lac in French) has generally been used in previous reports. All of the specimens examined have been deposited in the Fish Division, Department of Zoology, National Science Museum, Tokyo (NSMT).

### Results and Discussion

Fifty-six species in 38 genera and 22 families were collected from Lake Tonle Sap during this expedition (listed in Table 1), 20 species (35.7% of all confirmed species) in 11 genera belonging to the family Cyprinidae. Sixteen species in 11 genera are the first reliable records from the lake on the basis of collected specimens (Table 1).

Seven species (12.5% of all confirmed species), viz., *Setipinna melanochir* (Engraulidae), *Henicorhynchus* sp. (Cyprinidae), *Labiobarbus leptocheila* (Cyprinidae), *Osteochilus hasseltii* (Cyprinidae), *O. melanopleura* (Cyprinidae), *Puntius orphoides* (Cyprinidae), and *Trichogaster trichopterus* (Osphronemidae), collected from the lake during this survey conspicuously differed from specimens from the Mekong River system, except for the lake, in body and fin coloration (see Comments on specimens). Apart from the coloration, however, the most specimens from the lake were difficult to distinguish from the Mekong specimens because their meristic characters and proportional measurements fully overlapped. Lake Tonle Sap had been isolated before ca. 5000 to 5600 years B.P., subsequently becoming connected with the Mekong River for the first time (e.g., Tsukawaki, 2000; Okawara and Tsukawaki, 2002). Because it is not very long since the lake connected with the river, it is likely that these distinct populations of the Mekong River and Lake Tonle Sap are now in the process of speciating.

Recently, in fact, populations of a threadfin, *Polynemus melanochir*, in Lake Tonle Sap and other localities have been regarded as separate subspecies by Motomura and Sabaj (2002): *P. m. dulcis* Motomura & Sabaj, 2002 (Lake Tonle

Sap) and *P. m. melanochir* Valenciennes in Cuvier & Valenciennes, 1831 (other localities). *Polynemus melanochir dulcis* is a unique subspecies endemic to the lake at the present moment, but there is every possibility that several new subspecies are described from the lake by further examination.

### Comments on specimens

*Coilia lindmani* (Engraulidae): Rainboth (1996) suggested that specimens from the Mekong basin differed from *C. lindmani* sensu Whitehead *et al.* (1988) in having a small but distinct lower lobe on the caudal fin. The present specimens also had that caudal fin character, suggesting a need for further examination.

*Setipinna melanochir* (Engraulidae): This species usually has a dusky or jet black pectoral fin with a short filament (Whitehead *et al.*, 1988). However, the present specimens had a white pectoral fin without filament. The pectoral fin of an example (from Cambodia) of the species figured in Rainboth (1996: pl. 2–12) was also white and lacked a filament. Clearly, the Cambodian specimens need further review.

*Cyclocheilichthys enoplos* (Cyprinidae): This species is characterized by having bifurcated or multifurcated lateral-line tubes in adults (e.g., Smith, 1945; Rainboth, 1996; Kottelat, 2001: fig. 34). Such were not obvious in the present specimens, which were all juveniles.

*Henicorhynchus* sp. (Cyprinidae): The present specimens were similar to *H. lobatus* Smith, 1945, but had a slightly longer snout and black caudal fin posterior margin.

*Labiobarbus leptocheila* (Cyprinidae): The present specimens had faint longitudinal stripes above the lateral line, although the figures of Rainboth (1996: pl. 11–88 as *Dangila* sp. cf. *cuvieri*) and Kottelat (2001: fig. 102) indicate distinct stripes.

*Osteochilus hasseltii* (Cyprinidae): All of the fins of the present specimens were translucent, although the dorsal, pelvic, anal and caudal fins of a specimen figured in Rainboth (1996: pl. 13–97) were bright red.

Table 1. Fishes of Lake Tonle Sap near Siem Reap, Cambodia. Families, with English names in parentheses, follow the systematic order of Nelson (1994), with generic and specific names being arranged alphabetically for each family.

| Species  | Registration number<br>(NSMT-P) | Number of<br>specimen | Size<br>(mm in SL) | Figure | Record/<br>Comment |
|--|---------------------------------|-----------------------|--------------------|--------|--------------------|
| <b>Notopteridae</b> (Featherbacks)   |                                 |                       |                    |        |                    |
| <i>Notopterus notopterus</i> (Pallas, 1769)                                    | 64710                           | 3                     | 128.2–161.1        | 3A     |                    |
| <b>Engraulidae</b> (Anchovies)   |                                 |                       |                    |        |                    |
| <i>Coilia lindmani</i> Bleeker, 1858   | 64713                           | 6                     | 92.0–112.6         | 3B     | +                  |
| <i>Lycothrissa crocodilus</i> (Bleeker, 1851)                                  | 64692                           | 3                     | 145.9–173.6        | 3C     |                    |
| <i>Setipinna melanochir</i> (Bleeker, 1849)                                    | 64706                           | 3                     | 82.3–111.0         | 3D     | F/+                |
| <b>Clupeidae</b> (Herring, Sprat)  |                                 |                       |                    |        |                    |
| <i>Clupeoides borneensis</i> Bleeker, 1851                                     | 64712                           | 11                    | 33.9–53.6          | 3E     |                    |
| <b>Cyprinidae</b> (Carp, Minnow, Barb)   |                                 |                       |                    |        |                    |
| <i>Cirrhinus microlepis</i> (Sauvage, 1878)                                    | 64669                           | 1                     | 200.8              | 3F     |                    |
| <i>Cyclocheilichthys armatus</i> (Valenciennes in Cuvier & Valenciennes, 1842) | 64670                           | 52                    | 59.7–89.5          | 3G     |                    |
| <i>Cyclocheilichthys enoplos</i> (Bleeker, 1850)                               | 64667                           | 3                     | 127.2–146.1        | 3H     | +                  |
| <i>Hampala macrolepidota</i> Kuhl & van Hasselt in van Hasselt, 1823           | 64684                           | 2                     | 135.1–148.6        | 3I     |                    |
| <i>Henicorhynchus siamensis</i> (Sauvage, 1881)                                | 64661                           | 3                     | 113.9–135.1        | 3J     |                    |
| <i>Henicorhynchus</i> sp.  | 64663                           | 2                     | 88.8–106.5         | 4A     | F/+                |
| <i>Labiobarbus leptocheila</i> (Valenciennes in Cuvier & Valenciennes, 1842)   | 64675                           | 2                     | 76.7–87.1          | 4B     | +                  |
| <i>Osteochilus hasseltii</i> (Valenciennes in Cuvier & Valenciennes, 1842)     | 64673                           | 5                     | 69.4–102.8         | 4C     | +                  |
| <i>Osteochilus lini</i> Fowler, 1935   | 64674                           | 2                     | 79.9–84.9          | 4D     | F                  |
| <i>Osteochilus melanopleura</i> (Bleeker, 1852)                                | 64666                           | 1                     | 122.1              | 4E     | +                  |
| <i>Parachela siamensis</i> (Günther, 1868)                                     | 64681                           | 61                    | 58.1–85.4          | 4F     |                    |
| <i>Puntioplites proctozysron</i> (Bleeker, 1865)                               | 64686                           | 2                     | 103.8–117.8        | 4G     |                    |
| <i>Puntius brevis</i> (Bleeker, 1850)  | 64678                           | 200                   | 38.5–73.4          | 4H     |                    |
| <i>Puntius brevis</i> (Bleeker, 1850)  | 64679                           | 64                    | 42.5–74.2          |        |                    |
| <i>Puntius orphoides</i> (Valenciennes in Cuvier & Valenciennes, 1842)         | 64660                           | 2                     | 99.4–106.6         | 4I     | +                  |
| <i>Rasbora aurotaenia</i> Tirant, 1885   | 64651                           | 2                     | 43.9–60.5          | 4J     | F                  |
| <i>Rasbora daniconius</i> (Hamilton, 1822)                                     | 64652                           | 8                     | 33.3–54.1          | 5A     | F                  |
| <i>Rasbora paviei</i> (Tirant, 1885)   | 64677                           | 1                     | 21.7               | 5B     | F                  |
| <i>Rasbora rubrodorsalis</i> Donoso-Büchner & Schmidt, 1997                    | 64653                           | 1                     | 17.9               | 5C     | F/+                |
| <i>Rasbora</i> sp.   | 64658                           | 1                     | 74.0               | 5D     | F/+                |
| <i>Thynnichthys thynnoides</i> (Bleeker, 1852)                                 | 64668                           | 2                     | 103.6–119.3        | 5E     |                    |
| <b>Cobitidae</b> (Loach)   |                                 |                       |                    |        |                    |
| <i>Botia helodes</i> Sauvage, 1876   | 64659                           | 1                     | 126.2              | 5F     |                    |
| <i>Botia modesta</i> Bleeker, 1865   | 64654                           | 2                     | 65.3–76.2          | 5G     |                    |
| <b>Balitoridae</b> (Hillstream loach)  |                                 |                       |                    |        |                    |
| <i>Nemacheilus pallidus</i> Kottelat, 1990                                     | 64650                           | 3                     | 38.4–49.9          | 5H     | +                  |
| <b>Bagridae</b> (Bagrid catfish)   |                                 |                       |                    |        |                    |
| <i>Mystus bocourti</i> (Bleeker, 1864)   | 64685                           | 1                     | 148.3              | 5I     | F/+                |
| <i>Mystus multiradiatus</i> Roberts, 1992                                      | 64664                           | 1                     | 112.3              | 5J     |                    |
| <i>Mystus mysticetus</i> Roberts, 1992   | 64655                           | 2                     | 77.6–88.4          | 6A     | +                  |
| <i>Mystus wolffii</i> (Bleeker, 1851)  | 64657                           | 1                     | 78.1               | 6B     |                    |
| <b>Siluridae</b> (Sheatfish)   |                                 |                       |                    |        |                    |
| <i>Micronema apogon</i> (Bleeker, 1851)  | 64680                           | 5                     | 156.9–254          | 6C     |                    |
| <i>Micronema cheveyi</i> (Durand, 1940)  | 64665                           | 1                     | 116.1              | 6D     | F                  |
| <i>Ompok bimaculatus</i> (Bloch, 1794)   | 64662                           | 1                     | 126.5              | 6E     | +                  |
| <b>Pangasiidae</b> (Pangasius)   |                                 |                       |                    |        |                    |
| <i>Pangasianodon hypophthalmus</i> (Sauvage, 1878)                             | 64672                           | 1                     | 216.8              | 6F     |                    |
| <i>Pangasius macronema</i> Bleeker, 1851                                       | 64671                           | 2                     | 88.3–93.4          | 6G     | F                  |
| <b>Clariidae</b> (Walking catfish)   |                                 |                       |                    |        |                    |
| <i>Clarias macrocephalus</i> Günther, 1864                                     | 64682                           | 1                     | 186.2              | 6H     |                    |

Table 1. Continued

| Species   | Registration number<br>(NSMT-P) | Number of<br>specimen | Size<br>(mm in SL) | Figure | Record/<br>Comment |
|---|---------------------------------|-----------------------|--------------------|--------|--------------------|
| <b>Belonidae</b> (Garfish, Needlefish)                |                                 |                       |                    |        |                    |
| <i>Xenentodon cancila</i> (Hamilton, 1822)            | 64690                           | 3                     | 175.9–196.6        | 6I     |                    |
| <b>Synbranchidae</b> (Swamp eel)                      |                                 |                       |                    |        |                    |
| <i>Monopterus albus</i> (Zuiew, 1793)                 | 64705                           | 1                     | 462.0              | 6J     |                    |
| <b>Mastacembelidae</b> (Spiny eel)                    |                                 |                       |                    |        |                    |
| <i>Macrognathus semiocellatus</i> Roberts, 1986       | 64711                           | 1                     | 123.1              | 7A     | F/+                |
| <i>Macrognathus siamensis</i> (Günther, 1861)         | 64707                           | 4                     | 146.1–189.1        | 7B     | F                  |
| <b>Chandidae</b> (Glassfish)                          |                                 |                       |                    |        |                    |
| <i>Parambassis siamensis</i> (Fowler, 1937)           | 64714                           | 20                    | 32.2–43.6          | 7C     | F                  |
| <i>Parambassis wolffii</i> (Bleeker, 1851)            | 64687                           | 9                     | 97.5–121.7         | 7D     |                    |
| <b>Polynemidae</b> (Threadfin)                        |                                 |                       |                    |        |                    |
| <i>Polynemus</i> sp.                                  | 64693                           | 12                    | 100.8–134.1        | 7E     | +                  |
| <b>Toxotidae</b> (Archerfish)                         |                                 |                       |                    |        |                    |
| <i>Toxotes chatareus</i> (Hamilton, 1822)             | 64688                           | 2                     | 124.9–132.2        | 7F     |                    |
| <b>Pristolepididae</b> (Mud perch)                    |                                 |                       |                    |        |                    |
| <i>Pristolepis fasciata</i> (Bleeker, 1851)           | 64691                           | 80                    | 39.0–91.7          | 7G     |                    |
| <b>Gobiidae</b> (Goby)                                |                                 |                       |                    |        |                    |
| <i>Glossogobius aureus</i> Akihito & Meguro, 1975     | 64694                           | 9                     | 67.0–162.8         | 7H     |                    |
| <b>Anabantidae</b> (Climbing Perch)                   |                                 |                       |                    |        |                    |
| <i>Anabas testudineus</i> (Bloch, 1792)               | 64709                           | 2                     | 116.2–117.1        | 7I     |                    |
| <b>Osphronemidae</b> (Gourami, Fighting fish)         |                                 |                       |                    |        |                    |
| <i>Betta</i> sp.                                      | 64656                           | 1                     | 19.9               | 7J     |                    |
| <i>Trichogaster microlepis</i> (Günther, 1861)        | 64683                           | 32                    | 66.6–86.6          | 8A     |                    |
| <i>Trichogaster trichopterus</i> (Pallas, 1770)       | 64676                           | 9                     | 43.7–63.0          | 8B     | F/+                |
| <i>Trichopsis schalleri</i> Ladiges, 1962             | 64648                           | 21                    | 15.9–23.4          | 8C     | F                  |
| <b>Channidae</b> (Snakehead)                          |                                 |                       |                    |        |                    |
| <i>Channa striata</i> (Bloch, 1793)                   | 64689                           | 1                     | 235.2              | 8D     |                    |
| <b>Tetraodontidae</b> (Puffer)                        |                                 |                       |                    |        |                    |
| <i>Tetraodon cochinchinensis</i> (Steindachner, 1866) | 64647                           | 6                     | 32.6–54.6          | 8E     |                    |
| <i>Tetraodon leirus</i> Bleeker, 1851                 | 64708                           | 4                     | 85.8–117.1         | 8F     |                    |

F, first reliable record from Lake Tonle Sap; + commented in text.

*Osteochilus melanopleura* (Cyprinidae): The pelvic fin tip and anal fin membranes of the present specimen were tinged with bright orange red when fresh, although usually white or translucent (see Rainboth, 1996: pl. 13–99; Kottelat, 2001: fig. 133).

*Puntius orphoides* (Cyprinidae): Although this species has a conspicuous black blotch on the caudal peduncle (e.g., Rainboth, 1996, as *Systomus orphoides*; Kottelat, 2001), the present specimens lacked a blotch either when fresh or preserved. Further review is necessary.

*Rasbora rubrodorsalis* (Cyprinidae): The specimen was collected by hand net from a small channel (13°40'26.8"N, 104°01'29.4"E) flowing into Lake Tonle Sap, near Siem Reap.

*Rasbora* sp. (Cyprinidae): Rainboth (1996: pl.

5–34) identified a specimen as *Rasbora dusonensis* (Bleeker, 1851), but Kottelat (2001: fig. 180) identified another fish as *R. dusonensis*. The present specimen appears to be the same with species of Rainboth's *R. dusonensis*. However, the present identification of Rainboth's *R. dusonensis* is still unknown (M. Kottelat, pers. comm.).

*Nemacheilus pallidus* (Balitoridae): The specimens were collected by hand net from a small channel (13°40'26.8"N, 104°01'29.4"E) flowing into Lake Tonle Sap, near Siem Reap.

*Mystus bocourti* (Bagridae): According to Roberts (1994), this species, distributed in the Chao Phraya and Mekong basins, is relatively uncommon.

*Mystus mysticetus* (Bagridae): Although Lim

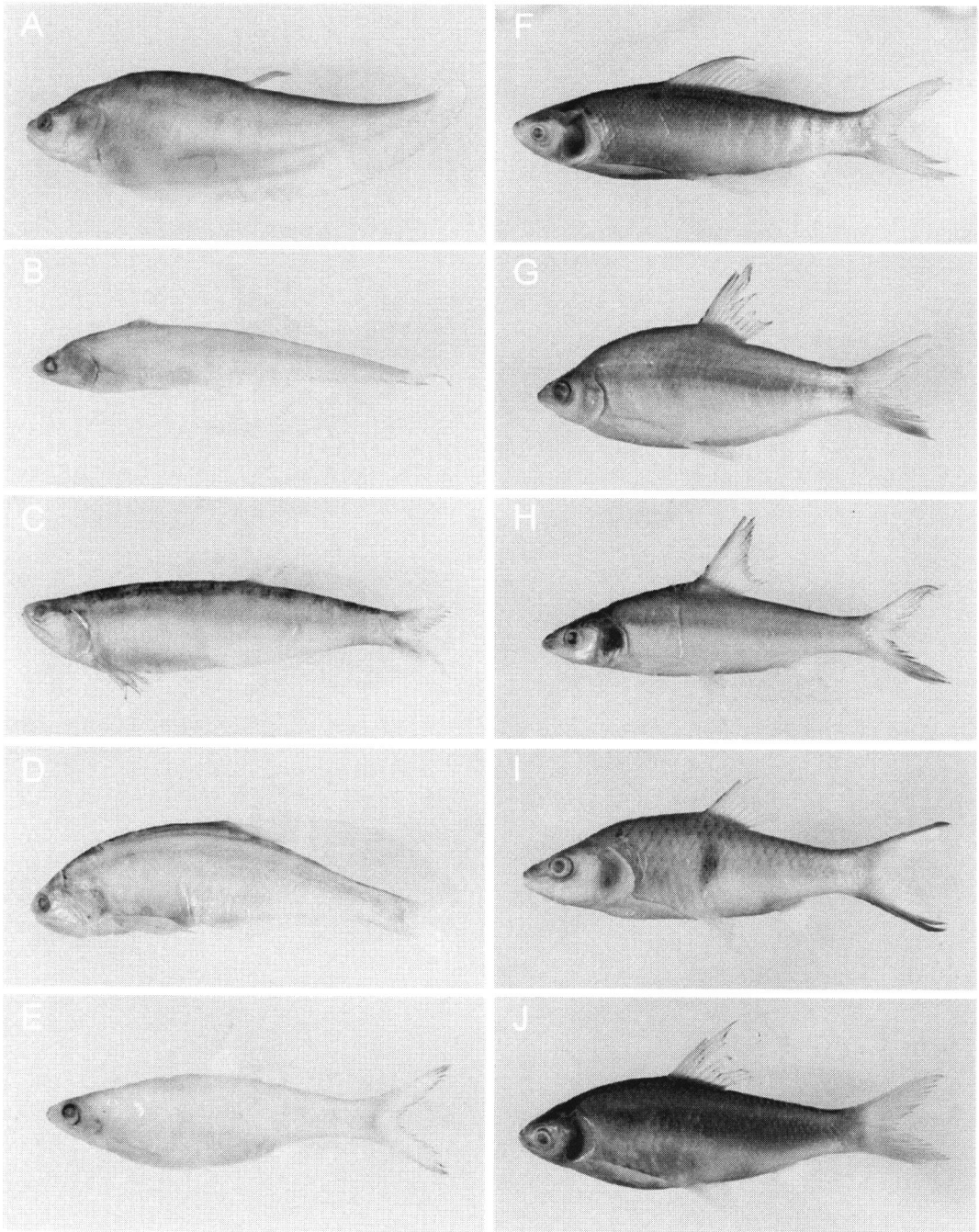


Fig. 3. Fishes of Lake Tonle Sap. A, *Notopterus notopterus*, NSMT-P 64710, 161.1 mm SL; B, *Coilia lindmani*, NSMT-P 64713, 112.6 mm SL; C, *Lycothrissa crocodilus*, NSMT-P 64692, 172.0 mm SL; D, *Setipinna melanochir*, NSMT-P 64706, 111.0 mm SL; E, *Clupeoides borneensis*, NSMT-P 64712, 53.3 mm SL; F, *Cirrhinus microlepis*, NSMT-P 64669, 200.8 mm SL; G, *Cyclocheilichthys armatus*, NSMT-P 64670, 89.5 mm SL; H, *C. enoplos*, NSMT-P 64667, 132.1 mm SL; I, *Hampala macrolepidota*, NSMT-P 64684, 135.1 mm SL; J, *Henicorhynchus siamensis*, NSMT-P 64661, 123.5 mm SL.

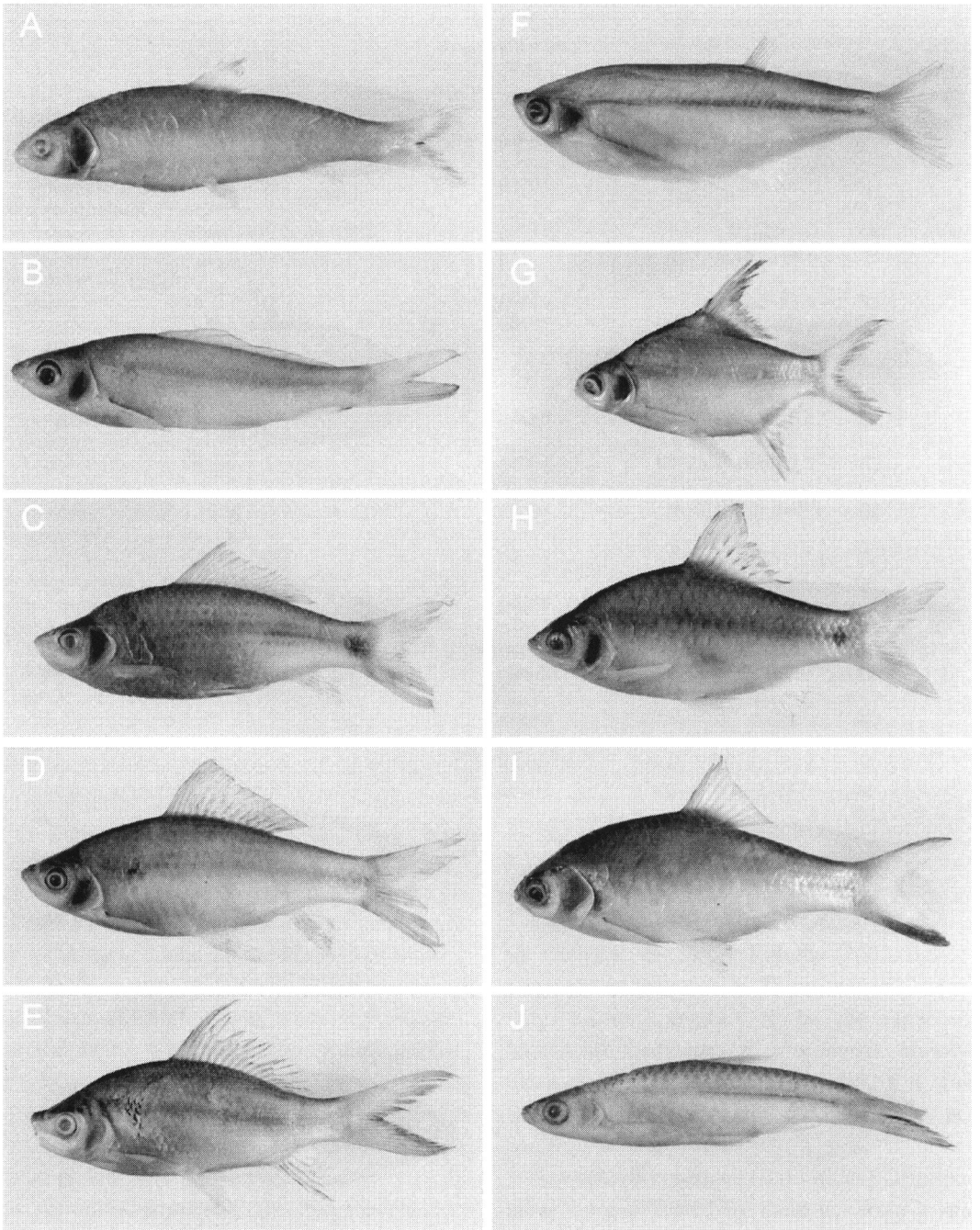


Fig. 4. Fishes of Lake Tonle Sap. A, *Henicorhynchus* sp., NSMT-P 64663, 106.5 mm SL; B, *Labiobarbus leptocheila*, NSMT-P 64675, 87.1 mm SL; C, *Osteochilus hasseltii*, NSMT-P 64673, 102.8 mm SL; D, *O. lini*, NSMT-P 64674, 84.9 mm SL; E, *O. melanopleura*, NSMT-P 64666, 122.1 mm SL; F, *Parachela siamensis*, NSMT-P 64681, 80.6 mm SL; G, *Puntioplites proctozyron*, NSMT-P 64686, 117.8 mm SL; H, *Puntius brevis*, NSMT-P 64678, 71.3 mm SL; I, *P. orphoides*, NSMT-P 64660, 99.4 mm SL; J, *Rasbora aurotaenia*, NSMT-P 64651, 60.5 mm SL.



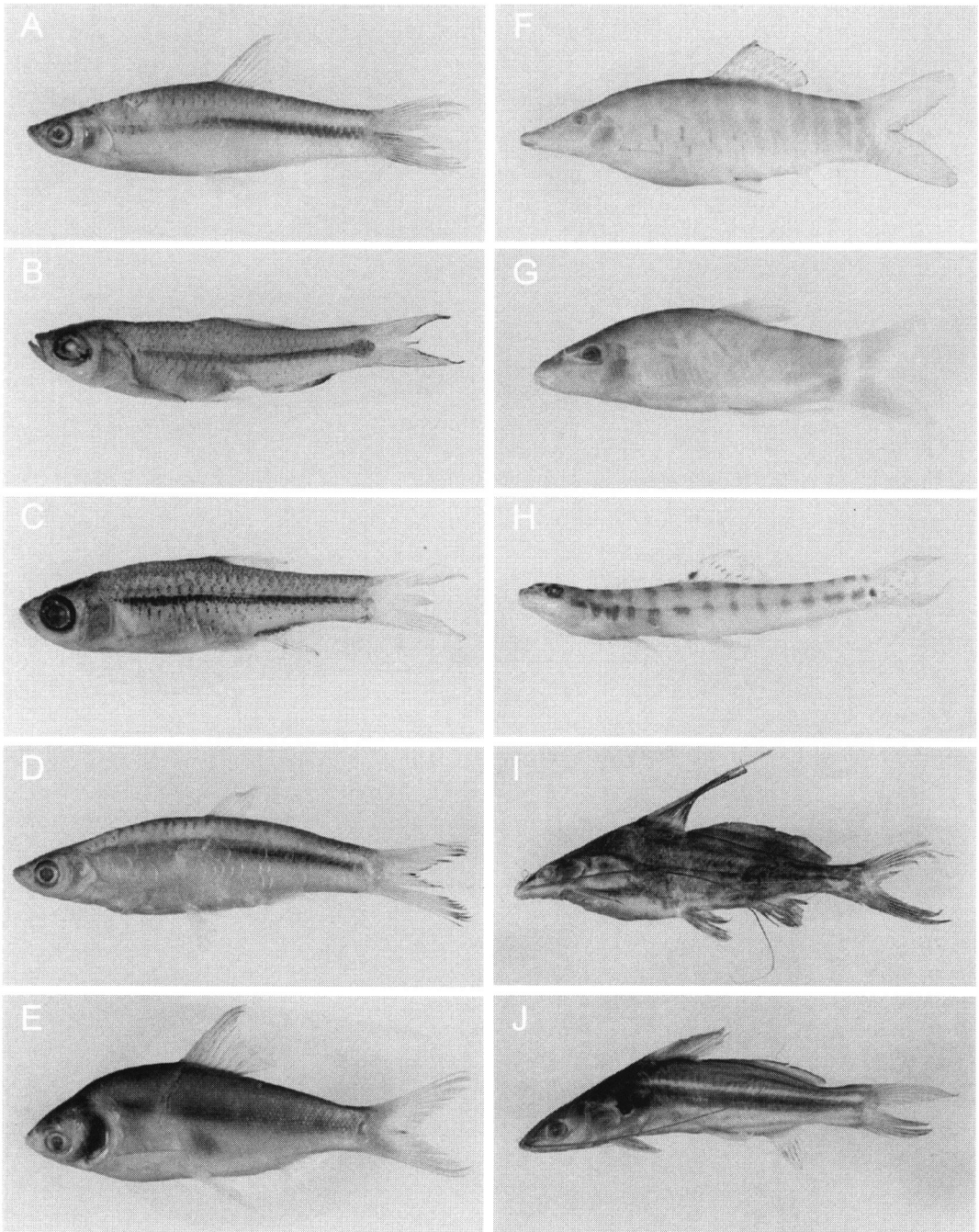


Fig. 5. Fishes of Lake Tonle Sap. A, *Rasbora daniconius*, NSMT-P 64652, 54.1 mm SL; B, *R. paviei*, NSMT-P 64677, 21.7 mm SL; C, *R. rubrodorsalis*, NSMT-P 64653, 17.9 mm SL; D, *Rasbora* sp., NSMT-P 64658, 74.0 mm SL; E, *Thynnichthys thynnoides*, NSMT-P 64668, 119.3 mm SL; F, *Botia helodes*, NSMT-P 64659, 126.2 mm SL; G, *B. modesta*, NSMT-P 64654, 76.2 mm SL; H, *Nemacheilus pallidus*, NSMT-P 64650, 44.8 mm SL; I, *Mystus bocourti*, NSMT-P 64685, 148.3 mm SL; J, *M. multiradiatus*, NSMT-P 64664, 112.3 mm SL.

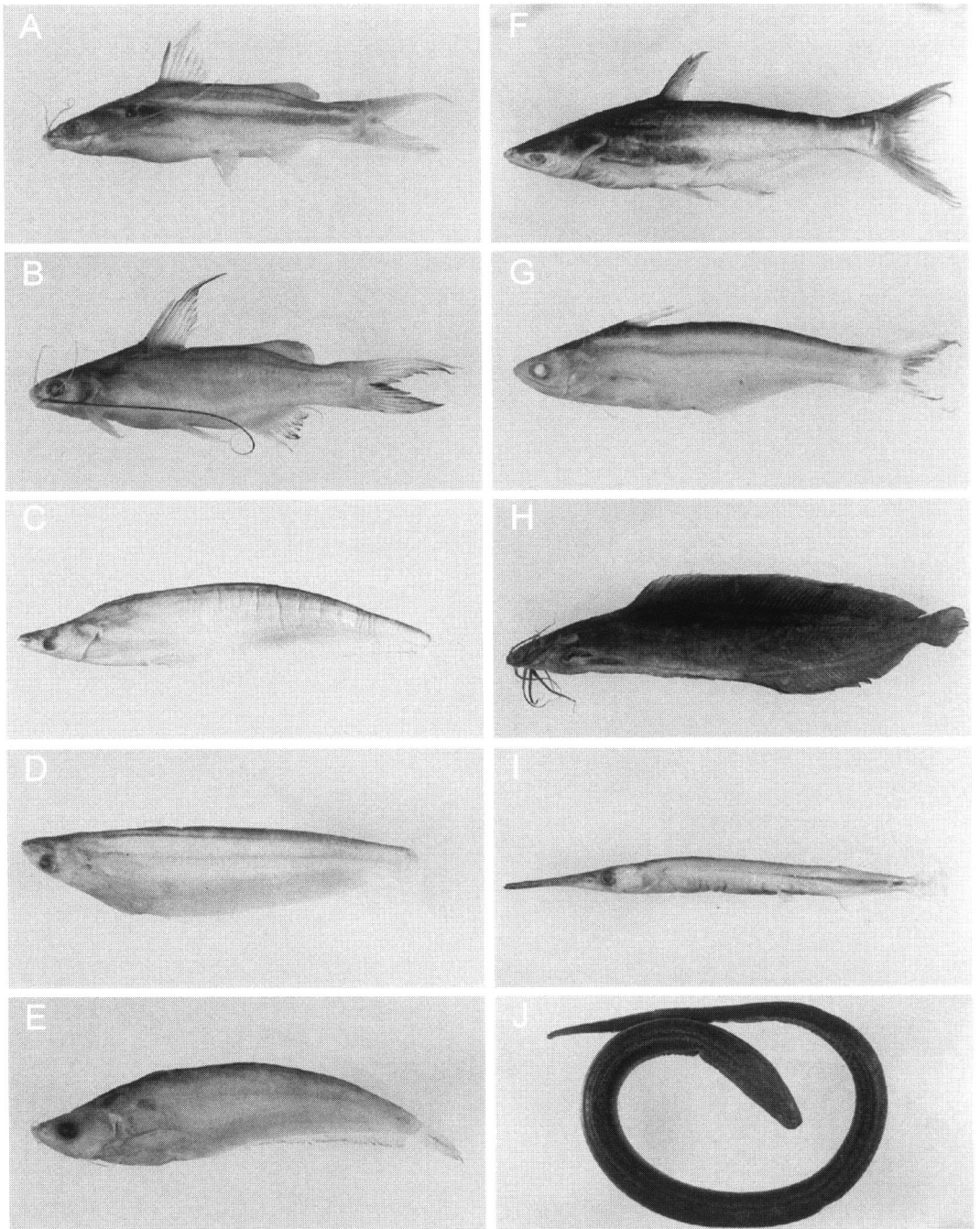


Fig. 6. Fishes of Lake Tonle Sap. A, *Mystus mysticetus*, NSMT-P 64655, 77.6 mm SL; B, *M. wolffii*, NSMT-P 64657, 78.1 mm SL; C, *Micronema apogon*, NSMT-P 64680, 254.1 mm SL; D, *M. cheveyi*, NSMT-P 64665, 116.1 mm SL; E, *Ompok bimaculatus*, NSMT-P 64662, 126.5 mm SL; F, *Pangasianodon hypophthalmus*, NSMT-P 64672, 216.8 mm SL; G, *Pangasius macronema*, NSMT-P 64671, 88.3 mm SL; H, *Clarias macrocephalus*, NSMT-P 64682, 186.2 mm SL; I, *Xenentodon cancila*, NSMT-P 64690, 183.2 mm SL; J, *Monopterus albus*, NSMT-P 64705, 462.0 mm SL.

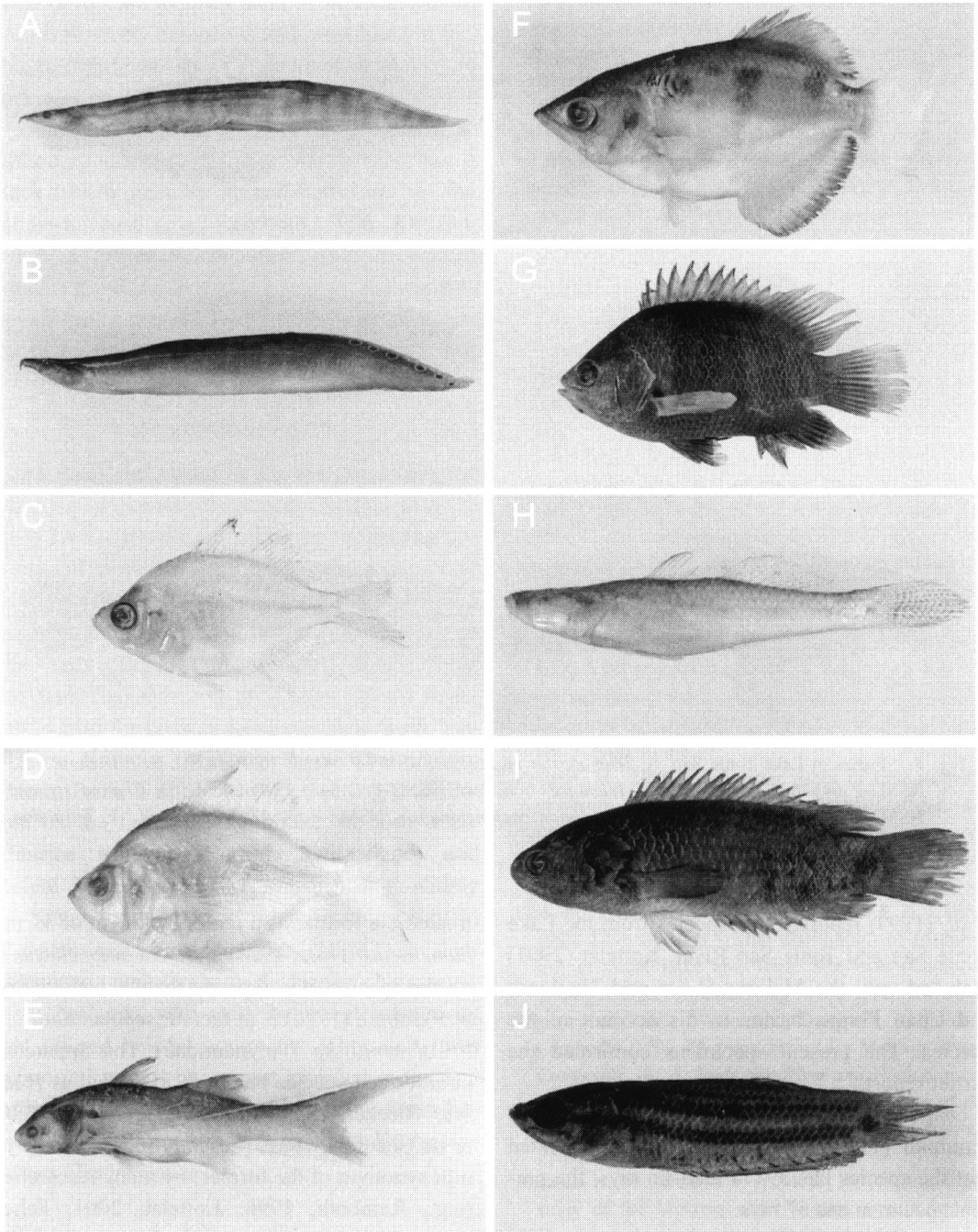


Fig. 7. Fishes of Lake Tonle Sap. A, *Macrornathus semicellatus*, NSMT-P 64711, 123.1 mm SL; B, *M. siamensis*, NSMT-P 64707, 163.9 mm SL; C, *Parambassis siamensis*, NSMT-P 64714, 43.6 mm SL; D, *P. wolffii*, NSMT-P 64687, 121.7 mm SL; E, *Polynemus* sp., NSMT-P 64693, 134.1 mm SL; F, *Toxotes chatareus*, NSMT-P 64688, 124.9 mm SL; G, *Pristolepis fasciata*, NSMT-P 64691, 90.8 mm SL; H, *Glossogobius aureus*, NSMT-P 64694, 149.8 mm SL; I, *Anabas testudineus*, NSMT-P 64709, 117.1 mm SL; J, *Betta* sp., NSMT-P 64656, 19.9 mm SL.

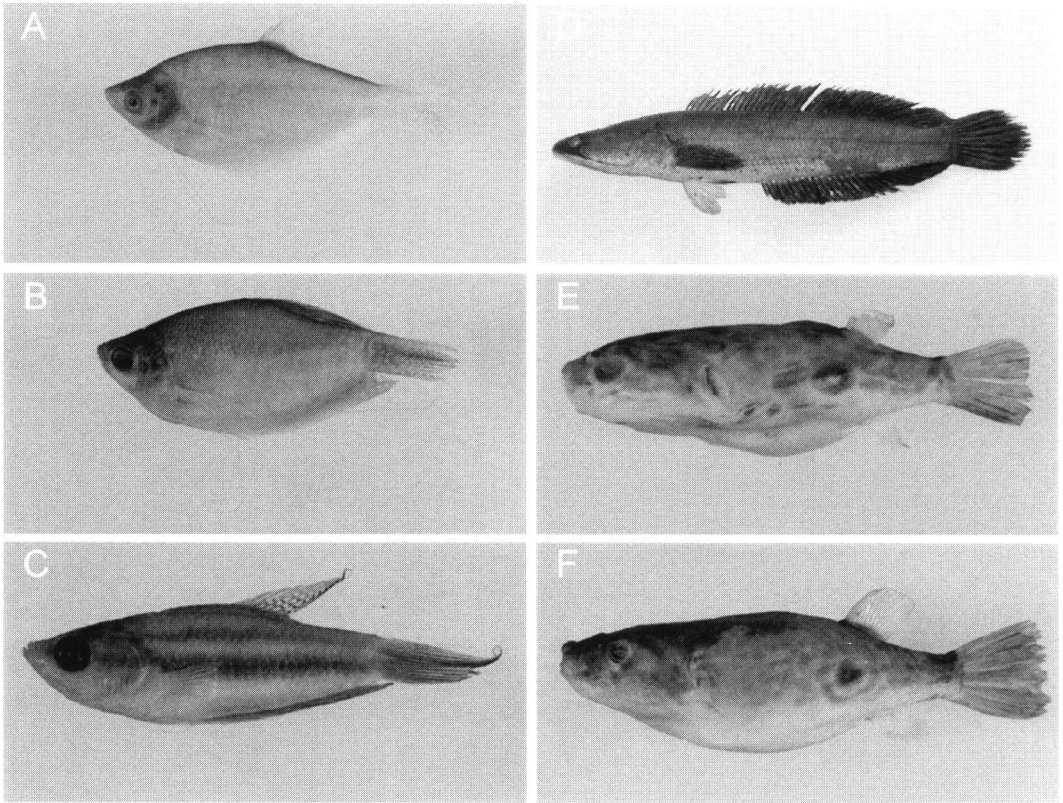


Fig. 8. Fishes of Lake Tonle Sap. A, *Trichogaster microlepis*, NSMT-P 64683, 76.9 mm SL; B, *T. trichopterus*, NSMT-P 64676, 63.0 mm SL; C, *Trichopsis schalleri*, NSMT-P 64648, 23.4 mm SL; D, *Channa striata*, NSMT-P 64689, 235.2 mm SL; E, *Tetraodon cochinchinensis*, NSMT-P 64647, 54.6 mm SL; F, *Tetraodon leiurus*, NSMT-P 64708, 117.1 mm SL.

*et al.* (1999) reported this species from the Lake Tonle Sap and Tonle Sap River, Kottelat (2001) included only the Mekong (Laos and Thailand) and Chao Phraya basins in his account of the species. The present specimens confirmed the earlier report.

*Ompok bimaculatus* (Siluridae): Although Rainboth (1996) and Kottelat (2001) indicated that the species has 59–74 anal-fin rays, the present specimen has 57 rays.

*Macrognathus semiocellatus* (Mastacembelidae): The specimen collected was similar in body color pattern to a specimen figured in Rainboth (1996: pl. 23–182), identified as *M. taeniagaster* (Fowler, 1935). Although Rainboth (1996) regarded *M. taeniagaster* as a senior synonym of *M. semiocellatus* Roberts, 1986, Kottelat (2001)

treated the former as a junior synonym of *M. circumcinctus* (Hora, 1924) and *M. semiocellatus* as a valid species. It is apparent that *M. taeniagaster* of Rainboth (1996) is in fact *M. semiocellatus*.

*Polynemus* sp. (Polynemidae): This apparently undescribed species has been identified as *P. dubius* Bleeker, 1853 (or *P. longipectoralis* Weber & de Beaufort, 1922, presently regarded as a junior synonym of the former) by many researchers (e.g., Rainboth, 1996; Kottelat, 2001; Feltes, 2001). *Polynemus borneensis* of Rainboth (1996: p. 187, pl. 24–140) is apparently *P. melanochir melanochir* (see Motomura & Sabaj, 2002). Because the review of the seven-spined *Polynemus* species by Motomura *et al.* (2002) recognized the distribution of *P. paradiseus* Linnaeus, 1758 as being from India to Thailand, the record of the

latter from Cambodian waters by Kottelat (1985: 273) is probably erroneous and most likely referable to *Polynemus* sp. or *P. melanochir dulcis*, an endemic species to Lake Tonle Sap.

*Trichogaster trichopterus* (Osphronemidae): Although this species characteristically has a black blotch laterally at mid-body and on the caudal-fin base (e.g., Rainboth, 1996; Kottelat, 2001), 6 of the 9 specimens collected lacked blotches (both fresh and preserved), the remaining specimens having a faint blotch on the caudal-fin base only.

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