

## MUGILIFORMES – mullets

Fishes of the Mugiliformes, comprising only a single family Mugilidae, are silvery active swimmers, and are commonly found in coastal marine waters, brackish estuaries and adjacent freshwaters from temperate to tropical regions worldwide. Most of the mugilid fishes have a moderately elongated and subcylindrical body, small and terminal mouth, 2 well-separated dorsal fins, 4 slender pungent spines of the first dorsal fin, pectoral fin high on the body, pelvic fin behind a vertical line through base of the pectoral-fin, 1 spine and 5 segmented rays of the pelvic fin, and medium to large scales on the head and body. Due to their great similarities in general appearance, species identification of the mugilid fishes are difficult for non-specialists. The details of jaws and scales, and development of an adipose eyefold are useful for identifying genera/species of the mugilid fishes.

Generic classification of the mugilid fishes follows Senou *in* Nakabo (1993, 2000, 2002) rather than Durand *et al.* (2012). For example, according to Senou, well-known genera *Liza* and *Valamugil* are considered to be junior synonyms of *Chelon* and *Moolgarda*, respectively, and *Ellochelon* is a distinct genus. Senou's classification (*in* Nakabo, 2002) was subsequently largely supported by recent molecular analysis (Durand *et al.*, 2012).

Ghasemzadeh *et al.* (2004) described a new genus *Paramugil*, and placed 2 species (*P. georgii* and *P. parmatus*) in the genus. Their decision was, however, not supported by the molecular phylogeny (Durand *et al.*, 2012). On some discrepancies in the genus-level classification between Senou *in* Nakabo (1996, 2000, 2002) and Durand *et al.* (2012), see "Notes" of *Chelon subviridis* (p. 313) and *Moolgarda perusii* (p. 314).

Vidthayanon (2008) recorded the following 11 species of the mugilid fishes from the Mekong Delta: *Chelon parmata*, *Chelon subviridis*, *Chelon planiceps* (as *C. tade*), *Ellochelon vaigiensis*, *Moolgarda cunnesius*, *Mo. ophuysenii* (as *ophuyseni*), *Mo. pedaraki*, *Mo. perusii*, *Mo. seheli*, *Mo. speigleri*, and *Mugil cephalus*. One of these, *Mo. ophuysenii*, was regarded as a junior synonym of *Mo. cunnesius* by Harrison & Senou (1999), and, thus, the number of mugilid species hitherto recorded from the



Non-Mekong specimens of mullets (Bangpakong, Thailand, photo: KS)

Mekong is 10. Kottelat (1989a) also recorded *Chelon melinoptera* (as *Liza melinoptera*) from the Mekong, but the record is not included here; he noted that the mullet's systematics is "very confused and most of the records need confirmation." Six of these 10 species (*viz.*, *C. parmata*, *C. subviridis*, *E. vaigiensis*, *Mo. cunnesius*, *Mo. pedaraki*, and *Mo. perusii*) were collected from the Mekong during our field surveys in 2007–2013; in the Mekong, all these mullets were restrictedly found in the Vietnamese region. In addition to these 6 species, *Mo. seheli* and *Mu. cephalus* are also shown in this book, based on non-Mekong specimens (from Phú Quốc Island and Hồ Chí Minh, Vietnam).

***Ellochelon vaigiensis*** (Quoy & Gaimard, 1825)

**Family:** Mugilidae (FC: 245)

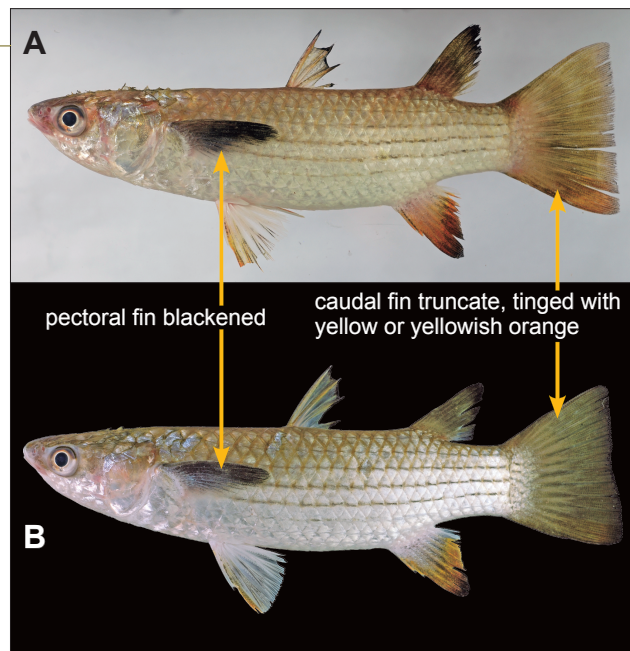
**Size:** 60 cm TL (Harrison & Senou, 1999: 2094, as *Liza vaigiensis*).

**Distribution:** Mekong Basin in Vietnam; Indo-Pacific.

**Notes:** A medium-sized species of mullets, commonly found in shallow coastal marine waters; it frequently enters brackish estuaries in particular in the early-life stages (juveniles and young). *Ellochelon vaigiensis* is not so common in the Mekong, but the young fish are sometimes sold at local markets around the coastal region.

*Ellochelon vaigiensis* is a characteristic species, which is readily distinguished from the other Mekong mullets by having blackened pectoral fin, a short and deep caudal peduncle, and a truncate caudal fin tinged with yellow or yellowish orange. Its blackened pectoral fin and yellowish caudal fin are vivid even in small specimens, and the identification is very easy.

This species was frequently assigned to *Chelon* (or its synonym, *Liza*) (*e.g.*, Harrison & Senou, 1999), but Senou *in* Nakabo (2002) regarded *Ellochelon* as a distinct genus, comprising only a single species *E. vaigiensis*.



A) CTU-P-4585 (photo: HVM); B) CTU-P-4584 (photo: HVM)

*Chelon subviridis* (Valenciennes, 1836)

**Family:** Mugilidae (FC: 245)

**Size:** 40 cm SL (Harrison & Senou, 1999: 2093, as *Liza subviridis*).

**Distribution:** Mekong Basin in Vietnam; Indo-Pacific.

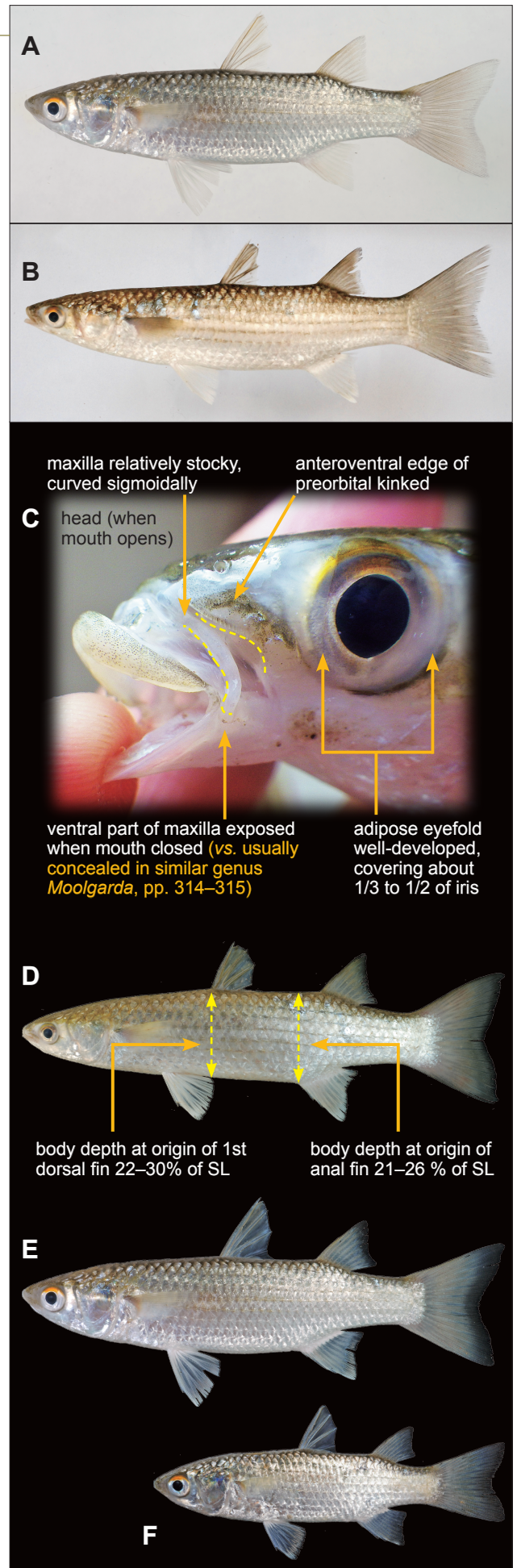
**Notes:** A medium-sized species of mullets, commonly found in shallow coastal marine waters, brackish estuaries and adjacent freshwater areas. This is the most common species of the mugilids found in the Vietnamese Mekong, and abundantly found particularly in the brackish estuaries.

*Chelon* is similar to *Moolgarda* and *Mugil* in general appearance, but differs in having a kinked anteroventral edge of the preorbital (vs. slightly concave or nearly straight in *Moolgarda* and *Mugil*), maxilla relatively stocky and curved sigmoidally, with its posteroventral part that is visible when the mouth is closed (vs. maxilla slender and straight or weakly curved, with its posteroventral part not clearly visible when the mouth is closed in *Moolgarda* and *Mugil*), and ctenoid scales with a non-membranous hind margin (vs. with a membranous hind margin in *Moolgarda*) (see also p. 317).

The genus-level classification follows Senou *in* Nakabo (1993, 2000, 2002), who regarded the genus *Liza* as a junior synonym of *Chelon*. Based on the molecular phylogeny, Durand *et al.* (2012) concurred Senou *in* Nakabo (1993, 2000, 2002) on the *Chelon-Liza* synonymy. Durand *et al.* (2012), however, applied the generic name *Planiliza* for the Indo-West Pacific subclade, whereas *Chelon* for the Atlantic and Mediterranean subclade. Since these 2 subclades form a single clade (see figs 1–2 of Durand *et al.*, 2012), we here lump these together into a single genus *Chelon*, as Senou *in* Nakabo (1993, 2000, 2002) did. The third subclade (named as a new genus *Parachelon* by Durand *et al.*, 2012), composed of a single species *grandispuamis*, is a sister group of *Chelon* + *Planiliza* of Durand *et al.* (2012), and thus can be also placed in *Chelon* herein recognized; actually, for example, Harrison (2016) assigned the species to *Chelon* (as *Liza*), together with the species of *Chelon* of Durand *et al.* (2012).

Of the 3 species of *Chelon* hitherto recorded from the Mekong (*viz.*, *C. parmata*, *C. planiceps*, and *C. subviridis*), *C. subviridis* is distinguished from the other 2 by having moderately slender body, and its depth at origin of anal fin is 21–24% (perhaps up to 26%) of SL (vs. 29–33 and 19–20 in *C. parmata* and *C. planiceps*, respectively) (Harrison & Senou, 1999, as species of *Liza*). *Chelon subviridis* is also similar to *C. macrolepis* and *C. melinoptera*, the other common Indo-Pacific species expected (but not yet recorded) from the Mekong estuaries, but has a more-developed adipose eyefold, covering 1/3 to 1/2 of iris in specimens larger than 10 cm SL (vs. absent or poorly developed as a narrow rim around the eye in the latter 2 species).

Considerable variations in the head and body shape (*e.g.*, shape of snout and body depth) and coloration are found within the Mekong specimens of *Chelon subviridis* (see photographs). According to the key to species of mullets in the Western-Central Pacific region by Harrison & Senou (1999, as a species of *Liza*), however, all of these specimens can be identified as *C. subviridis*; this identification was provisionally confirmed by H. Senou (Kanagawa Prefectural Museum of Natural History, Odawara, Japan), although he also suggested that these specimens possibly contain more than a single species.



A & E) CTU-P 2484 (photo: LXT); B) CTU-P 4969 (photo: HVM); C) one of CTU-P collection (Bến Tre, Vietnam, photo: KS); D) CTU-P 1433 (photo: LXT); F) CTU-P 2310 (photo: LXT)

# MUGILIDAE

## *Chelon parmata* (Cantor, 1849)

**Family:** Mugilidae (FC: 245)

**Size:** 30 cm TL (Harrison & Senou, 1999; 2093, as *Liza parmata*).

**Distribution:** Mekong Basin in Vietnam; Western Pacific.

**Notes:** A relatively small-sized species of mullets, found in shallow coastal marine waters and brackish estuaries. The photographed specimen shown here is a small young, collected from a mangrove creek at Bạc Liêu, Vietnam.

Its extremely deep body readily distinguishes *Chelon parmata* from the other mugilids in the Mekong. *Chelon melinoptera*, which is also expected from the Mekong (but not yet recorded there), may have a similar deep body (depth at anal-fin origin 23–29% of SL), but differs in having more gill raker counts (45–59 vs. 30–45 in *C. parmata*) (Harrison & Senou, 1999).

Based on the phylogenetic analysis of morphological characters, Ghasemzader *et al.* (2004) placed 2 mullet species in their new genus *Paramugil*; these are *P. parmatus* and *P. georgii* (known only from Australia). However, recent molecular analysis did not agree with their classification; for example, in the phylogenetic tree made by Durand *et al.* (2012), *P. parmatus* is deeply nested within the Indo-Pacific clade of their *Planiliza* + *Chelon*. We thus assign this species to *Chelon* (see also "Notes" of *C. subviridis*, p. 313).

## *Moolgarda perusii* (Valenciennes, 1836)

**Family:** Mugilidae (FC: 245)

**Size:** 25 cm TL (Harrison & Senou, 1999; 2106, as *Valamugil perusii*).

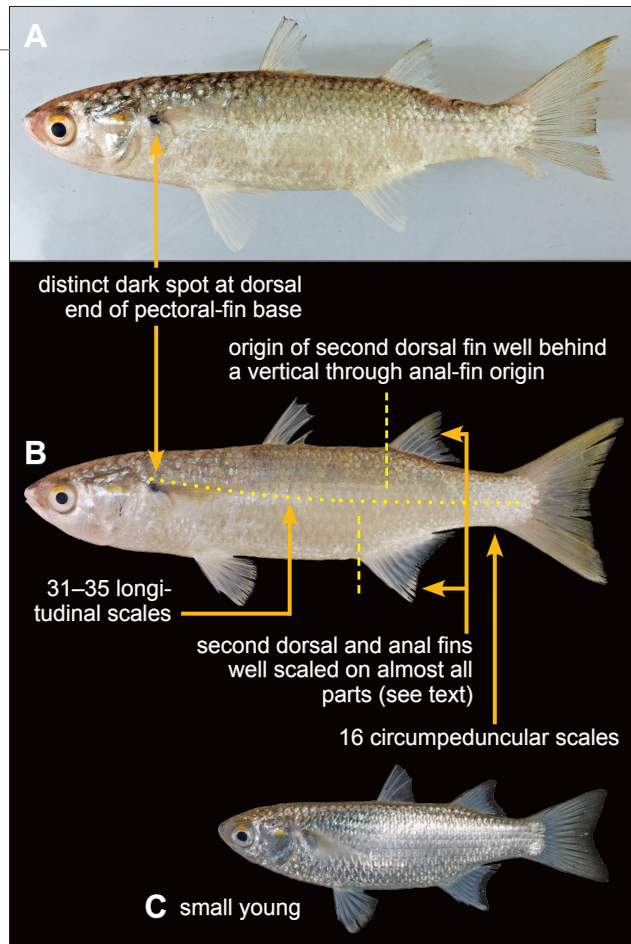
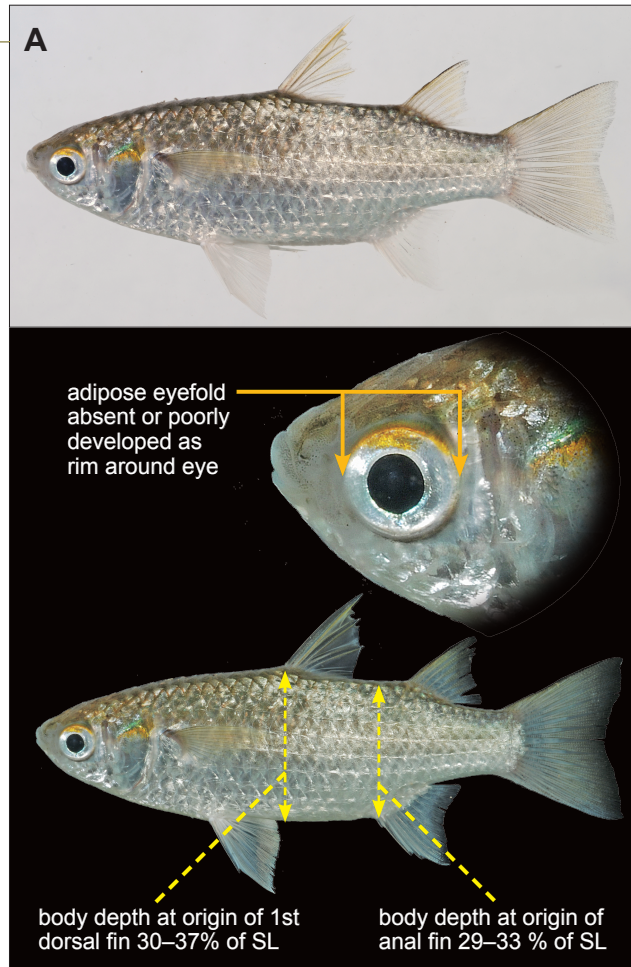
**Distribution:** Mekong Basin in Vietnam; Indo-West Pacific.

**Notes:** A relatively small-sized species of mullets, found in shallow coastal marine waters and brackish estuaries; it is commonly seen at the local markets around the coastal region.

*Moolgarda* can be distinguished from *Chelon* and *Mugil* by having a membranous hind margin of scales on the body (vs. body scales are weak ctenoid, without a membranous hind margin in *Chelon* and *Mugil*), a weakly curved maxilla (the posterior part of which is usually concealed when the mouth is closed vs. visible when the mouth is closed in *Chelon*), and a preorbital with weakly concaved (rather than kinked) anteroventral edge and a non-pointed posterioventral tip (vs. anteroventral edge is kinked in *Chelon*, anteroventral edge is nearly straight and posterioventral tip is pointed in *Mugil*) (see also p. 317).

Durand *et al.* (2012) considered *Moolgarda* as *nomen dubium*, and did not use the name in their revision of the mugilid genera. On the other hand, Senou *in* Nakabo (1993, 2000, 2002) stated that the type species is undoubtedly the same species as *M. seheli*; Kottelat (2013c) referred the Senou's opinion, and indicated that the figured holotype of *M. pura* keyed out as *M. seheli* or possibly *M. buehanani* of Harrison & Senou (1999). Following Senou *in* Nakabo (1993, 2000, 2002) and Kottelat (2013c) (except for status of *Crenimugil*), we use *Moolgarda* as the genus name for the species belonging to a clade composed of *Osteomugil* + *Crenimugil* of Durand *et al.* (2012).

*Moolgarda perusii* differs from the other Mekong congeners (viz., *M. pedaraki*, *M. cunnesius*, and *M. seheli*) in fewer counts of transverse and circumpeduncular scales, and well scaled second dorsal and anal fins. See also the key to species of *Moolgarda* in the Western-Central Pacific given by Harrison and Senou (1999, as *Valamugil*).

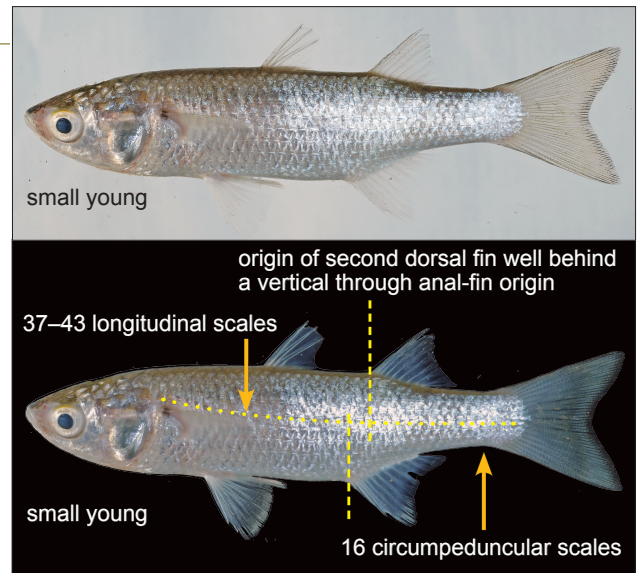


CTU-P-2561 (photo: LXT)

CTU-P-4548 (photo: HVM); B) CTU-P-4547 (photo: HVM); C) CTU-P-3087 (photo: LXT)

***Moolgarda cunnesius*** (Valenciennes, 1836)**Family:** Mugilidae (FC: 245)**Size:** 14 cm SL (Harrison & Senou, 1999: 2103, as *Valamugil cunnesius*).**Distribution:** Mekong Basin in Vietnam; Indo-West Pacific.**Notes:** A small-sized species of mullets, found in shallow coastal marine waters and brackish estuaries.

*Moolgarda cunnesius* is similar to *Moolgarda engeli* (not shown in this book, but is expected from the Mekong) and *M. perusii* (left page) by having usually 16 circumpeduncular scales (vs. usually 19 or 20 in *M. seheli* and *M. pedaraki*, below) and the origin of the second dorsal fin well behind the anal-fin origin (vs. almost opposite), but has 37–43 longitudinal scales (vs. 30–36 in *M. engeli* and *M. perusii*). The other congener *M. speigleri*, also recorded from the Mekong (Vidthayanon, 2008), has similar counts of the scales, although it differs in having fewer gill rakers on the lower limb of the first gill arch (35–45 vs. 62–75 in *M. cunnesius*), and well scaled second dorsal and anal fins (vs. only the anterior and basal parts of the fins are scaled) (Harrison & Senou, 1999, as species of *Valamugil*).

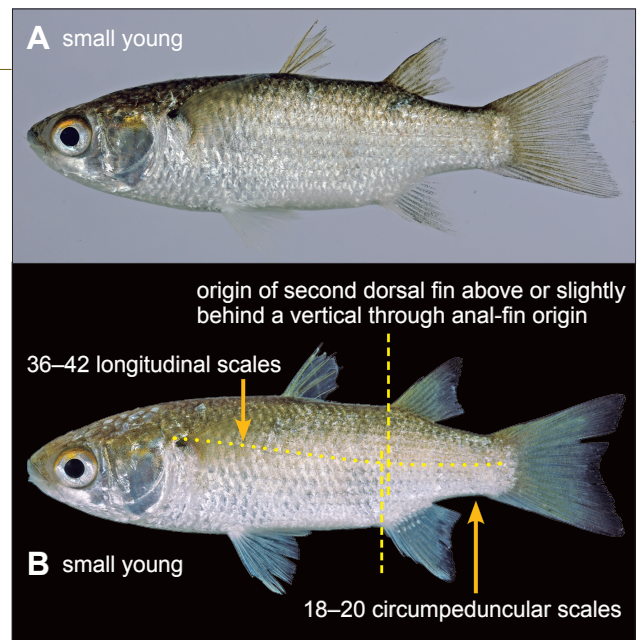


CTU-P 1466 (photo: LXT)

***Moolgarda seheli*** (Forsskål, 1775)**Family:** Mugilidae (FC: 245)**Size:** 25 cm TL (Harrison & Senou, 1999: 2106, as *Valamugil seheli*).**Distribution:** Mekong Basin in Vietnam; Indo-Pacific.

**Notes:** A relatively small-sized species of mullets, found in shallow coastal marine waters, brackish estuaries and adjacent freshwater areas. Vidthayanon (2008) recorded this species from the Mekong Delta, but, during our field surveys in 2007–2013, we could not confirm this from the region. The photographed specimen (small young) shown here was collected from Phú Quốc Island, off the western coast of the Mekong Delta in Vietnam, where this species appears to be common.

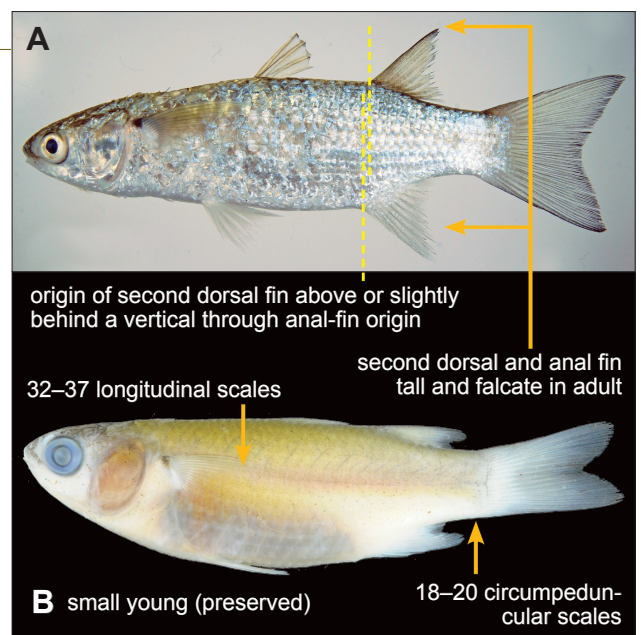
*Moolgarda seheli* resembles *M. pedaraki* (below) in having 18–20 (usually 19 or 20) circumpeduncular scales (vs. usually 16 in the other Mekong congeners) and almost opposite second dorsal and anal fins (vs. origin of the second dorsal fin distinctly behind the origin of the anal fin). *Moolgarda seheli* can be distinguished from the *M. pedaraki* by a slightly higher count of longitudinal scales (36–42 vs. 32–37 in *M. pedaraki*), a longer snout (usually 18% or more of head length vs. 14–19%), and weakly falcate second dorsal and anal fins (vs. falcate in adult) (Harrison & Senou, 1999, as species of *Valamugil*).



A) CTU-P 4218 (photo: LXT); B) CTU-P 4217 (photo: LXT)

***Moolgarda pedaraki*** (Valenciennes, 1836)**Family:** Mugilidae (FC: 245)**Size:** 50 cm SL (Harrison & Senou, 1999: 2102, as *Valamugil buchanani*).**Distribution:** Mekong Basin in Vietnam; Indo-Pacific.

**Notes:** A medium-sized species of mullets, found in shallow coastal marine waters and brackish estuaries. *Moolgarda buchanani* (or *Valamugil buchanani*, originally described as *Mugil buchanani* Bleeker, 1853) is a synonym (Senou in Nakabo, 2000, 2002, 2013). See "Notes" of a similar congener *M. seheli* (above).



A) Non-Mekong specimen, IFREDI-P 6128 (Koh Kong, Cambodia, photo: PT); B) 1 of CTU-P 4041 (photo: KS)



**Mugil cephalus** Linnaeus, 1758

**Family:** Mugilidae (FC: 245)

**Size:** 91 cm TL (Harrison & Senou, 1999: 2096).

**Distribution:** Mekong Basin in Vietnam; tropical, subtropical and temperate regions worldwide.

**Notes:** A medium to large-sized species of mullets, found in coastal marine waters, brackish estuaries and adjacent freshwater areas. *Mugil cephalus* is a famous cosmopolitan fish, but is less abundant in the tropics (Bhatia & Wongratana, 1974; Harrison & Senou, 1999). Wongratana *et al.* (1984) discovered 3 preserved specimens of *M. cephalus* from Songkhla Lake, a brackish water lake in the southern part of the peninsular Thailand, and noted "The appearance of only three specimens during the long search for the fish is therefore due to its rarity in Thai waters." Subsequently Vidthayanon (2008: 162, fig. 221) recorded this species from the Mekong Delta, with a note, "Uncommon in Southeast Asian markets." During our field surveys in 2007–2013, we could not find any specimens of *M. cephalus* from the Mekong; photographed specimen shown here was purchased at a fish market in Hồ Chí Minh City, Vietnam.

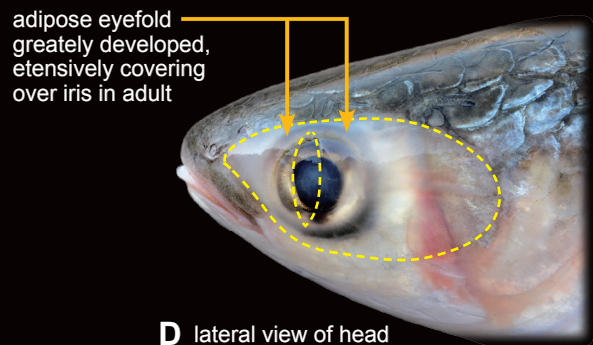
*Mugil* is somewhat similar to *Chelon* (pp. 313–314) and *Moolgarda* (pp. 314–315) in general appearance, but can be distinguished by having, *e.g.*, an extensive adipose eyefold in adult (*vs.* usually less extensive, marginal or absent in *Chelon* and *Moolgarda*) and a nearly straight maxilla extending ventrally to a point just behind the corner of rictus (*vs.* downwardly curved and extending well beyond the corner of rictus).



dark blue spot at upper base of pectoral fin

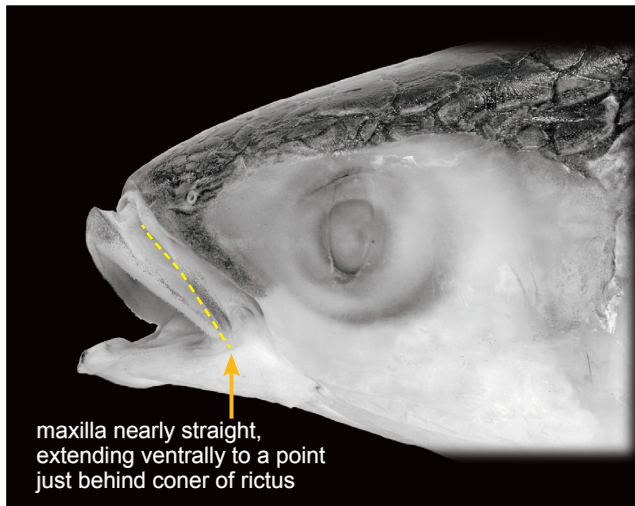


usually 8 (rarely 9) soft anal-fin rays in adult



adipose eyefold greatly developed, extensively covering over iris in adult

D lateral view of head



maxilla nearly straight, extending ventrally to a point just behind corner of rictus

E ventral view of head

A) Marketed fish, including CTU-P 5399 (bottom one of large mullets) (Hồ Chí Minh City, Vietnam, photo: KS); ; B–F) CTU-P 5399 [photo: HVM (B and C) and KS (D–F)]

## Comparison of 3 similar-looking mugilid genera in the Mekong

Many of the mugilid fishes found in the Mekong represent similar-looking appearances, and their identification may be difficult for non-taxonomists in many cases, except for a few distinctive species, e.g., *Ellochelon vaigiensis* (p. 312). Examples include *Chelon*, *Moolgarda*, and *Mugil*. Although *Mugil* appears to be uncommon in the Mekong, fishes of the other 2 genera are abundantly seen around the estuarine area in the Vietnamese Mekong. Some selective characters, which are

useful in identification of these genera (*viz.*, details of mouth region and scale morphology), are shown below.

Two additional similar-looking mugilid genera, *Crenimugil* and *Oedalechilus*, are also found in the Phú Quốc Island of Vietnam (off the western coast of the Mekong Delta) and the coastal area of western Cambodia, but, considering their habitat preference, mullets of these genera are hardly expected from the Mekong.

