

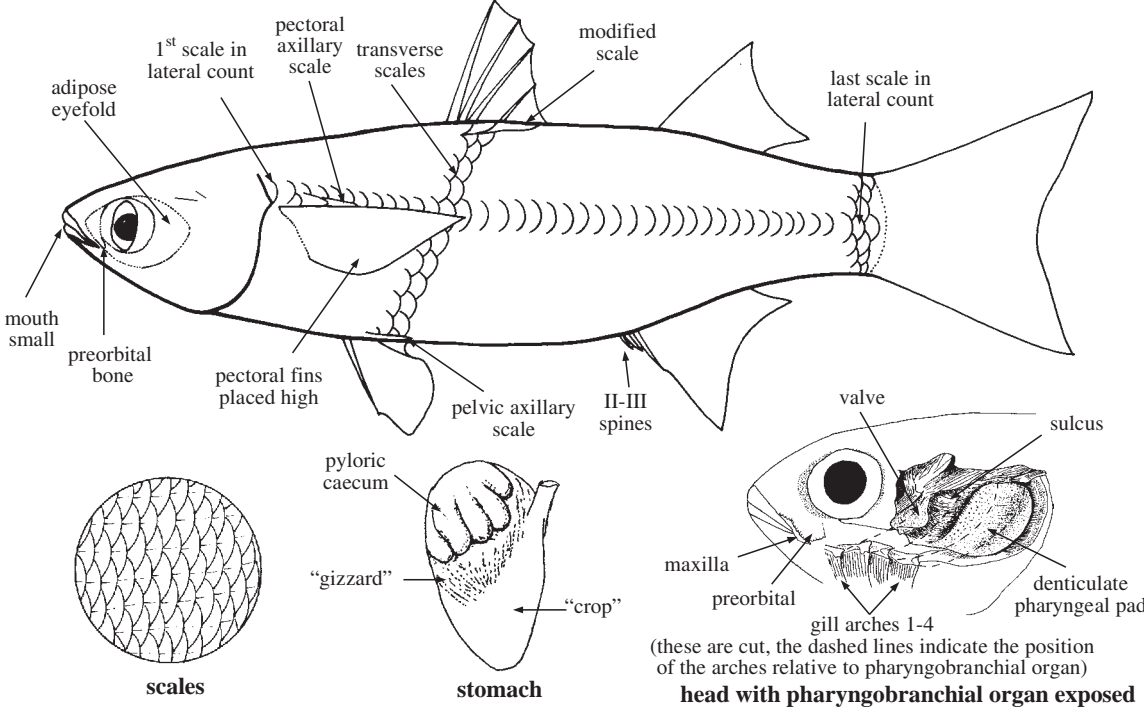
Order MUGILIFORMES

MUGILIDAE

Mullet

by I.J. Harrison and H. Senou

Diagnostic characters: Medium- to large-sized fishes; elongate with subcylindrical body. **Head often broad and flattened dorsally** (except *Aldrichetta* and *Cestraeus*). **Eyes often partly covered by adipose "eyefold" tissue.** **Mouth small or moderate in size, terminal or inferior;** premaxillae protractile; teeth relatively small, hidden or absent. **Two short dorsal fins, well separated; first with IV slender spines;** second dorsal fin usually with 9 or 10 soft rays; anal fin short with II or III spines and 7 to 12 soft rays in adults; caudal fin emarginate or forked; **pectoral fins inserted high on body;** dorsal ray of pectoral fins developed as a short spur or 'spine' (not a true spine); pelvic fins with I spine and 5 soft rays, **inserted about equidistant between origins of pectoral fins and first dorsal fin.** **Lateral line absent.** Scales large to moderate size, cycloid or ctenoid on head and body, with 1 or more longitudinal rows of striae (grooves); with membranous hind margin in *Valamugil*; 24 to 64 scales in longitudinal series on midline, counted from just behind head (behind operculum), above pectoral fins, to point of caudal flexure (i.e. not including scales on caudal fin); 18 to 16 transverse scales, counted from origin of pelvic fins to origin of first dorsal fin; 15 to 27 scales in transverse series entirely around caudal peduncle; **large, modified scales may be present above pectoral and pelvic fins (axillary scales) and below first dorsal fin.** Oral and branchial filter-feeding mechanism involving gill rakers and a **specialized "pharyngobranchial organ" comprising large, denticulate "pharyngeal pad" and pharyngeal "sulcus" on each side of pharyngobranchial chamber** (less evident in *Aldrichetta* and *Cestraeus*). Pharyngobranchial organ may be seen by lifting operculum and pulling first 3 gill arches forward from fourth arch. The pharyngeal pad is a large, rounded structure with numerous, fine denticulate teeth giving an apparently "furry" surface. The sulcus is the deep groove anterior to the denticulate pad. Anterior wall of sulcus may bear 1 or 2 "valves" which can be difficult to see but, when present, are small to moderate flaps of tissue on lower or midpart of sulcus and lying back against sulcus wall. Sulcus and valves best seen by pulling first 2 gill arches forward from third and fourth arches. **Stomach with muscular gizzard** (except in *Aldrichetta* and *Cestraeus*) and pyloric caeca positioned ventrally. Stomach and caeca can be seen by cutting the fish along the abdomen and removing the liver, lying ventral to the alimentary tract. **Intestine elongate and elaborately coiled** (less so in *Aldrichetta*, *Cestraeus*, and *Myxus*). Vertebrae 24 to 26. **Colour:** dark blue, dark olive, greenish, or greyish dorsally; **flanks silvery**, often with more or less distinct dark stripes (about 3 to 9) following rows of scales; ventral parts of body also silvery, or pale/yellowish; fins dusky or pale yellowish (particularly pelvic fins) perhaps with margins dusky; dark bar or spot sometimes dorsally at base of pectoral fins.



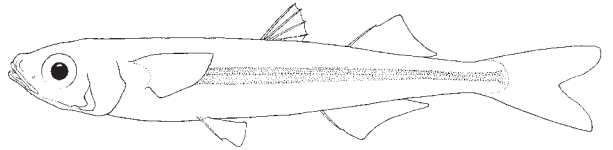
head with pharyngobranchial organ exposed

Habitat, biology, and fisheries: Most species are euryhaline; inhabiting coastal marine waters, brackish water lagoons, estuaries, and may enter fresh waters (particularly at young stages); usually to depths of 20 m, but will go deeper. Some species more typically inhabit fresh water but can be found in brackish waters. Coastal species usually spawn offshore; fresh-water species spawn in brackish waters. Feeding: browsing on submerged surfaces and filtering large quantities of benthic detritus; ingesting microalgae, detritus, small invertebrates, micro-organisms, and particulate organic material. Several species are of moderate to major importance to fisheries and are caught with diverse net types. From 1990 to 1995, the FAO Yearbook of Fishery Statistics reports a range of yearly catch of Mugilidae of around 41 900 to 55 100 t from the Western Central Pacific. Small-scale and subsistence fisheries are probably also relatively large. The hardiness, simple diet, and rapid growth of mullets has made some species the object of aquaculture.

Remarks: Mugilidae are most speciose in the Indo-West Pacific region; many species are morphologically very similar (e.g. *Liza* and *Valamugil*). Several nominal species appear to be conspecific and others show a degree of morphological or meristic variability which makes straightforward diagnoses almost impossible. The taxonomy of Mugilidae in this region is therefore very confused and parts of the following key and diagnoses are provisional pending forthcoming revision.

Similar families occurring in the area

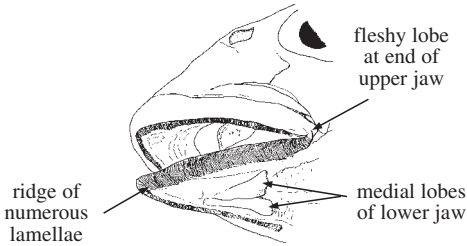
Atherinidae: body more slender, a prominent silvery stripe along flanks; eyes larger; anal-fin rays usually more than 10 (usually, but not always, less than 10 in Mugilidae).



Atherinidae

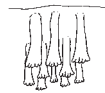
Key to the species of Mugilidae occurring in the area

- 1a. Lower jaw bordered ventrally by a ridge of numerous lamellae (Fig. 1a); upper and lower jaws ending posteriorly in fleshy lobes (Figs 1a and 3) (*Cestraeus*) → 2
- 1b. No such ridges of lamellae or fleshy lobes associated with jaws (Fig. 2) → 4



a) ventrolateral view of head

Fig. 1 *Cestraeus oxyrhynchus*



b) upper jaw teeth



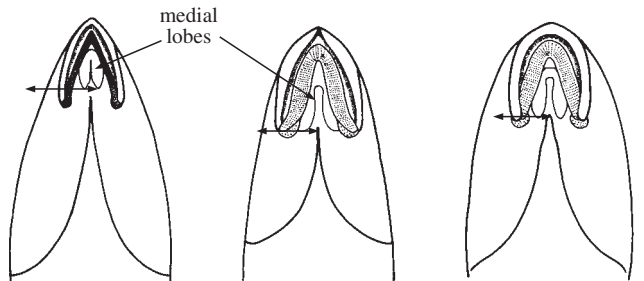
ventrolateral view of head

Fig. 2 *Liza*

- 2a. Medial lobes on lower jaw not reaching corner of mouth (Figs 1a and 3a); teeth in upper jaw multicuspid and close-packed (Fig. 1b) *Cestraeus oxyrhynchus*
- 2b. Medial lobes on lower jaw reaching corner of mouth (Fig. 3b and c); teeth in upper jaw bicuspid or unicuspid → 3

- 3a. Pectoral fins as long as or longer than head; usually distinct tooth patches on vomer; interorbit strongly convex (Fig. 4) and dentary symphysis pointed (Fig. 3b) *Cestraeus goldiei*

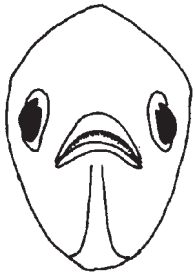
- 3b. Pectoral fins shorter than head; vomer usually edentate; interorbit only moderately convex and dentary symphysis more rounded than pointed (Fig. 3c) *Cestraeus plicatilis*



a) *Cestraeus oxyrhynchus* b) *Cestraeus goldiei* c) *Cestraeus plicatilis*

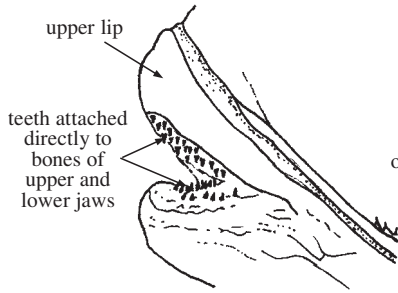
Fig. 3 ventral view of head

- 4a. Scales in longitudinal series 55 or more; several rows of teeth directly attached to jaw bones (Fig. 5) *Aldrichetta forsteri*
- 4b. Scales in longitudinal series less than 50; teeth borne on edges of lips (Fig. 6), often minute or absent →5



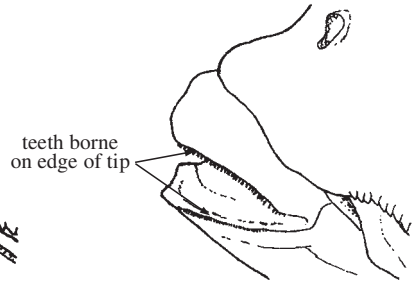
frontal view of head

Fig. 4 *Cestraeus goldiei*



lateral view of head

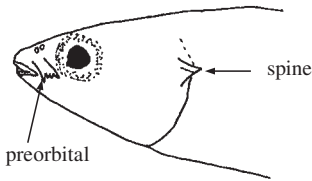
Fig. 5 *Aldrichetta forsteri*



lateral view of head

Fig. 6 *Liza* sp.

- 5a. Posteroventral edge of preorbital very strongly serrate, forming large spurs (Fig. 7a, b); opercle with short spine at dorsoposterior corner, above pectoral-fin base (Fig. 7a) *Sicamugil hamiltoni*
(fresh-water and brackish estuaries of Myanmar; not yet recorded from the area)
- 5b. Posteroventral edge of preorbital serrate, but not distinctly so, and not forming large spurs (Fig. 8a, b); opercle lacking short spine at dorsoposterior corner (Fig. 8a) → 6

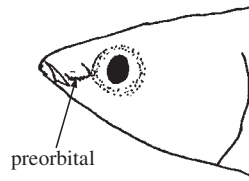


a) lateral view of head

Fig. 7 *Sicamugil hamiltoni*



b) posteroventral edge of preorbital



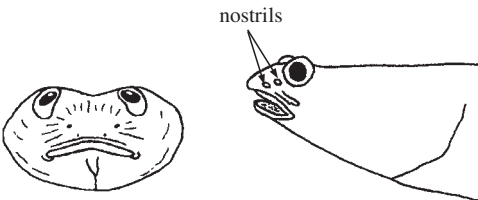
a) lateral view of head

Fig. 8 *Liza* sp.



b) posteroventral edge of preorbital

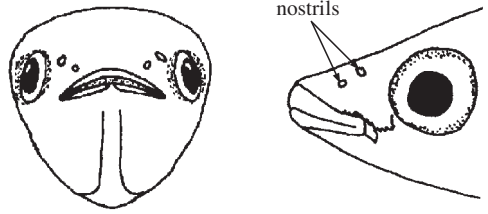
- 6a. Head very distinctly flattened and concave between eyes (Fig. 9a); anterior nostril positioned low on snout and eyes dorsolateral, high on head; snout projecting beyond inferior, upper lip (Fig. 9b) *Rhinomugil nasutus*
- 6b. Head moderately flattened and more or less convex between eyes (Fig. 10a); nostrils positioned high on snout and eyes lateral on head; upper lip not inferior to snout (Fig. 10b) → 7



a) frontal view of head

b) lateral view of head

Fig. 9 *Rhinomugil nasutus*



a) frontal view of head

b) lateral view of head

Fig. 10 *Liza* sp.

- 7a. Upper lip usually distinctly thickened, its depth at point of snout 5 to 11 times in head length (usually less than 10 times in head length); lower part of upper lip with rugose fringe or bearing distinct crenulations or papillae (Fig. 11a-c); (thickening of lip and papillae may be less distinct in small specimens) (*Crenimugil*, *Oedalechilus*) → 8
- 7b. Upper lip not distinctly thickened, its depth at point of snout greater than 12 times in head length (usually about 15 to 20 times in head length); upper lip not rugose nor bearing distinct crenulations or papillae (Fig. 11d) → 10

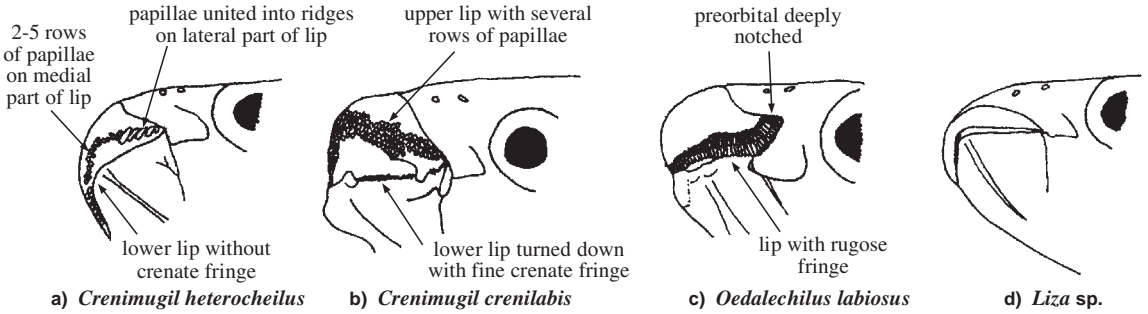


Fig. 11 mouth

- 8a. Preorbital deeply notched; lips with distinct rugose fringe (Fig. 11c); upper lip thickened, split into longitudinal lobes (Fig. 12); lips deeply folded into preorbital notch at corner of mouth (Fig. 11c); 3 or 4 pyloric caeca *Oedalechilus labiosus*
- 8b. Preorbital only slightly or not notched; upper lip not split into longitudinal lobes but thickened with lower part bearing rows of papillae; lips not deeply folded into corners of mouth (Fig. 11a, b); 6 to 10 pyloric caeca (*Crenimugil*) → 9
- 9a. Upper lip with 1 to 10 rows of papillae on medial and lateral parts; upper lip thickness 5.2 to 9.5 times in head length; anterior edge of lower lip turned slightly out and down, with fine crenate fringe on inner part (Fig. 11b) *Crenimugil crenilabis*
- 9b. Upper lip with 2 to 5 rows of papillae, these rows united into file-like ridges on lateral parts of lip; upper lip thickness 6 to 11 times in head length; lower lip thin, without crenate fringe (Fig. 11a) *Crenimugil heterocheilus*
- 10a. Lower lip thick-edged, deflected downwards; teeth on lower lip directed down, with trifid tips, and in 2 or more rows (Fig. 13a and b) *Neomyxus leuciscus*
- 10b. Lower lip thin, directed forwards; teeth on lower lip directed forwards or upwards, without trifid tips, or teeth absent (Fig. 14) → 11

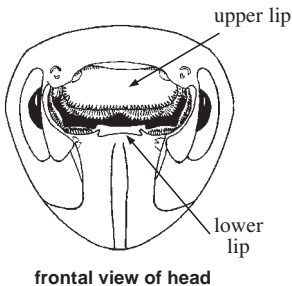


Fig. 12 *Oedalechilus labiosus*

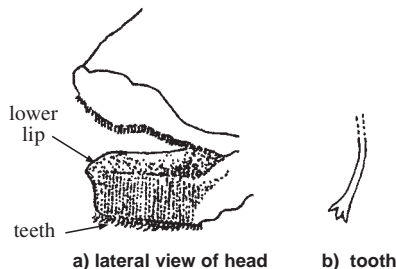


Fig. 13 *Neomyxus leuciscus*

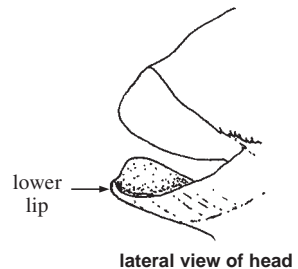


Fig. 14 *Liza* sp.

11a. Maxilla straight, posterior tip not curved down (Fig. 15a); preorbital slender with straight anteroventral edge and a pointed posteroventral end (Fig. 15a); adipose eyefold always extensive in adults (Fig. 16a); dentary symphysis pointed, usually less than 90° (Fig. 17a); in adults, anal fin with III spines and 8 or 9 soft rays (if 8, then this character in combination with longitudinal series scale count of 36 to 44); (anal fin with II spines and 9 or 10 soft rays in juveniles about 30 mm standard length or less) (*Mugil*) → 12

11b. Maxilla with posterior tip slightly curved down (less distinct in *Myxus*) or more distinctly sigmoidally curved (Fig. 15b, c); preorbital with a slightly concave or distinctly kinked anteroventral edge and a blunt (*Valamugil*; Fig. 15b) or broad squarish (*Liza*, *Myxus*) posteroventral end (Figs 15c and 20); adipose eyefold often marginal or absent in adults (Fig. 16b, c), rarely as extensive as in *Mugil* (never extensive in species with more than 43 scales in longitudinal series); dentary symphysis usually blunt, more than 90° (Fig. 17b); in adults, anal fins usually with III spines and 9 (rarely 8) soft rays (correspondingly II spines and 10 or 9 soft rays in juveniles about 30 mm standard length or less), except typically III spines and 8 soft rays in adult *Liza vaigiensis* with less than 30 scales in longitudinal series (cf. *Mugil*) (*Myxus*, *Liza*, *Valamugil*) → 13

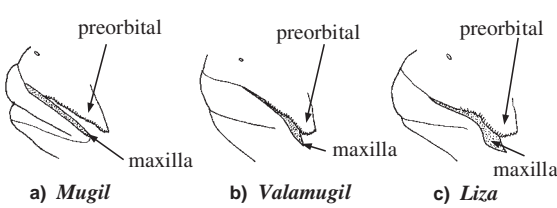


Fig. 15 lateral view of mouth (maxilla shaded)

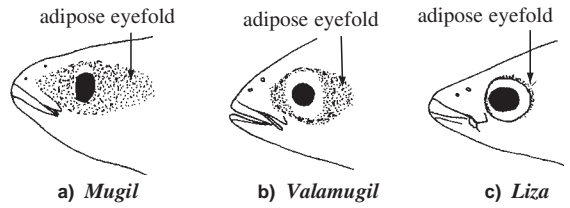


Fig. 16 lateral view of head

12a. Anal fin usually with 8 (rarely 9) soft rays in adults; second dorsal and anal fins with scales only on anterior and basal parts of fins *Mugil cephalus*

12b. Anal fin with 9 soft rays in adults; second dorsal and anal fins with scales on all parts of fins . . . *Mugil broussonetti*

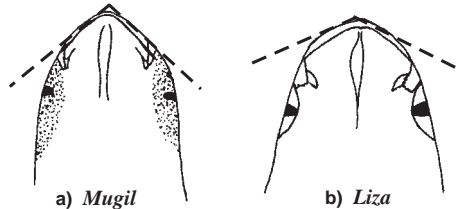


Fig. 17 ventral view of head

13a. Scales in longitudinal series 43 or more; predorsal scales never keeled, and ventral valve of pharyngobranchial organ appears as papilla covered pad (Fig. 18a); (2 pyloric caeca - specimen must be dissected to see this) (*Myxus*) → 14

13b. Scales in longitudinal series 43 or less; predorsal scales with or without keel; in species with more than 40 scales in longitudinal series the pharyngobranchial organ either lacks valves (Fig. 18b) and predorsal keel, or if valves present, then they are not papillose and predorsal keel also present (Fig. 19); (4 or more pyloric caeca, except in *Liza argentea* with 2 caeca but also less than 40 scales in longitudinal series, cf. *Myxus*) (*Liza*, *Valamugil*) → 15

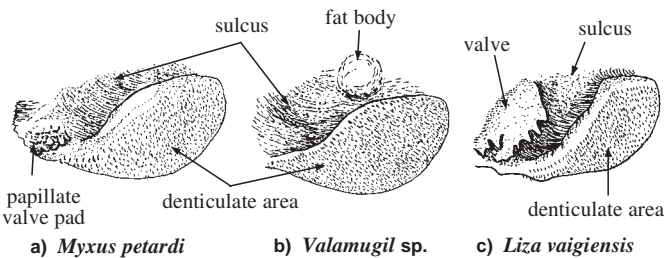


Fig. 18 lateral view of pharyngobranchial organs

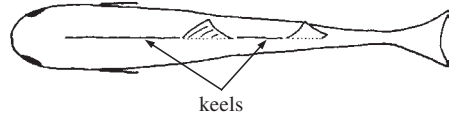


Fig. 19 *Liza affinis* (dorsal view)

- 14a. Scales in longitudinal series 47 to 52; teeth in upper lip small and ciliiform or absent; gill rakers on first arch 1/2 length of longest gill filaments *Myxus petardi*
- 14b. Scales in longitudinal series 43 to 46; teeth in upper lip spatulate with constricted tips (Fig. 20a, b); gill rakers on first gill arch as long as longest gill filaments *Myxus elongatus*

- 15a. Preorbital with a kink (often distinct) on the serrate anteroventral edge and a broad, squarish, posteroventral tip (Figs 15c and 16c); maxilla stocky and curved sigmoidally near posterior tip, which is often visible posteroventral to corner of closed mouth (Figs 15c and 16c); scales ctenoid but lacking a membranous, digitated hind margin (Fig. 21a); pharyngobranchial organ with 1 or usually 2 valves (Fig. 18c) (*Liza*) → 16
- 15b. Preorbital with a more or less concave (rather than kinked) serrate anteroventral edge and a narrow posteroventral tip (Figs 15b and 16b); maxilla slender and weakly curved down at posterior tip, which is usually not clearly visible posteroventral to corner of closed mouth (exposed when mouth opened) (Figs 15b and 16b); scales with a membranous, digitated hind margin (Fig. 21b) or appearing cycloid where membrane poorly developed (*Valamugil georgii*); pharyngobranchial organ with a broad sulcus and lacking valves (Fig. 18b) (*Valamugil*) → 25

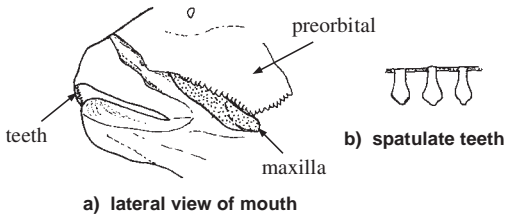


Fig. 20 *Myxus elongatus*

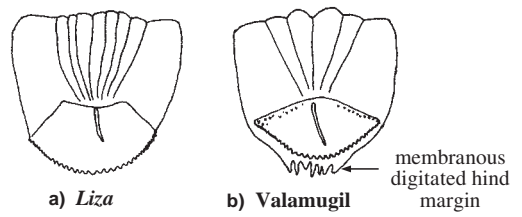


Fig. 21 scales

- 16a. Anal fin with 8 soft rays in adults; caudal fin squarish, its posterior margin nearly straight; pectoral fins black (lower section yellowish in adults) (Fig. 22); (10 or more pyloric caeca - specimen must be dissected to see this) . . . *Liza vaigiensis*
- 16b. Anal fin with 9, or less frequently 8, soft rays in adults; caudal fin clearly emarginate or forked; pectoral fins perhaps dusky but never black; (less than 10 pyloric caeca - specimen must be dissected to see this) □ 17

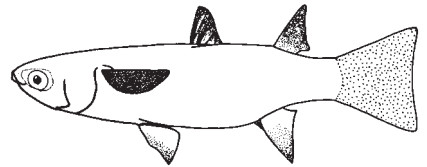


Fig. 22 *Liza vaigiensis*

- 17a. Predorsal scales with keel (Fig. 19) *Liza affinis*
- 17b. Predorsal scales lacking keel → 18

- 18a. Scales in transverse series 13 to 15 1/2 (Fig. 23); usually 10 or more anal-fin rays in adults; gill rakers on lower limb of first gill arch 100 or more and very long (equal to or longer than longest gill filaments) → 19
- 18b. Scales in transverse series less than 13 (Fig. 24); usually less than 10 anal-fin rays in adults; gill rakers on lower limb of first gill arch less than 100 and of moderate or short length □ 20

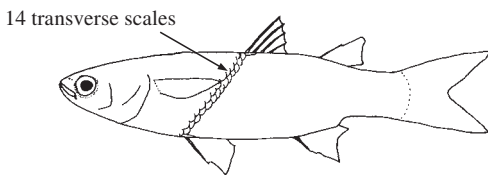


Fig. 23 *Liza argentea*

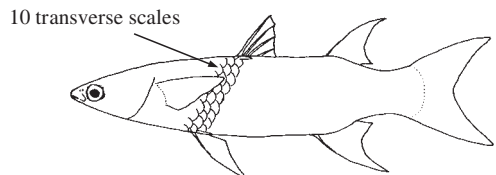


Fig. 24 *Liza alata*

- 19a. Adults usually with 10 anal-fin rays *Liza argentea*
- 19b. Adults with 11 anal-fin rays *Liza ramsayi*

20a. All fins long and falcate; pelvic and pectoral fins longer than length of head minus snout (Fig. 24); scale margins dark, giving reticulate appearance to flank pigmentation *Liza alata*

20b. Fins less distinctly falcate and shorter, particularly pelvic, second dorsal, and anal fins (Figs 25 and 26); pelvic fins shorter than length of head minus snout, and pectoral fins usually shorter than or equal to head minus snout; flank pigmentation less obviously reticulate. → 21

21a. Body slender and elongate (body depth at origin of first dorsal fin 22% or less of standard length, and at anal-fin origin 20% or less of standard length); head depressed and pointed (Fig. 26); eye diameter usually less than 20% of head length; 5 to 7 indistinct stripes sometimes present on upper flanks of larger specimens *Liza planiceps*

21b. Body more robust (body depth at origin of first dorsal fin 22% or more of standard length, and at anal-fin origin greater than 20% of standard length); head not markedly depressed or pointed (Fig. 25); eye diameter 21% or more of head length; stripes on flanks absent (except in *Liza subviridis* with 3 to 6 indistinct stripes) → 22

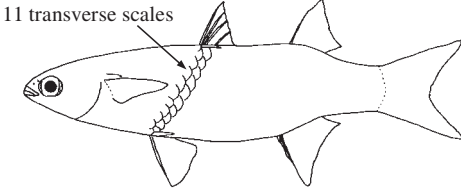


Fig. 25 *Liza macrolepis*

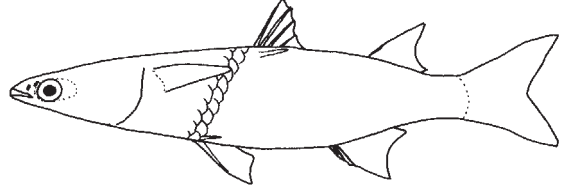


Fig. 26 *Liza planiceps*

22a. Upper lip with an outer row of short, yet distinct, peg-like setiform teeth which are very close-set in a fine "comb", and 1 or 2 inner rows of finer, more wide-set teeth (Fig. 27a); 31 to 35 (commonly 32 or 33) scales in longitudinal series, and 10 or 11 in transverse series (Fig. 25); adipose eyefold marginal (Fig. 28a), or absent *Liza macrolepis*

22b. Upper lip with an outer row of short, fine teeth which can be wide-set or moderately close-set, but do not appear peg-like or form a distinct fine-set "comb" (cf. *Liza macrolepis*); 1 or 2 inner rows of smaller ciliform or setiform teeth may be present, but these are small and irregularly spaced (Fig. 27b) (cf. more regular arrangement in *Liza macrolepis*); 25 to 32 (rarely 33; usually 30 or less) scales in longitudinal series, and 9 to 11 (rarely 12) in transverse series; adipose eyefold either marginal or partly developed over eye and side of head (Fig. 28b) → 23

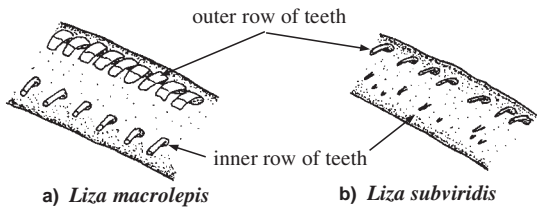


Fig. 27 inner surface of upper lip

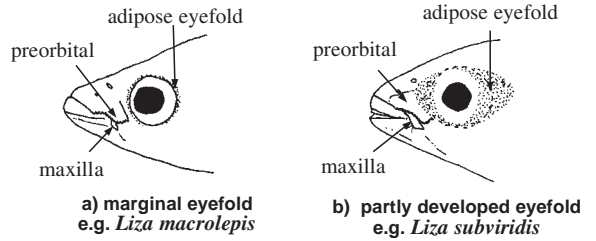


Fig. 28 *Liza* spp.

23a. Lower limb of first gill arch with 30 to 45 gill rakers; body depth at origin of anal fin 29 to 33% of standard length; pectoral fins usually extend to ninth or tenth (rarely eighth or eleventh) scale in longitudinal series *Liza parmata*

23b. Lower limb of first gill arch usually with 45 to 68 or more gill rakers (rarely 41 to 44 in *Liza subviridis*); body depth at origin of anal fin 21 to 29% of standard length; pectoral fins extend to seventh or eighth (rarely ninth) scale in longitudinal series → 24

- 24a. Adipose eyefold covering about 1/3 to 1/2 of iris (in specimens about 10 cm standard length or larger) (Fig. 28b; body appears fusiform or not distinctly deep in profile (Fig. 29a), body depth at origin of first dorsal fin usually 22 to 26% of standard length (sometimes attaining 27 to 30%); caudal fin bluish with dark pigmentation restricted to margins *Liza subviridis*
- 24b. Adipose eyefold marginal, not extending over iris (Fig. 28a); body appears more distinctly "robust" or deep in profile (Fig. 29b), body depth at origin of first dorsal fin 27 to 31% (rarely to 34%) of standard length; dark pigmentation over entire caudal fin *Liza melinoptera*

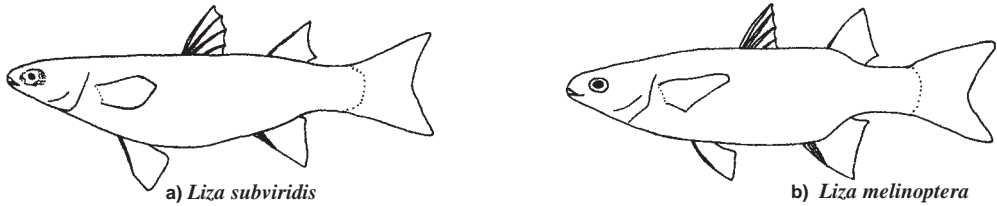


Fig. 29 lateral view

- 25a. Eighteen or more (usually 19 or 20) scales in transverse series entirely around caudal peduncle (i.e. inclusive of both sides of body); origin of fully erected second dorsal fin on vertical through anal-fin origin, or only just behind it (Fig. 30a, b) → 26
- 25b. Eighteen or less (usually 16) scales in transverse series entirely around caudal peduncle (i.e. inclusive of both sides of body); origin of fully erected second dorsal fin on vertical through about third soft ray of anal fin, i.e. behind anterior quarter or more of anal fin (Fig. 31a, b) → 27

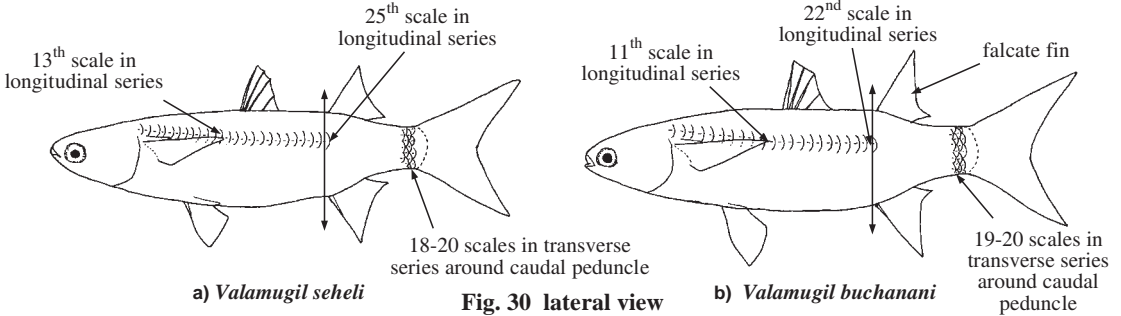


Fig. 30 lateral view

- 26a. Scales in longitudinal series 36 or more; second dorsal and anal fins not strongly falcate; at least 23 (usually 24) scales in longitudinal series anterior to origin of second dorsal fin (Fig. 30a); pectoral fins 84 to 104% of head length, but not often longer than head; snout usually 18% or more of head length (rarely 17%) *Valamugil seheli*
- 26b. Scales in longitudinal series 32 to 36 (rarely 37); second dorsal and anal fins falcate; usually less than 24 scales in longitudinal series anterior to origin of second dorsal fin (Fig. 30b); pectoral fins 90 to 139% of head length, often longer than head; snout 14 to 19% of head length *Valamugil buchanani*

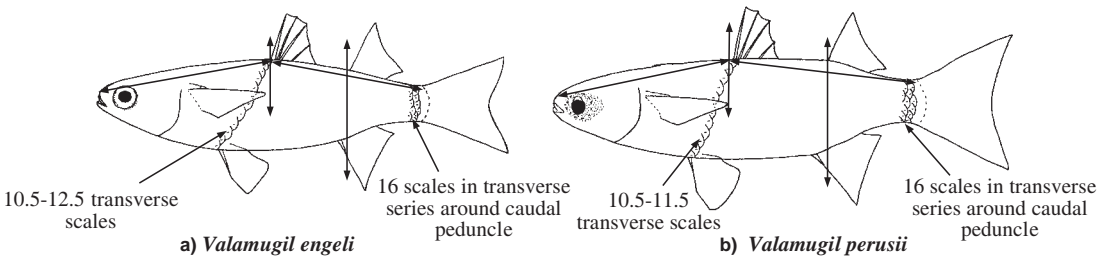


Fig. 31 lateral view

- 27a Scales in longitudinal series 37 to 43 → 28
- 27b. Scales in longitudinal series 30 to 36 → 29

28a. Second dorsal and anal fins weakly scaled, with scales only on anterior and basal parts; 62 to 75 gill rakers on lower limb of first gill arch; maxilla slightly curved downwards and anterior edge of preorbital weakly concave (Fig. 32a) *Valamugil cunnesius*

28b. Second dorsal and anal fins well scaled on all parts; 35 to 45 gill rakers on lower limb of first gill arch; maxilla and anterior edge of preorbital almost straight (Fig. 32b) *Valamugil speigleri*

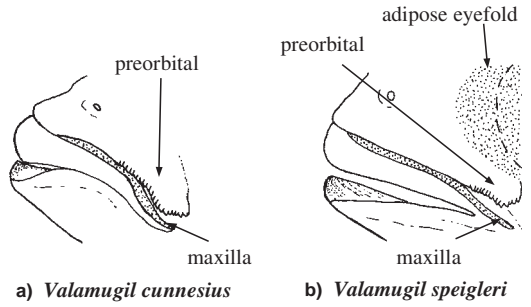


Fig. 32

29a. Tip of pectoral fins distinctly anterior to level of first dorsal fin (Fig. 33); 12 or 13 (11 1/2) scales in transverse series; pyloric caeca extensively branched, up to 22 in total (Fig. 34a) *Valamugil georgii*

29b. Pectoral fins just reaching level of origin of first dorsal fin or extending beyond this (Fig. 31); 10 or 11 (rarely 12) scales in transverse series; 5 to 7 pyloric caeca (Fig. 34b) → 30

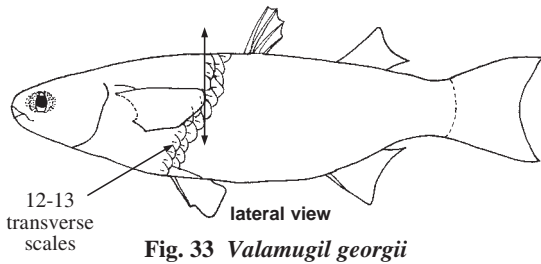


Fig. 33 *Valamugil georgii*

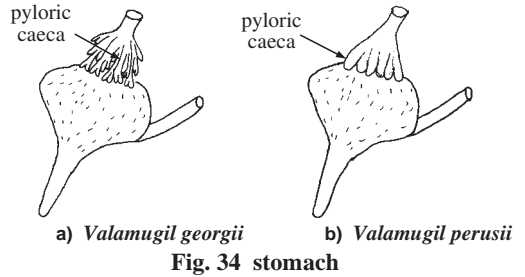


Fig. 34 stomach

30a. Second dorsal and anal fins with scales only on anterior and basal parts; adipose eyefold rudimentary; origin of first dorsal fin usually nearer base of caudal fin than anterior tip of snout (Fig. 31); predorsal scales extending to tip of snout (Fig. 35a) *Valamugil engeli*

30b. Second dorsal and anal fins moderately or well scaled on all parts; adipose eyefold reasonably developed, covering up to 1/2 of iris; origin of first dorsal fin usually equidistant between anterior tip of snout and base of caudal fin (Fig. 31); predorsal scales extending to posterior nostril (Fig. 35b) *Valamugil perusii*

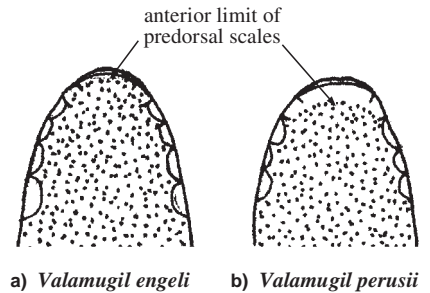


Fig. 35 dorsal view of heads

List of species occurring in the area

The symbol ➡ is given when species accounts are included.

- ➡ *Aldrichetta forsteri* (Valenciennes, 1836)
- ➡ *Cestraeus goldiei* Macleay, 1883
- ➡ *Cestraeus oxyrhynchus* Valenciennes, 1836
- ➡ *Cestraeus plicatilis* Valenciennes, 1836
- ➡ *Crenimugil crenilabis* (Forsskål, 1775)
- ➡ *Crenimugil heterocheilus* (Bleeker, 1855)
- ➡ *Liza affinis* (Günther, 1861)
- ➡ *Liza alata* (Steindachner, 1892)
- ➡ *Liza argentea* (Quoy and Gaimard, 1825)

- ✦ *Liza macrolepis* (Smith, 1846)
- ✦ *Liza melinoptera* (Valenciennes, 1836)
- ✦ *Liza parmata* (Cantor, 1850)
- ✦ *Liza planiceps* (Valenciennes, 1836)
- ✦ *Liza ramsayi* (Macleay, 1883)
- ✦ *Liza subviridis* (Valenciennes, 1836)
- ✦ *Liza vaigiensis* (Quoy and Gaimard, 1825)
- ✦ *Mugil broussonneti* Valenciennes, 1836
- ✦ *Mugil cephalus* Linnaeus, 1758
- ✦ *Myxus elongatus* Günther, 1861
- ✦ *Myxus petardi* (Castelnau, 1875)
- ✦ *Neomyxus leuciscus* (Günther, 1871)
- ✦ *Oedalechilus labiosus* (Valenciennes, 1836)
- ✦ *Rhinomugil nasutus* (DeVis, 1883)
- ? *Sicamugil hamiltoni* (Day, 1869)^{1/}
- ✦ *Valamugil buchanani* (Bleeker, 1853)
- ✦ *Valamugil cunnesius* (Valenciennes, 1836)
- ✦ *Valamugil engeli* (Bleeker, 1858)
- ✦ *Valamugil georgii* (Ogilby, 1897)
- ✦ *Valamugil perusii* (Valenciennes, 1836)
- ✦ *Valamugil seheli* (Forsskål, 1775)
- ✦ *Valamugil speigleri* (Bleeker, 1859)

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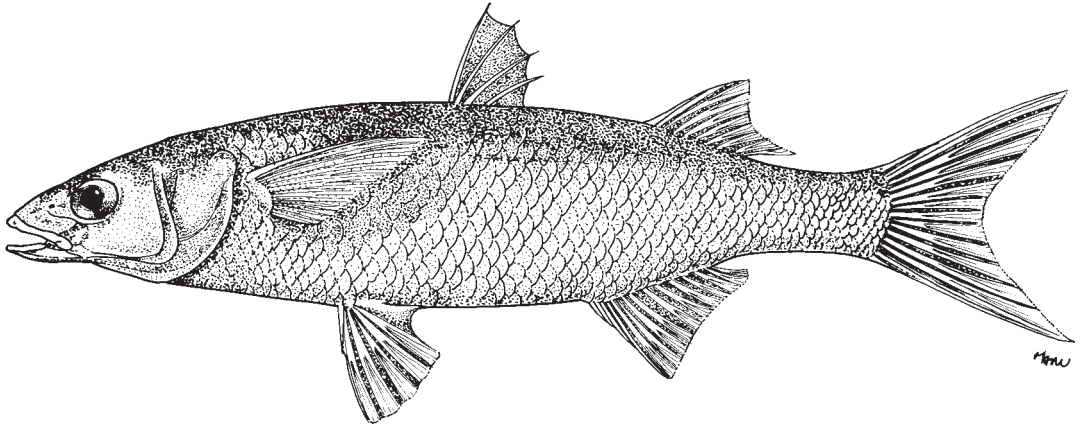
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^{1/} Known from Sittang and Irrawaddy rivers and estuaries of Myanmar. Not yet recorded from the area, but might occur along the Malay Peninsula.

Aldrichetta forsteri (Valenciennes, 1836)

Frequent synonyms / misidentifications: *Agonostomus forsteri* (Valenciennes, 1836); *Agonostoma diemensis* (Richardson, 1840) / None.

FAO names: En - Yelloweye mullet.

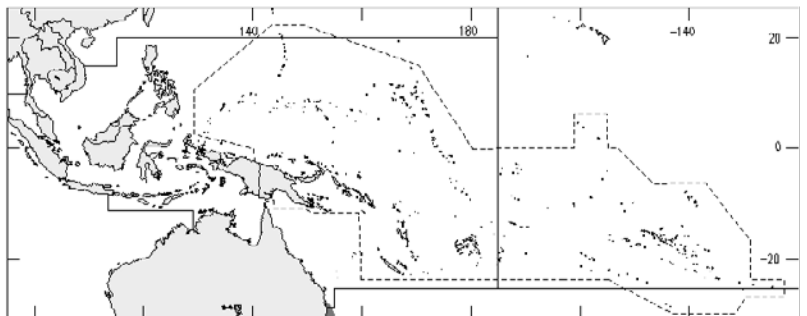


Diagnostic characters: A small to medium-sized species; body slender. Interorbit not strongly convex. **Snout longer than eye diameter and moderately pointed. Dentary symphysis acutely pointed.** Lips thin, without papillae; lower lip directed forwards. No lobes associated with mouth. **Teeth small, attached directly to jaw bones**, in 2 or 3 rows in each jaw, perhaps indistinct in large specimens. Sparse, movable, ciliiform teeth attached on lower lip. Vomer well toothed. Maxilla and serrate anteroventral edge of preorbital straight; posteroventral tip of preorbital broad and squarish. Distance between anterior and posterior nostril less than maximum diameter of posterior nostril. Adipose eyefold absent or very rudimentary anteriorly. Gill rakers on lower limb of first gill arch 24 to 48. Origin of first dorsal fin midway between tip of snout and base of caudal fin, or slightly nearer latter. Origin of fully erected second dorsal fin on vertical through anterior half of anal fin; both fins scaled only anterobasally. **Anal fin with III spines and 12 (rarely 13) soft rays** in adults (usually II spines and 13 soft rays in juveniles about 30 mm standard length or less). Caudal fin emarginate. Pectoral fins with I 'spine' and 15 soft rays, not reaching level of origin of first dorsal fin; pectoral fins 19 to 23% standard length, 73 to 93% head length. Scales strongly ctenoid on abdomen, weakly ctenoid or cycloid on other parts of body; **53 to 64 scales in longitudinal series; 14 or 15 in transverse series; 22 or more (perhaps up to 27) scales in transverse series entirely around caudal peduncle.** Pharyngobranchial organ not well developed; **sulcus V-shaped, shallow dorsally, a deep furrow ventrally; tissue anterior to sulcus papillose; anterior and medial pharyngobranchial teeth stout, directly attached to bones; posterior and lateral teeth loosely attached to denticulate pads.** Pyloric caeca 2. **Colour:** olive-brown dorsally, silvery to yellowish white on flanks and abdomen; eyes with yellow iris; fins with brownish margin.

Size: Maximum reported total length 40 cm; commonly between 15 and 20 cm total length, rarely above 32 cm total length.

Habitat, biology, and fisheries: Inhabits coastal waters, bays, estuaries, and may ascend rivers into fresh water. Usually found from the surface to a depth of 10 m, over sandy-muddy bottoms and seagrass meadows. Frequently schooling. Probably spawns near the mouths of estuaries. Omnivorous, feeding on benthic detritus, algae, and worms. Constitutes an important fishery; caught in beach and seine nets and can be taken by hook.

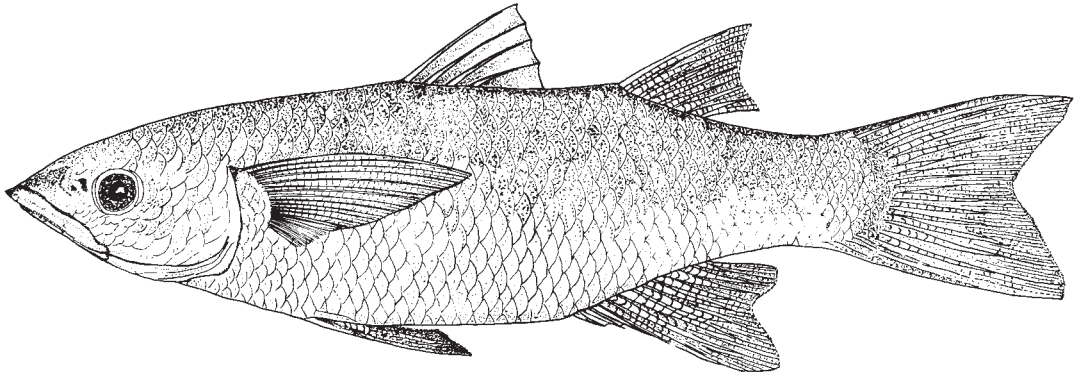
Distribution: Generally restricted to temperate waters of Australia and New Zealand. Specimens might be found at the southern extreme of the area, in northern New South Wales.



Cestraeus goldiei (Macleay, 1883)

Frequent synonyms / misidentifications: *Aeschrichthys goldiei* Macleay, 1883 / None.

FAO names: En - Goldie river mullet.

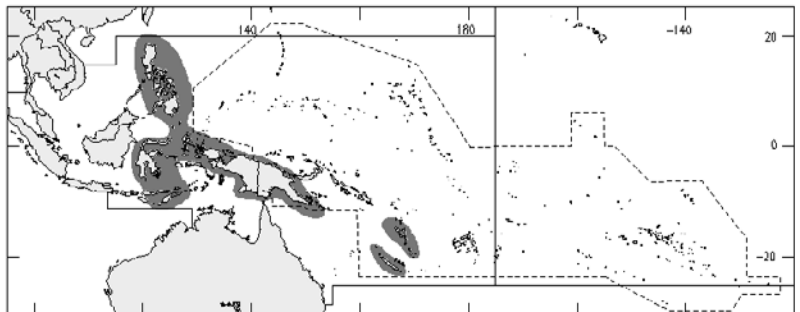


Diagnostic characters: A small to medium-sized species; body relatively deep and robust. Eye diameter 14 to 22% head length. **Interorbit convex. Snout longer than eye diameter but rather blunt in profile.** Dentary symphysis acutely pointed. **Small fleshy lobes at ends of upper and lower jaws, in each corner of mouth. Lower jaw also with lobes positioned medially in the gular region and extending posteriorly as far as or beyond level of corner of mouth.** Upper lip moderately thick, not papillate. **Lower lip thick-edged, directed forwards, and bordered ventrally by a ridge of numerous lamellae.** **Teeth attached directly to jaw bones. Upper jaw with outer row of bicuspid or unicuspid teeth which are not very close-packed; inner row of smaller, unicuspid teeth present or absent.** Small teeth scarce on lower jaw or absent in large specimens (about 30 cm standard length). **Vomer usually with distinct tooth patches on each lateral part.** Maxilla and serrate anteroventral edge of preorbital straight; posteroventral tip of preorbital broad and squarish. Distance between anterior and posterior nostril less than maximum diameter of posterior nostril. Adipose eyefold absent or very rudimentary. Gill rakers on lower limb of first gill arch 50 to 65. Origin of first dorsal fin midway between tip of snout and base of caudal fin, or slightly closer to snout. Origin of fully erected second dorsal fin on vertical posterior to origin of anal fin; both fins scaled only anteriorly and basally. Anal fin with III spines and 9 soft rays in adults (II spines and 10 soft rays in juveniles about 30 mm standard length or less). Caudal fin emarginate. Pectoral fins with I 'spine' dorsally, 13 or more soft rays enclosed in fin membrane and, ventrally, **about 12 or more soft rays free from fin membrane; pectoral fins reaching level of origin of first dorsal fin or beyond; pectoral fins almost always as long as head or longer, 23 to 30% standard length.** **Ctenoid scales in longitudinal series 36 to 43; 12 to 14 in transverse series; about 23 to 26 scales in longitudinal series anterior to origin of second dorsal fin; 22 in transverse series entirely around caudal peduncle.** **Rudimentary pharyngobranchial organ with narrow, shallow sulcus and 2 small denticulate pads bearing stout, sessile teeth.** Pyloric caeca 2. **Colour:** greyish dorsally, silvery on flanks and white ventrally; dorsal fins and caudal fin dark with paler, speckled distal margins; dark spot or bar at base of caudal fin; anal fin and pectoral fins darkish, but may have basal or distal margins paler; pelvic fins pale but with some dark pigment on midportion of fin.

Size: Maximum reported fork length 40 cm, perhaps commonly reaching about 20 cm total length.

Habitat, biology, and fisheries: Fresh and brackish waters; adults ascending some way up rivers, reported to 350 m above sea-level. Probably taken incidentally or as part of subsistence fisheries in rivers.

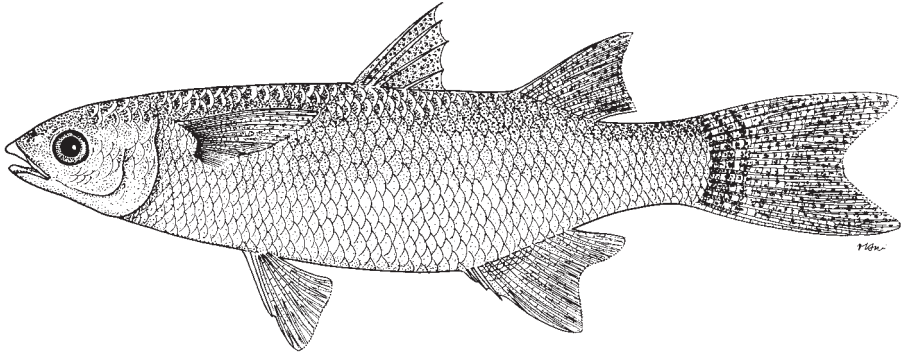
Distribution: Indo-West Pacific from Philippines to New Caledonia. New Guinean reports are commonly from Port Moresby district.



Cestraeus oxyrhynchus Valenciennes, 1836

Frequent synonyms / misidentifications: None / None.

FAO names: En - Sharpnosed river mullet.

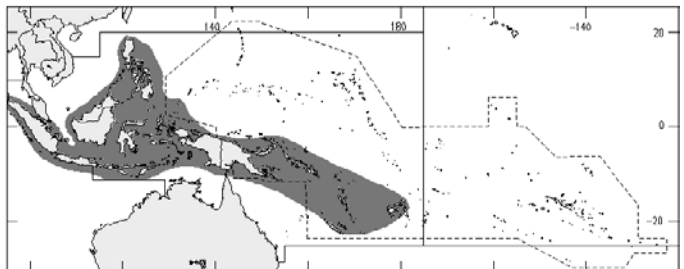


Diagnostic characters: A small to medium-sized species; body relatively deep and robust. Eye diameter 22 to 29% head length. **Interorbit convex. Snout longer than eye diameter and pointed, in profile, in adults.** Dentary symphysis acutely pointed. **Small fleshy lobes at ends of upper and lower jaws, in each corner of mouth. Lower jaw also with lobes positioned medially in the gular region and not extending posteriorly to level of corner of mouth.** Upper lip moderately thick, not papillate. **Lower lip thick-edged, directed forwards, and bordered ventrally by a ridge of numerous lamellae. Teeth attached directly to jaw bones. Upper jaw with outer row of close-packed, multicuspid teeth, and 1 to 3 inner rows of close-packed, spade-like teeth.** Caniniform teeth sparse or absent on lower jaw. Vomer with sparse teeth, in small patches on lateral parts of bone. Maxilla and serrate anteroventral edge of preorbital straight; posteroventral tip of preorbital broad and squarish. Distance between anterior and posterior nostril less than maximum diameter of posterior nostril. Adipose eyefold absent or very rudimentary. Gill rakers on lower limb of first gill arch 36 to 54. Origin of first dorsal fin midway between tip of snout and base of caudal fin. Origin of fully erected second dorsal fin on vertical posterior to origin of anal fin; both fins scaled only anteriorly and basally. Anal fin with III spines and 9 (rarely 10) soft rays in adults (usually II spines and 10 soft rays in juveniles about 30 mm standard length or less). Caudal fin emarginate. Pectoral fins with I 'spine' and about 18 to 20 soft rays, **ventral 4 or 5 soft rays free from fin membrane; pectoral fins not reaching level of origin of first dorsal fin; pectoral fins 18 to 20% standard length, 75 to 85% head length. Ctenoid scales in longitudinal series 41 to 47; 12 to 14 in transverse series; 26 to 29 scales in longitudinal series anterior to origin of second dorsal fin; 22 in transverse series entirely around caudal peduncle. Rudimentary pharyngobranchial organ with narrow, shallow sulcus and 2 small denticulate pads bearing stout, sessile teeth.** Pyloric caeca 2. **Colour:** olivaceous dorsally, silvery ventrally; dorsal fins and caudal fin uniformly speckled brown or black; vertical dark bar at base of caudal fin; anal fin paler, speckled brown distally; pectoral fins weakly speckled and pelvic fins pale.

Size: Maximum reported total length 39 cm, perhaps commonly reaching about 20 cm total length.

Habitat, biology, and fisheries: Very little available data. Probably found in both fresh and brackish waters, possibly ascending some way up rivers. Probably taken incidentally or as part of subsistence fisheries in rivers.

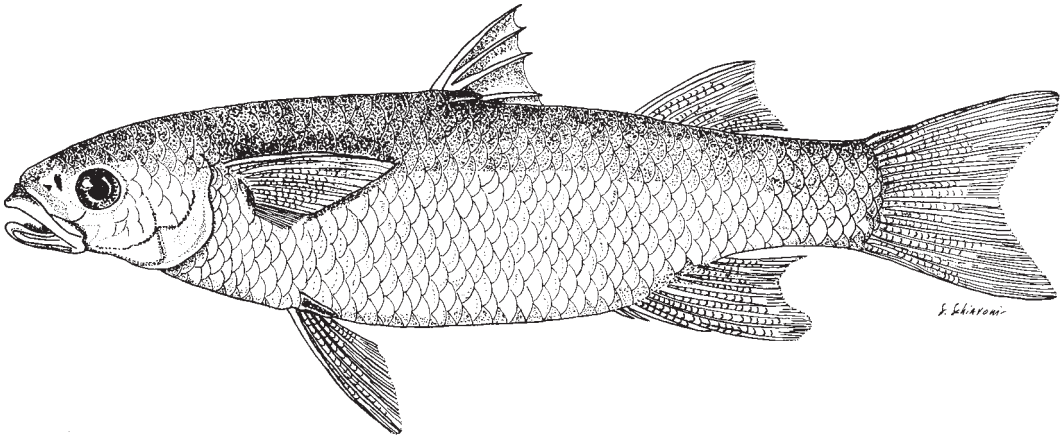
Distribution: Indo-West Pacific from Indonesia to Fiji; north to Philippines, south to New Caledonia.



Cestraeus plicatilis Valenciennes, 1836

Frequent synonyms / misidentifications: None / None.

FAO names: En - Lobed river mullet.

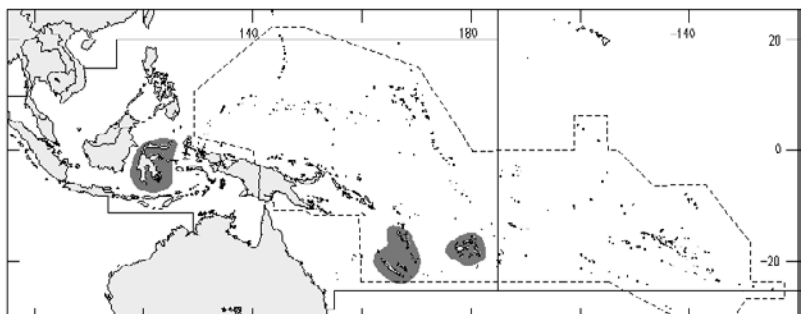


Diagnostic characters: A small to medium-sized species; body relatively deep and robust. Eye diameter 21 to 25% head length. **Interorbit only moderately convex. Snout longer than eye diameter but moderately blunt in profile. Dentary symphysis more rounded than pointed. Small fleshy lobes at ends of upper and lower jaws, in each corner of mouth. Lower jaw also with lobes positioned medially in the gular region and extending posteriorly as far as level of corner of mouth. Upper lip moderately thick, not papillate. Lower lip thick-edged, directed forwards, and bordered ventrally by a ridge of numerous lamellae. Teeth attached directly to jaw bones. Upper jaw with outer row of bicuspid or unicuspid teeth which are not very close-packed; inner row of smaller, unicuspid teeth present or absent. Small teeth scarce or absent on lower jaw. Vomer may be toothed, but usually edentate.** Maxilla and serrate anteroventral edge of preorbital straight; posteroventral tip of preorbital broad and squarish. Distance between anterior and posterior nostril less than maximum diameter of posterior nostril. Adipose eyefold absent or very rudimentary. Gill rakers on lower limb of first gill arch 52 to 66. Origin of first dorsal fin midway between tip of snout and base of caudal fin, or slightly closer to snout. Origin of fully erected second dorsal fin on vertical posterior to origin of anal fin; both fins scaled only anteriorly and basally. Anal fin with III spines and 9 soft rays in adults (II spines and 10 soft rays in juveniles about 30 mm standard length or less). Caudal fin emarginate. Pectoral fins with I 'spine' and about 18 or 19 soft rays, **ventral 4 or 5 soft rays free from fin membrane; pectoral fins not reaching level of origin of first dorsal fin; pectoral fins 19 to 21% standard length, shorter than head (83 to 95% head length).** **Ctenoid scales in longitudinal series 40 to 45; 13 or 14 in transverse series; about 25 or 26 scales in longitudinal series anterior to origin of second dorsal fin; 22 or 23 in transverse series entirely around caudal peduncle. Rudimentary pharyngobranchial organ with narrow, shallow sulcus and 2 small denticulate pads bearing stout, sessile teeth.** Pyloric caeca 2. **Colour:** dark greenish dorsally, flanks greyish, white ventrally; all fins well speckled brown or black except anterobasal part of anal fin and basal part of pelvic fins, which are less speckled; dark spot or vertical bar at base of caudal fin.

Size: Maximum reported total length 32.5 cm, perhaps commonly reaching about 20 cm total length.

Habitat, biology, and fisheries: Very little available data. Probably found in both fresh and brackish waters, possibly ascending some way up rivers. Probably taken incidentally or as part of subsistence fisheries in rivers.

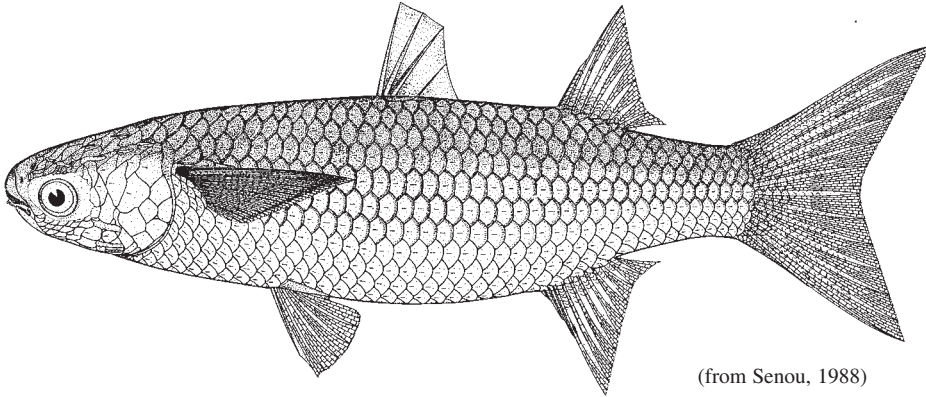
Distribution: Celebes, New Caledonia, Vanuatu, and Fiji.



Crenimugil crenilabis (Forsskål, 1775)

Frequent synonyms / misidentifications: *Mugil cirrhostomus* Valenciennes, 1836; *M. macrocheilos* Bleeker, 1854 / None.

FAO names: En - Fringelip mullet; Fr - Mulet boxeur; Sp - Lisa labride.



(from Senou, 1988)

Diagnostic characters: A medium-sized species; body moderately deep. Head relatively flattened dorsally. Snout shorter than eye diameter and blunt in profile. Dentary symphysis obtuse (blunt). **Upper lip very thick; lip thickness at point of snout 5.2 to 9.5 times in head length. Ventral quarter to half of upper lip with 1 to 10 rows of papillae medially and laterally; papillae in lower rows are larger than those in upper rows, flask-shaped, and may have bifid tips; papillae first appear in fish of about 6 cm standard length. Lower lip thin, with anterior margin turned out and downwards; 1 or 2 rows of papillae on inner part of lower lip, giving a fine crenate fringe. Lips and vomer edentate.** Maxilla curved down, weakly sigmoid near posterior tip. Preorbital weakly concave (**not kinked**) on serrate anteroventral edge and slightly expanded into squarish, posteroventral tip. Distance between anterior and posterior nostril less than maximum diameter of posterior nostril. Adipose eyefold forms narrow rim around eye. Gill rakers on lower limb of first gill arch 50 to 78. Origin of first dorsal fin midway between tip of snout and base of caudal fin, or slightly closer to latter. Origin of fully erected second dorsal fin just posterior to vertical level of origin of anal fin; both fins at least moderately scaled (on anterior and basal parts) or well scaled on all parts. Anal fin with III spines and 9 (rarely 8 or 10) soft rays in adults (usually II spines and 10 soft rays in juveniles about 30 mm standard length or less). Caudal fin forked. Pectoral fins with I 'spine' and 15 to 18 (usually 16) soft rays, falcate, **reaching origin of first dorsal fin**; pectoral fins 20 to 27% standard length, 76 to 109% head length (usually more than 90%). Scales cycloid or very weakly ctenoid; **36 to 42 (usually 37 to 40) scales in longitudinal series; 12 to 14 in transverse series**; 24 to 26 scales in longitudinal series anterior to origin of second dorsal fin; **19 or 20 scales in transverse series entirely around caudal peduncle.** Pharyngobranchial organ with broad sulcus, small papillose anterior valve and longer-based, low posterior valve. Pyloric caeca 7 to 10. **Colour:** olive-green dorsally, flanks silvery and abdomen whitish; fins greyish except pectoral fins which is yellowish and has distinct dark purplish spot at upper part of base.

Size: Maximum reported standard length 50 cm; commonly to 26 cm standard length.

Habitat, biology, and fisheries: Found in coastal waters, in sandy or muddy areas of lagoons, reef flats and tidepools; entering harbours. Forms large schools before spawning, at beginning of ebb tide (in June), over shallow, open areas of the lagoon slope. Important food-fish in Polynesia; caught in gill nets and taken as a bycatch with seines. Marketed fresh. Also used as live bait in pole-and-line tuna fishing.

Distribution: Widespread throughout tropical Indo-Pacific, from Red Sea and Madagascar to Tuamotu Islands; south to Lord Howe Island and north to southern Japan and, perhaps, Hawaii.

