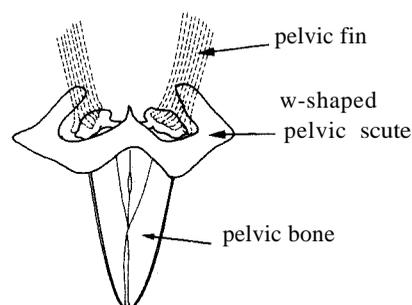
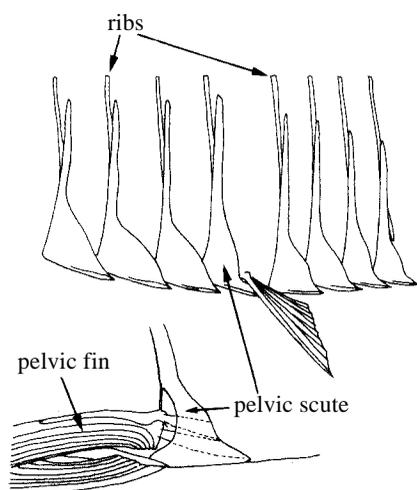


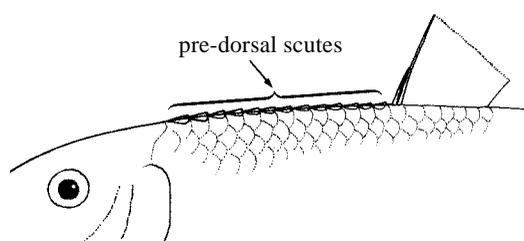
2. ORDER CLUPEIFORMES - SUBORDER CLUPEOIDEI

Moderate-sized or small or very small fishes (2 to 100 cm standard length) with no spines in the fins, the dorsal fin single and short (11 to 23 finrays) and usually near the midpoint of the body (further back in *Chirocentridae* and some *Pristigasteridae*, the latter including *Raconda* without a dorsal fin); the Pelvic fins small (6 to 10 finrays), a little before, under or a little behind the dorsal fin base (but absent in some *Pristigasteridae*); the anal fin usually short or moderate (10 to 36 finrays), but longer in some *Pristigasteridae* (34 to 93) and some *Engraulididae* (14 to 81, or about 100 in *Coilia*); the caudal fin forked (except rhomboid in *Coilia*).

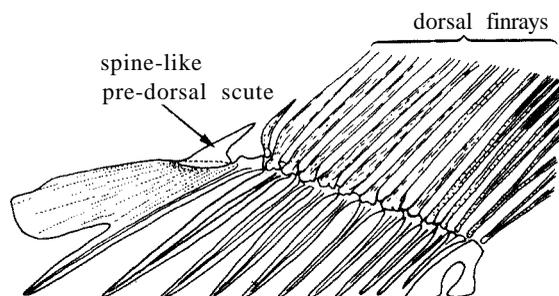
The body is usually fusiform, sometimes almost round in cross-section (some *Dussumieria*, *Etrumeus*, also *Engraulis*), but more often compressed, sometimes highly compressed (*Chirocentridae*, some *Pristigasteridae*). Typically, there is a pelvic scute with ascending arms just in front of the pelvic fins (absent in *Chirocentridae*; W-shaped in the *Dussumieriinae*, and a series of similar scutes in front of the pelvic fins and behind them, but absent in the *Dussumieriinae*, some *Pellonulinae*, *Engraulis*, some specimens of *Stolephorus purpureus* and all New World *Engraulididae*; the scutes do not reach forward to the isthmus in some *Engraulididae*. Fossil clupeoids (e.g. the Eocene *Knightia*) had a series of scutes from the occiput to the dorsal fin origin; such a complete dorsal series occurs in the *Pellonulinae* (*Potamalosa*, *Hyperlophus*) and the *Alosinae* (*Ethmidium*), while the *Dorosomatinae* (*Clupanodon*), *Clupeinae* (*Harengula* and others) and *Pristigasteridae* (*Pristigaster*) include species with one, two or a few pre-dorsal scutes; in the *Engraulididae*, some *Stolephorus* and all other Indo-Pacific genera have a single spine-like scute just before the dorsal fin.



Dussumieria, *Etrumeus*,
Spratelloides, *Jenkinsia*



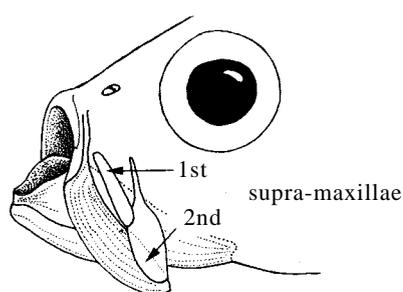
Potamalosa, *Hyperlophus*,
Ethmidium



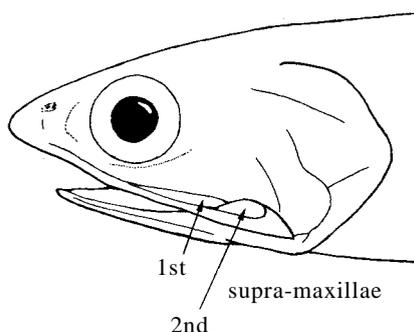
Thryssa, *Setipinna*, etc.

The mouth is small, with the lower jaw deep and triangular in the *Chirocentridae*, *Clupeidae* and *Pristigasteridae*, but slender and long in most *Engraulididae*. The pre-maxillae are triangular (but rectangular in *Dussumieriinae*) and the maxillae usually have an anterior (first) and posterior (second) supra-maxilla along the

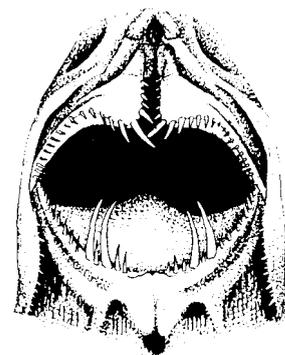
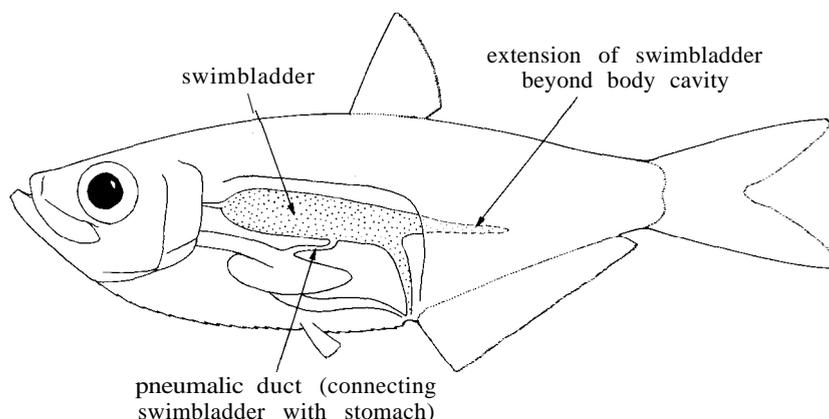
upper edge. Small conical teeth are typically present in the jaws and on the vomer, palatines and endo- and ectopterygoids (i.e. the roof of the mouth), but some or all may be absent, or the jaws may bear canine teeth (*Chirocentridae*, also *Chirocentrodon* of the *Pristigasteridae* and both *Lycengraulis* and *Lycotrissa* of the *Engraulididae*). The gut may be short (carnivores) or long and coiled (phytoplankton feeders, filter feeders) and in some the stomach is muscular like a gizzard (*Dorosomatinae*; partially so in some *Clupeinae*); food is collected in a bolus by pharyngeal pouches in the *Dorosomatinae* and some *Clupeinae*. A swimbladder is present, sometimes double-chambered (some *Engraulididae*), with a pneumatic duct joined to the oesophagus or stomach blind-sac; in the *Pristigasteridae* (*Ilisha*) some species have one or a pair of post-coelomic tubes extending from the hind end of the swimbladder back into the muscles of the body.



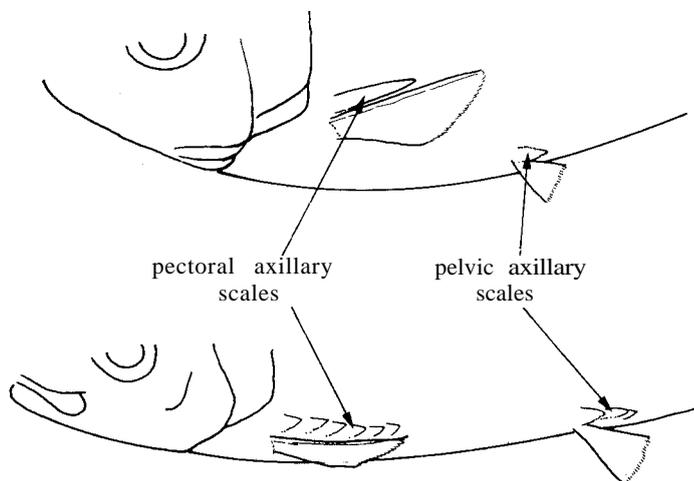
Clupeidae



Engraulidae

Chirocentrodon

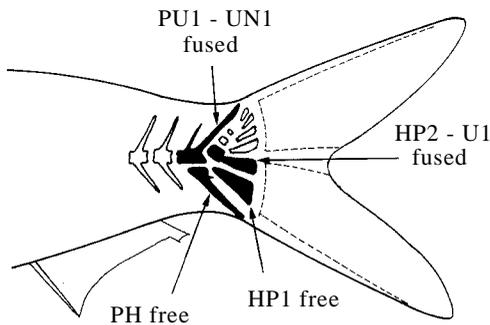
Almost all species have a complete covering of cycloid scales on the body (mostly lost in *Thrattidion* and *Sierrathrissa* of the *Pellonulinae*), which are frequently deciduous; small scales occasionally cover the bases of the dorsal, anal and/or caudal fins, and one or sometimes several axillary scales lie above the bases of the first pectoral and pelvic finrays. There is no lateral line canal with pored scales along the flanks (occasionally one or two behind the gill opening). A branching and mainly cutaneous sensory canal system covers the top and sides of the head; the supra-orbital, infra-orbital, pre-opercular and pterotic canals all meet in the *recessus lateralis*, a special chamber characteristic of clupeiform fishes, its inner wall being a membrane sealing the perilymphatic space that surrounds the inner ear.



Two important internal features characterize the Clupeoidei:

- (a) A pair of fine tubes from the front of the swimbladder penetrate the skull and expand inside bony capsules (bullae) in the pro-otics and (except in *Sprattus* and *Clupeonella*) also in the pterotic bones. A membrane within each pro-otic bulla separates gas (from the swimbladder) from perilymphatic liquid (surrounding the inner ear). This system, together with the head canal system and the recessus lateralis, probably monitors information necessary for schooling and other swimming activities, as also detection of predators and hazards.
- (b) The small bones supporting the caudal fin have a characteristic arrangement and series of fusions between particular elements.

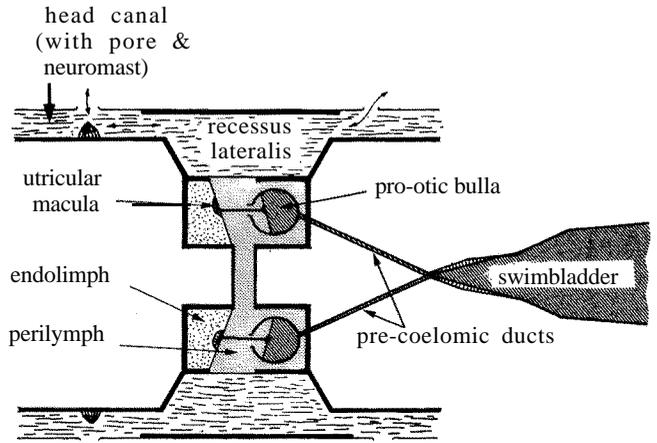
Most species of Clupeoidei are marine, coastal and schooling fishes, but some enter brackish- or freshwaters and some live permanently in fresh-water (rivers or lakes). In this catalogue are given over 300 species of 80 genera, placed in 4 families; in most earlier literature the family Pristigasteridae is given as a subfamily of the Clupeidae, but recent work suggests that it is distinct (Grande, in press).



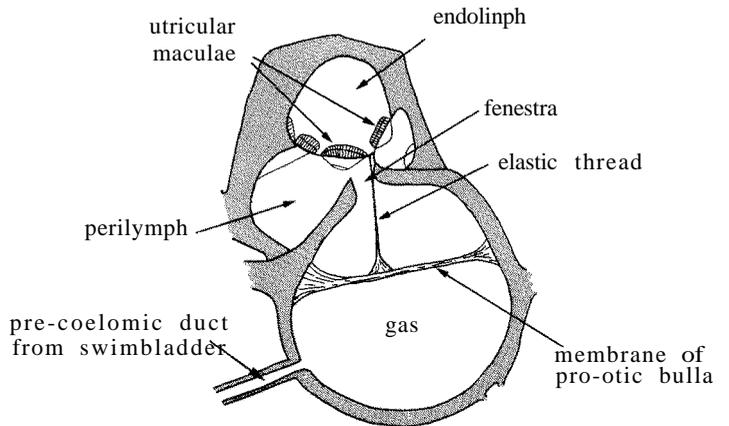
typical clupeoid caudal fin skeleton; the first uroneural (UN1) and first pre-ural vertebra (PU1) are fused; the first of the six hypural plates (HP1) is free; the second (HP2) is fused at its base to the first ural vertebra (U1); and the hypural (PH) is free at its base

Key to the Clupeoid Families

- 1a. Articulation of lower jaw under or only just behind eye, lower jaw deep (Fig. 1)



dorsal view (schematic) of connexions between swimbladder, inner ear and canals on head; black-gas; stippled- endo- and perilymph; wavy lines - water



lateral view (cross-section) of connexion between pro-otic bulla (below) and inner ear (above); variations in gas pressure in the swimbladder are transmitted to the membrane of the pro-otic bulla; a fine elastic thread signals movements of the membrane to the inner ear

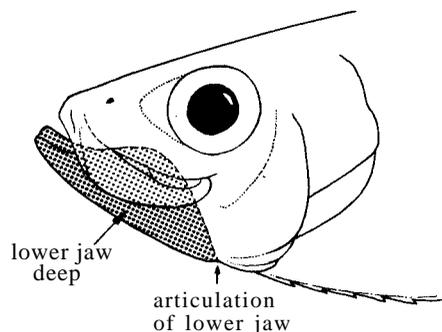


Fig. 1