

A SYNOPSIS OF THE CLUPEOID FISHES OF INDIA*

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ABSTRACT

The clupeoid fishes (families Chirocentridae, Clupeidae and Engraulidae) are the most important single group in Indian fisheries, representing 15-20% of total catches. Some 68 species have been recorded from Indian waters or are likely to be found. The absence of any modern systematic review of Indian clupeoids has often led to faulty identification and nomenclature, which in turn has limited the value of some otherwise useful biological studies.

The synopsis given here is a synthesis of many recent but scattered papers on clupeoid systematics. It contains keys to all Indo-Pacific genera and all Indian Ocean species. The synonymies include the original reference to all generic and species synonyms. Each species is figured and reference to further information is given under the headings synonymy, description, distribution and notes. The clupeoid fishes listed by Russell and Hamilton-Buchanan are also tabulated and identified separately.

Many systematic problems remain, especially in the genera *Sardinella*, *Ilisha* and *Thryssa*, but the present synopsis consolidates recent progress and provides a framework for future research.

INTRODUCTION

This synopsis is a synthesis of the many recent but scattered studies on the systematics of those herrings (Clupeidae) and anchovies (Engraulidae) likely to be found in Indian waters. Field and museum workers have often voiced an understandable despair at the profusion of Indian clupeoid species (over sixty), the multitude of names that have been applied to them (over two hundred and fifty) and the lack of any modern and comprehensive review of the group. As a result, some otherwise useful biological studies have suffered through poor identifications or the use of obsolete names. The last complete review, which included all Indo-Pacific clupeoid species, was that of Fowler (1941), many of whose conclusions are now seen to have been wrong but whose references to the literature have never been rivalled. More recent reviews, such as those of Misra (1949—India, Ceylon, Burma), Munro (1955—Ceylon) and Quereshi (1957—Pakistan), repeat Fowler's mistakes and predate the renewed interest in Indian clupeoid systematics that occurred during the 1960's (studies by Babu Rao, Bennet, Dutt, Jones, Radhakrishnan, Sekharan, to name but a few). Numerous problems remain, especially in the genera *Sardinella*, *Ilisha*, *Thryssa* and *Coilla*, but the present synopsis should provide a framework within which the nomenclature can eventually be brought to reflect the true biological picture.

Some 68 clupeoid species have either been recorded from Indian waters or may be found when more thorough collections are made. Of these, none was known to

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Linnaeus, but by the beginning of the 19th century Schneider (1801) was able to list 8 clupeoids and two decades later Russell (1822) described and figured a further 12. By 1850, chiefly through the work of Hamilton-Buchanan, and Cuvier and Valenciennes, the total of Indian clupeoid species had risen to 49, with only four further species known when Day published his *Fishes of India* (clupeoid part in 1878). Prior to 1950, another 9 species were added and since that date 12 species have been described as new, of which 6 are here recognised as valid. The extent of the clupeoid fauna is now fairly well known, but for the vast majority of species knowledge of their biology is still quite inadequate.

TABLE 1. List of clupeoid fishes recorded from Indian waters or likely to occur there

CHIROCENTRIDAE	
1. <i>Chirocentrus dorab</i> (Forskål)	32. <i>Goniatalosa manmina</i> (Ham.-Buch.)
2. <i>Chirocentrus nudus</i> (Swainson)	33. <i>Anodontostoma chacunda</i> (Ham.-Buch.)
	34. <i>Anodontostoma chanpole</i> (Ham.-Buch.)
CLUPEIDAE	
Subfamily DUSSUMIERIINAE	
3. <i>Dussumieria acuta</i> (Valenciennes)	
Subfamily SPRATelloIDINAE	
4. <i>Spratelloides gracilis</i> (Schlegel)	35. <i>Pellona ditchela</i> Valenciennes
5. <i>Spratelloides delicatulus</i> (Bennett)	36. <i>Ilisha elongata</i> (Bennett)
	37. <i>Ilisha melastoma</i> (Schneider)
	38. <i>Ilisha megaloptera</i> (Swainson)
	39. <i>Opisthopterus tardoore</i> (Cuvier)
	40. <i>Raconda russelliana</i> Gray
Subfamily CLUPEINAE	
6. <i>Herklotsichthys punctatus</i> (Rüppell)	
7. <i>Sardinella longiceps</i> Valenciennes	
8. <i>Sardinella melanura</i> (Cuvier)	
9. <i>Sardinella dayi</i> Regan	
10. <i>Sardinella jussieui</i> (Valenciennes)	
11. <i>Sardinella brachysoma</i> Bleeker	
12. <i>Sardinella albella</i> (Valenciennes)	
13. <i>Sardinella fimbriata</i> (Valenciennes)	
14. <i>Sardinella gibbosa</i> (Bleeker)	
15. <i>Sardinella sindensis</i> (Day)	
16. <i>Sardinella sirm</i> (Walbaum)	
17. <i>Sardinella clupeoides</i> (Bleeker)	
18. <i>Sardinella leiogaster</i> Valenciennes	
19. <i>Escualosa thoracata</i> (Valenciennes)	
Subfamily PELLONULINAE	
20. <i>Corica soborna</i> Ham.-Buch.	
21. <i>Sauvagella madagascariensis</i> (Sauvage)	
22. <i>Spratellomorpha bianalis</i> (Bertin)	
23. <i>Gilchristella aestuarius</i> (Gilchrist)	
24. <i>Dayella malabarica</i> (Day)	
25. <i>Ehirava fluviatilis</i> Deraniyagala	
Subfamily ALOSINAE	
26. <i>Hilsa</i> (<i>Hilsa</i>) <i>kelee</i> (Cuvier)	
27. <i>Hilsa</i> (<i>Tenualosa</i>) <i>ilisha</i> (Ham.-Buch.)	
28. <i>Hilsa</i> (<i>Tenualosa</i>) <i>tolii</i> (Valenciennes)	
29. <i>Gudusia chapra</i> (Ham.-Buch.)	
Subfamily DOROSOMATINAE	
30. <i>Nematalosa nasus</i> (Bloch)	
31. <i>Nematalosa arabica</i> Regan	
	Subfamily PRISTIGASTERINAE
	35. <i>Pellona ditchela</i> Valenciennes
	36. <i>Ilisha elongata</i> (Bennett)
	37. <i>Ilisha melastoma</i> (Schneider)
	38. <i>Ilisha megaloptera</i> (Swainson)
	39. <i>Opisthopterus tardoore</i> (Cuvier)
	40. <i>Raconda russelliana</i> Gray
	ENGRAULIDAE
	Subfamily ENGRAULINAE
	41. <i>Engraulis japonicus</i> Temm. & Schl.
	42. <i>Stolephorus heterolobus</i> (Rüppell)
	43. <i>Stolephorus</i> Species A
	44. <i>Stolephorus buccaneeri</i> Strasburg
	45. <i>Stolephorus macrops</i> Hardenberg
	46. <i>Stolephorus</i> Species C
	47. <i>Stolephorus andhraensis</i> Babu Rao
	48. <i>Stolephorus tri</i> (Bleeker)
	49. <i>Stolephorus indicus</i> (van Hasselt)
	50. <i>Stolephorus commersonii</i> Lacépède
	51. <i>Stolephorus bataviensis</i> Hardenberg
	52. <i>Thryssa baelama</i> (Forskål)
	53. <i>Thryssa setirostris</i> (Broussonet)
	54. <i>Thryssa mystax</i> (Schneider)
	55. <i>Thryssa purava</i> (Ham.-Buch.)
	56. <i>Thryssa dussumieri</i> (Valenciennes)
	57. <i>Thryssa vitrirostris</i> (Gilch. & Thomp.)
	58. <i>Thryssa hamiltoni</i> (Gray)
	59. <i>Thryssa malabarica</i> (Bloch)
	60. <i>Thryssa kammalensis</i> (Bleeker)
	61. <i>Setipinna taty</i> (Valenciennes)
	62. <i>Setipinna phasa</i> (Ham. Buch.)
	63. <i>Setipinna godavari</i> Babu Rao
	Subfamily COILINAE
	64. <i>Coilia ramcarati</i> (Ham.-Buch.)
	65. <i>Coilia neglecta</i> Whitehead
	66. <i>Coilia korua</i> Dutt & Rao
	67. <i>Coilia mystus</i> (Linnaeus)
	68. <i>Coilia dussumieri</i> Valenciennes

For the species listed here, some 263 names have been proposed. A number of the earlier nominal species lack types, but types have now been redescribed for the

clupeoid species of Richardson (Whitehead, 1966a), Bleeker (Whitehead *et al.*, 1966), Lacépède, Cuvier and Valenciennes (Whitehead, 1967a), Bloch and Schneider (Whitehead, 1969a), Steindachner (Whitehead, 1970) and Day (Talwar & Whitehead, 1971). In addition, the types of Günther, Day, Regan, Deraniyagala, Norman and others deposited in the British Museum (Natural History) and the types of various authors whose material is deposited in Paris, Vienna, Leiden and Berlin have been examined. Studies of particular clupeoid groups include those on the round herrings (Whitehead, 1963a), the shads (Whitehead, 1965b), the gizzard shads (Whitehead, 1962b and Nelson, in press—*Nematalosa* only) and the Indian Ocean anchovies (Whitehead, 1968b). The present paper bridges the gap between clupeoid studies of the Western Indian Ocean (Losse, 1966—East Africa; Whitehead, 1965a—Red Sea) and those to the east (Whitehead, 1966a—Hong Kong; Whitehead, 1969b—Malaya).

In compiling this synopsis, previous literature has been relied upon sparingly and distribution records have been based where possible on specimens in the British Museum or those that I have examined elsewhere. Thus, many Indian species are more common than these records suggest. References to papers dealing with the biology of species are included here when the identity of the species seems reasonably certain, but the possibility of mixed material should not be overlooked in genera such as *Sardinella*, *Ilisha* or *Stolephorus*. The generic keys given here include all Indo-Pacific genera and the species keys are usually as comprehensive except where doubtful Australian species are involved. The synonymies also cover all Indo-Pacific junior synonyms relevant to the genus or species. The names used by Russell (1803) and Hamilton-Buchanan (1822) are so frequently cited—and misidentified—in the literature that these are also listed separately in Tables 2 and 3. The 55 clupeoid fishes listed by Day (1878) are identified by Talwar and Whitehead (1971).

The overall classification of the clupeoids still presents many problems. The suborder Clupeoidei comprises 79 genera (full listing in Whitehead, 1968a: table 2—*Chirocentrus*, *Sierrathrissa*, *Dayella* and *Thrattidion* omitted) and about 285 species. The supra-generic classification given by Whitehead *et al.* (1966) or Whitehead (1969b), which was largely derived from the clupeoid studies of Regan (1916, 1917 a, b, c, 1922) and Norman (1922) and was later adopted by Fowler (1941), has become increasingly unsatisfactory. Thus, the round herrings (Dussumieriidae *sensu* Whitehead, 1963a) probably represent three distinct lineages, of which two seem to belong in the clupeid subfamily Pellonulinae (Whitehead, in press). The Pristigasterinae (*Ilisha*, *Pellona*, etc.), on the other hand, may merit separation from other clupeids at superfamily level (Nelson, 1970), whereas *Chirocentrus*, placed in its own suborder by Berg (1940: 422), is now seen to be much more closely related to the clupeids, perhaps representing another superfamily (Nelson, 1967, 1970). Finally, the separation of the shads (Alosinae) from the gizzard shads (Dorosomatinae) is certainly artificial, as Regan (1917b) believed, although certain members of the Clupeinae and the Alosinae are perhaps misplaced (Nelson, 1970). Thus, radical changes in the classification can be expected. Since the present paper is chiefly concerned with genera and species and their identification, however, the existing and rather artificial arrangement is retained with a few minor modifications.

The clupeoid fishes are of prime importance to Indian fisheries, representing 15-20% of total catches. Some species support major fisheries, the largest being that for the oil sardine (*Sardinella longiceps*), which accounted for 274,000 tons or 2/3 of the total clupeoid catch in 1964; next in importance are species of *Hilsa*, and

TABLE 2. *The Indian clupeoid fishes listed by Russell (1803)*

Page	Plate	Name	Names based on Russell	Identification
70	186	<i>Kowal</i> or <i>Kowarloo</i>	<i>Clupea coval</i> Cuvier, 1829	<i>nomen dubium</i> fide Whitehead (1964b)
71	187	<i>Natto</i> or <i>Nettooli</i>	{ <i>Clupea indicus</i> van Hasselt, 1823 <i>Engraulis albus</i> Swainson, 1839	} <i>Stolephorus indicus</i> (van Hasselt, 1823)
72	188	<i>Ditchelee</i>	<i>Pellona ditchela</i> Valenciennes, 1847	<i>Pellona ditchela</i> Valenciennes, 1847
72	189	<i>Poorwah</i>	<i>Thryssa subspinosa</i> Swainson, 1839	<i>Thryssa mystax</i> (Schneider, 1801)
73	190	<i>Pedda Poorawah</i>	<i>Thryssa megastoma</i> Swainson, 1839	<i>Thryssa purava</i> (Ham.-Buch., 1822)
73	191	<i>Jangarloo</i>	{ <i>Platygaster macrophthalmus</i> Swainson, 1838 <i>Platygaster megalopterus</i> Swainson, 1839	} <i>Ilisha megalopterus</i> (Swainson, 1839)
74	192	<i>Ditchooe</i>	{ <i>Platygaster verticalis</i> Swainson, 1838 <i>Platygaster indicus</i> Swainson, 1839 <i>Pellona ditchoa</i> Valenciennes, 1847	} <i>Ilisha melastoma</i> (Schneider, 1801)
74	193	<i>Tartoore</i>	{ <i>Pristigaster tardoore</i> Cuvier, 1829 <i>Pristigaster elongata</i> Swainson, 1838 <i>Pristigaster indicus</i> Swainson, 1839	} <i>Opisthopterus tardoore</i> (Cuvier, 1829)
75	194	<i>Poorwa</i>	<i>Thryssa cuvieri</i> Swainson, 1839	<i>Thryssa malabarica</i> (Bloch, 1795)
75	195	<i>Keelee</i>	<i>Clupea kelee</i> Cuvier, 1829	<i>Hilsa kelee</i> (Cuvier, 1829)
76	196	<i>Kome</i>	in part, <i>Chatoessus come</i> Richardson, 1846	? <i>Nematalosa nasus</i> (Bloch, 1795)
77	197	<i>Pedda Kome</i>	—	? <i>Nematalosa come</i> (Richardson, 1846)
77	198	<i>Palasah</i>	<i>Clupea palasah</i> Cuvier, 1829	<i>Hilsa ilisha</i> (Ham.-Buch., 1822)
78	199	<i>Wallah</i>	<i>Chirocentrus russellii</i> Swainson, 1838 <i>Chirocentrus nudus</i> Swainson, 1839	} <i>Chirocentrus nudus</i> Swainson, 1839
79	200	<i>Quala paragah</i>	—	<i>Coilla dussumieri</i> Valenciennes, 1848
80	210	<i>Yeka Poorwah</i>	—	<i>Thryssa setirostris</i> (Broussonet, 1782)
80	202	<i>Marrawa</i>	—	<i>Dussumieria acuta</i> Valenciennes, 1847

1. Body normal, caudal bilobed ; gillrakers present on posterior face of 3rd epibranchial.....ENGRAULINAE (p. 216)
2. Body tapering, 'rat-tailed', caudal and anal fins confluent ; no gillrakers on posterior face of 3rd epibranchial.....
.....COILINAE (p. 239)

Family CHIROCENTRIDAE

A single Indo-Pacific genus, *Chirocentrus*, with two species. For relationships of *Chirocentrus*, see Nelson (1967, 1970) and Whitehead (in press).

Chirocentrus Cuvier, 1816

Chirocentrus Cuvier, 1816, *Règne Animal*, 1st ed., 2: 178 (Type: *Clupea dorab* Forskål) (for dating, see Whitehead, 1967b).

Neosudis Castelnau, 1873, *Proc. zool. acclim. Soc. Victoria*, 2: 119 (Type: *Neosudis vorax* Castelnau).

Species: Luther (1966), on the basis of over eight thousand Indian specimens of both sexes, demonstrated the presence of two species of *Chirocentrus* in Indian waters, *C. dorab* (Forskål) and *C. nudus* (Swainson); contrary to earlier workers, he found in a hundred specimen sample no meristic characters and only two morphometric characters that did not overlap, but the latter were reinforced by a difference in dorsal fin colouration in fresh material. Luther's conclusions are supported by measurements of 42 specimens in the British Museum and in Copenhagen from the entire range of *Chirocentrus* (Japan to Natal) (Figure 1) and Luther's key is adopted here (with slight modifications to the range of values).

Luther (*loc. cit.*) assumed *C. hypselosoma* Bleeker to be a synonym of *C. nudus*, whereas the pectoral measurement of the holotype (Whitehead *et al.*, 1966) places this species in *C. dorab*; Bleeker's *Atlas* figure and a non-typical Bleeker specimen labelled *C. hypselosoma* (BMNH. 1867.11.28.1) agree with *C. nudus*, however. Swainson's species was based on *Wallah* of Russell (1803: pl. 199), whose pectoral length and depth at eye agree with the higher figures given by Luther for *C. nudus*. The holotype of Forskål's *Clupea dorab* is lost (Klauswitz & Nielsen, 1965: 13) but for convenience it can be assumed not to be the same as *C. nudus*. The two species occupy almost the same range (based on specimens examined).

Key to the species of *Chirocentrus*

1. In fresh specimens, dorsal fin black except for white crescentic area at base of finrays ; pectoral fin (10.4) 11.6-13.4% of S.L. ; depth at eye 8.4-10.8% of S.L. ; maxilla failing to reach pre-opercular margin.....
.....*C. dorab* (p. 167)
2. In fresh specimens, dorsal fin white tinged with yellow except for dark streaks along anterior and posterior margins ; pectoral fin 13.4-17.8% of S.L. ; depth at eye 10.3-12.3 (13.5) ; maxilla reaching beyond pre-opercular margin in fishes over 210 mm S.L..... *C. nudus* (p. 168)

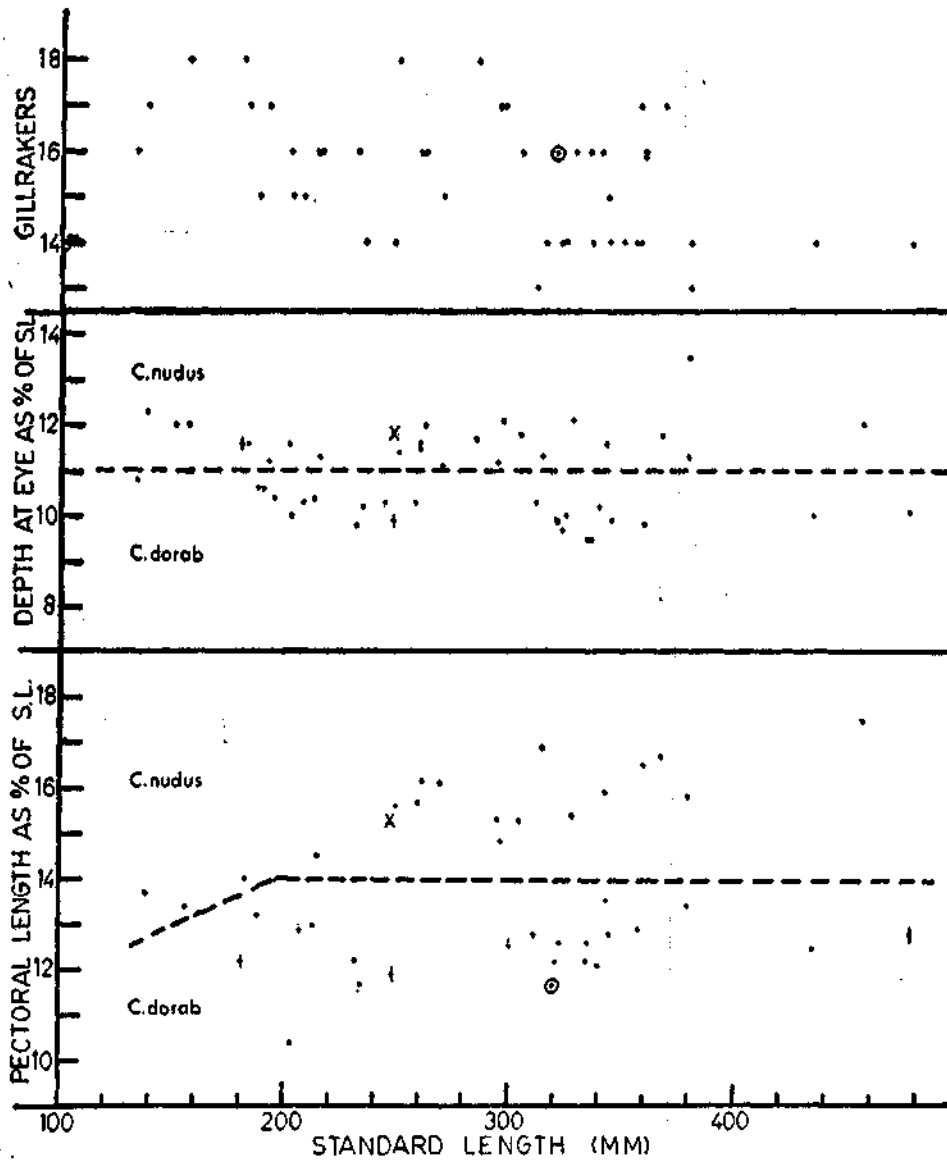


Fig. 1. *Chirocentrus dorab* and *C. nudus*. Comparison of pectoral length, depth at eye and gillraker numbers in 42 specimens in the British Museum (Natural History) and the Universitetets Zoologiske Museum, Copenhagen. Figures included for Russell's *Wallah* (x) and the holotype of Bleeker's *C. hypselosoma* ⊙.

1. *Chirocentrus dorab* (Forskål, 1775) (Fig. 2)

Clupea dorab Forskål, 1775, *Descr. Anim.*: xiii, 7 (Djedda and Mocha, Red Sea; type now lost *vide* Klauswitz & Nielsen, 1965).

Clupea dentex Schneider, 1801, *Syst. Ichth. Bloch.*: 428 (on *Clupea dorab* Forskål).

Esox chirocentrus Lacépède, 1803, *Hist. Nat. Poiss.*, 5 : 296, 317, pl. 8 (1) (*des Indes*, on Commerçon drawing ; species indeterminate).

Chirocentrus hypselosoma Bleeker, 1852, *Natuurk. Tijdschr. Ned.-Indië*, 3 : 71 (Holotype from Singapore or Samarang ; some Bleeker specimens are *C. nudus*—see above ; *Atlas* figure also appears to be *C. nudus*).

Neosudis vorax Castelnau, 1873, *Proc. zool. acclim. Soc. Victoria*, 2 : 118 (Noumea, New Caledonia).

Synonymy : Whitehead *et al.*, 1966 : 27 (*hypselosoma* wrongly identified as *nudus*) ; Whitehead, 1969a : 266 (*dentex*=*dorab*).

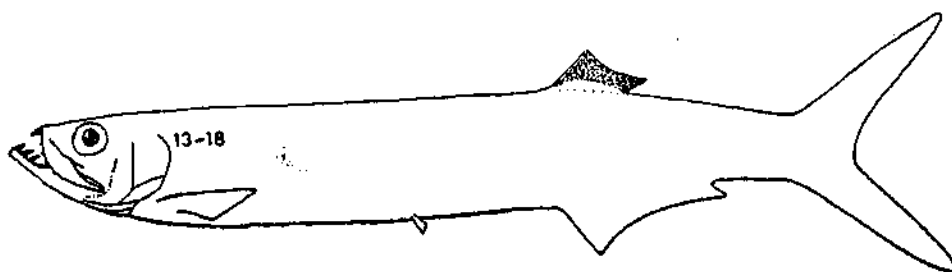


Fig. 2. *Chirocentrus dorab* (Forskål).

Description : Whitehead, 1965a : 233 (Muscat specimen) ; Luther, 1966 (50 Indian specimens) ; Whitehead *et al.*, 1966 : 27 (type of *hypselosoma*) ; Losse, 1968 (13 East African specimens).

Distribution : ? East London (Smith, 1953 : 87), Natal (BMNH specimen), East African coast (Losse, 1968), Muscat (BMNH specimen), India (southeast coasts to Madras—Luther, 1966), Ceylon (Munro, 1955 : 33), Penang, Singapore, Java, Amboina, Thailand, Cape York and Japan (BMNH specimens).

Note : studies on *Chirocentrus* (all reported as *C. dorab*) include notes on general biology (Prabhu, 1953), breeding (Hora, 1924), eggs and larvae (Delsman, 1922, 1930b), juveniles (Chacko, 1950 ; Basheerudin & Nayar, 1962), the caudal skeleton (Cavender, 1966), the skull (Ridewood, 1904) and the swimbladder (Srivastava, 1955). The intestinal Ringfalten are spiral but not homologous with the chondrichthyan Spiral-falten (Whitehead, 1962a).

2. *Chirocentrus nudus* Swainson, 1839 (Fig. 3)

Chirocentrus russellii Swainson, 1838, *Nat. Hist. Anim.*, 1 : 289 (on Wallah of Russell, 1803) (*nomen oblitum*).

Chirocentrus nudus Swainson, 1839, *Ibid.*, 2 : 294 (also on Wallah).

Synonymy : Whitehead, 1967a : 11 (*russellii* a *nomen oblitum*).

Description : Luther, 1966 (50 Indian specimens).

Distribution : Persian Gulf (BMNH specimens), India (southeast coasts to Madras—Luther, 1966 ; BMNH specimens from Calcutta, Madras, Mangalore ; type

locality Vizagapatnam), Ceylon (Munro, 1955), Penang, Java, Sarawak, Koh Kong and Canton (BMNH specimens).

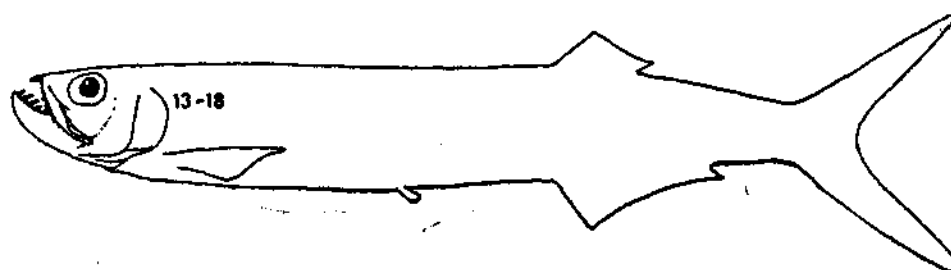


Fig. 3. *Chirocentrus nudus* Swainson.

Family CLUPEIDAE

Seven subfamilies are recognised here (see key) although this arrangement is almost certainly artificial.

Subfamily *DUSSUMIERIINAE*

Two widespread genera recognised, *Dussumieria* and *Etrumeus*, the latter found chiefly in subtropical seas (but also Red Sea) and not yet recorded from Indian waters. Genera revised by Whitehead (1963a).

Key to the genera of *Dussumieriinae*

1. Pelvic fins under dorsal base ; two supra-maxillae present ; anal rays 14-19 ; isthmus pointed anteriorly (Fig. 4b).....*Dussumieria* (p 169.)
2. Pelvic fins behind dorsal base ; a single (posterior) supra-maxilla ; anal rays 9-13 ; isthmus with lateral 'wings' anteriorly.....*Etrumeus* (Japan, Australia, South Africa, Red Sea, New World)

Dussumieria Valenciennes, 1847

Dussumieria Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 467 (Type : *Dussumieria acuta* Valenciennes).

Montalbania Fowler, 1934, *Proc. Acad. nat. Sci. Philad.*, 85 : 244, fig. 7 (Type : *Etrumeus* (*Montalbania*) *albulina* Fowler, 1934).

Montalbiana Bertin, 1943, *Bull. Inst. océanogr. Monaco*, No. 853 : 7 (misspelt).

Synonymy : Whitehead, 1963a : 317.

Species : a single species, *D. acuta*, widespread in the Indo-Pacific (Whitehead, 1963a).

3. *Dussumieria acuta* Valenciennes, 1847 (Fig. 4)

Clupea flosmaris Richardson, 1846, *Ichthyol. China Japan* : 305 (Canton, on Reeves drawing No. 64) (name suppressed by International Commission in 1970, Opinion 901, *Bull. zool. Nomencl.*, 26 : 217).

Dussumieria acuta Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 467, pl. 606 (Bombay, Coromandel).

?*Elops javanicus* Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 271 (on coloured, unpublished drawing of Kuhl & van Hasselt bearing this name).

Dussumieria elopsoides Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 12 (Madura Strait, Java Sea, etc.).

Dussumieria hasseltii Bleeker, 1850, *Natuurk. Tijdschr. Ned.-Indië*, 1 : 422 (Batavia, Cheribon, Samarang, Surabaya).

Dussumieria productissima Chabanaud, 1933, *Bull. Inst. océanogr. Monaco*, No 627 : 4, figs. 3-6 (Gulf and Isthmus of Suez, Grand Lac Amer, Lac Timsah).

Etrumeus (Montalbania) albulina Fowler, 1934, *Proc. Acad. nat. Sci. Philad.*, 85 : 244, fig. 7 (Iloilo, Philippines).

Synonymy : Whitehead, 1963a : 312 and Whitehead *et al.* 1966 : 30, 31 (*elopsoides*, *hasseltii*, *productissima*, *albulina* discussed) ; Whitehead, 1966b : 29, pl. 2 (2) (*flosmaris* a nomen oblitum, possibly *Herklotsichthys* or *Sardinella*) ; Chan, 1966 (*flosmaris* = *D. acuta*) ; Whitehead, 1967a (*javanicus*).

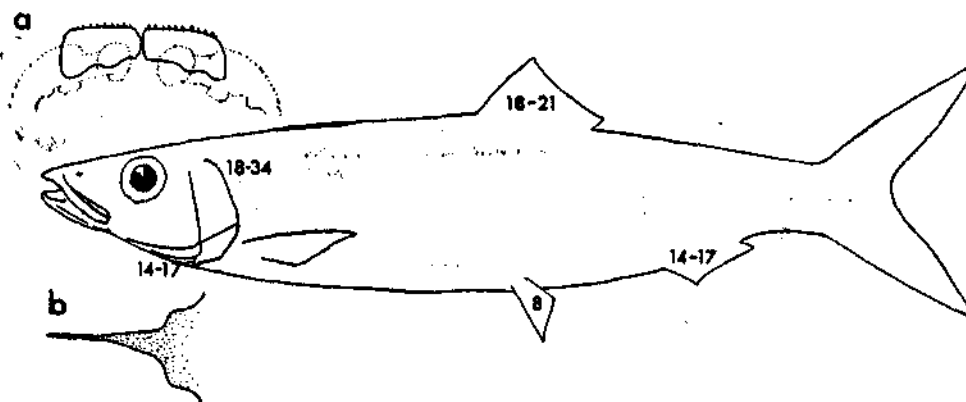


Fig. 4. *Dussumieria acuta* Valenciennes, showing rectangular pre-maxillae (a) and tapering isthmus (b).

Description : Whitehead, 1963a : 319, fig. 5 (*elopsoides*, *hasseltii* types, eight Calicut specimens, six Gulf of Aden specimens).

Distribution : Madagascar (Fourmanoir, 1961), East African coasts (Losse, 1968), eastern Mediterranean, Red Sea, Persian Gulf (Whitehead, 1963a), India (Bombay, Malabar and Coromandel coasts—BMNH specimens ; Laccadives—Jones, 1969), Ceylon (Munro, 1955), Andaman Is., Indo-Malayan Archipelago (Whitehead, 1963a), Palau (BMNH specimens), Hong Kong, Amoy, Foochow (Whitehead, 1966a : 48).

Note : studies on this species (often reported as *hasseltii*) include notes on bionomics (Devanesen & Chacko, 1944), general biology (Mahadevan & Chacko, 1962), food (Kuthalingam, 1961), breeding (Dharmamba, 1960), eggs and larvae (Delsman, 1925), juveniles (Chacko, 1950; Basheerudin & Nayar, 1962), temperature tolerance of larvae (Kuthalingam, 1959), the gut (Harder, 1958) and seasonal variations in fat composition (Sekharan, 1949).

Subfamily SPRATELLOIDINAE

Two genera known, the Indo-Pacific *Spratelloides* and the Western Atlantic *Jenkinsia* (both revised by Whitehead, 1963a).

Spratelloides Bleeker, 1851

Spratelloides Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Indië*, 2 : 214 (Type : *Clupea argyrotaenia* Bleeker; no diagnosis); *Idem*, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24 : 29 (generic diagnosis).

Stolephorus (non Lacépède) : Fowler, 1941, *Bull. U.S. natn. Mus.*, 13 (100) : 561.

Synonymy : Whitehead, 1963a : 340 and 1963b.

Species : two species, each with a pair of subspecies (Whitehead, 1963a); only the nominate forms occur in the Indian Ocean.

Key to the species of *Spratelloides*

1. A bright silver midlateral stripe, often grey or black in preserved material; posterior frontal fontanelles 1.5-1.8 mm long, broadly divided anteriorly by wedge of bone (Fig. 5a); expanded portion of 2nd supra-maxilla oblate, lower lobe larger than upper (Fig. 5b).....*S. gracilis*
2. No silver band, flanks silvery; posterior frontal fontanelles 0.8-1.4 mm long, narrowly separated anteriorly (Fig. 6a); expanded portion of 2nd supra-maxilla almost circular, upper and lower lobes equal (Fig. 6b)....
.....*S. delicatulus*

4. *Spratelloides gracilis* (Schlegel, 1846) (Fig. 5)

Clupea gracilis Schlegel, 1846 (22nd Nov.), *Fauna Japonica, Poiss.*, pt. 5, inst. 13 : 238, pl. 108 (2) (southeast coast of Nagasaki).

Clupea argyrotaeniata Bleeker, 1849, *J. Ind. Arch.*, 3 : 72 (Macassar; putative neotype described, Whitehead *et alii*, 1966 : 35).

Stolephorus japonicus (non Lacépède) : Fowler, 1941, *Bull. U.S. natn. Mus.*, 13 (100) : 567 .

Spratelloides atrofasciatus Schultz, 1943, *Bull. U.S. natn. Mus.*, No. 180 : 8, fig. 1 (Samoa).

Synonymy : Whitehead, 1963a (*japonicus*, *atrofasciatus*); Whitehead *et al.*, 1966 (*argyrotaeniata*).

Description : Whitehead, 1963a : 343, fig. 18 (18 specimens from Japan, Formosa and one Bleeker specimen); Whitehead, 1965a : 237, figs. 2, 3 (31 specimens, Red Sea); Losse, 1968 (16 specimens, East Africa).

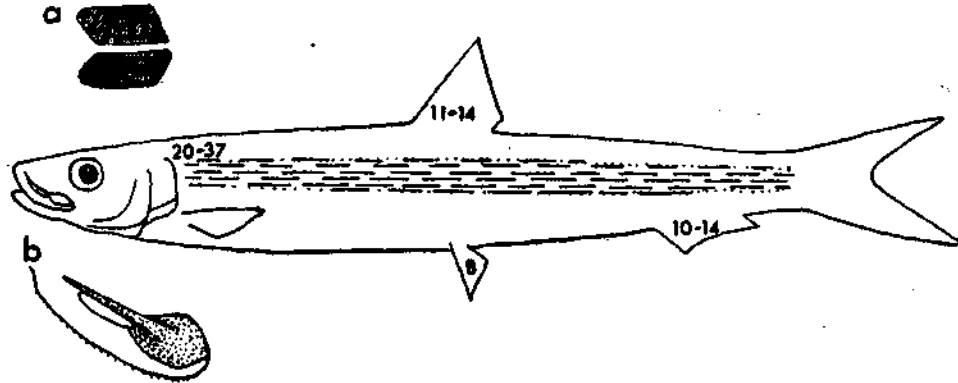


Fig. 5. *Spratelloides gracilis* (Schlegel), showing characteristic shape of posterior frontal fontanelles (a) and 2nd supra-maxilla (b—stippled).

Distribution : East African coasts (Losse, 1968), Red Sea (Whitehead, 1965a), **India** (Laccadive Sea—Jones, 1961), Ceylon (Munro, 1955), Sumatra (Whitehead, 1963a : 375), Lingga Archipelago (Hardenberg, 1933), Hong Kong, Taiwan (Whitehead, 1966a : 48), Japan (Whitehead, 1963a), Samoa (the subspecies *S.g. atrofasciatus*—Whitehead, 1963a).

Note : the Samoan subspecies differs from the nominate form in having fewer gillrakers and scales (19-23 and 41-42 ; cf. 24-37 and 44-49).

5. *Spratelloides delicatulus* (Bennett, 1831) (Fig. 6)

Clupea delicatula Bennett, 1831, *Proc. zool. Soc. Lond.*, 1 : 168 (Mauritius).

Clupea macassarensis Bleeker, 1849, *J. Ind. Arch.*, 3 : 72 (Macassar).

Alausa alburnus Kner & Steindachner, 1866, *Sitzb. K. Akad. Wiss. Wien*, 54 : 387, pl. 1(16) ('Valparaiso'—in fact, Samoa).

Spratelloides robustus Ogilby, 1897, *Proc. Linn. Soc. N.S.W.*, 22 : 64 (New South Wales).

Synonymy : Whitehead, 1963a (*robustus* a subspecies); Whitehead *et al.*, 1966 : 34 (*macassarensis* redescribed); Whitehead, 1970 : 6 (*alburnus*, true locality, redescription).

Description : Whitehead, 1963a : 347, figs. 19, 30, 31) (23 specimens, Seychelles, Maldives, Thousand Is., Bonham Is., New South Wales); Whitehead, 1965a : 241, figs. 2, 3 (35 specimens, Red Sea); Losse, 1968 (13 East African fishes).

Distribution : Mauritius (type locality), ? South Africa (Smith, 1953 : 89), East African coasts (Losse, 1968), Red Sea (Whitehead, 1965a), **India** (Laccadive Sea—

Jones, 1961), Indo-Malayan Archipelago (Bleeker specimens, seen), Philippines (Whitehead, 1963a), Palau, Guam (BMNH specimens), not Hong Kong (Whitehead,

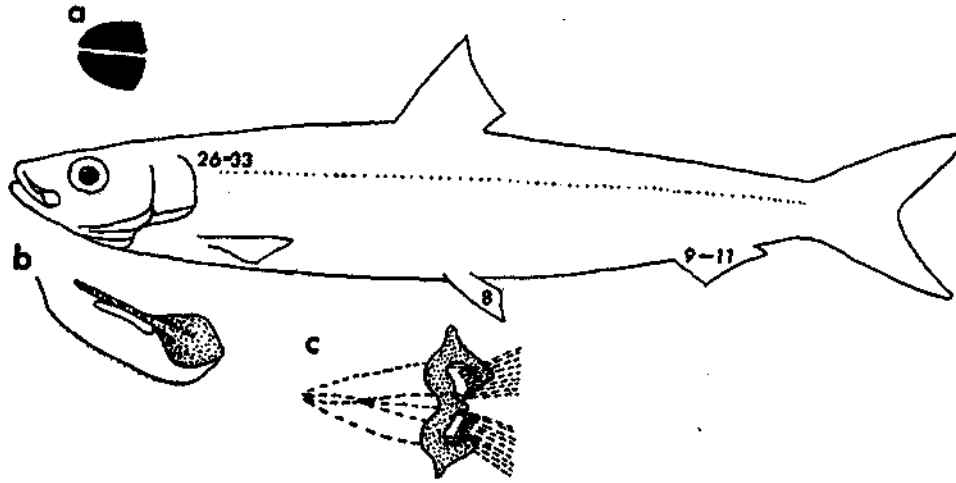


Fig. 6. *Spratelloides delicatulus* (Bennett), showing characteristic shape of posterior frontal fontanelles (a), 2nd supra-maxilla (b—stippled) and W-shaped pelvic scute (c—stippled).

1966a : 48), Miyako I. (25°N—BMNH specimens), not north of Amami Oshima (28°N—Suzuki, 1964), south to Australia (the subspecies *S. d. robustus*—Whitehead, 1963a).

Note : the Australian subspecies differs from the nominate form in having fewer scales and longer pectoral fins (32-42 and 11.1-12.8% of S.L. ; cf. 36-46 and 9.2-11.5%).

Subfamily *CLUPEINAE*

Fourteen genera are recognised (listed in Whitehead, 1968a : table 2) of which six are found in the Indo-Pacific (*Clupea*, *Sprattus* and *Sardinops* not known in Indian Ocean, however).

Key to the Indo-Pacific genera of Clupeinae

- I. Operculum striated ; fleshy 'rakers' along upper edge of hyoid.....
*Sardinops* (Japan, Australia, South Africa, New World)
- II. Operculum smooth ; upper edge of hyoid smooth
 - A. No pterotic bulla containing diverticulum of swimbladder.....
*Sprattus* (Australia, Europe, S. America)
 - B. Bullae present in pterotics as well pro-otics
 - 1. Bilobed dermal outgrowth on vertical arm of cleithrum (Fig. 7c) ; flanks wholly silver

- a. Lower portion of 2nd supra-maxilla longer than upper (Fig. 7b); fronto-parietal striae 3-6; vertical scale striae continuous across scale (Fig. 7d).....*Herklotsichthys* (p. 174)
 - b. Lower portion of 2nd supra-maxilla equal to upper (Fig. 8b); fronto-parietal striae usually numerous (7-14) (Fig. 8a); vertical scale striae interrupted at centre of scale, at least in anterior scales (Fig. 11a).....*Sardinella* (p. 176)
- 2. Posterior margin of gill opening smooth, no dermal outgrowths
 - a. Pelvic rays 7; silver stripe down flanks.....*Escualosa* (p. 189)
 - b. Pelvic rays 9; flanks silvery.....*Clupea* (Japan, Europe, N. America)

Herklotsichthys Whitley, 1951

Herklotsella Fowler, 1934, *Proc. Acad. nat. Sci. Philad.*, **85** : 246 (Type: *Harengula dispilonotus* Bleeker) (non *Herklotsella* Herre, 1933, a siluroïd genus).

Herklotsichthys Whitley, 1951, *Proc. R. zool. Soc. N.S.W.*, 1949-50 : 67 (replacement for *Herklotsella* Fowler).

Synonymy : Whitehead, 1964a (*Harengula* Valenciennes not applicable to Indo-Pacific species); Whitehead, 1964b (generic diagnosis).

Species : a single Indian Ocean species, *H. punctatus*, distinguished from the Indonesian *H. dispilonotus* by the absence of two black, saddle-like blotches on the back (Whitehead, 1969b : 229, fig. 5). The Philippine *H. tawilis* (Herre), the Indonesian *H. konigsbergeri* (Weber & DeBeaufort), and the Australian *H. castelnaui* (Ogilby), *H. maccullochi* (Whitley) and *H. lippus* Whitley need investigation.

6. Herklotsichthys punctatus (Rüppell, 1837) (Fig. 7)

Clupea punctata Rüppell, 1837, *Neue Wirbelth., Fische* : 78, pl. 21 (2) (Red Sea).

Clupea quadrimaculata Rüppell, 1837, *Neue Wirbelth., Fische* : 78, pl. 21 (3) (Bay of Massawa, Red Sea).

Sardinella lineolata Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 272 (Trincomalee and Bourou I).

Harengula bipunctata Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 98 (on MS. descr. of *Clupea bipunctata* by Ehrenberg, ex Massawa).

Harengula arabica Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 298 (on MS. descr. of *Clupea arabica* by Ehrenberg, ex Mohila, Red Sea).

Clupeonia fasciata Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 349 (Saint-Denis de Bourbon).

Meletta obtusirostris Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 375 (Seychelles).

Meletta venenosa Valenciennes, 1847, *Hist. Nat. Poiss.*, **20** : 377 (Seychelles).

Aausa schrammi Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, **22** : 11 (Boleling, Bali).

Harengula moluccensis Bleeker, 1853, *Natuurk. Tijdschr. Ned.-Indië*, **4** : 609 (Ternate, Amboina, Ceram).

Harengula kunzei Bleeker, 1856, *Natuurk. Tijdschr. Ned.-Indis*, 12 : 209 (Ternate).

Clupea (Harengula) dubia Bleeker, 1872, *Atlas Ichthyol. Ind. Néerland.*, 6 : 108 (on *Sardinella lineolata* Valenciennes).

?*Clupea profundis* Kent, 1889, *Prelim. Rept. Food Fish Queensland* : 11 (Queensland, name only).

?*Clupea torresiensis* Kent, 1889, *Prelim. Rept. Food Fish Queensland* : 11 (Queensland, name only).

?*Clupea ranelayi* Kent, 1889, *Prelim. Rept. Food Fish Queensland* : 11 (Queensland, name only).

?*Harengula stereolepis* Ogilby, 1897, *Proc. Linn. Soc. N.S.W.*, 22 : 759 (Torres Straits, Darnley I., S-E New Guinea).

?*Clupea mizum* Kishinouye, 1907, *J. Imp. Fish. Bureau Tokyo*, 14 : 98, pl. 20 (3) (Riu Kiu Is., Japan).

?*Clupea rechingeri* Steindachner, 1908, *Sitzb. K. Akad. Wiss. Wien*, 115 (1) : 1424 (Upolu, Samoa).

Synonymy : Whitehead, 1965a (*punctata*, *quadrimaculata* ; *Clupea ovalis* Bennett, 1831 not this species) ; Whitehead *et al.*, 1966 (*schrammi*, *moluccensis*, *kunzei*, *dubia*) ; Whitehead, 1967a (*lineolata*, *bipunctata*, *arabica*, *fasciata*, *obtusirostris*, *venenosa*) ; Whitehead, 1970 : 7 (*rechingeri*) ; Australian and Japanese synonyms not yet investigated critically but based on Fowler, 1941 : 591-2.

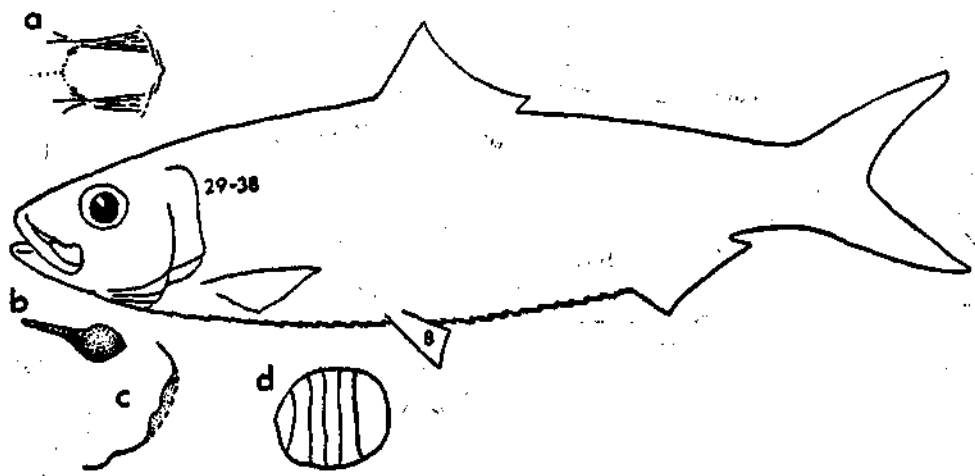


Fig. 7. *Herklotsichthys punctatus* (Rüppell), showing fronto-parietal striation pattern (a), shape of 2nd supra-maxilla (b—stippled), bilobed dermal flap on vertical arm of cleithrum (c) and pattern of continuous vertical scale striae (d).

Description : Whitehead, 1965a (6 Rüppell types and 30 specimens, Red Sea, Gulf of Aden) ; Whitehead *et al.*, 1966 (types of *schrammi*, *moluccensis*, *kunzei*) ; Whitehead, 1967a (types of *lineolata*, *fasciata*, *obtusirostris*, *venenosa*) ; Losse, 1968 (109 specimens, East Africa) ; Raja & Hiyama, 1969a (as *schrammi*, 100 specimens, Taiwan).

Distribution : 30 miles south of Durban (BMNH specimens), Reunion I. (*fasciata* type), East African coasts (Losse, 1968), Seychelles (*obtusirostris* and *venenosa* types), Red Sea (Whitehead, 1965a), India (no BMNH specimens ; Vizhinjam specimens *vide* Lazarus, *in litt.* ; no certain references), Maldiva Is., Ceylon, Nicobar

Is., Andaman Is., Indo-Malayan Archipelago, Philippines, Palau, Samoa, Fiji Is., N. Queensland (BMNH specimens), Taiwan (Chu & Tsai, 1958; Raja & Hiyama, 1969a—as *schrammi*).

Note: Losse (1968) distinguished two forms of *H. punctata* off East African coasts.

1. Body depth 29-33% (mean 31.4%) of S.L. in fishes of 48-85 mm S.L.; in life, orange midlateral line, humeral patch and base of dorsal, with black patch on anterior ten dorsal rays.....Form A
2. Body depth 24-29% (mean 26.7%) of S.L. in fishes of 32-100 mm S.L.; in life, electric blue midlateral line with distinct darker line below it, dorsal fin greyish with a yellow tinge.....Form B

Form B resembles Rüppell's Red Sea specimens of *Clupea punctata* in body proportions and gillraker counts but not in colouration, which is nearer to that of Form A (Losse, 1968). Previous descriptions rarely give good colour notes and the two forms have not yet been distinguished elsewhere. Both forms were distinguished by Lazarus (*in litt.*) from Vizhinjam.

Sardinella Valenciennes, 1847

Sardinella Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 18 (Type: *Sardinella aurita* Valenciennes, designated by Gill, 1861, *Proc. Acad. nat. Sci. Philad.* : 35).

Clupeonia Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 345 (Type: *Clupeonia jussieui* Valenciennes, designated by Gill, *op. cit.* : 35).

Kowala Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 362 (Type: *Kowala albella* Valenciennes, designated by Gill, *op. cit.* : 37).

Amblygaster Bleeker, 1849, *J. Ind. Arch.*, 3 : 73 (Type: *Amblygaster clupeoides* Bleeker).

Clupalosa Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 12 (Type: *Clupalosa bulan* Bleeker = *Kowala albella* Valenciennes *vide* Whitehead, 1967a : 53).

Sardinia Poey, 1860, *Mem. Hist. nat. Cuba*, 2 : 311 (Type: *Sardinia pseudohispanica* Poey = *S. aurita*).

Paralosa Bleeker, 1868, *Versl. Meded. K. Akad. wet. Amst.*, 2 (2) : 300 (Type: *Harengula (Paralosa) valenciennesi* Bleeker = *Clupea melanura* *vide* Whitehead *et al.*, 1966 : 66).

Wilkesina Fowler & Bean, 1923, *Proc. U.S. natn. Mus.*, 63 : 3 (Type: *Harengula fijitense* Fowler & Bean, prob. = *S. fimbriata*).

Fimbriclupea Whitley, 1940, *Aust. Zool.*, 9 (4) : 399 (Type: *Fimbriclupea dactylolepis* Whitley).

Fiscina Whitley, 1940, *Aust. Zool.*, 9 (4) : 400 (Type: *Fiscina posterus* Whitley).

Fusichelupea Whitley, 1940, *Aust. Zool.*, 9 (4) : 401 (Type: *Sardinops daktini* Whitley = *Clupea sirm* Walbaum).

Synonymy: Whitehead, 1964a (*Clupalosa*, *Paralosa*, *Wilkesina*, *Fimbriclupea*), Whitehead, 1964b (synonymy, diagnosis), Whitehead *et al.*, 1966 (*Amblygaster*, *Clupalosa*, *Paralosa*), Whitehead, 1967a (*Sardinella*, *Clupeonia*, *Kowala*).

Species: the excellent revision of Indo-Pacific species of *Sardinella* by Chan (1965) in which 15 species were recognised, must be modified in the light of more recent

work. Thus, *Sardinella nigricaudata* Chan is *S. melanura* (Cuvier) (Whitehead, 1967a : 68) ; *Chupanodon jussieu* Lacépède has been deemed a *nomen dubium* (Whitehead, *loc. cit.* : 54), the name *Sardinella gibbosa* (Bleeker) replacing it ; *Clupeonia jussieu* Valenciennes is a distinct species and not a synonym of Lacépède's *jussieu* (Whitehead, *loc. cit.* : 59) ; *Sardinella albella* (Valenciennes), not included by Chan, is a species close to *S. fimbriata* (Whitehead, 1967a : 53) ; a new species has been described, *S. marquesensis* Berry & Whitehead, 1968 ; and Chan's *S. nymphaea* (Richardson) was based on the type of Richardson's *Clupea isingleena*, identified as *S. fimbriata* (Whitehead, 1966a) but the scales resembling those of *S. zumasi* (Chan, 1965 : figs. 8, 10). Much more work is needed before the species can be enumerated with confidence.

The genus can be conveniently split into three subgenera, following Chan (*loc. cit.*).

- A. Pelvic finrays i 8 ; pseudobranch long, with distinct ventral ridge ; epibranchial gillrakers curled upwards ; lower gillrakers 145-258 (in Indo-Pacific adults)subgenus *Sardinella* (p. 177)
- B. Pelvic finrays i 7 ; pseudobranch short, flat ; epibranchial gillrakers almost straight ; lower gillrakers not more than 130.
 1. A double row of median pre-dorsal scales ; abdominal scutes strongly keeled ; lower gillrakers 45-130.....subgenus *Clupeonia* (p. 179)
 2. A single median pre-dorsal scale row ; abdominal scutes barely keeled, belly rounded ; lower gillrakers 26-42.....subgenus *Amblygaster* (p. 186)

Subgenus *Sardinella*

Three principal species are known : *S. brasiliensis* (Steindachner) of the Western Atlantic, *S. aurita* Valenciennes of the Atlantic (both sides), Mediterranean and Western Pacific (including Indonesia), and *S. longiceps*, which replaces *S. aurita* in the Indian Ocean but is recorded also from the Philippines (Chan, 1965).

Key to Indo-Pacific species of *Sardinella* (*Sardinella*)

1. Head length 25.0-27.4% of S.L. ; exposed part of interoperculum crescentic (Chan, 1965 : fig. 5a).....*S. aurita* (not known from Indian Ocean)
2. Head length 29.0-34.4% of S.L. ; exposed part of interoperculum an approximate semicircular segment (Chan, 1965 : fig. 5b).....*S. longiceps* (p. 177)

7. *Sardinella longiceps* Valenciennes, 1847 (Fig. 8)

Sardinella longiceps Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 273 (Pondicherry).

Sardinella neohowii Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 274 (Cannanore).

Alausa scombrina Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 442 (Cannanore).

[18]

†*Clupea mauritiana* Bennett, 1833, *Proc. zool. Soc.* : 32 (Mauritius).

Synonymy: Whitehead, 1967a (*longiceps*, *neohowii*, *scombrina*).

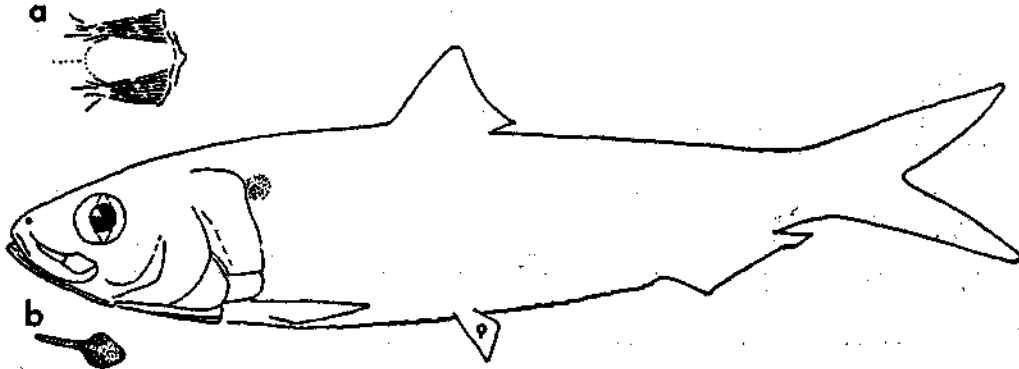


Fig. 8. *Sardynella longiceps* Valenciennes, showing fronto-parietal striation pattern (a) and shape of 2nd supra-maxilla (b)

Description: Whitehead, 1965a (25 specimens, Aden, Abyan); Chan, 1965 (51 specimens, Philippines, India, Borneo); Whitehead, 1967a (types of *longiceps*, *neohowii*, *scombrina*); Losse, 1968 (27 East African specimens); Raja & Hiyama, 1969a (200 Indian specimens).

Distribution: East African coasts and Seychelles (Losse, 1968), Gulf of Aden Gulf of Oman (Whitehead, 1965a), Red Sea (at Massawa *vide* Losse, *in litt.*), India (Sind, Malabar coasts, Madras—BMNH specimens; Coromandel coast—Valenciennes' types; 'India'—Raja & Hiyama, 1969; Bombay, Cannanore, Calicut—Murty, 1969), Ceylon (Munro, 1955 : 25), Philippines, N. Borneo (Chan, 1965 : 4).

Note: the ranges of *S. aurita* and *S. longiceps* overlap in the Philippines (Chan, *loc. cit.*); the former reaches westwards to Java (Batavia, the lectotype of *S. lemuru* Bleeker—Whitehead *et al.* 1966 : 47), but the latter is not recorded north or east of the Philippines. Bennett's *Clupea mauritiana* is poorly described but the pelvic count of 9 suggest the present species. Fowler (1941) placed it in the synonymy of *Anadontostoma chacunda* but this is unlikely, that species being recorded from the Persian Gulf (Whitehead, 1965a) but not to the south.

This is the most important of all clupeoid species in Indian fisheries and many studies have been made, including descriptions of its general biology (Chacko & Mathew, 1956a; Nair, 1960a; Radhakrishnan, 1969a; Raja, 1969), shoaling behaviour (Balan, 1961), growth (Chidambaram, 1950; Dhulkhed, 1967a, Bensam, 1968a; Balan, 1968; Bennet, 1971), food (Kuthalingam, 1960; Dhulkhed, 1964; Bensam, 1967; Kagwade, 1967; Noble, 1969), breeding (Nair, 1958, 1960b; Dhulkhed, 1967; Prabhu, 1967; Raja, 1967, 1971; Balan, 1971), temperature tolerance of larvae (Kuthalingam, 1959), gonadal peculiarities (Bensam, 1969), variations in lipid composition (Gopakumar, 1969), epibranchial organs (Bensam, 1967a), and caudal fin regeneration (Bensam, 1965).

Subgenus *Clupeonia*

This subgenus was redefined by Whitehead (1967a : 59). It contains a number of species (10 recognised here) distinguished chiefly by scale characters, gillraker counts and body depths based on samples that rarely span the full range of each species. A full revision is urgently needed.

Key to the Indo-Pacific species of Sardinella (Clupeonia)

- I. Caudal tips jet black ; lower gillrakers 45-68 (at 75-101 mm S.L.) ; body depth 27-31% of S.L.; scutes 17+12.....*S. melanura* (p. 180)
- II. Caudal tips plain, at most caudal margin dusky ; lower gillrakers 43-124
 - A. Post-pelvic scutes 12-14 (rarely 11 or 15)
 1. Lower gillrakers 88-198
 - a. Scales perforated, fimbriated and eroded posteriorly (Fig. 10a) ; lower gillrakers 88-198 (at 97-135 mm S.L.) ; alar scales present.....*S. dayi* (p. 181)
 - b. Scales without perforations, barely eroded or fimbriated posteriorly (Fig. 11a) ; lower gillrakers 84-98 at 121.2-139.6 mm S.L.) ; alar scales? absent.....*S. jussieui* (p. 181)
 2. Lower gillrakers 47-89
 - a. Posterior scales with vertical striae numerous, overlapping or continuous at scale centre (Chan, 1965 : fig. 10) ; posterior margin of scale much perforated
 - i. Body depth 33-38% of S.L. ; lower gillrakers 54-65 (at 76-124 mm S.L.) ; scales greatly fimbriated posteriorly (Fig. 12a)*S. brachysoma* (p. 182)
 - ii. Body depth 29.1-32.6% of S.L. (at 89.5-113.5 mm S.L.) ; lower gillrakers 48-57 ; scales little fimbriated posteriorly.....*S. zunasi* (China, Japan)
 - b. Posterior scales with 4-5 vertical striae, interrupted at centre of scale (Chan, 1965 : fig. 7)
 - i. Scales perforated and fimbriated at posterior margin (Fig. 13a)
 - α. Lower gillrakers 47-62 (at 70-110 mm S.L.) ; body depth 32-35% of S.L.....*S. albella* (p. 183)
 - β. Lower gillrakers 60-81 (at 87-123 mm S.L.) ; body depth 28-34% of S.L.....*S. fimbriata* (p. 184)
 - ii. Scales not perforated or fimbriated posteriorly ; lower gillrakers 59-89 (at 80-107 mm S.L.) ; body depth 22.8-28.5% of S.L.*S. marquesensis* (Marquesas, Hawaii)
 - B. Post-pelvic scutes 15-16 (rarely 14 or 17-18)
 1. Lower gillrakers 43-63 (at 90-150 mm S.L.).....*S. gibbosa* (p. 185)
 2. Lower gillrakers 58-72 (at 69-122 mm S.L.).....*S. sindensis* (p. 186)

8. *Sardinella melanura* (Cuvier, 1829) (Fig. 9)

Clupea melanura Cuvier, 1829, *Règne Animal*, 2nd ed., 2 : 318 (footnote : ' *Cl. melanura*, N., Lacép., V, xi, 3, sous le nom de *Clupanodon Jussieu*, mais la description se rapporte à la fig. xi, 3, nommée variété du *Clupanodon chinois* ').

Clupeonia commersoni Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 350 (coasts near Bombay).

Clupea otaitensis Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 351 (on Solander MS. name) (synonym of *C. commersoni*—*nomen nudum*).

Clupeonia vittata Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 352 (Vanikoro).

Harengula melanurus Bleeker, 1853, *Natuurk. Tijdschr. Ned.-Indië*, 5 : 245 (Ceram) (claimed non *Alausa melanura* of Valenciennes).

Clupea atricauda Günther, 1868, *Cat. Fishes Brit. Mus.*, 7 : 426 (Ceram ; on specimen of Bleeker's *Harengula melanurus*).

Harengula (Paralosa) valenciennesi Bleeker, 1868, *Versl. Meded. K. Akad. wet. Amst.*, (2) 2 : 300 (Waigou—replacement name for *Harengula melanurus*).

Harengula vanlicoris Jordan & Seale, 1906, *Bull. U. S. Bur. Fish.*, 25 : 187 (on *Alausa melanura* Valenciennes).

?*Clupea ogura* Kishinouye, 1911, *J. Coll. Agric. Imp. Univ. Tokyo*, 2 : 384, pl. 30(2) (Futani Harbour Chichijima, Bonin Is.).

Sardinella nigricaudata Chan, 1965, *Jap. J. Ichth.*, 13 : 7, fig. 19 (Malekula I.).

Synonymy : Whitehead *et al.*, 1966 (*atricauda*, *valenciennesi*, Bleeker's *melanurus*); Whitehead, 1967a (*melanura*, *commersoni*, *otaitensis*, *vittata*, *nigricaudata*).

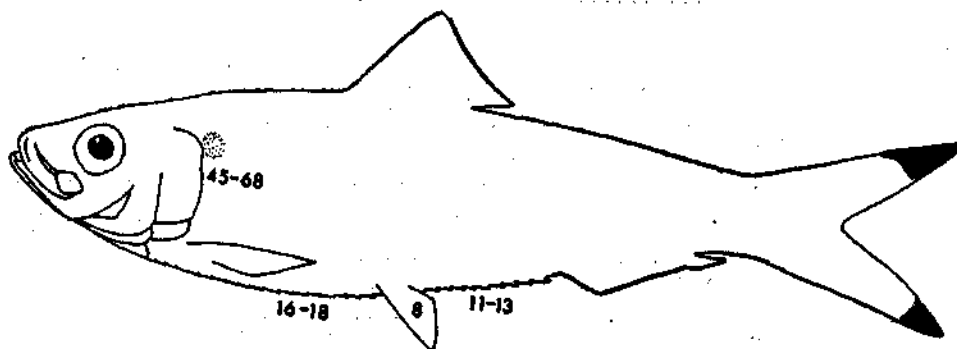


Fig. 9. *Sardinella melanura* (Cuvier).

Description : Whitehead, 1965a : 247 (17 specimens, Gulf of Aden, Red Sea—as *Herklotsichthys vittatus*); Chan, 1965 : 5 (28 specimens, Fiji, New Hebrides).

Distribution : Mauritius (Baissac, 1951), Comoro Is. (BMNH specimens), Gulf of Aden, Red Sea (Whitehead, 1965a), India (Bombay—*commersoni*; ? Travancore—Pillay, 1929; Laccadives—Jones, 1969), Ceylon (Deraniyagala, 1929—as *atricauda*), Indo-Malayan Archipelago (Bleeker specimens of *melanurus*), Vanikoro (*vittata*

types), New Hebrides (Chan's *nigricaudata*), Taiwan (Chu & Tsai, 1958), Samoa (BMNH specimens).

Note : Data on the biology of this species are given by Nair (1960a).

9. *Sardinella dayi* Regan, 1917 (Fig. 10)

Sardinella dayi Regan, 1917, *Ann. Mag. Nat. Hist.*, (8) 19 : 381 (India).

?*Sardinella samarensis* Roxas, 1934, *Philipp. J. Sci.*, 55 : 275, pl. 2, fig. 11 (scale) (Samar).

Synonymy : Whitehead, 1967a : 60 (*dayi* possibly related to the *maderensis* group but distinct from *S. jussieui*).

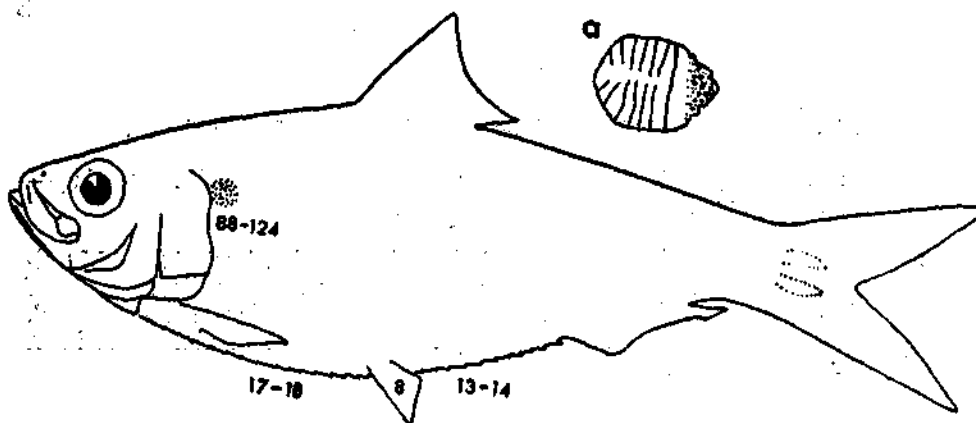


Fig. 10. *Sardinella dayi* Regan, showing pattern of interrupted scale striae (a).

Description : Regan, 1917 (the holotype) ; Chan, 1965 : 12 (2 specimens, Ceylon) ; Whitehead, 1967a : 60 (notes on holotype).

Distribution : Gulf of Masira (BMNH specimens), India (Karwar—Regan 1917), Ceylon (Chan, 1965), ? Philippines (*S. samarensis*).

Note : this species closely resembles *S. jussieui*, except in its scales (perforated, fimbriated, eroded), but more specimens are needed. The gillraker count (96-102) and pectinate scales of *S. samarensis* suggest the present species but more specimens are needed.

10. *Sardinella jussieui* (Valenciennes, 1847) (Fig. 11)

Chupeonia jussieui Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 346, pl. 599 (Ile-de-France).

Alausa argyrochloris (part) : Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 440 (two syntypes, 121.2 and 122.3 mm S. L., ex Bombay, coll. Dussumier).

?*Sardinella dayi* : Fowler, 1941, *Bull. U.S. natn. Mus.*, 13 (100) : 604 (Mauritius and Calicut specimens).

Synonymy : Whitehead, 1967a : 54, 60, 94 (*jussieui* not Lacépède's *jussieu* ; *argyrochloris* syntypes).

Description: Whitehead, 1967a (*jussieui* holotype, notes on *argyrochloris* syntypes); ? Fowler, 1941 (*dayi* specimens).

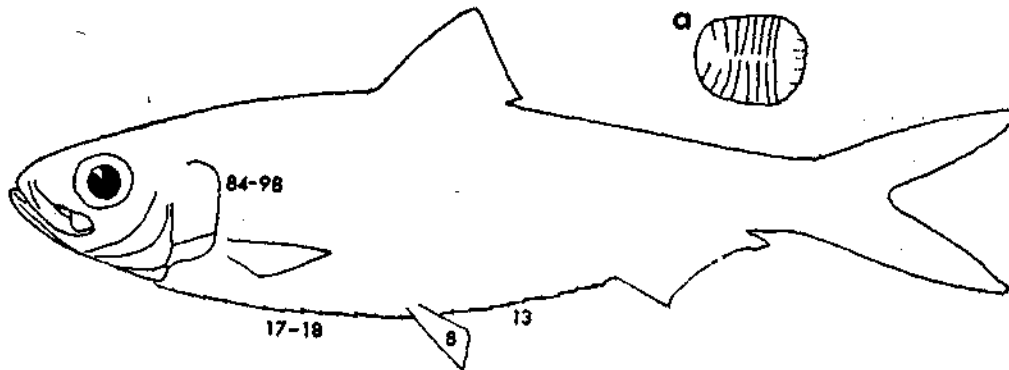


Fig. 11. *Sardinella jussieui* (Valenciennes), showing pattern of scale striae (a).

Distribution: Mauritius (*jussieui* holotype; ?Fowler, 1941), India (Bombay—*argyrochloris* syntypes; ? Calicut—Fowler, 1941).

Note: compared with specimens of *S. dayi*, the holotype of *S. jussieui* from Mauritius is a slender fish (depth 29.8% in S.L.; cf. 35-37%); the Bombay syntypes of *argyrochloris* are deeper bodied (32.5-33.5% of S.L.) but do not have the perforated, fimbriated and eroded scales found in *S. dayi*. The absence of alar scales in *S. jussieui* needs confirmation.

11. *Sardinella brachysoma* Bleeker, 1852 (Fig. 12)

Clupea isingleena Richardson, 1846, *Ichthyol. Seas China Japan*: 304 (China Seas) (name suppressed by International Commission in 1970, Opinion 901, *Bull. zool. Nomencl.*, 26: 217).

Sardinella brachysoma Bleeker, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24: 19 (Batavia).

Harengula hypselosoma Bleeker, 1855, *Natuurk. Tijdschr. Ned.-Indië*, 8: 427 (Amboina).

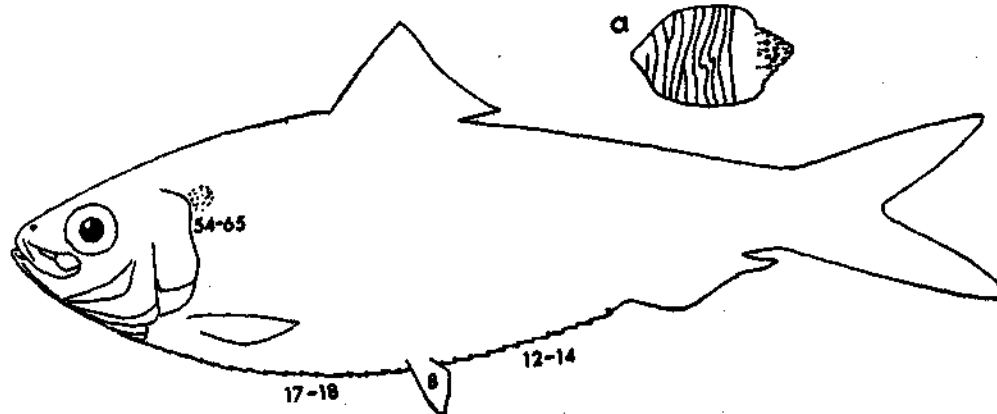


Fig. 12. *Sardinella brachysoma* Bleeker, showing pattern of continuous scale striae in posterior scales (a).

Synonymy : Whitehead *et al.*, 1966 (*brachysoma*, *hypselosoma*); Whitehead, 1966a, b (*isingleena*=*fimbriata*—an error); Chan, 1966 (*isingleena*=*brachysoma*).

Description : Chan, 1965 :19 (28 specimens, Taiping, Hong Kong, Calicut); Whitehead *et al.*, 1966 (types of *brachysoma*, *hypselosoma*).

Distribution : India (? Calicut—Chan, 1965, 1 specimen; Madras—BMNH specimen; Palk Bay, Bay of Bengal—Murty, 1969), Java, Sumatra, Amboina, Bangka (Bleeker material), Hong Kong, Taiping (Chan, 1965).

Note : Studies on this species include references to its general biology (Sekharan, 1967) and its food and feeding habits (John, 1939).

12. *Sardinella albella* (Valenciennes, 1847) (Fig. 13)

Kowala albella Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 362 (Pondicherry).

Clupalosa bulan Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 12 (Madura Strait, Kamal, Surabaya, Batavia, Samarang).

Clupea perforata Cantor, 1850, *J. Asiatic Soc. Bengal*, 18 : 1276 (Penang Sea, Malay Peninsula, Singapore, Sumatra).

Synonymy : Whitehead, 1964b (*bulan*, *perforata*); Whitehead *et al.*, 1966 (*bulan*); Whitehead, 1967a : 53 (*albella*).

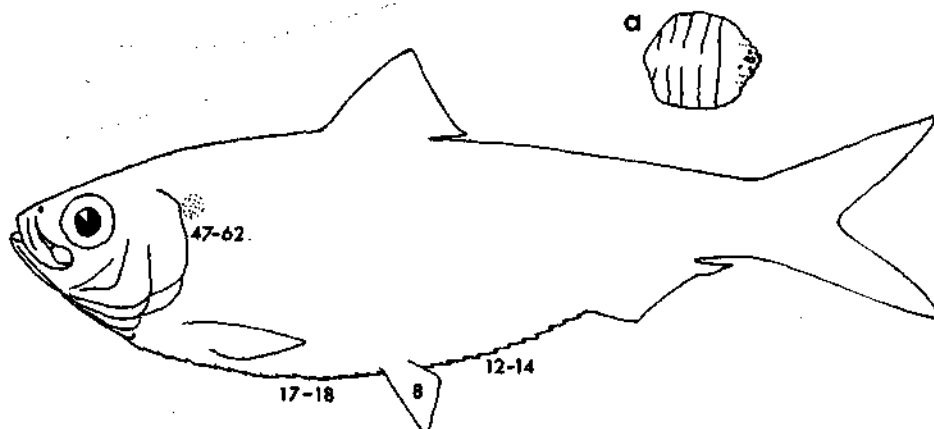


Fig. 13. *Sardinella albella* (Valenciennes), showing pattern of scale striae in posterior scale (a).

Description : Whitehead, 1964b (*bulan* lectotype); Whitehead, 1965a (13 specimens, Gulf of Aden, Persian Gulf); Chan, 1965 (as *perforata*, 50 specimens, Burma, Borneo, Thailand, Hong Kong, Hainan); Whitehead *et al.*, 1966 (*bulan* lectotype); Whitehead, 1967a (*albella* lectotype, fig. 3, scales); Losse, 1968 (35 specimens, East Africa); Raja & Hiyama, 1969a (as *bulan*, 100 specimens, Hong Kong).

Distribution : Lourenço Marques, Madagascar (BMNH specimens), East African coast (Losse, 1968), Gulf of Aden, Persian Gulf (Whitehead, 1965a), India (Pondi-

cherry—*albella* type ; Palk Bay—Murty, 1969), Burma (Chan, 1965), Java, Madura (Bleeker material), Borneo, Thailand, Hainan, Hong Kong, Taiwan (Chan, 1965).

Note : Studies which seem to relate to this species include those on general biology (Chacko & Mathew, 1956b ; Nair, 1960a ; Radhakrishnan, 1961 ; Sadasivan, 1965—as *bulan*), growth and breeding (Sekharan, 1965, 1967) eggs and larvae (Delsman, 1933b) ; food (Sekharan, 1971) ; and scales and age (Okera, 1970).

13. *Sardinella fimbriata* (Valenciennes, 1847) (Fig. 14)

Spratella fimbriata Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 359 (Malabar).

Sardinella fimbriata : Dutt, 1971. *J. mar. biol. Ass. India*, 13 (1) : 145 (Cantor's *Kowala thoracata* probably this species).

?*Kowala lauta* Cantor, 1850, *J. Asiatic Soc. Bengal*, 18 : 270 (Penang).

Synonymy : Dutt, 1962 (*fimbriata* distinct from *gibbosa*) ; Whitehead, 1967a (the same) ; Whitehead, 1969b : 232, 236 (*lauta* syntypes).

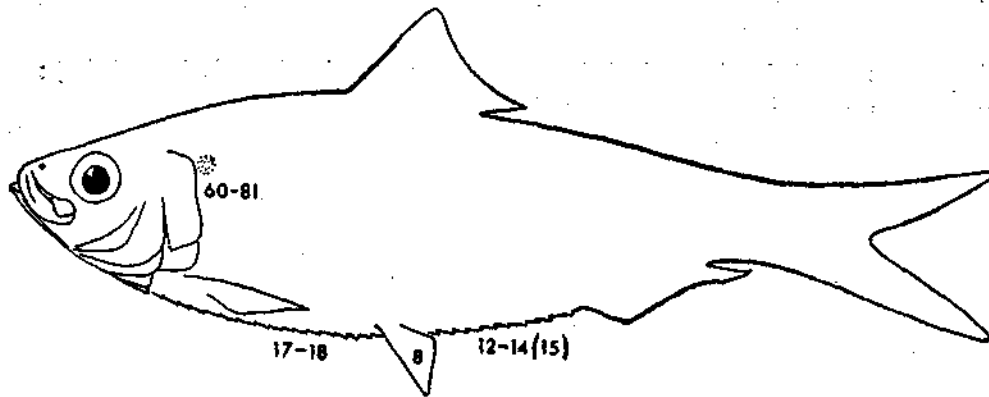


Fig. 14. *Sardinella fimbriata* (Valenciennes).

Description : Dutt, 1962 (vertebrae, pectoral rays, gillrakers, large samples of Waltair specimens) ; Whitehead, 1965a (29 specimens, Red Sea, Persian Gulf) ; Chan, 1965 (50 specimens, Calicut, Ernakulam, Madras, Thailand, Philippines) ; Whitehead, 1967a (*fimbriata* types).

Distribution : Mauritius (BMNH specimens), Red Sea, Persian Gulf (Whitehead, 1965a), India (Calicut, Ernakulam, Madras—Chan, 1965 ; Waltair—Dutt, 1962 ; Laccadives—Jones, 1969), Indo-Malayan Archipelago (Whitehead, 1969b), Thailand, Philippines, Taiwan (Chan, 1965), Hong Kong (Whitehead, 1966a).

Note : Dutt (1961a, 1962) compared this species with the very similar *S. gibbosa* and showed a small but constant difference in gillraker numbers even though the number increases with size of fish. The two species seem to be more easily separated on the number of post-pelvic scutes (following Chan, 1965).

The general biology of the species is outlined by Nair (1960a) and Radhakrishnan (1967b); eggs and larvae presumed to be this species were described by Delsman (1926) and juveniles by Basheerudin & Nayar (1962) and Dharmamba (1967).

14. *Sardinella gibbosa* (Bleeker, 1849) (Fig. 15)

?*Clupanodon jussieu* Lacépède, 1803, *His. Nat. Poiss.*, 5 : 469, 471, ? pl. 11 (2) (on *Grande Sardine de l'Île de France* of Commerson) (*nomen dubium*).

?*Clupea coval* Cuvier, 1829, *Régne Animal*, 2nd ed. : 318, footnote (on *Kowal* of Russell, 1803, *Fishes of Coromandel* : pl. 186) (*nomen dubium*).

Clupea gibbosa Bleeker, 1849, *J. Ind. Arch.*, 3 : 72 (Macassar).

Spratella tembang Bleeker, 1851, *Natuurk. Tijdschr. Ned-Indië*, 2 : 214 (name only, to replace *gibbosa*).

?*Harengula dollfusi* Chabanaud, 1933, *Bull. Inst. océanogr. Monaco*, No. 627 : 1, figs. 1-2 (Gulf of Suez).

Sardinella taiwanensis Raja & Hiyama, 1969, *Rec. oceanogr. Works Japan*, 10 (1) : 90, pl. 2b (Taiwan).

Synonymy : Whitehead, 1965a (*dollfusi*) ; Whitehead *et al.*, 1966 : 58 (*gibbosa*, *tembang*) ; Whitehead, 1967a : 54 (*jussieu* a *nomen dubium*, not the same as *jussieu*).

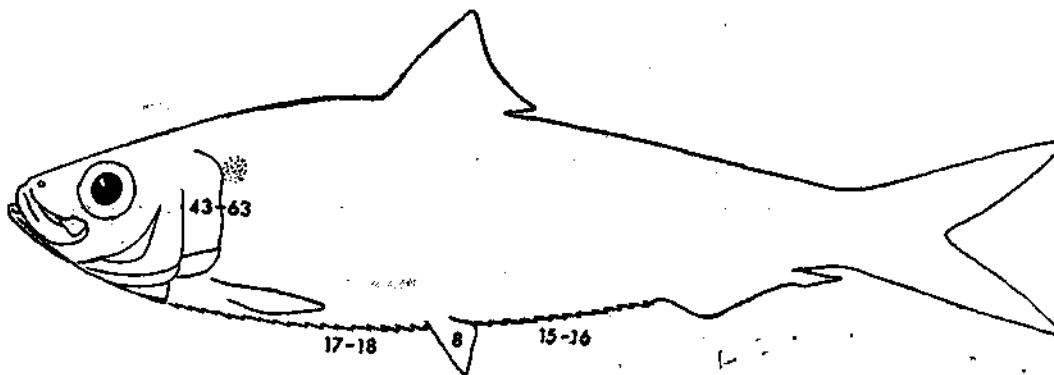


Fig. 15. *Sardinella gibbosa* (Bleeker).

Description : Dutt, 1961a (vertebrae, pectoral rays, gillrakers, large samples of Waltair specimens) ; Whitehead, 1965a (11 specimens, as *jussieu*, Gulfs of Aden and Oman) ; Chan, 1965 (50 specimens, as *jussieu*, Vizagapatnam, Malaya, Thailand, Philippines, Hong Kong) ; Whitehead *et al.*, 1966 (*gibbosa* type) ; Losse, 1968 (68 specimens, East Africa) ; Raja & Hiyama, 1969a (*taiwanensis*, 12 specimens, Taiwan ; *gibbosa*, 326 specimens, India, Malaysia, Taiwan, Hong Kong).

Distribution : ? Mauritius, ? Madagascar, East Africa (Losse, 1968), Red Sea, Gulfs of Aden and Oman (Whitehead, 1965a), India (Waltair coast—Dutt, 1961a ; Calicut—Murty, 1969), Malaya, Thailand, Philippines, Hong Kong (Chan, 1965), Taiwan (Raja & Hiyama, 1969a—*taiwanensis*, *gibbosa*).

Note : *Clupea nymphaea* Richardson, 1846, a name now suppressed by Opinion 901 of the International Commission, was based on a Reeves drawing (= *S. gibbosa* — Chan, 1966) perhaps a specimen (= *S. aurita* — Whitehead, 1966 a, b). Studies on this species include details of general biology (Chacko, 1946 ; Ganapati & Rao, 1957 ; Nair, 1960a), breeding (Dharmamba, 1960 ; Sekharan, 1965) and juveniles (Chacko, 1950 ; Dharmamba, 1960) and food (Sekharan, 1971 ; Bensam 1971).

15. *Sardinella sindensis* (Day, 1878) (Fig. 16)

Clupea sindensis Day, 1878, *Fishes of India*, pt. 4 : 638, pl. 163 (2) (Karachi).

Synonymy : Chan, 1965 (*sindensis* distinct from *jussieu*, i.e. *gibbosa*) ; Whitehead, 1967a : 59 (*sindensis* wrongly included in *gibbosa*) ; Talwar and Whitehead (types).

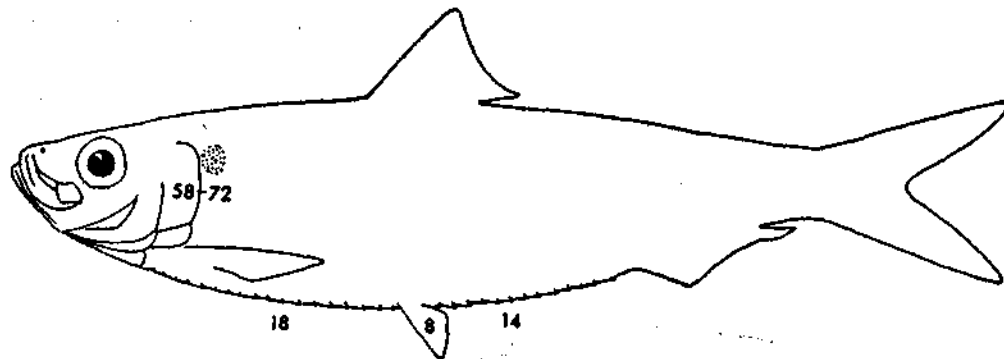


Fig. 16. *Sardinella sindensis* (Day).

Description : Chan, 1965 (44 specimens, Philippines) ; Talwar & Whitehead (1971 — Day's syntypes).

Distribution : Karachi (BMNH specimens), India (Bombay—Regan, 1917c), Philippines (Chan, 1965), Sydney (Stockholm specimen NRS 8450).

Note : Many more Indian specimens should be examined before the separation of this species from *S. gibbosa* can be confirmed.

Subgenus *Amblygaster*

Three species are recognised (Chan, 1965), all from the Indian Ocean.

Key to the species of *Sardinella* (*Amblygaster*)

- I. A series of 10-20 dark blue spots along flanks ; maxilla reaching vertical from anterior margin of eye ; lower gillrakers 34-42..... *S. sirm* (p. 187)
- II. No dark spots along flanks ; maxilla not reaching to anterior margin of eye ; lower gillrakers 26-36

[27]

- A. Body depth 24-27% in S.L. ; lower gillrakers 26-30 ; dorsal origin slightly nearer to snout than to caudal base..... *S. clupeioides* (p. 188)
- B. Body depth 22-24% of S.L. ; lower gillrakers 31-36 ; dorsal origin equidistant between snout and caudal base..... *S. leiogaster* (p. 188)

16. *Sardinella sirm* (Walbaum, 1792) (Fig. 17)

Clupea sirm Walbaum, 1792, *Artedi, Pisc.*, 3 : 38 (on Forskål, 1775, *Descript. Anim.* : 17—Arabia).

Sardinella leiogastroides Bleeker, 1854, *Natuurk. Tijdschr. Ned.-Indië*, 7 : 255 (Manado, Celebes).

Clupea pinquis Günther, 1872, *Ann. Mag. nat. Hist.*, (4) 10 : 425 (Misol ; gillrakers 34, 36, maxilla to beyond anterior eye border).

Synonymy : Fowler, 1941 : 617 (*pinquis*) ; Chan, 1965 (*leiogaster* not a synonym of *sirm*) ; Whitehead *et al.*, 1966 (*leiogastroides*).

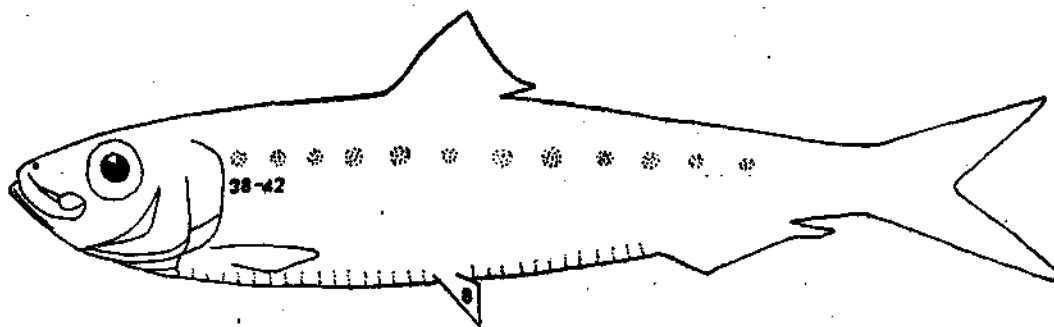


Fig. 17. *Sardinella sirm* (Walbaum).

Description : Whitehead, 1965a (8 specimens, Red Sea, Gulf of Aden) ; Chan, 1965 (50 specimens, Samoa, Caroline Is., Celebes, Thailand) ; Whitehead *et al.*, 1966 (*leiogastroides* holotype) ; Losse, 1968 (23 specimens, East Africa) ; Raja & Hiyama, 1969a (200 specimens, India, Philippines) ; Raja & Hiyama, 1969b (50 specimens, Okinawa).

Distribution : East Africa (Losse, 1968), Madagascar (Paris Museum specimens), Red Sea, Gulf of Aden (Whitehead, 1965a), India ('India'—Raja & Hiyama, 1969a ; Gulf of Mannar, Palk Bay—Murty, 1969), Ceylon (BMNH specimens), Indo-Malayan Archipelago (*leiogastroides* type ; Chan, 1965), Thailand, Caroline Is., Samoa (Chan, 1965), Philippines (Raja & Hiyama, 1969a), Okinawa (Raja & Hiyama, 1969b).

Note : Studies of this species include descriptions of general biology (Nair, 1960a ; Ronquillo, 1960 ; Chacko & Gnanamekalai, 1963), age and growth (Gnanamekalai, 1964), eggs and larvae (John, 1951) and juveniles (Basheerudin & Nayar 1962).

17. *Sardinella clupeioides* (Bleeker, 1849) (Fig. 18)

Amblygaster clupeioides Bleeker, 1849, *J. Ind. Arch.*, 3: 73 (Macassar).

?*Clupea okinawensis* Kishinouye, 1907, *J. Imp. Fish. Bur. Tokyo*, 14 (3): 96 (Okinawa).

Synonymy: Chan, 1965 (distinguished from *sirm* and *leiogaster*); Whitehead *et al.*, 1966 (*clupeioides* type).

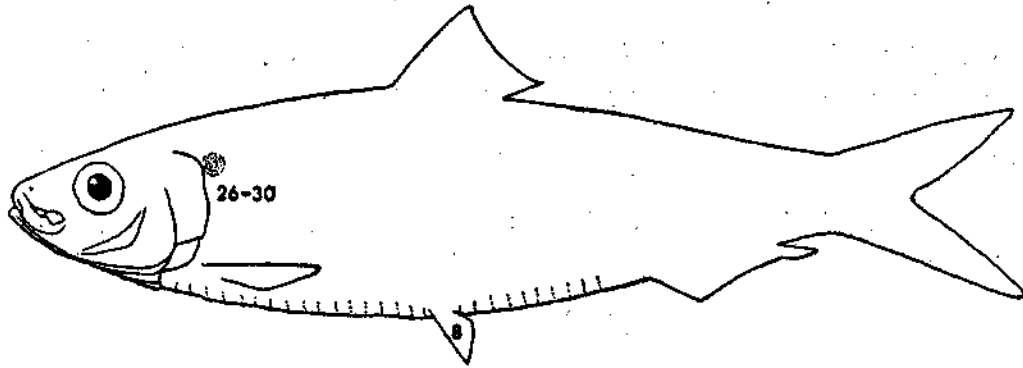


Fig. 18. *Sardinella clupeioides* (Bleeker).

Description: Bennet, 1965 (103 specimens, meristic counts, S. India); Chan, 1965 (24 specimens, Thailand, South Vietnam, Philippines); Whitehead *et al.*, 1966 (*clupeioides* type).

Distribution: India (Gulf of Mannar and Vizhingam—Bennet, 1965; Laccadives—Jones, 1969), Ceylon (Deraniyagala, 1929), Malaya Peninsula (BMNH specimens), Singapore, Thailand, Vietnam, Philippines (Chan 1965), ? Japan (Kishinouye's *okinawensis*).

Note: Raja & Hiyama (1969b) noted that the black spots on the flanks of their Okinawa specimens of *S. sirm* (lower gillrakers 33-42) were only faintly discernible or absent in some fishes, suggesting that Kishinouye's *okinawensis* was actually *S. sirm* (no gillraker counts given). Bleeker's *S. leiogastroides* type has no spots, nor are they figured in the *Atlas*; is it an immaculate *S. sirm*? Certainly, the very obvious green gold spots in fresh *S. sirm* quickly turn black on preservation and frequently disappear.

18. *Sardinella leiogaster* Valenciennes, 1847 (Fig. 19)

Sardinella leiogaster Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 270 (Indian Ocean and Trincomalee).

Synonymy: Chan, 1965 (not a synonym of *sirm*); Whitehead, 1967a: 68 (the same).

Description: Chan, 1965 (8 specimens, Singapore, Pelew I., Philippines); Whitehead, 1967a (*leiogaster* type).

Distribution : East Africa (Lösse, 1968), Red Sea (Fowler, 1941—as *clupeoides*), India ('Indian Ocean'—*leiogaster* holotype), Ceylon (*leiogaster* syntypes, lost—Whitehead, 1967a : 68), Singapore (Chan, 1965), Sumatra, Java, Celebes, Ceram (Whitehead, 1969b), Pelew I., Philippines (Chan, 1965), Hong Kong (Whitehead, 1966a).

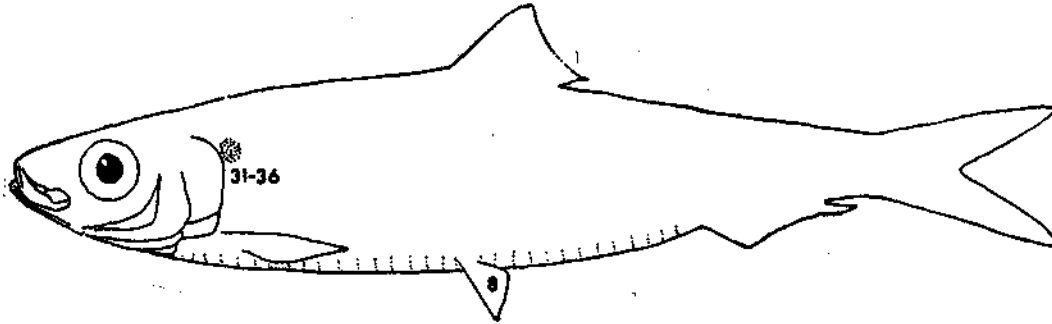


Fig. 19. *Sardinella leiogaster* Valenciennes.

Note : *Clupea caeruleovittata* Richardson, 1846, a name now suppressed by Opinion 901 of the International Commission, was based on a Reeves drawing identified as 'probably *S. leiogaster*' by Whitehead (1966a, b) but now known to be *S. aurita* (Chan, 1966).

Eggs and larvae believed to be of this species were described by Delsman (1926).

Escualosa Whitley, 1940

Leptogaster Bleeker, 1872, *Atlas Ichthyol. Ind. Néerland.*, 6 : pl. 262 (5) [Type : *Clupea (Leptogaster) argyrotaenia*] (*nomen oblitum*).

Kowala (non Valenciennes) : Regan, 1922, *Ann. Mag. nat. Hist.*, (9) 10 : 587 (Type : *Kowala thoracata* Valenciennes, designated by Regan but overlooking the earlier designation of *K. albella* by Gill—see *Sardinella* synonymy).

Escualosa Whitley, 1940, *Aust. Zool.*, 9 (4) : 402 (Type : *Clupea macrolepis* Steindachner—*K. thoracata* Valenciennes).

Synonymy : Whitehead, 1964b (*Kowala, Escualosa*); Whitehead *et al.*, 1966 (*Leptogaster*).

Species : a single species, confined to the Indo-Pacific. It is easily separated from small *Sardinella*, *Herklotsichthys* and *Hilsa* by its large and rectangular 2nd supra-maxilla, even in fishes of only 40 mm S.L. (Fig. 20a).

19. Escualosa thoracata (Valenciennes, 1847) (Fig. 20)

Kowala thoracata Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 363 (Pondicherry).

Meletta lile Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 378 (Pondicherry, Coromandel).

Alausa champil Cantor, 1850, *J. Asiatic Soc. Bengal*, 18 (2) : 1284 (Penang).

Rogenia argyrotaenia Bleeker, 1852, *Natuurk. Tijdschr. Ned.-Indië*, 3 : 457 (Muntok, Batavia).

Clupea macrolepis Steindachner, 1879, *Denkschr. Akad. Wiss. Wien*, 41 (2) : 13 (Townsville, Queensland).

?*Clupea huae* Tirant, 1932, *Serv. océanogr. Pêches Indochine*, 19e note : 9 (Hué).

Synonymy : Whitehead, 1964b (*thoracata*, *macrolepis*); Whitehead *et al.*, 1966 (*argyrotaenia*); Whitehead, 1967a (*thoracata*, *lile*); Whitehead, 1970 (*macrolepis*).

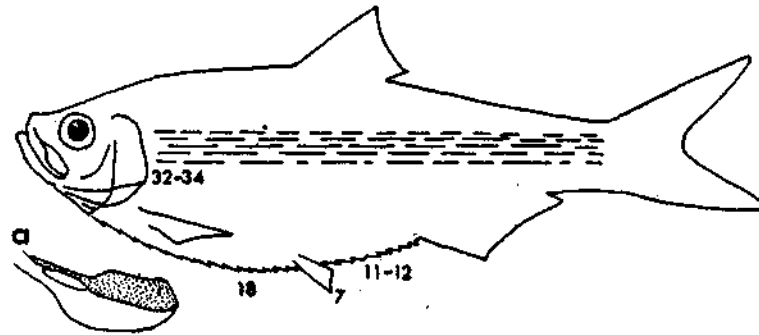


Fig. 20. *Escualosa thoracata* (Valenciennes), showing the characteristic rectangular 2nd supra-maxilla (a).

Description : Whitehead, 1964b (types of *thoracata*, *macrolepis*), Whitehead *et al.*, 1966 (*argyrotaenia* lectotype), Whitehead, 1967a (*thoracata*, *lile* types), Whitehead, 1970 (*macrolepis* type).

Distribution : Karachi (BMNH specimens), India (Pondicherry—*thoracata*, *lile* types; Bombay, Malabar coast, Madras—BMNH specimens; Palk Bay, Gulf of Mannar—Murty, 1969), Ceylon (Deraniyagala, 1929), Indo-Malayan Archipelago (BMNH specimens and Whitehead, 1969b), Papua (Munro, 1964—as *macrolepis*). Townsville, Queensland (*macrolepis* type).

Note : *Clupea coval* Cuvier, based on the *Kowal* of Russell (1803 : fig. 186) cannot be identified with certainty and should be considered a *nomen dubium* (Whitehead, 1967a : 70). It is here tentatively identified as *Sardinella gibbosa*.

Studies on this species include details of its general biology (Devanesen & John, 1941; Mookerjee & Battacharya, 1950; Nair, 1952) and its eggs and larvae (Delsman, 1933a; Anon., 1949). The species appears under the names *coval* and *lile* in earlier literature.

Subfamily PELLONULINAE

The separation of the 21 pelloneuline genera from the Clupeinae on the basis of a single feature (absence of the anterior supra-maxilla) is unsatisfactory (Nelson, 1970). Within the Pellonulinae, the West African freshwater genera (*Pellonula*, etc.) seem to stand apart, while there appear to be three distinct groups of genera in the Indo-Pacific (see key). The five genera in part II of the key were formerly placed with the round herrings because they either lack or have poorly developed

scutes (Whitehead, 1963a), but this feature also occurs in certain West African pellonulines (see discussion in Poll *et al.*, 1965). The affinities of the two Australian genera with pre-dorsal scutes (part 1B of the key) have not been determined satisfactorily. Future work may justify uniting some or all the Pellonulinae with the Clupeinae, but with a grouping of the genera into tribes.

Key to the Indo-Pacific genera of the Pellonulinae

I. Belly keeled, with prominent pre- and post-pelvic scutes

A. No pre-dorsal scutes

1. Anal fin entire, last two rays not separate; jaw teeth small.....
.....*Clupeoides* (Sumatra, Borneo)
2. Anal fin with last two rays detached, forming a separate finlet (see also the scuteless *Spratellomorpha*)
 - a. Jaw teeth small; lower jaw articulation below eye centre; upper jaw less than half head length.....*Corica* (p. 192)
 - b. Jaw teeth enlarged, caniniform in both jaws; lower jaw long, its articulation behind eye centre; upper jaw at least half head length.....*Clupeichthys* (Sumatra, Borneo)

B. Pre-dorsal scutes present

1. Pelvic with 8 rays; 8 branchiostegal rays.....
.....*Potamalosa* (Australia)
2. Pelvic with 7 rays; 4 branchiostegal rays.....
.....*Hyperlophus* (Australia)

II. Belly rounded, pre-pelvic scutes lacking keels or absent entirely

A. No pre- or post-pelvic scutes; gillrakers present on posterior face of 3rd epibranchial

1. Anal fin entire, last two rays not separate.....
.....*Sauvagella* (p. 192)
2. Last two rays detached, forming a separate finlet.....
.....*Spratellomorpha* (p. 193)

B. 6-9 unkeeled pre-pelvic scutes

1. Gillrakers present on posterior face of 3rd epibranchial
 - a. Pelvic base before dorsal origin.....*Gilchristella* (p. 194)
 - b. Pelvic base behind dorsal origin.....*Dayella* (p. 195)
2. Gillrakers absent on posterior face of 3rd epibranchial.....
.....*Ehirava* (p. 195)

Corica Ham.-Buch., 1822

Corica Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 253, 283 (Type : *Corica soborna* Ham.-Buch.).

Synonymy : Whitehead, 1969a (distinct from *Clupeichthys*).

Species : Fowler (1941 : 644) recognised 5 species but the genus appears to be monotypic (Whitehead, 1969b).

20. Corica soborna Ham.-Buch., 1822 (Fig. 21)

Corica soborna Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 253, 383 (Mahanadi river).

Corica argentata Swainson, 1839, *Nat. Hist. Anim., Fishes*, 2 : 294 (on Hamilton-Buchanan's *soborna*).

Spratella pseudopterus Bleeker, 1852, *Natuurk. Tijdschr. Ned.-Indië*, 3 : 432 (Pamangkat, S. W. Borneo).

?*Corica laciniata* Fowler, 1935, *Proc. Acad. nat. Sci. Philad.*, 37 : 92, fig. 11 (Bangkok, Paknam).

Corica perakensis Herre, 1936, *Bull. Raffles Mus.*, No. 12 : 5, pl. 1 (Perak river, Malaya).

Corica bleekeri Hardenberg, 1936, *Treubia*, 15 (3) : 229 (Kapuas river, S. W. Borneo).

Synonymy : Whitehead *et al.*, 1966 (*pseudopterus*) ; Whitehead, 1969b (*perakensis*, *bleekeri*).

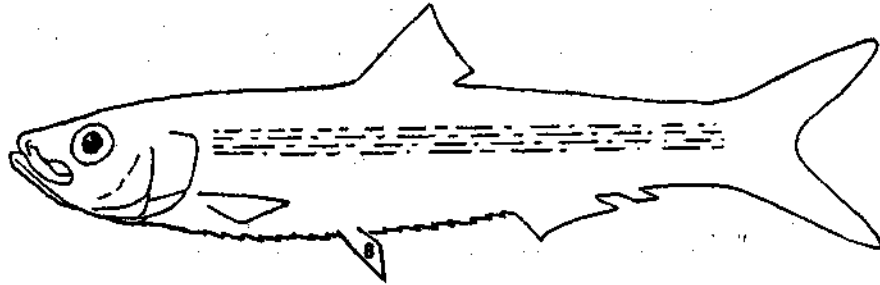


Fig. 21. *Corica soborna* Ham.-Buch.

Description : Whitehead *et al.*, 1966 : 76 (*pseudopterus* types).

Distribution : India (Mahanadi river—*soborna* ; Orissa—BMNH specimens), Perak river (BMNH specimens), Singapore, S.E. Sumatra, S.W. Borneo (Whitehead, 1969b).

Sauvagella Bertin, 1940

Sauvagella Bertin, 1940, *Bull. Mus. Hist. nat. Paris*, (2) 12 : 300 (Type : *Spratelloides madagascariensis* Sauvage, but excluding *S. madagascariensis bianalis* Bertin, 1940, which is *Spratellomorpha bianalis*).

Pellonulops Smith, 1949, *Ann. Mag. nat. Hist.*, (12) 2 : 98 (Type : *Spratelloides madagascariensis* Sauvage).

Synonymy : Whitehead, 1963a (*Sauvagella* applied to *Spratellomorpha*—in error). Smith (1949) identified his *Pellonulops* specimens as *S. madagascariensis* but their possession of 10-11+9 abdominal scutes rules out *Sauvagella* and its allies; the scute count is too low, however, for *Herklotsichthys*, *Sardinella*, *Escualosa*, *Hilsa*, *Ilisha* and *Pellona*.

Species : The genus appears to be monotypic.

21. *Sauvagella madagascariensis* (Sauvage, 1883) (Fig. 22)

Spratelloides madagascariensis (part) Sauvage, 1883, *Bull. Soc. philomath. Paris*, (7) 7 : 160 (Madagascar) (excluding *S. madagascariensis bianalis* Bertin, 1940).

Sauvagella madagascariensis longianalis Bertin, 1940, *Bull. Mus. Hist. nat. Paris*, (2) 12 : 300 (Madagascar).

Sauvagella madagascariensis brevidorsalis Bertin, 1940, *Bull. Mus. Hist. nat. Paris*, (2) 12 : 300 (Madagascar—based on the holotype of *madagascariensis*).

Synonymy : Whitehead, 1963a (as *Ehirava madagascariensis*).

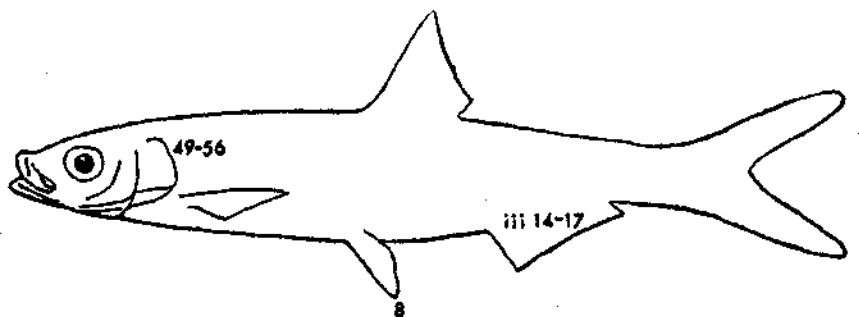


Fig. 22. *Sauvagella madagascariensis* (Sauvage).

Description : Whitehead, 1963a (type and 11 specimens of *madagascariensis*, Madagascar, S. Africa; the 11 S. African specimens not this species—see Note).

Distribution : Madagascar, (Whitehead, 1963a—as *E. madagascariensis*).

Note : Sauvage (1891) figured pre- and post-pelvic scutes in this species, but scutes are absent from the types. Bertin (1940) split Sauvage's *madagascariensis* into three subspecies, of which *bianalis* belongs in the genus *Spratellomorpha*. The 11 S. African specimens from Buffalo River included in the description of Whitehead (1963a) have up to 7 thin pre-pelvic scutes and may belong to a new species of *Gilchristella* (Talwar and Whitehead, 1971).

Spratellomorpha Bertin, 1946

Spratellomorpha Bertin (in Angel, Bertin & Guibé) 1946, *Bull. Mus. Hist. nat. Paris*, (2) 18 : 473 (Type: *Sauvagella madagascariensis bianalis* Bertin, 1940)

Synonymy : Whitehead, 1963a (as *Sauvagella*, in error).

Species : monotypic (Whitehead, 1963a).

22. *Spratellomorpha bianalis* (Bertin, 1940) (Fig. 23)

Sauvagella madagascariensis (part) Sauvage, 1883, *Bull. Soc. philomath. Paris*, (7) 7: 160 (Madagascar) (excluding *S. madagascariensis longianalis* and *S. m. brevidorsalis* Bertin, 1940).

Sauvagella madagascariensis bianalis Bertin, 1940, *Bull. Mus. Hist. nat. Paris*, (2) 12: 300 (Madagascar).

Synonymy: Whitehead, 1963a (as *Sauvagella bianalis*, in error).

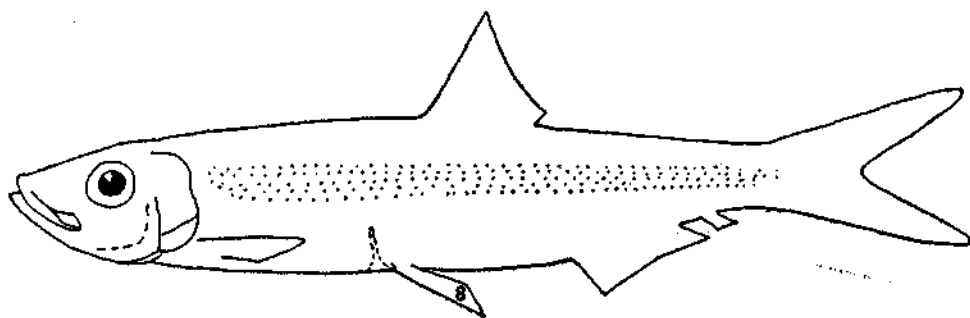


Fig. 23. *Spratellomorpha bianalis* (Bertin).

Description: Whitehead, 1963a (types of *bianalis*, 4 specimens, Madagascar); Losse, 1968 (7 specimens—Mombasa).

Distribution: Madagascar (Whitehead, 1963a—as *Sauvagella bianalis*), Mombasa (Losse, 1968).

***Gilchristella* Fowler, 1935**

Gilchristella Fowler, 1935, *Proc. Acad. nat. Sci. Philad.*, 87: 365, fig. 4 (Type: *Spratelloides aestuaris* Gilchrist).

Synonymy: Whitehead, 1963a.

Species: Monotypic (Whitehead, 1963a), but possibly a second species (Talwar and Whitehead, 1971).

23. *Gilchristella aestuaris* (Gilchrist, 1914) (Fig. 24)

Spratelloides aestuaris Gilchrist, 1914, *Mar. Biol. Rep. S. Afr.*, No. 1: 55 (Swartkops river, S. Africa).

Synonymy: Whitehead, 1963a.

Description: Whitehead, 1963a (7 specimens, S. Africa).

Distribution: South Africa (Swartkops river, East London, Knysna, St. Lucia, Keimouth, Milnerton—Whitehead, 1963a).

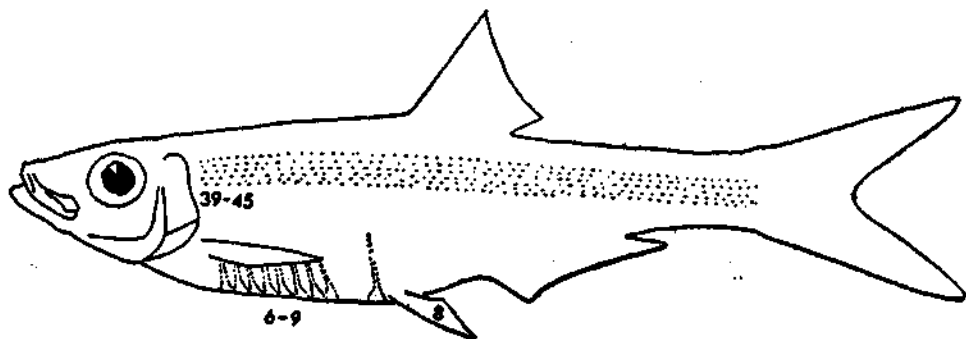


Fig. 24. *Gilchristella aestuarius* (Gilchrist).

Dayella Talwar and Whitehead, 1971

Dayella Talwar and Whitehead, 1971, *Bull. Br. Mus. nat. Hist. (Zool.)*, 23 (2) : 63
(Type : *Spratelloides malabaricus* Day).

Species : Monotypic (Talwar & Whitehead, 1971).

24. Dayella malabarica (Day, 1873)

Spratelloides malabaricus Day, 1873, *Proc. zool. Soc. Lond.* : 240 ('Sea, ascending rivers in Malabar, and attaining 3 inches in length'); *Idem*, 1878, *Fishes of India*: 648, pl. 161 (5) ('Western Coasts of India, in rivers and estuaries'); *Idem*, 1889, *Fauna British India, Fishes*, 1 : 400, fig. 124 (repeat).

Dayella malabarica Talwar & Whitehead, 1971, *Bull. Br. Mus. nat. Hist. (Zool.)*, 23 (2) : 63 (types described).

Synonymy : Distinct from *Ehirava fluviatilis* (Talwar & Whitehead, 1971).

Description : Talwar & Whitehead, 1971 (syntypes).

Distribution : India (Canara, Malabar—types).

Note : Only four of Day's sixteen specimens are this species, the remainder being *Ehirava fluviatilis* (Talwar & Whitehead, 1971).

Ehirava Deraniyagala, 1929

Ehirava Deraniyagala, 1929, *Spolia Zeylan.*, 15 : 34, pl. 14 (Type : *Ehirava fluviatilis* Deraniyagala).

Synonymy : The genus no longer includes Day's *Spratelloides malabaricus*.

Species : Two were recognised by Whitehead (1963a), but *Spratelloides madagascariensis* Sauvage lacks scutes and merits a separate genus, *Sauvagella*.

25. *Ehirava fluviatilis* Deraniyagala, 1929 (Fig. 25)

Ehirava fluviatilis Deraniyagala, 1929, *Spolia Zeylan.*, 15 : 35, pl. 14 (Western Province, Ceylon).

Synonymy : Whitehead, 1963a : 331 (*fluviatilis* = *malabarica*, an error); Talwar & Whitehead, 1971 (*fluviatilis* distinct).

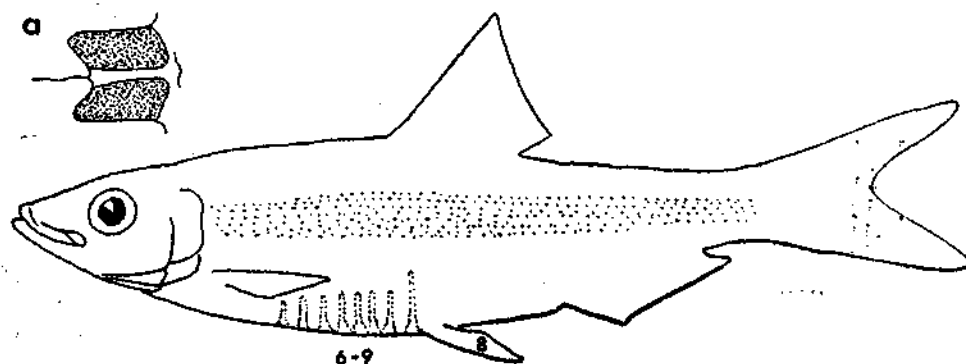


Fig. 25. *Ehirava fluviatilis* Deraniyagala showing posterior frontal fontanelles (a).

Description : Deraniyagala (1929); the description of Whitehead, (1963a) included some measurements on Day's *malabaricus* specimens; Poll *et al.*, 1965 : 286 (pre-pelvic scutes present); Talwar & Whitehead, 1971 (pre-pelvic scutes, key, notes, fontanelles).

Distribution : India (Malabar, Canara—Day material labelled *malabaricus*), Ceylon (rivers and estuaries up to 15 miles from sea in Western Province—*fluviatilis* types).

Subfamily ALOSINAE

The seven Indo-Pacific species of shads were revised by Whitehead (1965b) and at the species level there seem to be few problems. The four species placed in the subgenus *Hilsa* (*Tenualosa*) differ as much from *Hilsa* (*Hilsa*) *kelee* as they do from members of the third Indo-Pacific genus, *Gudusia*; future work may justify recognition of *Tenualosa* as a distinct genus. Nelson (1970), like Regan (1917b), found no reason to separate the shads from the gizzard shads (Dorosomatinae).

Key to the Indo-Pacific genera of the Alosinae

1. Scales large, 40-50 in lateral series; lower edge of operculum at about 20° to horizontal; marine, anadromous
 - A. Fronto-parietal region bearing many longitudinal striae (Fig. 26a); maxilla with 4-6 ridges on expanded portion; cleithral lobe prominent; gill filaments of anterior hemibranch on 1st arch not more than half length of filaments on posterior hemibranch; gillrakers on 2nd, 3rd and 4th arches curled outwards.....*Hilsa* (*Hilsa*) (p. 197)
 - B. Fronto-parietal region covered by thick skin, few or no longitudinal striae (Fig. 27a); exposed portion of maxilla smooth; cleithral lobe

small ; gill filaments of anterior hemibranch on 1st arch more than half length of those on posterior hemibranch ; gillrakers on 2nd, 3rd and 4th arches straight or only slightly curved *Hilsa (Tenuالosa)* (p. 199)

2. Scales very small, 80-120 in lateral series ; lower edge of operculum at about 45° to horizontal ; fluviatile *Gudusia* (p. 201)

Hilsa Regan, 1917

Hilsa Regan, 1917, *Ann. Mag. nat. Hist.*, (8) 19 : 303 (Type : *Paralosa durbanensis* Regan = *Clupea kelee* Cuvier).

Tenuالosa Fowler, 1934, *Proc. Acad. nat. Sci. Philad.*, 85 : 246 (Type : *Alosa reevesii* Richardson).

Macrura Fowler, 1944, *Bull. U.S. natn. Mus.*, 13 (100) : 626 (Type : *Clupea kelee* Cuvier).

Synonymy : Whitehead, 1964a (*Paralosa* Bleeker based on a species of *Sardinella*) ; Whitehead, 1965b (*macrura* van Hasselt the name of a species, not a genus as Fowler (1941) had assumed ; *Tenuالosa* a subgenus).

Species : Five species recognised (Whitehead, 1965b).

Key to the species of Hilsa

- I. Fronto-parietal ridges numerous, etc. (see key, subgenus *Hilsa*) *Hilsa (Hilsa) kelee* (p. 197)
- II. Fronto-parietal ridges covered by thick skin, etc. (see key, subgenus *Tenuالosa*)
 - A. Caudal lobes as long as head ; pseudobranch attenuated, with ventral ridge and groove
 1. Lower edge of operculum more than twice in height of operculum ; 45-48 scales in lateral series *Hilsa (Tenuالosa) ilisha* (p. 199)
 2. Lower edge of operculum less than twice in height of operculum ; 42-45 scales in lateral series *Hilsa (Tenuالosa) reevesi* (China)
 - B. Caudal lobes longer than head ; pseudobranch not attenuated, without ventral ridge and groove
 1. Maxilla short, not reaching to eye centre ; suboperculum almost rectangular ; cleithral lobe small *Hilsa (Tenuالosa) macrura* (Indo-Malayan Arch.)
 2. Maxilla to eye centre or beyond ; suboperculum with rounded posterior margin ; cleithral lobe barely apparent *Hilsa (Tenuالosa) toli* (p. 200)

26. Hilsa (Hilsa) kelee (Cuvier, 1829) (Fig. 26)

Clupea sinensis Bloch, 1795, *Naturg. ausl. Fische*, 9 : 38, pl. 405 (on Tranquebar specimen sent by the Rev. John) (? non *Clupea sinensis* Linnaeus, 1758).

Clupea chinensis Cuvier, 1816, *Règne Animal*, 1st ed. : 174 (on Bloch but name probably an emendation of *Clupea sinensis* Linnaeus ; not repeated in 2nd ed.).

Clupea kelee Cuvier, 1829, *Règne Animal*, 2nd ed., 2 : 320 (on *Kelee* of Russell, 1803, *Fishes of Coromandel*, 2 : 75, pl. 195, upper figure, ex Vizagapatnam).

?*Clupea ovalis* Bennett, 1830, *Mem. Life of Raffles* : 690 (Sumatra).

Clupeonia blochii Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 353 (on *Clupea sinensis* Bloch, 1795).

Alosa brevis Bleeker, 1848, *J. Ind. Arch.*, 2 : 638 (Bima, Sumbawa I.).

Alausa kanagurta Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Indië*, 1 : 160 (Banka, name only); *Idem*, 1852, *ibid.*, 3 : 445 (Banka, name only); *Idem*, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24 : 34 (Batavia, Muntok).

Alausa brachysoma Bleeker, 1853, *Natuurk. Tijdschr. Ned.-Indië*, 5 : 527 (Padang, Sumatra) (non *Sardinella brachysoma* Bleeker).

Alosa malayana Bleeker, 1866, *Ned. Tijdschr. Dierk.*, 3 : 294 (Java, Sumatra—on *Alausa hisha* of Bleeker, 1852).

Clupea platygaster Günther, 1868, *Cat. Fishes Brit. Mus.*, 7 : 448 (replacement name for *Alausa brachysoma* Bleeker).

Harengula (Paralosa) zeylanica Hubrecht, 1879, *Sale Catalogue* (of Bleeker specimens) : 46 (*nomen nudum*).

Clupea durbanensis Regan, 1906, *Ann. Natal. Govt. Mus.*, 1 (4) : 4, pl. 4 (Durban Bay).

Synonymy : Whitehead, 1965b (*kelee*, *brevis*, *kanagurta*, *brachysoma*, *platygaster*, *durbanensis*; discussion of *sinensis* Linnaeus); Whitehead *et al.*, 1966 (*brevis*, *kanagurta*, *brachysoma*, *platygaster*, *zeylanica*, *malayana*); Whitehead, 1967a (*kelee*, *chinensis*; *sinensis* of Bloch and Linnaeus discussed); Whitehead, 1969a (*sinensis* of Bloch=*kelee*; *sinensis* of Linnaeus should be rejected as *nomen dubium*).

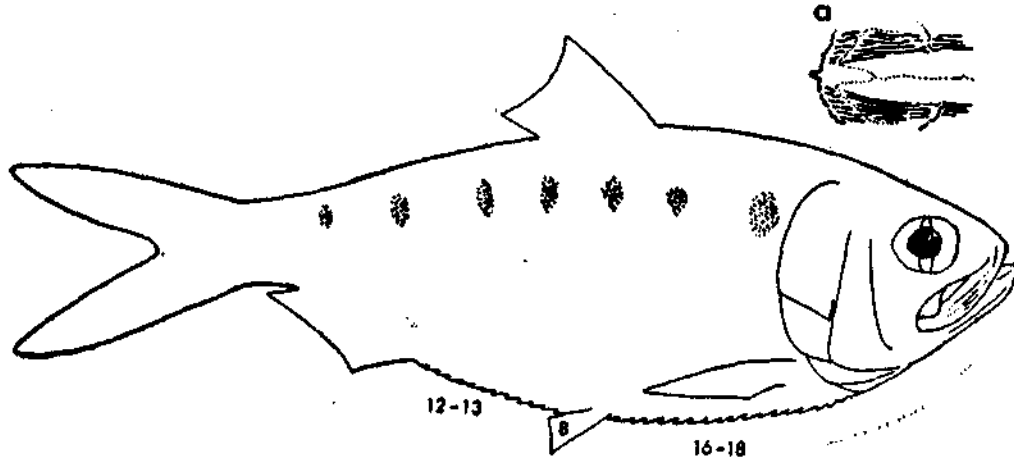


Fig. 26. *Hilsa (Hilsa) kelee* (Cuvier), showing pattern of fronto-parietal striae (a).

Description : Whitehead, 1965b (24 specimens, South and East Africa, Gulf of Aden, India, Indo-Malayan Archipelago); Whitehead *et al.*, 1966 (*brevis*, *kanagurta*, *brachysoma*, *malayana* types); Losse, 1968 (14 specimens, East Africa).

Distribution : South Africa (Natal—*durbanensis*), East Africa (Losse, 1968), Persian Gulf, Gulf of Aden (Whitehead, 1965b), W. Pakistan (BMNH specimen), India

(Calicut—Murty, 1969 ; Madras, Orissa—BMNH specimens ; Bombay—?Fowler, 1941), Ceylon (Munro, 1955), Indo-Malayan Archipelago, Thailand (Bleeker material and Whitehead, 1969b), Hong Kong (BMNH specimens, juveniles), Papua and New Guinea (Munro, 1964—as *brevis*).

Note : *Clupea sinensis* Linnaeus lacks a type and the original description could apply to several clupeids.

Notes on the breeding of this species are given by Hora (1924) and Chacko & Krishnamurthy (1949), eggs and larvae are described by Delsman (1926), and epi-branchial organs by Bensam (1967a.)

27. *Hilsa (Tenuulosa) ilisha* (Ham.-Buch., 1822) (Fig. 27)

Clupanodon ilisha Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 243, 382, pl. 79 (73) (Ganges estuaries).

Clupea palasah Cuvier, 1829, *Règne Animal*, 2nd ed., 2 : 320 (on *Palasah* of Russell, 1803, *Fishes of Coromandel*, 2 : 77, pl. 198, ex Vizagapatnam).

Synonymy : Whitehead, 1965b (*ilisha*, *palasah*) ; Whitehead, 1967a (*palasah*).

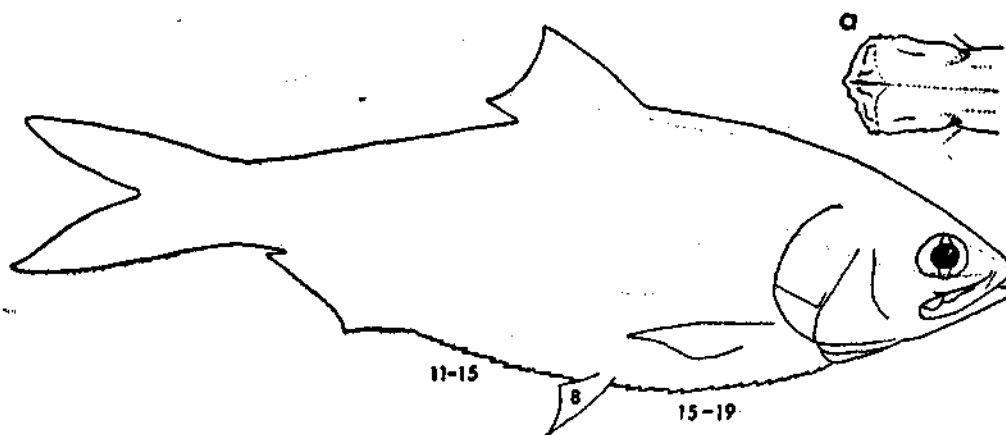


Fig. 27. *Hilsa (Tenuulosa) ilisha* (Ham.-Buch.), showing pattern of fronto-parietal striae (a).

Description : Pillay, 1957 (Hooghly river and Chilka lake specimens, morphometric comparison) ; Whitehead, 1965b (24 specimens, Tigris, Persian Gulf, India) ; Whitehead, 1967a (*palasah* types).

Distribution : Tigris, Persian Gulf (Whitehead, 1965a), W. Pakistan (Pillay & Rosa, 1963), India (Bombay, Malabar coast, Coromandel coast, Bengal coasts and Ganges estuaries—BMNH specimens), Irrawaddy up to Mandalay, coastal waters of Cochin ; China (Pillay & Rosa, 1963).

Note : this is one of the best-known of Indian clupeoids and considerable information on its biology was assembled by Pillay & Rosa (1963). Subsequent papers include details of breeding (Pillay, 1964 ; Dutt, 1966 ; Islam & Talbot, 1968 ;

Mathur, 1967), larvae (Chandra, 1964), juveniles (Babu Rao, 1969), artificial propagation (Malhotra *et al.*, 1969), distinction of subpopulations (Ghosh *et al.*, 1968), kidney ultrastructure (Chandrasekhar, 1961) and hilsa fisheries (Ghosh, 1967; Gopalakrishnan, 1969). The gill arch skeleton was figured by Khanna (1961).

28. Hilsa (*Tenualosa*) *toli* (Valenciennes, 1847) (Fig. 28)

Alausa toli Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 435 (Pondicherry, Bombay).

Alausa argyrochloris Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 440 (Bombay only).

?*Chatoessus tampo* Valenciennes, 1847, *Hist. Nat. Poiss.*, 21 : 117 (Malaya ; on drawing by Major Farquhar).

Alausa ctenolepis Bleeker, 1852, *Verh. batav. Genoot. Kunst. Wet.* 24 : 32 (Batavia, Muntok.).

Synonymy: Whitehead, 1965b (*Clupea sinensis* Linnaeus a possible synonym; *toli*, *argyrochloris*, *ctenolepis*); Whitehead *et al.*, 1966 (*ctenolepis*); Whitehead, 1967a (*argyrochloris* based on a Bombay specimen, the two Mauritian specimens being *Sardinella melanura*; *tampo* a possible synonym).

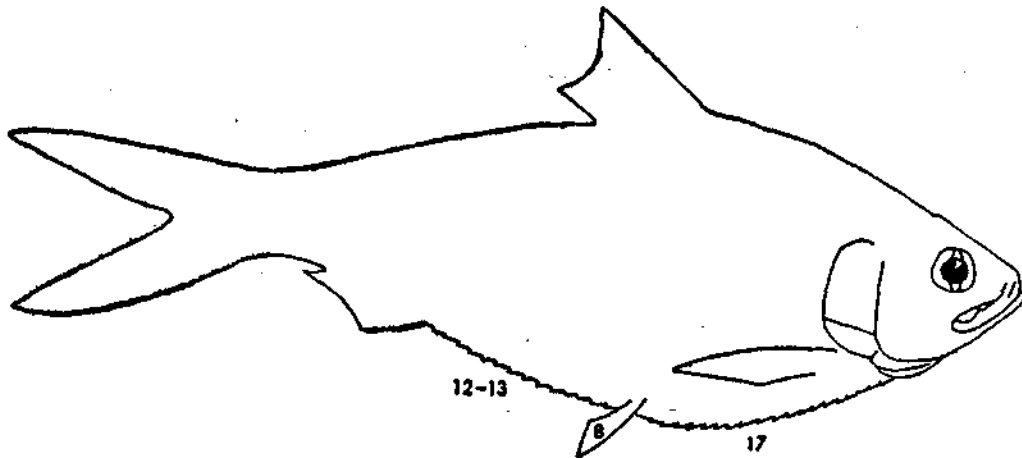


Fig. 28. *Hilsa (Tenualosa) toli* (Valenciennes).

Description: Whitehead, 1965b (11 specimens, India and Indo-Malayan Archipelago); Whitehead *et al.*, 1966 (*ctenolepis* type); Whitehead, 1967a (*argyrochloris* type).

Distribution: India (Bombay, Pondicherry, Orissa—BMNH specimens), Indo-Malayan Archipelago (Bleeker material and Whitehead, 1969b), Hong Kong, ? Taiwan (Whitehead, 1969b).

Note: Breeding in this species has been described by Chacko & Krishnamurthy, 1949.

Gudusia Fowler, 1911

Gudusia Fowler, 1911, *Proc. Acad. nat. Sci. Philad.*: 207 (Type: *Clupanodon chapra* Ham.-Buch.).

Synonymy: Whitehead (1965b).

Species: Two species, known from the rivers of India and Burma.

Key to the species of *Gudusia*

1. Body depth less than 40% of S.L.; head length more than 28% of S.L.; anal fin with iii 19-22 rays.....*G. chapra* (p. 201)
2. Body depth more than 40% of S.L.; head length less than 28% of S.L.; anal fin with iii 22-26 rays.....*G. variegata* (Burma)

29. *Gudusia chapra* (Ham.-Buch., 1822) (Fig. 29)

Clupanodon chapra Hamilton-Buchanan, 1822, *Fishes of the Ganges*: 248, 383 (upper Ganges).

Clupea indica Gray, 1834, *Illustr. Ind. Zool., Hardwicke*, 2: pl. 91 (1-2) (India—no locality).

Clupea champil Gray, 1834, *Illustr. Ind. Zool., Hardwicke*, 2: pl. 91 (5-6) (India—no locality).

Alausa microlepis Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 439 (Bengal).

?*Clupea suhia* Chaudhuri, 1912, *Rec. Ind. Mus.*, 7: 436, pl. 38 (1) (river Gandak in Saran, Bihar).

?*Gudusia godanahiai* Srivastava, 1968, *Fishes Eastern Uttar Pradesh*: 6, fig. 4a, b (Gorakhpur, Uttar Pradesh).

Synonymy: Whitehead, 1969b (*chapra*, *indica*, *champil*, *microlepis*, *suhia*); Hora, 1929 (*champil*=*Gonialosa manmina*); Whitehead, 1967a (*microlepis*); Fowler, 1941 (*suhia*); Talwar and Whitehead, 1971 (*suhia*, *godanahiai*).

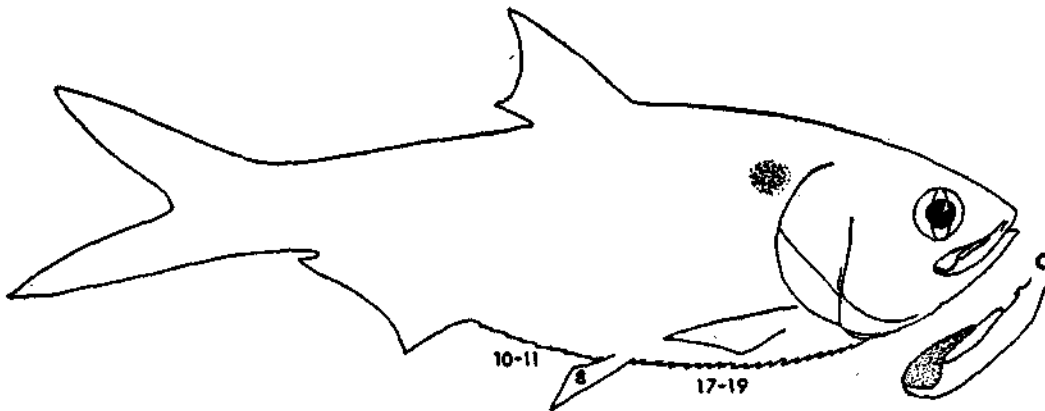


Fig. 29. *Gudusia chapra* (Ham.-Buch.), showing shape of 2nd supra-maxilla (a).

Description: Chaudhuri, 1912 (1 specimen, Bihar—as *suhia*); Whitehead, 1965b (10 specimens, Allahabad, Gauhati); Whitehead, 1967a (*microlepis* type); Srivastava, 1968 (10 specimens, Uttar Pradesh—types of *godanahiai*).

Distribution: India (Lahore, Orissa, Allahabad, Brahmaputra at Goalpara, Gowhatty—BMNH specimens; Gorakhpur—Srivastava, 1968, as both *chapra* and *godanahiai*).

Note: *godanahiai* is clearly Chaudhuri's *suhia*, distinguished by both authors from *chapra* by the presence of a row of dark spots along the upper flank (a single shoulder spot in *chapra*, sometimes absent), a pattern characteristic of the much deeper-bodied *G. variegata* (Day) of Burma (Whitehead, 1965b: fig. 12). Both sexes of the spotted form are known, occurring together with *G. chapra* in the Gorakhpur area (Srivastava, 1968); and also in the Brahmaputra at Jogigopa (Motwani *et al.*, 1962); the relationship of this form to *G. variegata* needs investigation.

Studies on this species include notes on its biology (Chaudhuri, 1912; Srivastava, 1968), digestive physiology (Agrawal & Verma, 1966), pituitary (Sathyanesan, 1961) and gillrakers (Kapoor, 1965).

Subfamily DOROSOMATINAE

Of the six genera known, only one occurs outside the Indo-Pacific region (*Dorosoma* of the Western North Atlantic, distinguished by the presence of two supra-maxillae). *Nematalosa*, *Anodontostoma* and *Gonialosa* are certainly represented in Indian waters, but Indian records for the monotypic *Clupanodon* and *Konosirus* are doubtful.

The gizzard shads are characterized by their gizzard-like stomach, but a muscular stomach is found in other clupeids (e.g. the New World *Opisthonema*, which also has a filamentous last dorsal ray). The 'flared dentary' of the gizzard shads, a feature used in almost all keys, is difficult to describe in more precise terms and while easy to recognise in *Nematalosa* is less obvious in *Clupanodon*. In many ways, the gizzard shads merely complete trends already found in the shads (Alosinae) and the separation of the two subfamilies is probably artificial (Regan, 1917b; Nelson, 1970).

Key to the genera of the Dorosomatinae

I. Last dorsal ray filamentous

- A. Gillrakers of 1st arch at least $\frac{3}{4}$ length of corresponding gill filaments; suboperculum more or less triangular; outer edge of dentary not or but slightly flared; paired pre-dorsal scales not overlapping in midline.
 - 1. Post-pelvic scutes (10) 11-12 (13); pre-dorsal scutes present*; vertebrae usually 44-45.....*Clupanodon* (China but not Japan)
 - 2. Post-pelvic scutes (13) 14-16 (17); no pre-dorsal scutes; vertebrae usually 48-50.....*Konosirus* (China, Japan)
- B. Gillrakers of 1st arch $\frac{1}{2}$ or less length of corresponding gill filaments; suboperculum rectangular; dentary flared; paired pre-dorsal scales overlapping in midline.....*Nematalosa* (p. 203)

*Nelson (in press) has described the pre-dorsal scutes in *Clupanodon thrissa* (20-25 scutes flanked by a row of larger 'pre-dorsal' scales which do not overlap in the midline).

II. Last dorsal ray not filamentous

- A. Maxilla slender, distal end slightly expanded and curved downwards (Fig. 32a); paired pre-dorsal scales, overlapping in midline.....
*Gonialosa* (p. 205)
- B. Maxilla straight, thin, tapering terminally (Fig. 33a); median series of pre-dorsal scales.....*Anodontostoma* (p. 206)

***Nematalosa* Regan, 1917**

Nematalosa Regan, 1917, *Ann. Mag. nat. Hist.*, (8) 19:313 (Type: *Clupea nasus* Bloch, designated by Jordan, 1920, *Genera of Fishes*, pt. 4:560).

Fluvalosa Whitley, 1943, *Austr. Zool.*, 10 (2):170 (Type: *Chatoessus elongatus* Macleay = *Chatoessus erebi* Günther).

Synonymy: *Fluvalosa* was said to include 'large fluviatile or estuarine Australian herrings', as distinct from 'the marine *Clupea nasus* Bloch' (Whitley, 1943); otherwise the diagnosis corresponds to that of *Nematalosa* (Whitehead, 1962b).

Species: Nelson (in preparation) has reviewed the species, with a full listing of the literature and more meristic data than ever assembled previously. In the synonymy of *N. erebi* (Günther) he places *Chatoessus richardsoni* Castelnau, *Chatoessus elongatus* McCleay, *Chatoessus horni* Zeitz, *Fluvalosa bulleri* Whitley, *Fluvalosa paracoma* Whitley and *Fluvalosa papuensis* Munro. Dr. Nelson has kindly allowed me to use his meristic and other data.

Key to the species of *Nematalosa*

- I. 3rd infra-orbital* greatly expanded, its anterior margin rising almost vertically from above lower jaw articulation (Whitehead, 1969a: fig. 1b).....
*N. nasus* (p. 204)
- II. 3rd infra-orbital* less expanded, its lower border oblique or horizontal and not reaching to lower jaw articulation, leaving exposed a triangular (*arabica*) or trapezoidal (others) space (Whitehead, 1969a: fig. 1a).
- A. Post-pelvic scutes (13) 14-15, total scutes (31) 32-33 (34); dentary moderately flared; body depth 33-40% of S.L.
1. Anal with 16-17 (18) branched rays; body depth 36.5-40.0% of S.L.....*N. arabica* (p. 205)
2. Anal with 18-20 (21) branched rays; body depth 33% of S.L.....
*N. japonica* (Vietnam, China, Japan)
- B. Post-pelvic scutes (9) 10-13 (14), total scutes (25-26) 27-31 (32); dentary strongly flared at edges; body depth 36-50% of S.L.
1. Pectoral axillary scale present.....*N. come*
 (Ryukyo Is., Taiwan to Indonesia and N. Australia)

* 3rd infra-orbital of Nelson (1969) = 2nd sub-orbital of Regan, Whitehead, etc.

2. Pectoral axillary scale rudimentary or absent

- a. Nuchal scales with anastomosing canals ; in freshwater.....
*N. erebi* (Australia, New Guinea)
- b. Nuchal scales with anastomosing canals ; marine.....
*N. vlaminghi* (W. Australia)

30. *Nematalosa nasus* (Bloch, 1795) (Fig. 30)

Clupea nasus Bloch, 1795, *Naturl. austr. Fische*, 9 : 116, pl. 429 (1) (Malabar).

Clupanodon nasica Lacepède, 1803, *Hist. Nat. Poiss.*, 5 : 468, 472 (Malabar—on Bloch).

?*Chatoessus altus* Gray, 1834, *Illustr. Indian Zool.*, Hardwicke, 2 : 91, fig. 2 (India).

?*Chatoessus chrysopterus* Richardson, 1846, *Fish. Seas China Japan* : 308 (on Reeves drawing, Canton or Macao).

Synonymy : Whitehead, 1969a (*nasus*).

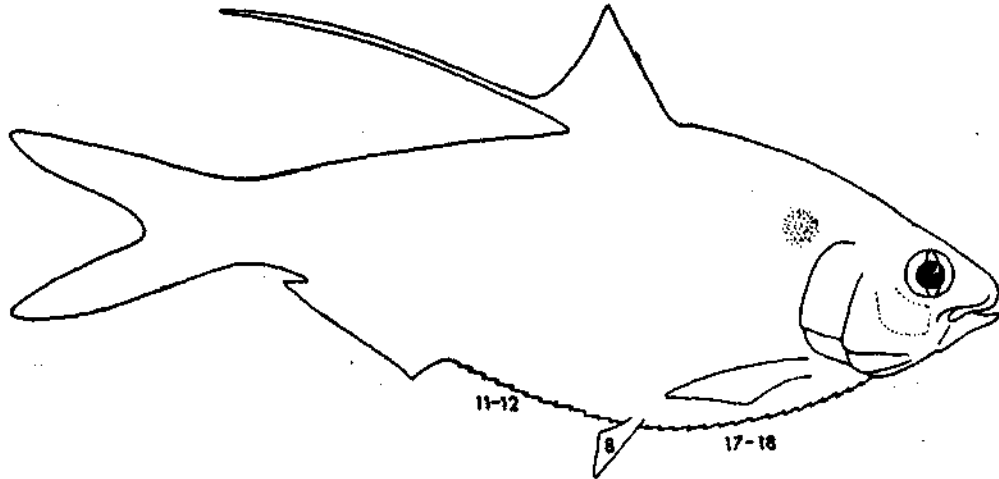


Fig. 30. *Nematalosa nasus* (Bloch).

Description : Whitehead, 1965a (2 specimens, Persian Gulf) ; Whitehead, 1969a (*nasus* holotype).

Distribution : Gulf of Aden, Persian Gulf (Whitehead, 1965a), India (Malabar—*nasus* holotype ; Canara, Sind, Calicut, Madras—BMNH specimens), Ceylon (BMNH specimens), Indo-Malayan Archipelago, Thailand (Whitehead, 1969b), Hong Kong (BMNH specimens). Full distribution given by Nelson (in preparation).

Note : Studies on this species include work on its general biology and fishery (Jones & Sujansingani, 1953 ; Chacko *et al.*, 1966) on its breeding (Annigeri,

1967); osteology (Moona, 1963), and swimbladder (Bal, 1959). Nelson (in preparation) recognises a closely related but undescribed species with a pair of grooves in the skin on top of the head and the mouth level with the eye centre or lower pupil margin (cf. with lower eye margin in *N. nasus*). This new species occurs in India, Malaya, Thailand and Vietnam.

31. *Nematalosa arabica* Regan, 1917 (Fig. 31)

Nematalosa arabica Regan, 1917, *Ann. Mag. nat. Hist.*, (8) 19 : 313 (Muscat).

Synonymy : Whitehead, 1965a (*arabica*).

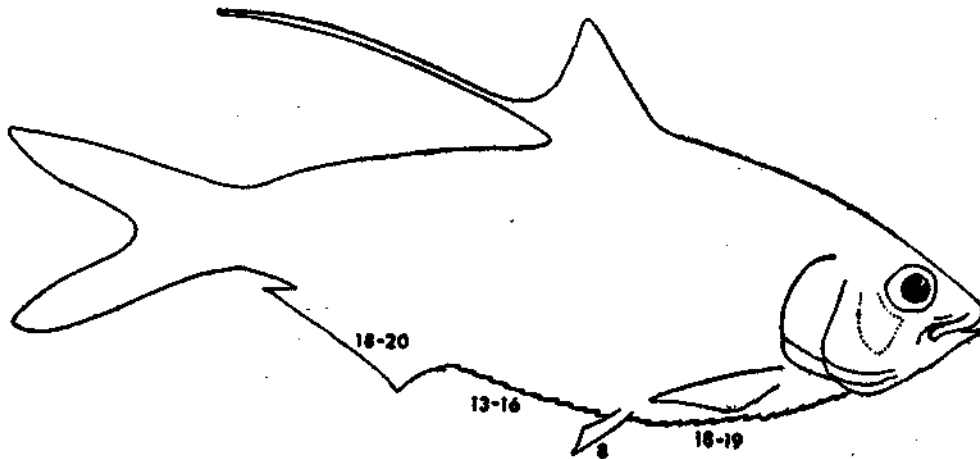


Fig. 31. *Nematalosa arabica* Regan.

Description : Whitehead, 1962b (*arabica* holotype and 7 specimens, Mukalla, Jibuti); Whitehead, 1965a (repeat).

Distribution : Gulf of Oman, Gulf of Aden (Whitehead, 1965a).

***Gonialosa* Regan, 1917**

Gonialosa Regan, 1917, *Ann. Mag. nat. Hist.*, (8) 19 : 315 (Type : *Chatoessus modestus* Day, designated by Jordan, 1920, *Genera of Fishes*, pt. 4 : 560).

Indialosa Herre & Myers, 1931, *Lingnan Sci. J.*, No. 10 : 238 (Type : *Clupanodon manmina* Ham.-Buch.).

Synonymy : Fowler, 1941.

Species : Two species recognised (Fowler, 1941).

Key to the species of Gonialosa

1. Body depth 40-50% of S.L. ; scales in lateral series 45-47.....*G. modesta* (Burma)

2. Body depth 32-39% of S.L.; scales in lateral series 55-65.....
 *G. manmina* (p. 206)

32. *Gonialosa manmina* (Ham.-Buch., 1822) (Fig. 32)

Clupanodon manmina Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 247, 249, 383 (freshwater branches of Ganges).

?*Clupanodon cortius* Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 249, 383 (Brahmaputra near Goyalpara).

Synonymy : Regan, 1917b and Fowler, 1941 (? *cortius*).

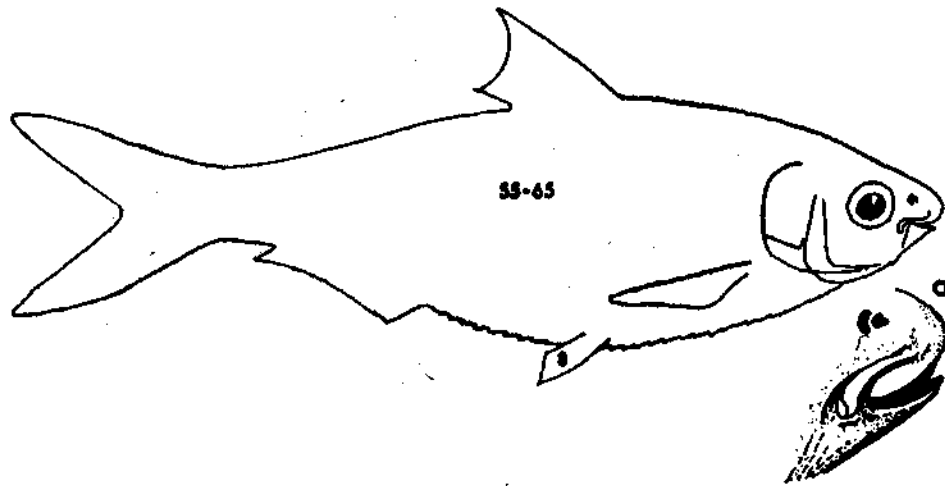


Fig. 32. *Gonialosa manmina* (Ham.-Buch.), showing detail of jaws (a).

Description : Regan, 1917b (N.E. India, Assam).

Distribution : India (N.E. India, Assam—BMNH specimens), ? Ceylon (Munro, 1955).

Anodontostoma Bleeker, 1849

?*Gonostoma* van Hasselt, 1823, *Algemeene Konst- en Letter-bode*, 1 (21) : 329 (Type : no species given) (non *Gonostoma* Rafinesque, 1810).

Anodontostoma Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 15 (Type : *Anodontostoma hasseltii* Bleeker = *Clupanodon chacunda* Ham.-Buch.).

Synonymy : Regan, 1917b ; Fowler, 1941.

Species : 2 species recognised (Fowler, 1941).

Key to the species of *Anodontostoma*

1. Dorsal with 15 rays ; 19 transverse scales ; snout little protruded.....
 *A. chanpole* (p. 208)

2. Dorsal with 17-18 rays ; 12-13 transverse scales ; snout well protruded..
*A. chacunda* (p. 207)

33. *Anodontostoma chacunda* (Ham.-Buch., 1822) (Fig. 33)

Clupanodon chacunda Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 246, 383 (Gangetic estuaries).

?*Gonostoma* sp. van Hasselt, 1823, *Algemeene Konst- en Letter-bode*, 1 : (21) : 329 ('*die zeer veel overeenkomst heeft met Meg. Naso Lacep.*' but without filamentous last dorsal ray) (see Alfred, 1961 for notes on van Hasselt).

Anodontostoma hasseltii Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 15 (Madura Straits, Java Sea).

Chatoessus selangkat Bleeker, 1852, *Natuurk. Tijdschr. Ned.-Indië*, 3 : 458 (Muntok, Batavia).

Gonostoma javanicum Hyrtl, 1855, *Denkschr Akad. Wiss. Wien*, 10 (1) : 49 ; Fowler, 1941, *Bull. U.S. natn. Mus.*, 13 (100) : 550 (name in synonymy).

Chatoessus breviceps Peters, 1876, *Mber. K. preuss. Akad. Wiss.* : 848 (New Hanover).

Synonymy : Fowler, 1941 (*javanicum*) ; Whitehead *et al.*, 1966 (*hasseltii*, *selangkat*) ; type of *breviceps* examined (unpublished).

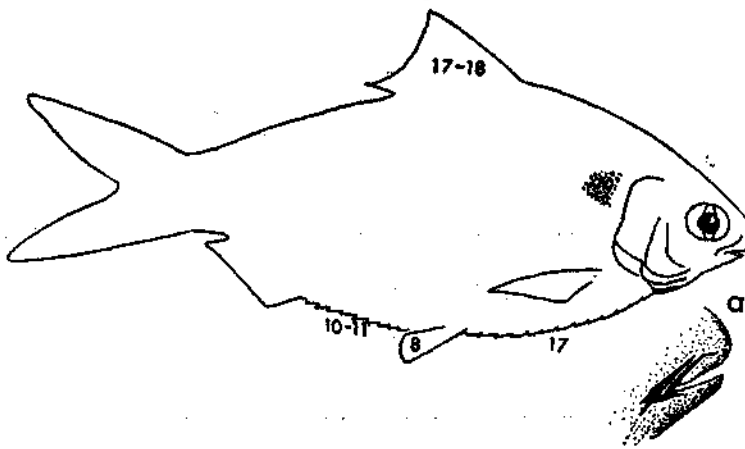


Fig. 33. *Anodontostoma chacunda* (Ham.-Buch.), showing detail of jaws (a).

Description : Fowler, 1941 (specimens from India, Borneo, Java, Philippines) ; Whitehead, 1965a (2 specimens, Persian Gulf) ; Whitehead *et al.*, 1966 (*hasseltii* type).

Distribution : Persian Gulf (Whitehead, 1965a), W. Pakistan (Karachi—BMNH specimens), India (Malabar, Madras, Orissa—BMNH specimens ; Gulf of Mannar—Murty, 1969 ; Godavari river—Babu Rao, 1965), Andaman Is. (BMNH specimens), Indo-Malayan Archipelago, Thailand (Bleeker specimens, BMNH specimens) ; Philippines (Fowler, 1941), ?Hainan (Oshima, 1926).

Note : Nelson (in press) noted that *Anodontostoma* has a median row of pre-dorsal scales, whereas all other Indo-Pacific gizzard shads have paired scales which overlap (except in *Chupanodon* and *Konosirus*, the latter considered a synonym of *Chupanodon* by Nelson). Studies on *A. chacunda* include descriptions of its general biology (Babu Rao, 1965), breeding (Chacko, 1954), eggs and larvae (Delsman, 1933a; Devanesen & Chidambaram, 1941), juveniles (Chacko, 1950; Basheerudin & Nayar, 1962) and the maturation of the eggs (Annigeri, 1967).

34. *Anodontostoma chanpole* (Ham.-Buch., 1822) (Fig. 34)

Clupanodon chanpole Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 249, 383, pl. 18 (74) (Bengal, ponds and ditches).

?*Clupanodon cagijs* Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 250 (Northern Bihar, rivers and ponds).

Synonymy : Perhaps not distinct from *chacunda*.

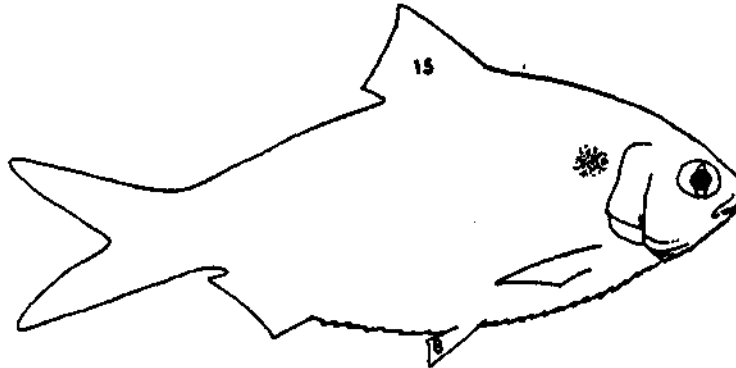


Fig. 34. *Anodontostoma chanpole* (Ham.-Buch.).

Description : Günther, 1868 : 410 (on skin, 6 inches).

Distribution : India (Bengal, ponds and ditches).

Subfamily PRISTIGASTERINAE

Of the 9 genera recognised (Whitehead, 1968a), one is endemic to the Indo-Pacific region (*Raconda*) and three are shared with the New World (*Pellona*, *Ilisha*, *Opisthopterus*); the remainder are confined to the New World.

Nelson (1970) noted that the gill arches of pristigasterines 'lack the advanced characters peculiar to the engraulids and clupeids' and he proposed superfamily rank for this group. The exceptionally wide distribution of genera such as *Ilisha*, *Pellona* and *Opisthopterus*, which is a rather rare feature amongst tropical clupeoids, suggests a relatively long period since separation from the remaining clupeoid stock. The group would well repay detailed comparative studies of osteology and other features.

Key to the genera of the Indo-Pacific Pristigasterinae

- I. Toothed hypo-maxilla present (Fig. 35a).....*Pellona* (p. 209)
- II. No toothed hypo-maxilla
- A. Pelvic fins present.....*Ilisha* (p. 210)
- B. Pelvic fins absent
1. Dorsal fin present ; maxilla rounded posteriorly, not reaching beyond eye centre.....*Opisthopterus* (p. 214)
2. Dorsal fin absent ; maxilla tapering posteriorly, extending to gill cover or beyond.....*Raconda* (p. 215)

Pellona Valenciennes, 1847

Pellona Valenciennes, 1847, Hist. Nat. Poiss., 20 : 300 (Type : *Pellona orbignyana Valenciennes* designated by Gill, 1861, *Proc. Acad. nat. Sci. Philad.* : 38).

Neosteus Norman, 1923, Ann. Mag. nat. Hist., (9) 11 : 17 (Type : *Pellona ditchela Valenciennes* by subsequent designation, Norman, 1923, *Zool. Rec. Pisces* : 25).

Synonymy : Whitehead, 1967a.

Species : Five species are recognised, of which one occurs in the Indo-Pacific region (Whitehead, 1970—key, discussion).

35. *Pellona ditchela Valenciennes, 1847* (Fig. 35)

Pellona ditchela Valenciennes, 1847, Hist. Nat. Poiss., 20 : 314 (on *Ditchelee* of Russell, 1803, *Fishes of Coromandel*, 2 : 72, pl. 88).

Pellona hoevenii Bleeker, 1852, Verh. batav. Genoot. Kunst. Wet., 24 : 21 (Batavia).

Meletta schlegelii Castelnau, 1873, Proc. zool. acclim. Soc. Vict., 2 : 93 (Port Darwin).

Pellona natalensis Gilchrist & Thompson, 1908, Ann. S. Afr. Mus., 6 : 202 (Natal coast).

Synonymy : Fowler, 1941 (*natalensis*); Whitehead *et al.*, 1966 (*hoevenii*; *melastoma*?=*ditchela*); Whitehead, 1967a (*ditchela*; *melastoma*=*ditchela*—an error); Whitehead, 1969a (*melastoma* a species of *Ilisha*).

Description : Whitehead *et al.*, 1966 (*hoevenii* type); Losse, 1968 (45 specimens, East Africa).

Distribution : Durban, Delagoa Bay, Madagascar (BMNH specimens), East Africa (Losse, 1968), India (Vizagapatnam—Russell's *Ditchelee*; Sind, Bombay, Porto Novo, Madras—BMNH specimens; Gulf of Mannar—Murty, 1969), Nicobar Is. (BMNH specimens), Indo-Malayan Archipelago, Thailand (Bleeker material, BMNH specimens), Philippines (Fowler, 1941), ? Queensland (McCulloch, 1922—as *hoeveni*), Taiwan (Liu & Shen, 1957—as *hoeveni*).

[50]

Note: Notes on the general biology of this species are given by Sadasivan (1965), the eggs and larvae were described by Delsman (1930a) and the fat content of the muscles was determined by Sekharan (1950).

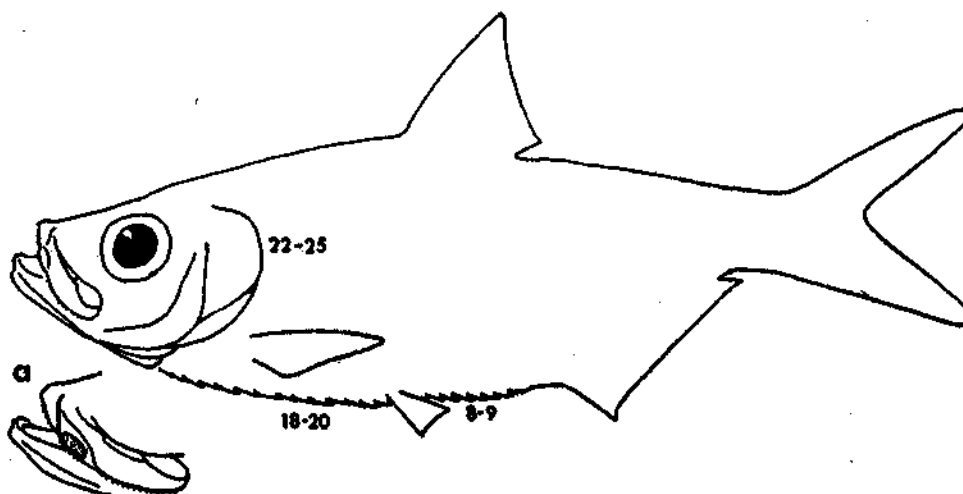


Fig. 35. *Pellona ditchela* Valenciennes, showing detail of jaws (a), the hypo-maxilla stippled.

Ilisha Richardson, 1846

Ilisha Richardson, 1846, *Ichthyol. Seas China Japan*: 306 (Type: *Ilisha abnormis* Richardson = *Alosa elongata* Bennett).

Platygaster Swainson, 1838, *Nat. Hist. Anim.*, 1: 278 (Type: *Clupea africana* Bloch, designated by Swain, 1882, *Proc. Acad. nat. Sci. Philad.*: 280) (name preoccupied in Hymenoptera).

Zunasia Jordan & Metz, 1913, *Mem. Carnegie Mus.*, 6 (1): 7 (Type: *Pristigaster chinensis* Basilewsky = *A. elongata* Bennett).

Pseudochirocentrodon Miranda-Ribeiro, 1923, *Comm. Linhas Telegr. Estrat. Matto Grosso Amazonas*, 58: 8 (Type: *P. amazonicum* Miranda-Ribeiro).

Euplatygaster Fowler, 1934, *Proc. Acad. nat. Sci. Philad.*, 85: 246 (Type: *Pellona brachysoma* Bleeker = *Clupea melastoma* Schneider, *i.e.*, *Ilisha indica* auct.).

Synonymy: Whitehead, 1970.

Species: In a listing of the 29 nominal species, 6 Indo-Pacific species were considered valid (Whitehead, 1970). Examination of further material suggests that *I. filigera* is a synonym of *I. megaloptera*, but that *I. sladeni* is distinct from *I. pristigastroides* (the latter discussed by Talwar & Whitehead (1971).

Note: In *Ilisha sladeni* the swimbladder is not prolonged beyond the 1st anal pterygiophore, but in all other Indo-Pacific *Ilisha* there is a single prolongation on the right side (*I. pristigastroides*, *I. elongata*, *I. megaloptera*, *I. macrogaster*) or a short double prolongation (*I. melastoma*); these tubular post-coelomic swimbladder extensions may reach to the base of the 15th anal ray or beyond in some species.

Key to Indo-Pacific species of *Ilisha*

- I. Anal origin below or in advance of middle of dorsal base; pre-pelvic scutes 23-27; gillrakers 17-22.
- A. Body moderate, its depth about 30% in S.L.; anal base 40% of S.L.; pre-pelvic scutes 26
I. pristigastroides (Java, Burma)
- B. Body more slender, its depth 22-26% of S.L.; anal base 30% of S.L.; pre-pelvic scutes 23-24
I. sladeni (Burma).
- II. Anal origin below posterior half of dorsal fin
- A. Body slender, its depth 24-29% of S.L.; scutes 23-26+10-14 (total 35-39)
I. elongata (p. 211)
- B. Body depth more than 30% of S.L.
1. Body very deep, its depth 37-41% of S.L.
- a. Scutes 25+11 (total 36)
I. macrogaster (Borneo)
- b. Scutes 19-22+(7) 8-10 (total 27-32)
I. melastoma (p. 212)
2. Body moderate, its depth 30-35% of S.L.; scutes 19-23 + (7) 8-10 (11, 12) (total 30-34—rarely 36)
I. megaloptera (p. 213)

36. *Ilisha elongata* (Bennett, 1830) (Fig. 36)

Alosa elongata Bennett, 1830, *Mem. Life of Raffles*: 691 (Sumatra).

Clupea affinis Gray, 1830, *Illustr. Ind. Zool. Hardwicke*, 1: pl. 96 (2) (India, on Hardwicke drawing).

Ilisha abnormis Richardson, 1846, *Rept. Ichthyol. Seas China Japan*: 306 (China Seas).

Pellona leschenaulti Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 311 (Pondicherry).

Pellona grayana Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 315 (on *affinis* Gray).

Pellona vimbella Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 317 (Macao).

Pellona novacula Valenciennes, 1847, *Hist. Nat. Poiss.*, 20: 319 (Rangoon).

Pellona schlegelii Bleeker, 1854, *Natuurk. Tijdschr. Ned.-Indië*, 6: 418 (Nagasaki).

Pristigaster chinensis Basilewski, 1855, *Nouv. Mém. Soc. Nat. Moscow*, 10: 243 (Gulf of Tschiliensis, China).

Pristigaster (Pristigaster) sinensis Sauvage, 1881, *Bull. Soc. philomath. Paris*, (7) 5: 107 (Swatow).

Synonymy: Whitehead *et al.*, 1966 (*schlegelii*); Whitehead, 1966a (*abnormis*); Whitehead, 1967a (*leschenaulti*, *grayana*, *vimbella*, *novacula*); Whitehead, 1970.

Description: Whitehead, *et al.*, 1966 (*schlegelii* type); Whitehead, 1966a (*abnormis* type); Whitehead, 1967a (*leschenaulti*, *vimbella*, *novacula* types; *sinensis* type compared).

Distribution : India (Pondicherry—*leschenaulti* type; no Indian BMNH specimens), Burma, Indo-Malayan Archipelago, China (*novacula*, *abnormis*, *vimbella* types and BMNH specimens), Japan (*schlegelii* type and BMNH specimens).

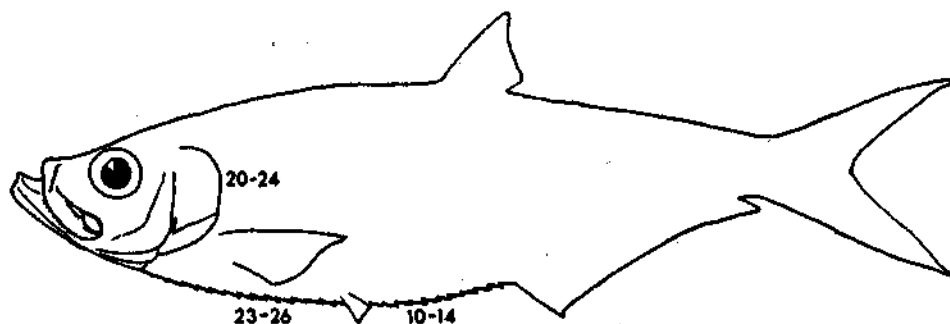


Fig. 36. *Ilisha elongata* (Bennett).

Note : Eggs and larvae believed to be this species were described by Delsman (1930a) and Uchida *et al.*, (1958). Thirteen British Museum specimens (Porto Novo, 78.3-121.4 mm S.L. and Madras, 134.3 mm S.L.) resemble this slender species (depth 26.4-30.0% of S.L.) but have fewer scutes (18-21 + 7-8, total 27-29). Evidently, this less scuted form does not replace *I. elongata* in Indian waters since the Pondicherry and Rangoon types of *leschenaulti* and *novacula* have the normal scute count. Scute number does not appear to increase with size of fish so that the Porto Novo and Madras specimens may represent a species distinct from *I. elongata*.

37. *Ilisha melastoma* (Schneider, 1801) (Fig. 37)

Clupea melastoma Schneider, 1801, *Syst. Ichth. Bloch.* : 427 (Indian Ocean, near Coromandel).

?*Clupanodon motius* Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 251, 383 (Brahmaputra).

Platygaster verticalis Swainson, 1838, *Nat. Hist. Anim.*, 1 : 278 (on *Ditchoe* of Russell, 1803, *Fishes of Coromandel*, 2 : 74, pl. 192).

Platygaster indicus Swainson, 1839, *Nat. Hist. Anim.*, 2 : 294 (on *Ditchoe*).

Platygaster parva Swainson, 1839, *Nat. Hist. Anim.*, 2 : 294 (on Gray, 1834, *Illustr. Ind. Zool. Hardwicke*, 2 : pl. 109 (3)—*Clupea motius*).

Pellona micropus Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 320 (Coromandel coast, Bengal).

Pellona ditchoa Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 313 (on *Ditchoe*).

Pellona brachysoma Bleeker, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24 : 22 (Batavia).

Synonymy : Whitehead *et al.*, 1966 (*brachysoma*) ; Whitehead, 1967a (*brachysoma* = *micropus* ; *verticalis*, *ditchoa* = *indica*) ; Whitehead, 1969a (*melastoma* a species of *Ilisha*) ; Whitehead, 1970 (all species). The name *Clupea melastoma*, formerly a *nomen oblitum* under Article 23(b) of the International Code, can now be used (Article 79 of 1972).

Description : Whitehead, 1965a (3 specimens, Persian Gulf); Whitehead *et al.*, 1966 (*brachysoma* type); Whitehead, 1967a (*micropus* type); Whitehead, 1969a (*melastoma* type); Dutt, 1967a (26 specimens, Vizagapatnam); Seshagiri Rao, in press a, b (as *indica*—frontal ridges; as *melastoma*, 50 specimens, Vizagapatnam).

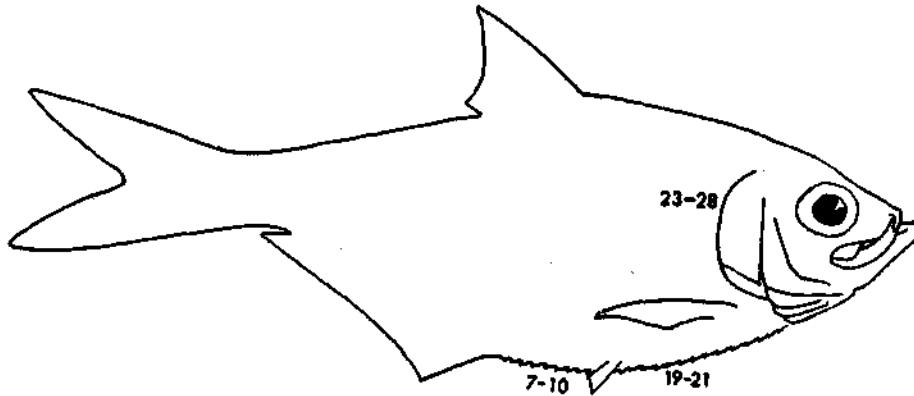


Fig. 37. *Ilisha melastoma* (Schneider).

Distribution : Persian Gulf (Whitehead, 1965a), W. Pakistan (BMNH specimens), India (Porto Novo, Madras, Calcutta, Allahabad, Assam—BMNH specimens; Coromandel coast—*Ditchoe*; Brahmaputra—*motius*), Penang (BMNH specimens), Batavia (*brachysoma*), Hong Kong (BMNH specimens).

Note : (Juveniles believed to be this species were described by Basheerudin & Nayar, 1962).

38. *Ilisha megaloptera* (Swainson, 1839) (Fig. 38)

Platygaster macrophthalma Swainson, 1838, *Nat. Hist. Anim.*, 1 : 278 (on *Jangarloo* of Russell, 1803, *Fishes of Coromandel*, 2 : 73, pl. 191) *nomen oblitum*.

Platygaster megalopterus Swainson, 1839, *Nat. Hist. Anim.*, 2 : 294 (on *Jangarloo*).

Pellona dussumieri Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 316, pl. 516 (Bombay, Malabar, Coromandel).

Pellona filigera Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 322 (Bombay, also Coromandel coast).

?*Pellona xanthoptera* Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Indië*, 2 : 439 (Sambas, Borneo).

Pellona russellii Bleeker, 1852, *Natuurk. Tijdschr. Ned.-Indië*, 3 : 72 (Java, Madura, Pasuruan Singapore).

Synonymy : Whitehead *et al.*, 1966 (*russellii*=*megaloptera*, but *xanthoptera* distinct); Whitehead, 1967a (*macrophthalma*, *megalopterus*, *dussumieri*, *filigera*); Whitehead, 1970 (all species; *filigera* distinct). The name *macrophthalma* cannot be used under Article 79b iii of the Code—because rejected by Whitehead (1967a : 113).

Description: Whitehead *et al.*, 1966 (*xanthoptera*, *russellii* types); Whitehead, 1967a (*dussumieri*, *filigera* types); Dutt, 1967a (23 specimens, Vizagapatnam—separately as *megaloptera* and *filigera*); Seshagiri Rao, in press a, b (as *megaloptera*—frontal ridges; as *macrophthalma*, 50 specimens, Vizagapatnam).

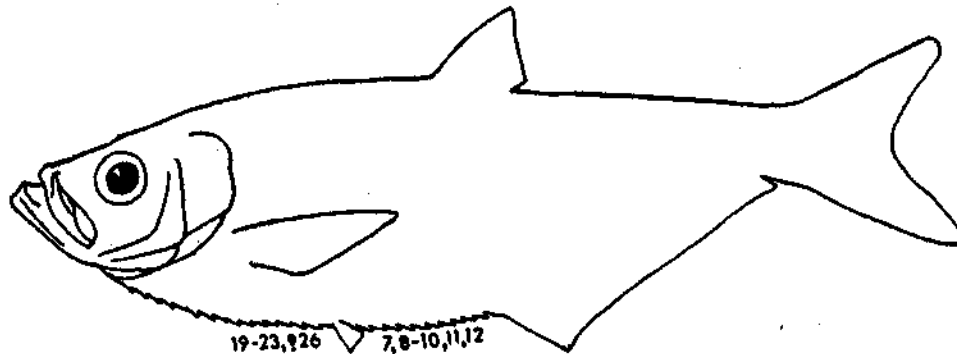


Fig. 38. *Ilisha megaloptera* (Swainson).

Distribution: W. Pakistan (BMNH specimens), India (Bombay, Malabar coast—*dussumieri*, *filigera* types and Dutt, 1967a; Porto Novo, Madras, Vizagapatnam, Sunderbans, Ganges—BMNH specimens; and *Jangarloo*), Ceylon (BMNH specimens), Indo-Malayan Archipelago (*russellii*, *xanthoptera* types, Weber & deBeaufort, 1913), ? Indo-China (Chevey, 1932).

Note: On the basis of British Museum material and the types that have been examined, no consistent differences have been found between material hitherto assigned to *megaloptera* and to *filigera*. Bleeker's *xanthoptera*, which has a rather high scute count (26+11), may be distinct; a single British Museum specimen (labelled 'India') also has this high count (25+12). A neotype has now been proposed by Seshagiri Rao (in press, b) for Swainson's *macrophthalma* (BMNH 1972.5.12.25, ex Vizagapatnam); it had earlier been recommended that the lectotype of *dussumieri* could serve as the type of *megaloptera* (Whitehead, 1967a), but this is now unnecessary.

Opisthopterus Gill, 1861

Opisthopterus Gill, 1861, *Proc. Acad. nat. Sci. Philad.*: 38 (Type: *Pristigaster tartoor* Valenciennes = *Pristigaster tardoore* Cuvier).

Synonymy: Whitehead, in press (Indo-Pacific and New World species not congeneric, the former possessing long post-coelomic swimbladder extensions).

Species: Two Indo-Pacific species (Whitehead *et al.*, 1966).

Key to the Indo-Pacific species of *Opisthopterus*

1. Maxilla about 3 times as long as deep, projecting markedly beyond 2nd supra-maxilla and beyond articulation of lower jaw; pectoral fin longer than head length..... *O. tardoore* (p. 215)
2. Maxilla about twice as long as deep, projecting little beyond either 2nd supra-maxilla or lower jaw articulation; pectoral fin shorter than head..... *O. valenciennesi* (Indo-Malayan Arch., China)

39. *Opisthopterus tardoore* (Cuvier, 1829) (Fig. 39)

Pristigaster tardoore Cuvier, 1829, *Règne Animal*, 2nd ed., 2 : 321 (on *Tartoore* of Russell, 1803, *Fishes of Coromandel*, 2 : 74, pl. 193).

Pristigaster elongata Swainson, 1838, *Nat. Hist. Anim.*, 1 : 278 (on *Tartoore*).

Pristigaster indicus Swainson, 1839, *Nat. Hist. Anim.*, 2 : 294 (on *Tartoore*).

Pristigaster tartoor : Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 328 (Pondicherry, Malabar).

Opisthopterus macrognathus Bleeker, 1866, *Verh. batav. Genoot. Kunst. Wet.*, 24 : 25 (Batavia).

Synonymy : Whitehead *et al.*, 1966 (*macrognathus*, *indicus*, *tardoore*) ; Whitehead, 1967a (*tardoore*, *elongata*, *indicus*, *tartoor*).

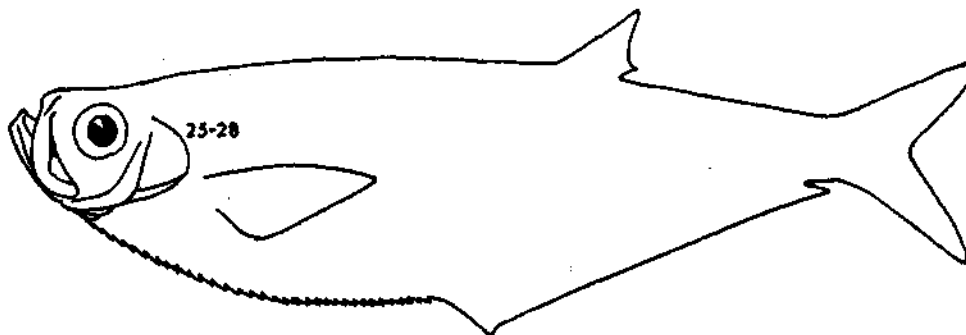


Fig. 39. *Opisthopterus tardoore* (Cuvier).

Description : Whitehead *et al.*, 1966 (*macrognathus* type) ; Whitehead, 1967a (*tardoore* type).

Distribution : India (Malabar, Pondicherry, Vizagapatnam—*Tartoore* and *tartoor* ; Bombay, Malabar, Madras—BMNH specimens), Ceylon (Munro, 1955), Indo-Malayan Archipelago (Whitehead, 1969b), ? Hong Kong (Fowler, 1931).

Note : Studies on this species include a description of the skull (Ridewood, 1904) and notes on its general biology (Radhakrishnan, 1961, 1968a), maturation and spawning (Radhakrishnan, 1967a), embryos and larvae (Bensam, 1968b), juveniles (John, 1951 ; Basheerudin & Nayar, 1962) and racial variations (Radhakrishnan, 1968b).

Raonda Gray, 1831

Raonda Gray, 1831, *Zool. Miscellany*, 1 : 9 (Type : *Raonda russeliana* Gray).

Apterygia Gray, 1835 (20 February), *Illustr. Ind. Zool.*, Hardwicke, 2 : pl. 92 (1) (Type : *Apterygia ramcarate* Gray, non *Mystus ramcarati* Ham.-Buch.)

Synonymy : types of *ramcarate* examined (unpublished).

Species : A single species known (Norman, 1923).

40. *Raconda russeliana* Gray, 1831 (Fig. 40)

Raconda russeliana Gray, 1831, *Zool. Miscellany*, 1 : 9 (Sangar roads, India)

Apterygia ramcarate Gray, 1835 (20 February), *Illustr. Ind. Zool., Hardwicke*, 2 : pl. 92 (1) (Sangar Rocks, India) (dating by Sawyer, 1933).

Apterygia hamiltoni Valenciennes, 1847, *Hist. Nat. Poiss.*, 20 : 333 (on *ramcarate*, non *Thryssa hamiltonii* Gray).

Synonymy : Whitehead, 1967a (*Apterygia hamiltoni* of Valenciennes not *Opisthopterus tardoore*) ; types of *russeliana* and *ramcarate* examined (unpublished).

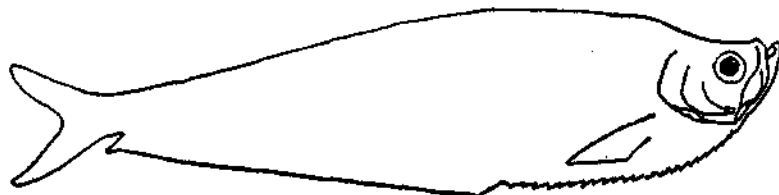


Fig. 40. *Raconda russeliana* (Gray).

Description : Norman, 1923 (types of *russeliana* and *ramcarate*).

Distribution : **India** (Sangar Roads—*russeliana*, *ramcarate* types ; Sunderbunds—BMNH specimens ; Bay of Bengal—Murty, 1969), Indo-Malayan Archipelago (Whitehead, 1969b).

Note : The biology of this species has been investigated by Varghese (1962).

Family ENGRAULIDAE

Of the 14 genera recognised (listed in Whitehead, 1968a, table 2) 7 are known from the Indo-Pacific region, the remainder being confined to the New World. Only one genus, *Engraulis*, is common to both areas (Whitehead, 1964c). *Engraulis* and all New World genera lack abdominal scutes (except the pelvic-scute, which is never keeled), whereas at least some keeled abdominal scutes are present in all Indo-Pacific species (except *Stolephorus purpureus*, absent in some individuals). The projecting snout and under-slung lower jaw make the anchovies easy to recognise, in spite of great variations in body form, but many species problems exist in the genera *Thryssa* and *Coilia*.

Subfamily ENGRAULINAE

A partial synopsis of Indian Ocean anchovies has already been published, based on specimens of 5 genera and 16 species collected during the International Indian Ocean Expedition of 1963-64 (Whitehead, 1968b), but a number of Indian Ocean species were not included and some modifications can now be made to the keys.

Key to the Indo-Pacific genera of Engraulinae

- I. No abdominal scutes (except pelvic scute) ; posterior tip of maxilla blunt, scarcely projecting beyond 2nd supra-maxilla (Fig. 41b) ; anal origin well

- behind last dorsal ray; posterior frontal fontanelles small, rectangular, occluded in adults (Fig. 41a).....*Engraulis* (p. 217)
- II. Abdominal scutes present, spine-like or distinctly keeled (absent in some individuals of *Stolephorus purpureus*); posterior tip of maxilla usually projecting well beyond supra-maxilla (Fig. 43a); anal origin usually before last dorsal ray; posterior frontal fontanelles triangular, usually retained in adult (Fig. 42a).
- A. Scutes with slender ascending arms, only present before pelvic base; anal fin short, with less than 25 rays.....*Stolephorus* (p. 218)
- B. Scutes with broad ascending arms, present both before and behind pelvic base; anal fin long, with more than 25 rays
1. No pre-pectoral scutes, or 1-2 followed by a gap
- a. Teeth small, close-set; two supra-maxillae.....*Thrissina* (p. 227)
- b. Teeth large, caniniform; no anterior supra-maxilla.....*Lycothrissa* (Borneo, Thailand, Cambodia)
2. Pre-pectoral scutes present, trenchant (except in *Papuengraulis*)
- a. All scutes trenchant; anterior supra-maxilla small or absent (Figs. 56a, 57a)
- i. 1st pectoral ray normal, not filamentous.....*Thryssa* (p. 228)
- ii. 1st pectoral ray filamentous.....*Setipinna* (p. 237)
- b. Scutes barely apparent except before pectorals; anterior supra-maxilla as long as expanded portion of posterior supra-maxilla....*Papuengraulis* (Papua, New Guinea)

Engraulis Cuvier, 1816

Engraulis Bosc, 1816, *Nouv. Dict. d'Hist. Nat. (Nouv. ed.)*, 1 : 493 (on *Engraulis* Cuvier, MS; no type).

Engraulis Cuvier, 1816 (17 December), *Règne Animal*, 1st ed., 2 : 174 (Type: *Clupea encrasicolus* Linnaeus, designated by Fleming, 1822, *Phil. Zool.*, 2 : 385).

Encrasicolus Fleming, 1828, *Hist. Brit. Anm.*: 183 (Type: *Engraulis encrasicolus* Linnaeus—*corrigenda* 'for *Encrasicolus* read *Engraulis*').

Alpsmaris Swainson, 1838, *Nat. Hist. Anm.*, 1 : 90 (subgenus of *Engraulis*, name only, two Mediterranean species included but not named).

Austranchovia Whitley, 1931, *Austr. Zool.*, 6 : 311 (Type: *Atherina australis* Shaw).

Synonymy: Whitehead, 1967a (*Engraulis, Encrasicolus*); Whitehead, 1967b (dating of Cuvier, 7 December 1816—error, 17 intended).

Species: *Engraulis*, formerly believed the only anchovy genus 'confined to temperate seas' (Jordan & Seale, 1926) and cited as an example of anti-tropical distri-

bution (Hubbs, 1952), is now known to include tropical forms, both from the Atlantic Ocean and from the Indo-Pacific (Whitehead, 1964c). The temperate forms, hitherto apparently well isolated geographically, were considered to be separate species, but study of the intervening tropical forms may demonstrate a single Indo-Pacific species ranging from Japan (*E. japonicus*) southwards to Australia (*E. australis*) and westwards to South Africa (*E. capensis*). For the present, the Indian Ocean form will be placed with the Japanese species.

41. *Engraulis japonicus* Temm. & Schl. (Fig. 41)

Engraulis japonicus Temminck & Schlegel, 1846, *Fauna Japonica*, pt. 13 : 239, pl. 108 (3) (S. W. Japan).

Engraulis zollingeri Bleeker, 1849, *J. Ind. Arch.*, 3 : 69, 73 (Macassar, Celebes).

?*Engraulis capensis* Gilchrist, 1913, *Mar. biol. Rep., Cape Tn.*, 1 : 62 (South Africa).

Synonymy : Whitehead, 1964c (*zollingeri* a species of *Engraulis*) ; Whitehead *et al.*, 1966 (*zollingeri* type).

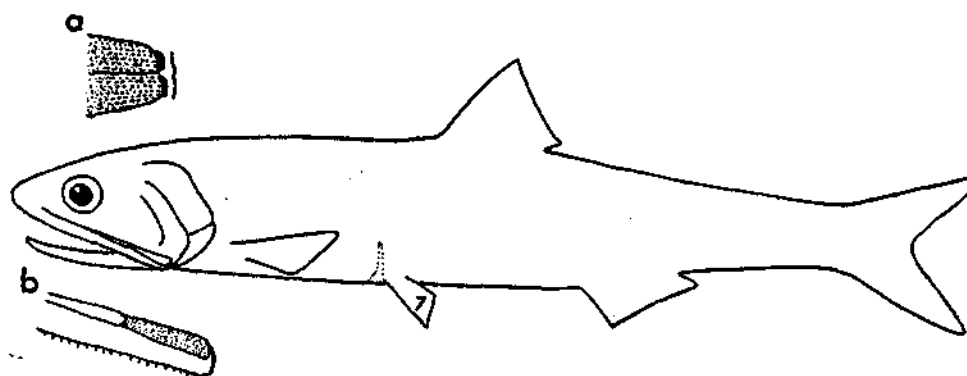


Fig. 41. *Engraulis japonicus* Temm. & Schl., showing almost occluded posterior frontal fontanelles (a) and the scant projection of the maxilla beyond the 2nd supra-maxilla (c).

Description : Whitehead *et al.*, 1966 (*zollingeri* type).

Distribution : South Africa (i.e. *S. capensis* ?=*S. japonicus*), Seychelles (BMNH specimens), India (no records), Indo-Malayan Archipelago (Bleeker's *zollingeri*), Philippines (BMNH specimens), Hong Kong, Chefoo, Japan (Whitehead, 1966a).

Note : This species may have been overlooked in Indian waters, as it has been elsewhere in the tropical Indo-Pacific. It is an important element in clupeoid fisheries in temperate regions (Japan, South Africa, Australia).

Stolephorus Lacépède, 1803

Stolephorus Lacépède, 1803, *Hist. Nat. Poiss.*, 5 : 381 (Type : *Stolephorus commersonii* Lacépède).

Encrasicolina Fowler, 1938, *Monogr. Acad. nat. Sci. Philad.*, 2 : 157 (Type : *Encrasicolina punctifera* Fowler = *Stolephorus buccaneeri* Strasburg).

Amentum Whitley, 1940, *Aust. Zool.*, 9 (4) : 402 (Type : *Stolephorus commersonii* Lacépède).

Anchoviella : Fowler, 1941, *Bull. U.S. natn. Mus.*, 13 (100) : 696 (Indo-Pacific species, non *Anchoviella* Fowler, 1911).

Synonymy : Jordan & Gilbert, 1883 (*Atherina japonica* Houttuyn type of *Stolephorus*); Whitehead, 1963b (type of *Stolephorus* an engraulid, not a dussumieriid); Opinions 93 and 749 of International Commission (*commersonii* type of *Stolephorus*); Whitehead, 1967a (discussion, *Anchoviella*); Ronquillo, 1970 (*Amentum*, *Encrasi-cholina*); *Encrasi-cholina punctifer*, type examined (unpublished).

Species : Through the work of Ronquillo (1970), order has been brought to this large and difficult genus and the key given here reflects Ronquillo's conclusions. Three species, designated A, B and C here, are awaiting description by Mr. Ronquillo. The key given by Babu Rao (1966) used egg shape for its basic dichotomy, a feature unsuitable for museum material but one of great interest in tracing the relationships of the species. Ten species have been recorded or may occur in Indian waters.

Key to the species of Stolephorus

- I. Anal origin under or a little behind last dorsal ray; muscular portion of isthmus not reaching to hind border of branchiostegal membrane, leaving portion of urohyal exposed.
 - A. Maxilla pointed posteriorly, projecting beyond anterior border of pre-operculum; urohyal plate bony (Fig. 42b)
 1. Lower gillrakers 24-27; head short, its length more than 4 times in S.L.; maxillary teeth even.....*S. heterolobus* (p. 220)
 2. Lower gillrakers 21-24 (rarely 25); head long, its length less than 4 times in S.L.; some maxillary teeth enlarged.....
..... Species A (p. 221)
 - B. Maxilla truncate posteriorly, not reaching beyond anterior border of pre-operculum; urohyal plate fleshy
 1. Maxilla 4-5 times in S.L., just reaching to anterior border of pre-operculum
 - a. Lower gillrakers 23-24.....*S. purpureus* (Hawaii)
 - b. Lower gillrakers 16-18.....Species B (Philippines, Taiwan)
 2. Maxilla 5-6 times in S.L., not reaching to anterior border of pre-operculum; lower gillrakers 24-26.....
..... *S. buccaneeri* (p. 222)
- II. Anal origin under dorsal base; muscular portion of isthmus extending forward beyond hind margin of branchiostegal membrane
 - A. Hind border of pre-operculum indented near maxilla tip (Fig. 43a)
 1. Double pigment line along back behind dorsal; body deep, its depth equal to upper jaw; snout short and blunt
 - a. Pre-dorsal spine present (but no spine on pelvic scute); lower gillrakers 20-27.....*S. macrops* (p. 223)
 - b. No pre-dorsal spine; lower gillrakers 23-30....Species C (p. 223)

2. No double pigment line on back, melanophores irregularly scattered or absent; body more slender, its depth less than upper jaw; snout longer, pointed
 - a. Head large, its length 23-25% in S.L.; lower gillrakers 26-30; pre-pelvic scutes 6-9.....*S. holodon* (South Africa)
 - b. Head smaller, its length 22-23% in S.L.; lower gillrakers 19-21; pre-pelvic scutes 5-6.....*S. andhraensis* (p. 224)
- B. Hind border of pre-operculum evenly rounded near maxilla tip (Fig. 48b)
 1. Pre-dorsal spine present and spine on pelvic scute; lower gillrakers 23-27.....*S. tri* (p. 224)
 2. No pre-dorsal spine, no spine on pelvic scute
 - a. Maxilla tip reaching to or beyond anterior border of pre-operculum; posterior frontal fontanelles narrow, lateral borders straight (Fig. 49a); 4-5 pre-pelvic scutes.....*S. indicus* (p. 225)
 - b. Maxilla tip reaching to or beyond posterior border of pre-operculum
 - i. Posterior frontal fontanelles broad, lateral borders sigmoid (Fig. 50a); lower gillrakers more than 21, more than 23 on entire 3rd arch
 - α. Pre-pelvic scutes 3-4 (rarely 5); lower gillrakers 23-27....
.....*S. commersonii* (p. 226)
 - β. Pre-pelvic scutes 5-6 (usually 6); lower gillrakers 25-29....
.....*S. chinensis* (Singapore to China)
 - ii. Posterior frontal fontanelles narrow, lateral borders straight (Fig. 51a); lower gillrakers not more than 23, less than 21 on entire 3rd arch.....*S. bataviensis* (p. 226)

42. *Stolephorus heterolobus* (Rüppell, 1837) (Fig. 42)

Engraulis heterolobus Rüppell, 1837, *Neue Wirbelth., Fische*: 79, pl. 4 (Red Sea).

Stolephorus pseudoheterolobus Hardenberg, 1933, *Nat. Tijdschr. Ned.-Indië*, 93 (2): 261 (Riau and Lingga Archipelago).

Synonymy: Whitehead, 1965a (*heterolobus*, *pseudoheterolobus*); Whitehead, 1968b (*pseudoheterolobus*); Ronquillo, 1970 (*pseudoheterolobus*; *heterolobus* and *pseudoheterolobus* of Babu Rao, 1966, mixed).

Description: Whitehead, 1965a (22 specimens, including type of *heterolobus*, Red Sea, Gulf of Aden, Gulf of Oman); Losse, 1968 (49 specimens, East Africa).

Distribution: Madagascar, East Africa (Losse, 1968), Red Sea region (Whitehead, 1965a), India (Cochin, Madras, Waltair—Ronquillo, 1970), Indo-Malayan Archipelago (Whitehead, 1969b), Palau (BMNH specimens), Hong Kong (Whitehead, 1966a), Taiwan (Liu & Shen, 1957—as *pseudoheterolobus*), Okinawa (BMNH specimens).

Note : This widespread species forms the bulk of the anchovy fisheries in Singapore, Thailand and the Philippines, as well as along the eastern coasts of India (Ronquillo,

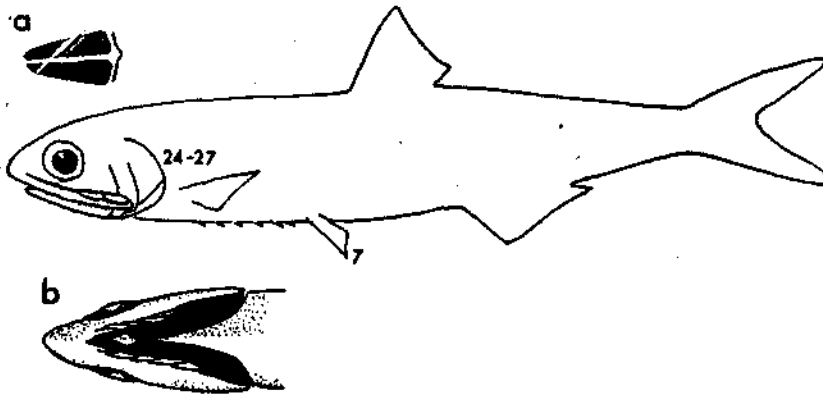


Fig. 42. *Stolephorus heterolobus* (Rüppell), showing the shape of the posterior frontal fontanelles (a) and the position of the diamond-shaped urohyal plate (b).

1970). The biology of this species has been commented upon by Sadasivan (1965), based on material from the Andamans.

43. *Stolephorus*, Species A (Fig. 43)

Stolephorus heterolobus Hardenberg, 1934, *Treubia*, 14 (3) : 324 (Singapore, etc.) (*non heterolobus* Rüppell).

?*Amentum devisi* Whitley, 1940, *Aust. Zool.*, 9 (4) : 404 (Cape York).

Stolephorus, Species A: Whitehead, 1967, *J. mar. biol. Ass. India*, 9 (1) : 17 (Bay of Bengal, Arabian Sea); *Idem*, 1969, *ibid.*, 9 (2) : 255 (Singapore); Ronquillo, 1970, FAO (duplicated typescript) : 14 (Hong Kong, Thailand, Singapore, east coast of India).

Synonymy : Whitehead, 1968b (*heterolobus*) ; Ronquillo, 1970 (*heterolobus*).

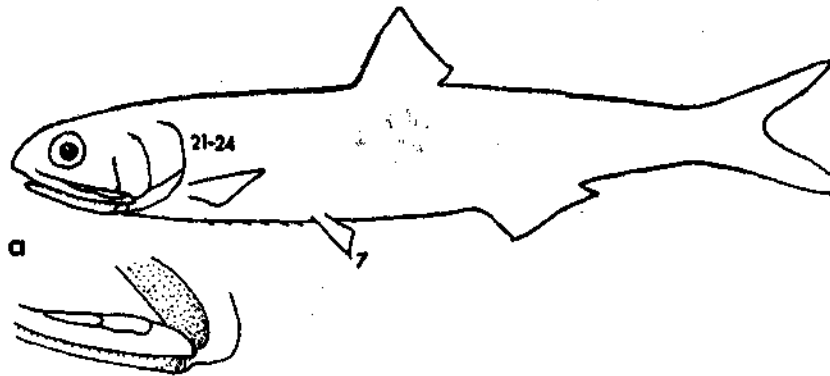


Fig. 43. *Stolephorus* Sp. A, showing (a) the indented posterior border of the pre-operculum (stippled).

Description : Hardenberg, 1934 (as *heterolobus*).

Distribution : Gulf of Aden (BMNH specimens), India (Cochin, Trivandrum, Madras, Waltair—Ronquillo, 1970 and BMNH specimens), Ceylon, Indo-Malayan Archipelago, Thailand, Philippines, Hong Kong, Taiwan (Ronquillo, 1970 and BMNH specimens).

Note : This species also differs from *S. heterolobus* in having larger teeth regularly interspersed amongst the smaller teeth of the upper jaw, especially in juveniles (Ronquillo, 1970). In this feature it resembles *Amentum devisi* Whitley and this may be the correct name for the species.

44. *Stolephorus buccaneeri* Strasburg, 1960 (Fig. 44)

Stolephorus buccaneeri Strasburg, 1960, *Pacific Sci.*, 14 (4) : 396 (Hawaii).

Stolephorus zollingeri : Hayashi & Tadokoro, 1962, *Bull. Jap. Soc. sci. Fish.*, 28 (1) : 27 (Japan) (non *Engraulis zollingeri* Bleeker).

Synonymy : Whitehead, 1969b (misuse of *zollingeri*) ; Ronquillo, 1970 (the same)

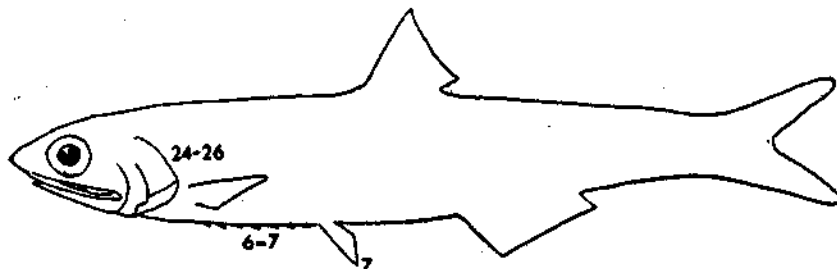


Fig. 44. *Stolephorus buccaneeri* Strasburg.

Description : Strasburg, 1960 (28 specimens, types, Hawaii) ; Hayashi & Tadokoro, 1962 (about 40 adults, Japan—as *zollingeri*) ; Whitehead, 1965a (6 specimens, Red Sea, Persian Gulf).

Distribution : Durban (Whitehead, 1965a), Comoro Is. (Whitehead, 1968b), Zanzibar (BMNH specimens), Mombasa (Losse, 1968), Suez, Persian Gulf (Whitehead, 1965a), India (Calicut, Vizhinjam—BMNH specimens), Indo-Malayan Archipelago (Ronquillo, 1970), Philippines (Ronquillo, 1970), Hong Kong, Taiwan (Whitehead, 1966a), Japan (Hayashi & Tadokoro, 1962—as *zollingeri*), Hawaii (Strasburg, 1960), Samoa (BMNH specimens).

Note : This very widespread species is commercially important in southern Japan and Taiwan and at times also in the Philippines, Thailand and Indonesia (Ronquillo, 1970). Owing to faulty description, Bleeker's name *zollingeri* (= *Engraulis japonicus*) has often been misapplied to the present species.

45. *Stolephorus macrops* Hardenberg, 1933 (Fig. 45)

Stolephorus baganensis macrops Hardenberg, 1933, *Natuurk. Tijdschr. Ned.-Indië*, 93 (2) : 260 (Indragiri river mouth, Sumatra).

Anchoviella baganensis bengalensis Dutt & Babu Rao, 1959, *Current Sci.*, 28 : 160 (Waltair, Kakinada).

Synonymy: Whitehead, 1968b (*macrops* fraction of Hardenberg's *baganensis*); Whitehead, 1969b (the same); Ronquillo, 1970 (the same; remainder of Hardenberg's description refers to *S. tri*; *A. baganensis baganensis* of Dutt & Babu Rao=*S. tri*).

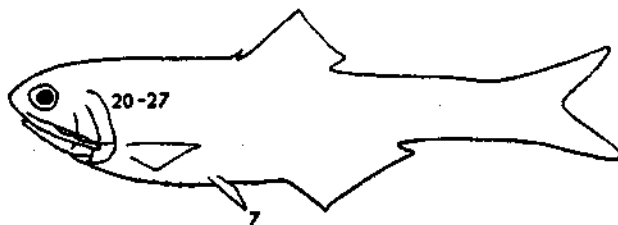


Fig. 45. *Stolephorus macrops* Hardenberg.

Description: Hardenberg, 1933 (as *S. baganensis macrops*); Dutt & Babu Rao, 1959 (85 specimens, as *S. baganensis bengalensis*).

Distribution: ? Gulf of Aden (Whitehead, 1968b—juvenile), India (Waltair, Kakinada—Dutt & Babu Rao, 1959; Bombay, Cochin—Ronquillo, 1970 and BMNH specimens), Indo-Malayan Archipelago, Thailand (*not* Philippines), Hong Kong, Taiwan (Ronquillo, 1970 and BMNH specimens).

Note: Hardenberg's *baganensis* material (apparently lost) seems to have been mixed and the species is frequently referred to as *baganensis* in the literature.

46. *Stolephorus*, Species C (Fig. 46)

Stolephorus, Species C : Whitehead, 1968, *J. mar. biol. Ass. India*, 9 (1) : 18 (Madagascar); Ronquillo, 1970, FAO (duplicated typescript) : 19 (Madagascar, India, Thailand, Philippines).

Synonymy: Whitehead, 1968b; Ronquillo, 1970.

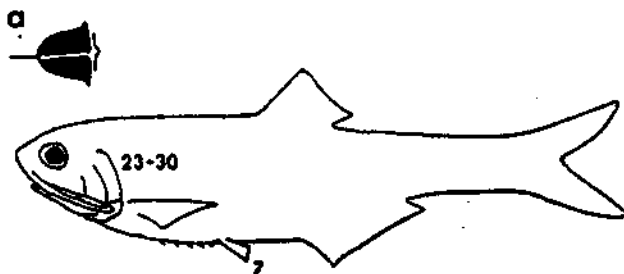


Fig. 46. *Stolephorus* Sp. C, showing shape of posterior frontal fontanelles (a).

Description: Whitehead, 1968b (key and notes only); Ronquillo, 1970 (the same).

Distribution: Madagascar (Whitehead, 1968b), India (Bombay—Ronquillo, 1970), Singapore, Thailand, Philippines (Ronquillo, 1970 and BMNH specimens).

47. *Stolephorus andhraensis* Babu Rao, 1966 (Fig. 47)

Stolephorus andhraensis Babu Rao, 1966, *Ann. Mag. nat. Hist.*, (13) 9: 103 (Waltair, Kakinada).

Synonymy: Ronquillo, 1970 (distinct from *holodon* and *bataviensis*).

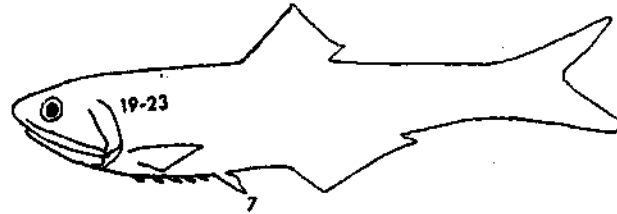


Fig. 47. *Stolephorus andhraensis* Babu Rao.

Description: Babu Rao, 1966 (50-183 specimens, Waltair).

Distribution: India (Waltair, Kakinada—Babu Rao, 1966), Singapore, Thailand (Ronquillo, 1970 and BMNH specimens).

48. *Stolephorus tri* (Bleeker, 1852) (Fig. 48)

Engraulis tri Bleeker, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24: 40 (Batavia).

Stolephorus rex, Jordan & Seale, 1926, *Bull. Mus. comp. Zool.*, 67: 380 (Canara).

Stolephorus baganensis Hardenberg, 1931, *Treubia*, 13 (1): 107 (Rokan river mouth—name only); *Idem*, 1933, *Natuurk. Tijdschr. Ned.-Indië*, 93: 258 (Rokan river mouth, Java, Borneo—excluding the *macrops* element).

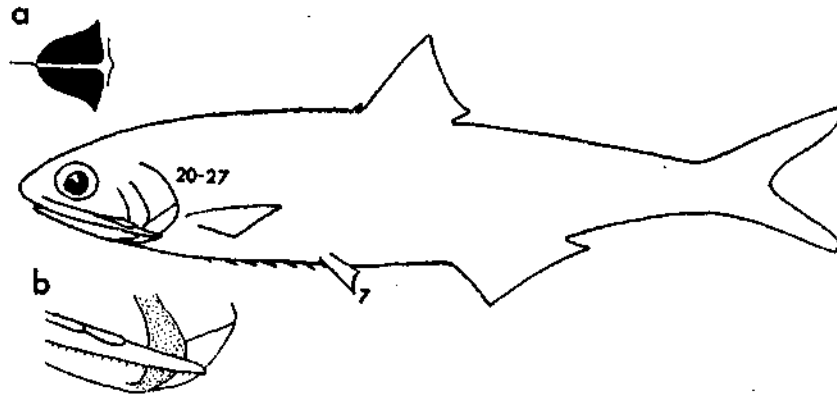


Fig. 48. *Stolephorus tri* (Bleeker), showing the shape of the posterior frontal fontanelles (a) and the rounded posterior margin of the pre-operculum (b).

Synonymy: Whitehead *et al.*, 1966 (*tri*); Ronquillo, 1970 (*baganensis* without *macrops* element = *tri*).

Description: Whitehead *et al.*, 1966 (*tri* type); Ronquillo, 1970 (key and notes only).

Distribution: India (Bombay, Waltair, Chilka Lake, Ganges, Mergui Archipelago—Ronquillo, 1970 and BMNH specimens), Indo-Malayan Archipelago (*tri*, Ronquillo, 1970 and BMNH specimens), Thailand (Songkla Lake), but *not* Hong Kong or Philippines (Ronquillo, 1970 and BMNH specimens).

Note: The pungent spine on the pelvic scute, present at 29-31 mm S.L., distinguishes this species from all others (Ronquillo, 1970).

49. *Stolephorus indicus* (van Hasselt, 1823) (Fig. 49)

Engraulis indica van Hasselt, 1823, *Algemeene Konst- en Letter-bode*, 1 (23): 329 (Java, and on *Nattoo* of Russell, 1803, *Fishes of Coromandel*, 2: 71 pl, 187).

Engraulis albus Swainson, 1839, *Nat. Hist. Anim.*, 2: 293 (on *Nattoo* of Russell, 1803, *Fishes of Coromandel*, 2: 71, pl. 187).

Engraulis balinensis Bleeker, 1849, *Verh. bataav. Genoot. Kunst. Wet.*, 22: 11 (Boleling, Bali) (in synonymy of *S. indicus*).

Engraulis brownii Cantor, 1850, *J. Asiatic Soc. Bengal*, 18: 1285 (Malay Peninsula and islands) (*non Atherina brownii* Gmelin).

Engraulis russellii Bleeker, 1852, *Nat. Tijdschr. Ned.-Indië*, 2: 472 (Rio—name only); *Idem*, 1852, *Verh. batav. Genoot. Kunst. Wet.*, 24: 38 (Batavia, Samarang, Boleling, Bali).

? *Engraulis samaminan* Thiollière, 1857, *Fauna Woodlark*: 208 (Woodlark I.).

Anchovia apiensis Jordan & Seale, 1906, *Bull. Bur. Fish.*, 25: 187 (Apia, Samoa).

Stolephorus insularum Jordan & Seale, 1926, *Bull. Mus. comp. Zool. Harvard*, 67 (11): 381 (Tahiti).

Stolephorus indicus nanus Hardenberg, 1933, *Natuurk. Tijdschr. Ned.-Indië*, 93: 263 (no locality).

Synonymy: Whitehead *et al.*, 1966 (*balinensis*, *russellii*); Whitehead, 1969b (*brownii*); Ronquillo, 1970 (*insularum*, *nanus*).

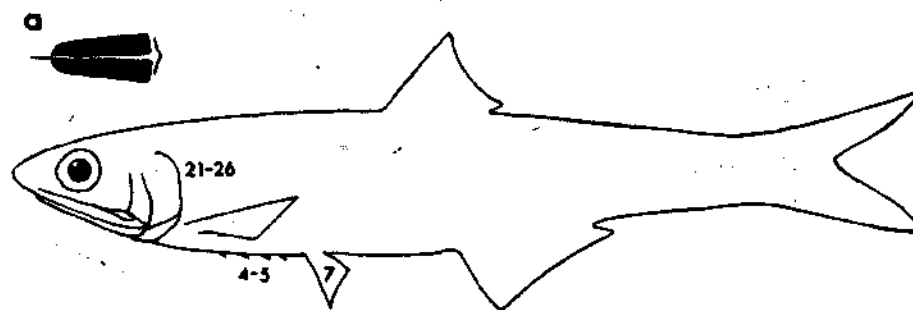


Fig. 49. *Stolephorus indicus* (van Hasselt), showing the shape of the posterior frontal fontanelles (a).

Description : Whitehead, 1965a (9 specimens, Red Sea, Persian Gulf); Whitehead *et al.*, 1966 (*russellii* type); Losse, 1968 (33 specimens, East Africa).

Distribution : Mozambique Channel (Whitehead, 1968b), East Africa (Losse, 1968), Red Sea, Persian Gulf (Whitehead, 1965a), India (Malabar, Cochin, Vizhinjam, Madras, Vizagapatnam—BMNH specimens), Indo-Malayan Archipelago (Bleeker material, BMNH specimens), Philippines (BMNH specimens), Hong Kong (Whitehead, 1966a), Papua (Munro, 1964), Samoa (BMNH specimens).

Note : A biometric study of this species was made by Babu Rao (1967).

50. *Stolephorus commersonii* Lacépède, 1803 (Fig. 50)

Stolephorus commersonii Lacépède, 1803, *Hist. Nat. Poiss.*, 5 : 381, 382, pl. 12 (1) (on Commerson's notes and drawing, Mauritius).

? *Clupea vittargentea* Lacépède, 1803, *Hist. Nat. Poiss.*, 5 : 424, 458 (on Commerson MS., Mauritius).

Synonymy : Whitehead, 1967a (Commerson's drawing of *commersonii*; *vittargentea*).

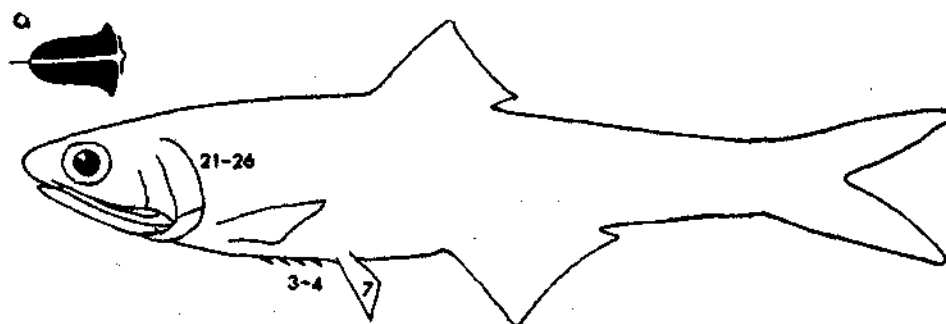


Fig. 50. *Stolephorus commersonii* Lacépède, showing the shape of the posterior frontal fontanelles (a).

Description : Whitehead, 1967a (1 specimen, East Africa—possible neotype); Losse, 1968 (21 specimens, East Africa).

Distribution : Mauritius (Commerson's notes), Madagascar, Comoro Is. (Whitehead 1968b), East Africa (Losse, 1968), not Red Sea (Whitehead, 1965a), India (Cochin, Madras, Waltair—Ronquillo, 1970 and BMNH specimens), Indo-Malayan Archipelago (Ronquillo, 1970 and BMNH specimens), Thailand, Philippines (BMNH specimens), not Hong Kong (Ronquillo, 1970).

51. *Stolephorus bataviensis* Hardenberg, 1933 (Fig. 51)

Stolephorus insularis Hardenberg, 1933, *Natuurk. Tijdschr. Ned.-Indië*, 93 : 260 (Java, Lingga, Bawean, Kangean, Moluccas); *idem*, 1934, *Treubia*, 14 (3) : 321 (Java, Sumatra, Borneo, Celebes, Singapore) (*non insularum* Jordan & Seale).

Stolephorus insularis bataviensis Hardenberg, 1933, *Natuurk. Tijdschr. Ned. Indië*, 93 : 261 (Batavia).

Synonymy : Whitehead, 1968b (*insularis* = *bataviensis*) ; Ronquillo, 1970 (the same).

Description : Hardenberg, 1933 (no number).

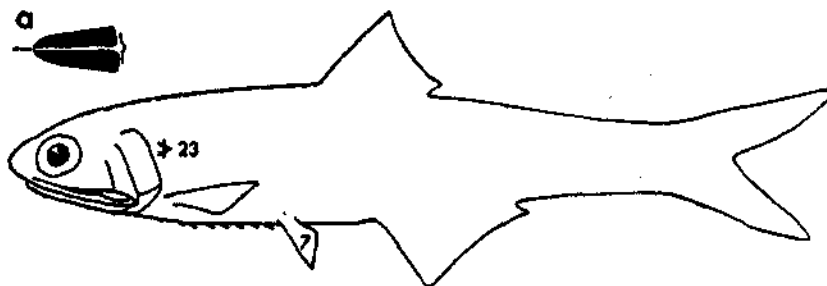


Fig. 51. *Stolephorus bataviensis* Hardenberg, showing the shape of the posterior frontal fontanelles (a).

Distribution : India (Cochin, Trivandrum, Waltair—Ronquillo, 1970 and BMNH specimens ; Bay of Bengal—Whitehead, 1968b), Indo-Malayan Archipelago, Thailand, Philippines, Hong Kong, Taiwan (Ronquillo, 1970).

Note : This species forms an important seasonal element in anchovy fisheries throughout its range. As noted by Fowler (1941), *insularis* is a junior primary homonym of *insularum*, but the name *insularis* has frequently been used in the literature.

Thrissina Jordan & Seale, 1925

Thrissina Jordan & Seale, 1925, *Copeia*, No. 141 : 30 (Type : *Clupea baelama* Forskål).

Synonymy : Fowler, 1941 (a subgenus of *Thrissocles*, i.e. *Thryssa*) ; Whitehead, 1965a (distinct genus, intermediate between *Stolephorus* and *Thryssa*).

Species : a single widespread species showing features in many ways intermediate between *Stolephorus* and *Thryssa*.

52. *Thrissina baelama* (Forskål, 1775) (Fig. 52)

Clupea baelama Forskål, 1775, *Descript. Animal.* : 72 (Djidda, Red Sea).

Clupea tuberculosa Lacepède, 1803, *Hist. Nat. Poiss.*, 5 : 425, 460 (on Commerson MS., Mauritius).

? *Engraulis nesogallitus* Bennett, 1831, *Proc. zool. Soc. Lond.*, 1 : 168 (Mauritius).

Engraulis encrasicholoides Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Indië*, 2 : 214 (Celebes—name only) ; *Idem*, 1852, *ibid.*, 3 : 173 (Batavia, Surabaya, Kammal, Kupang).

Engraulis polynemoides Günther, 1868, *Cat. Fishes Brit. Mus.*, 7 : 394 (Madagascar).

? *Anchovia evermanni* Jordan & Seale, 1905, *Bull. Bur. Fish.*, 25 : 188, fig. 4 (Apia, Samoa).

? *Engraulis macrops* Kishinouye, 1911, *J. Coll. agric. Tokyo*, 2 : 385 (Habajima, Bonin Is.) (as *micropus* in fig. 3).

Synonymy: Whitehead, 1965a (*baelama*, *boelama*); Whitehead *et al.*, 1966 (*encrasicholoides*); Whitehead, 1967a (*tuberculosa*); type of *polynemoides* examined (unpublished).

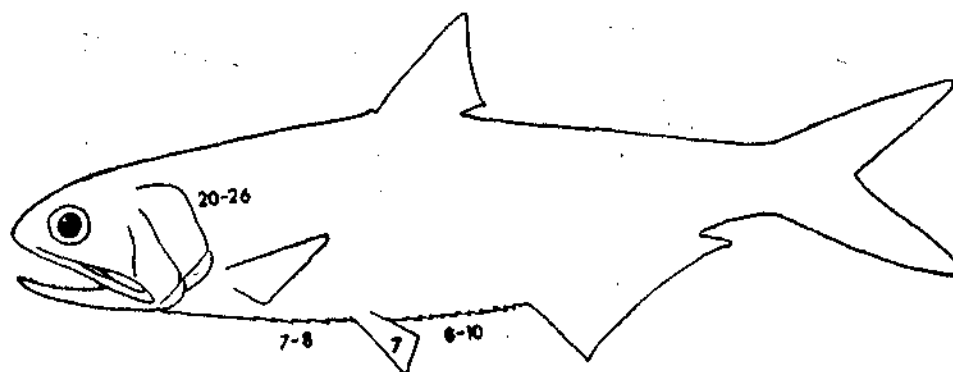


Fig. 52. *Thrissina baelama* (Forskål).

Description: Whitehead, 1965a (20 specimens, Red Sea, Gulf of Aden); Whitehead, *et al.*, 1966 (*encrasicholoides* type); Losse, 1968 (29 specimens, East Africa).

Distribution: Mauritius (*tuberculosa* and BMNH specimens), Comoro Is. (Whitehead, 1968b), East Africa (Losse, 1968), Red Sea, Gulf of Aden (Whitehead, 1965a), India (no specimens), Ceylon (Munro, 1955), Andaman Is. (BMNH specimens), Indo-Malayan Archipelago (Bleeker material), Cocos-Keeling Is. (BMNH specimens), Philippines, Palau, Guam (BMNH specimens), Solomon Is. (Whitehead, 1968b), New Britain (BMNH specimens), not Hong Kong (Whitehead, 1966a), Amoy (BMNH specimens).

Note: Pre-pectoral scutes are usually absent, but one or two keeled scutes have been found immediately behind the isthmus in few specimens (Bleeker fish, ? ex Ceylon—Whitehead *et al.*, 1966; 7 Ceylon fishes, SOFC Inv. 2972; Batavia specimen—Fowler, 1941 : 686). Pre-pectoral scutes are not present in specimens from Mauritius, Madagascar (*polynemoides* type), Comoro Is., East Africa, Red Sea, New Britain, Fiji Is., and Cocos Keeling Is. Sadasivan (1965) gave details of the biology of this species and certain abnormalities have been described by Marichamy (1970).

Thryssa Cuvier, 1829

Thryssa Cuvier, 1816, *Règne Animal*, 1st ed., 2 : 176 (Type : *Clupea mystus* Linnaeus (= *Coilia mystus*), designated by Bory St. Vincent, 1823, *Dict. Classique Hist. Nat.*, 4 : 231—overlooked, except by Whitley, 1935; *Clupea setirostris* Broussonet, designated by Jordan & Evermann, 1917, *Genera of Fishes*, pt. 1 : 98—generally accepted) (non *Thryssa* Rafinesque, 1815).

Thryssa Cuvier, 1829, *Règne Animal*, 2nd ed., 2 : 323 (Type : as before).

Thryssus Swainson, 1838, *Nat. Hist. Anim.*, 1 : 279, 280 (Type : *Clupea setirostris* Broussonet).

Trichosoma Swainson, 1839, *Nat. Hist. Anim.*, 2: 292 (Type: *Thryssa hamiltonii* Gray).

Thryssocles Jordan & Evermann, 1917, *Genera of Fishes*, pt. 1: 98 (Type: *Clupea setirostris* Broussonet).

Scutengraulis Jordan & Seale, 1925, *Copeia*, No. 141: 30 (Type: *Clupea hamiltonii* Gray).

Synonymy: Whitehead, 1965a (*Thryssa*, *Thryssa*, *Thryssus*, *Trichosoma*, *Thryssocles*, *Scutengraulis*); Whitehead, 1967a (*Thryssa*, *Thryssa*, type designations).

Species: Ten species were recognised by Whitehead (1968b) but much more work is required on this genus. In particular, the relative length of the maxilla, used here and elsewhere as a key character, may well show ontogenetic variation, while the absence of the small anterior supra-maxilla may be merely an individual variation (see under *T. vitrirostris*). The key given here is adapted from that in Whitehead (1968b), with the omission of two Chilka lake species (placed in the synonymies of *T. purava* and *T. malabarica*).

Key to the species of *Thryssa*

- I. Lower jaw with high coronoid process (Fig. 53a); maxilla very long, reaching to beyond pectoral tip.....*T. setirostris* (p. 230)
- II. Lower jaw slender; maxilla not reaching beyond pectoral tip
 - A. Maxilla long, to pectoral base or beyond
 1. Gillraker serrae uneven but not clumped; lower gillrakers 14-19
 - a. Anal with 35-41 rays; dorsal with 13-16 rays; mouth nearly horizontal; pre-pelvic scutes 17-19.....*T. mystax* (p. 231)
 - b. Anal with 43-49 rays; dorsal with 12-14 rays; mouth oblique; pre-pelvic scutes 14-17.....*T. purava* (p. 231)
 2. Gillraker serrae in distinct clumps; (at 43 mm S. L. in *T. dussumieri*) lower gillrakers 15-24
 - a. Maxilla reaching $\frac{1}{2}$ - $\frac{3}{4}$ along pectoral; post-pelvic scutes 7-9; anterior supra-maxilla absent (Fig. 56a).....*T. dussumieri* (p. 232)
 - b. Maxilla shorter, reaching to $\frac{1}{3}$ along pectoral; post-pelvic scutes 9-12; anterior supra-maxilla usually present (Fig. 57a).....*T. vitrirostris* (p. 233)
 - B. Maxilla short, not reaching to pectoral base
 1. Lower gillrakers 12-14; anal with 38-43 rays.....*T. hamiltonii* (p. 234)
 2. Lower gillrakers 16-29
 - a. Anal with 38-43 rays; lower gillrakers 16-20.....*T. malabarica* (p. 235)
 - b. Anal with 34 rays; lower gillrakers 27-29.....*T. kammalensis* (p. 236)

53. *Thryssa setirostris* (Broussonet, 1782) (Fig. 53)

Clupea setirostris Broussonet, 1782, *Ichthyol.* : text and pl. 2, no pagination (Pacific near Tanna Is., Society group).

Clupea mystacina Schneider, 1801, *Syst. Ichthyol. Bloch.* : 428 (Tanna Is.—on Forster MS. name, in synonymy of *Clupea setirostris*); Lichtenstein, 1844, *Descript. Anim. Forst.* : 295 (Tanna Is.—on Forster MS).

Clupea seticornis Rees, 1807, *New Cyclopaedia*, 8 (2), pt. 16 : no pagination, under *Clupea*.

Thryssa macrognathos Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 14 (Madura near Bangcallang, Kammal, Surabaya).

Synonymy : Whitehead, 1965a (*setirostris*); Whitehead *et al.*, 1966 (*macrognathos*).

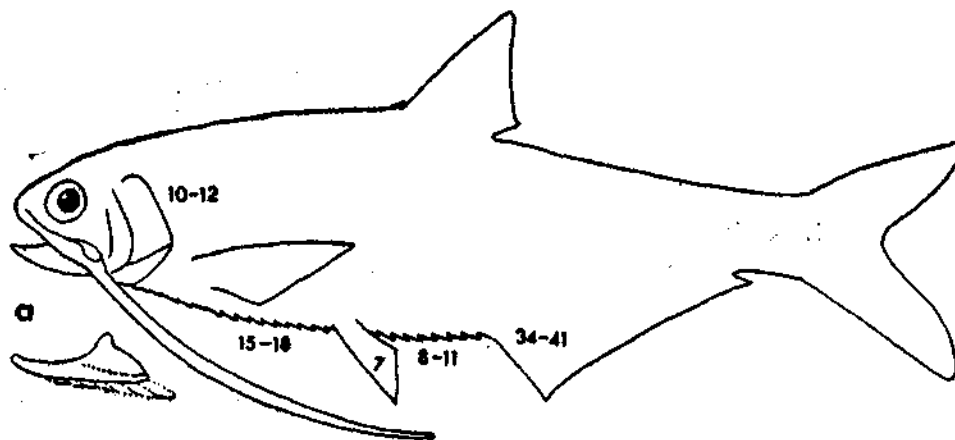


Fig. 53. *Thryssa setirostris* (Broussonet), showing the high coronoid process of the lower jaw (a).

Description : Whitehead, 1965a (12 fishes, Red Sea, Gulf of Aden); Losse, 1968 (18 specimens, East Africa).

Distribution : Durban (BMNH specimens), Mozambique (Barnard, 1925), East Africa (Losse, 1968), Red Sea, Gulf of Aden (Whitehead, 1965a), India (Bay of Bengal, Calicut—Murty, 1969; Porto Novo, Waltair—BMNH specimens), Ceylon (Munro, 1955), Indo-Malayan Archipelago (Bleeker specimens and Whitehead, 1968b), Papua (Munro, 1964), Thailand (BMNH specimens), Philippines (Fowler, 1941), Amoy (BMNH specimens).

Note : The deep lower jaw, with its high coronoid process, and the very long maxilla make this species unmistakable. The juveniles have been described by Basheerudin & Nayar (1962).

54. *Thryssa mystax* (Schneider, 1801) (Fig. 54)

Clupea mystax Schneider, 1801, *Syst. Ichthyol. Bloch.* : 426, pl. 83 (Malabar).

? *Thryssa subspinosa* Swainson, 1839, *Nat. Hist. Anim.*, 2 : 293 (on *Poorawah* of Russell, 1803, *Fishes Coromandel*, 2 : 72, pl. 189).

? *Thryssa poorawah* Jerdon, 1851, *Madras J. Lit. Sci.*, 17 : 145.

Engraulis mystacoides Bleeker, 1866, *Verh. batav. Genoot. Kunst. Wet.*, 24 : 42 (Batavia, Surabaya, Samarang, Pasuruan, etc.).

Stolephorus (Thryssa) valenciennesi Bleeker, 1866, *Ned. Tijdschr. Dierk.*, 3 : 306 (Singapore, Sumatra, Java, Borneo).

Synonymy : Whitehead, 1969a (*mystax*); Whitehead *et al.*, 1966 (*mystacoides*, *valenciennesi*).

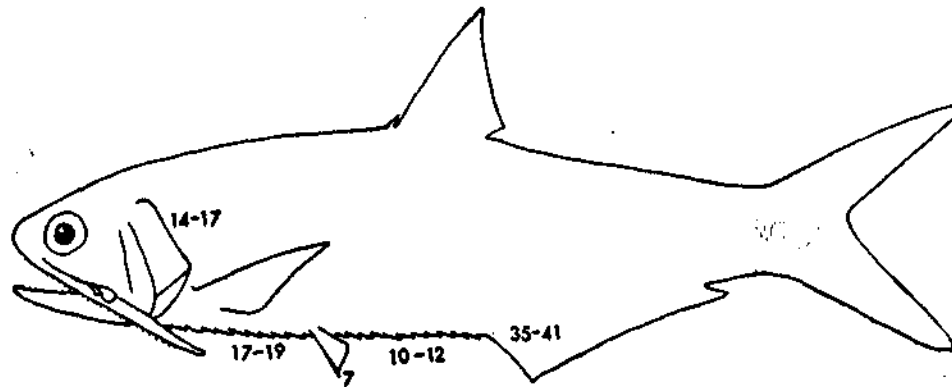


Fig. 54. *Thryssa mystax* (Schneider).

Description : Dutt, 1961b (98 specimens, Waltair); Whitehead *et al.*, 1966 (*mystacoides*, *valenciennesi* types); Whitehead, 1969a (*mystax* type).

Distribution : India (Bombay, Malabar, Canara, Madras, Waltair—BMNH specimens), Ceylon (BMNH specimens), Singapore, Thailand (BMNH specimens), Indonesia (Bleeker material), New Guinea, Borneo, Taiwan, Amoy (BMNH specimens).

Note : Studies on this species include descriptions of general biology (Venkataran, 1956), feeding (Ganapati & Rao, 1962), breeding biology (Dharmamba, 1960), larvae (Gopinath, 1946; Rao, 1967) and juveniles (Basheerudin & Nayar, 1962).

55. *Thryssa purava* (Ham.-Buch., 1822) (Fig. 55)

Clupea purava Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 238, 382 (Ganges estuaries).

Thryssa megastoma Swainson, 1839, *Nat. Hist. Anim.*, 2 : 293 (on *Pedda poorwah* of Russell, 1803, *Fishes of Coromandel*, 2 : 73, pl. 190).

? *Engraulis samam* Thiollière, 1857, *Fauna Woodlark* : 209 (Woodlark Island).

Engraulis hornelli Fowler, 1924, *J. Bomb. nat. Hist. Soc.*, 30 (1) : 41 (Calicut).

? *Engraulis annandalei* Chaudhuri, 1916, *Mem. Indian Mus.*, 5 (4) : 419 (Chilka lake).

Synonymy : Fowler (1941).

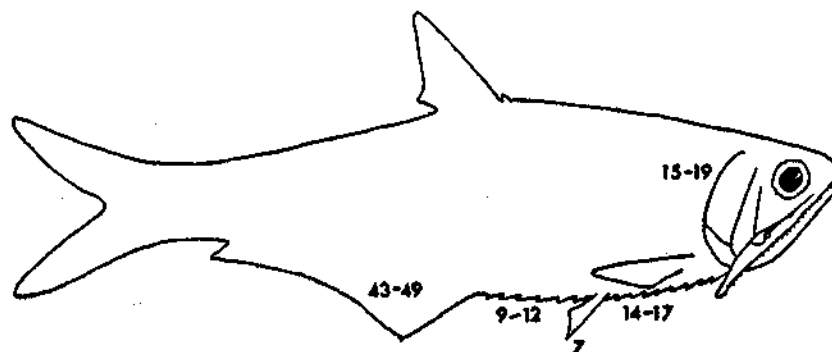


Fig. 55. *Thyssa purava* (Ham.-Buch.).

Description : Whitehead, 1965a (1 specimen, Persian Gulf).

Distribution : Persian Gulf, not Red Sea (Whitehead, 1965b), W. Pakistan (Karachi—BMNH specimens), India (Sind, Bombay, Ernakulam, Madras, Calcutta—BMNH specimens), ? Malaya (Whitehead, 1969b), Sittang river (Burma), Cochin China (BMNH specimens).

Note : *Engraulis annandalei* may represent a Chilka Lake variant of *T. purava*. The holotype (Indian Museum No. F 8781/1) has the following features (Babu Rao, 1971) : in percentages of S.L., body depth 28.6, head length 21.4, eye diameter 5.4, snout length 3.9, maxilla length 23.2 (to pectoral base), length of anal base 38.6 ; 14 pectoral rays, ii 43 anal rays, 14+18 gillrakers.

The skull of this species has been described by Moona (1968), breeding biology by Palekar & Karandikar (1952) and larvae by Rao (1967).

56. *Thyssa dussumieri* (Valenciennes, 1848) (Fig. 56)

Engraulis dussumieri Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 69 (no locality).

Engraulis auratus Day, 1865, *Proc. zool. Soc. Lond.* : 312 (Cochin, Malabar).

Trichosoma adalae Rutter, 1897, *Proc. Acad. nat. Sci. Philad.* : 65 (Swatow, China).

Synonymy : Fowler, 1941 (*auratus*, *adalae*); Whitehead, 1967a (*dussumieri*); Talwar & Whitehead, 1971 (*auratus*).

Description : Whitehead, 1967a (putative neotype, Arabian Sea); Whitehead, 1969b (Arabian Sea—maxilla length, scute and gillraker counts).

Distribution : Arabian Sea, W. Pakistan coasts (Whitehead, 1969b), India (Malabar—*auratus* ; Waltair, Bay of Bengal—BMNH specimens) ; Bombay, Calicut—Murty, 1969), Malaysia (Whitehead, 1969b), Java (Bleeker material), ? Swatow (*adetae*).

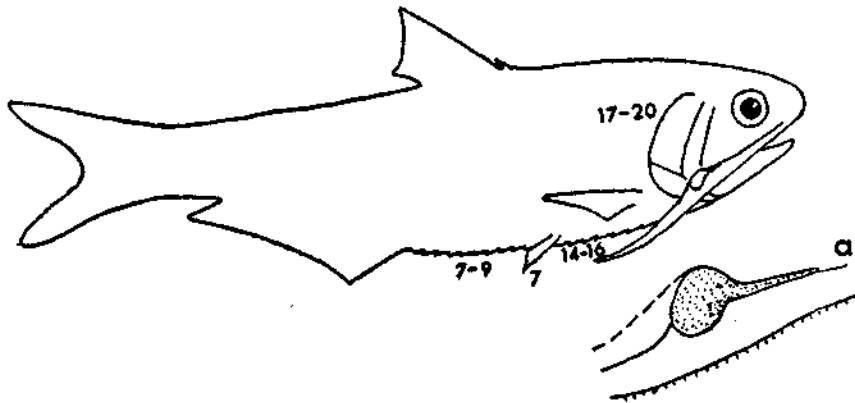


Fig. 56. *Thryssa dussumieri* (Valenciennes), showing absence of 1st supra-maxilla (a).

Note : In this species the relative length of the maxilla appears to remain constant at least in fishes over 45 mm. S.L. (maxilla 38.0-44.6% of S.L. in 12 fishes of 45.7-110.4 mm. S.L.—Whitehead, 1969b).

Comments on the breeding of *T. dussumieri* were given by Dharmamba (1960) and presumed juveniles of this species were described by Chacko (1950).

57. *Thryssa vitrirostris* (Gilch. & Thomp., 1908) (Fig. 57)

Engraulis vitrirostris Gilchrist & Thompson, 1908, *Ann. S. Afr. Mus.*, 6 : 201 (Durban, Natal).

Synonymy : Dutt, 1961b (*vitrirostris* distinct from *mystax*).

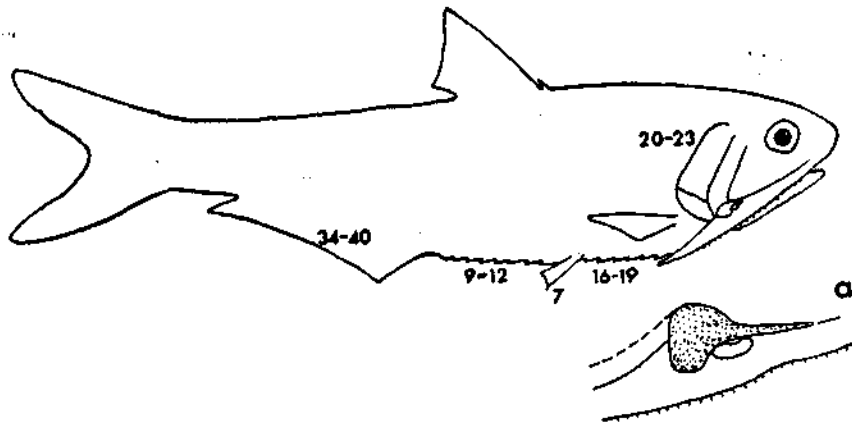


Fig. 57. *Thryssa vitrirostris* (Gilchr. & Thomp.), showing the presence of two supra-maxillae (a).

Description : Gilchrist & Thompson, 1908 (the types) ; Dutt, 1961b (25 specimens, Waltair) ; Whitehead, 1965a (12 specimens, Persian Gulf and Gulf of Oman) ; Losse, 1968 (20 specimens, East Africa).

Distribution : Madagascar, Natal (BMNH specimens), East Africa (Losse, 1968), Persian Gulf, Gulf of Oman (Whitehead, 1965a), Arabian Sea (Whitehead, 1969b), India (Bombay—BMNH specimens ; Waltair—Dutt, 1961b and BMNH specimens).

Note : The anterior supra-maxilla is usually present but in four Arabian Sea specimens (sample of seven) this bone was missing. Dutt (1961b) contrasted the bright orange gill cavity in this species with the lighter orange found in *T. mystax*. Babu Rao & Jayaswal (1969) found slight negative allometry in maxilla length relative to S.L. (22.6-27.9%, but only four fishes cited, 129-135 mm. S.L.).

Southern African specimens in the Smithsonian Oceanographic Sorting Center collections (samples 476, 480, ex Durban, Mozambique, 21.2-152.1 mm S.L.) have not or but faintly clumped gillraker serrae, although the gillraker counts of 21 (5 fishes), 22 (13), 23 (19), 24 (4) are higher than in the otherwise very similar *T. mystax* (14-17 in over 50 Vizagapatnam specimens—Dutt, *in litt.*). The maxilla reaches to or beyond the pectoral base in all specimens over 25 mm S.L., representing 27.4 (largest fish) and 30.8—32.4% of S.L. in 10 fishes of 65.4-120.5 and 152.1 mm S.L.

58. *Thryssa hamiltonii* (Gray, 1835) (Fig. 58)

Thryssa hamiltonii Gray, 1835, *Illustr. Ind. Zool., Hardwicke*, 2 : pl. 92 (no locality).

Engraulis grayi Bleeker, 1851, *Natuurk. Tijdschr. Ned.-Indië*, 2 : 492 (Batavia, Rio).

Synonymy : Whitehead *et al.*, 1966 (*grayi*).

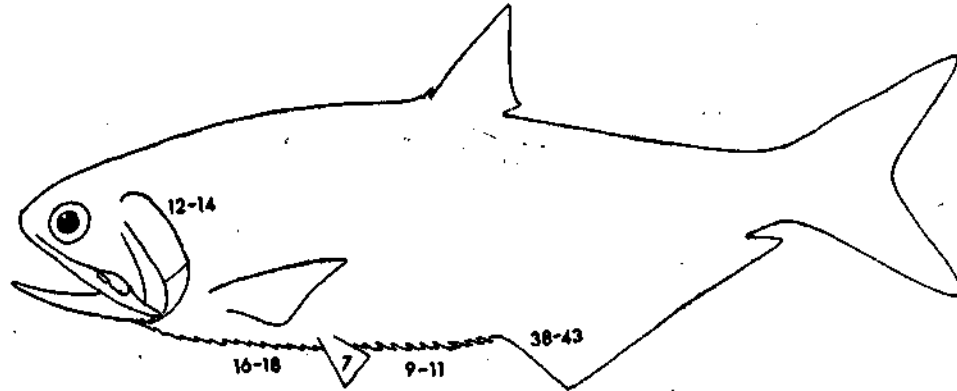


Fig. 58. *Thryssa hamiltonii* (Gray).

Description : Whitehead, 1965a (1 specimen, Persian Gulf) ; Whitehead *et al.*, 1966 (*grayi* type).

Distribution : Persian Gulf (Whitehead, 1965a, also Basra—BMNH specimens), W. Pakistan (BMNH specimens), India (Calicut, Porto Novo, Madras—BMNH

specimens), Ceylon (Smithsonian specimen), Andaman Is., Malaysia (BMNH specimens), Indonesia (Bleeker material—*poorawah*), China (BMNH specimens), W. Australia (BMNH specimens).

Note: Except for its shorter maxilla, this species closely resembles *T. mystax* and the two have probably been confused. Studies believed to relate to this species include descriptions of general biology (Mookerjee & Mookerjee, 1950), breeding (Masurekar & Rege, 1960) and eggs (Devanesen & Varadarajan, 1942; Vijayaraghavan, 1957—as *grayi*).

59. *Thryssa malabarica* (Bloch, 1795) (Fig. 59)

Clupea malabaricus Bloch, 1795, *Naturg. auslând. Fische*, 9 : 115, pl. 432 (Tranquebar).

Thryssa cuvieri Swainson, 1839, *Nat. Hist. Anm.*, 2 : 293 (on *Poorwa* of Russell, 1803, *Fishes of Coromandel*, 2 : 75, pl. 194).

? *Engraulis kempii* Chaudhuri, 1916, *Mem. Indian Mus.*, 5 (4) : 421, fig. 4 (Chilka lake).

? *Engraulis rambhae* Chaudhuri, 1916, *Mem. Indian Mus.*, 5 (4) : 423, fig. 5 (Chilka lake).

? *Engraulis scratchleyi* Ramsey & Ogilby, 1886, *Proc. Linn. Soc. N.S.W.*, (2) 1 : 18 (Strickland river New Guinea).

? *Thryssa gôutamiensis* Babu Rao, 1970, *Adv. Abstr. Contr. Fish. aquat. Sci. India*, 4 (1) : 63 (Godavari river—name only); *Idem*, 1971, *Copeta*, No. 3 : 479, fig. 1 (Godavari and Hooghly Rivers, India).

Synonymy: Whitehead, 1969a (*malabaricus*); Fowler, 1941 (*cuvieri*); Whitehead, 1969b (*scratchleyi*? = *malabarica*).

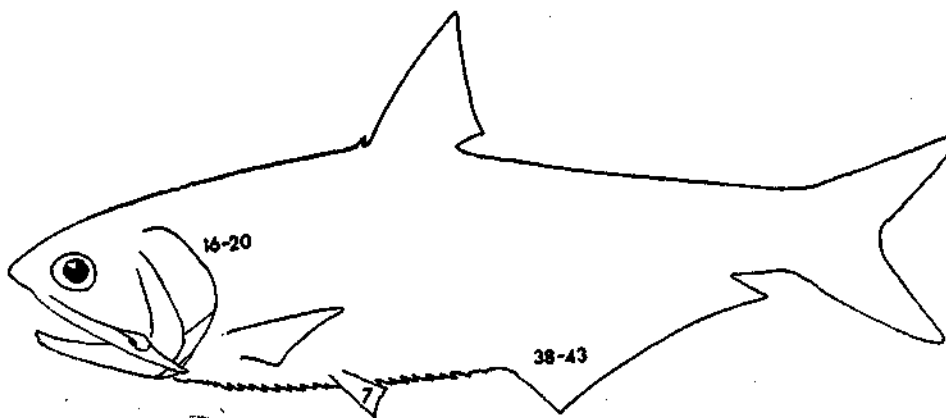


Fig. 59. *Thryssa malabarica* (Bloch).

Description: Whitehead, 1969a (*malabaricus*, type); Dutt, 1967b (*rambhae* type and 25 specimens, Chilka Lake).

Distribution: Not East Africa or Red Sea area (Losse, 1968; Whitehead, 1965a), W. Pakistan (Karachi—BMNH specimens), India (Bombay, Canara, Malabar,

Porto Novo, Madras, Waltair—BMNH specimens; ? Chilka Lake—Chaudhuri's species), not Indonesia (Whitehead, 1969b), ? New Guinea (*scratchleyi*).

Note: Babu Rao (1971) allied his *T. gautamiensis* most closely to Chaudhuri's *annandalei* (here referred tentatively to *T. purava*) and virtually ignored its much closer resemblance to *T. malabarica* (in which the maxilla also projects beyond the opercular margin in the putative neotype—Whitehead, 1969a: fig. 2). Babu Rao's specimens consistently lacked the 1st supra-maxilla, but its occasional absence in *T. vitrirostris* suggests that other features should be sought before the Godavari and Hooghly fishes are considered a distinct species. Babu Rao (loc. cit.) regarded Chaudhuri's *E. kempii* as juveniles of his *E. annandalei* (single specimen), hence their shorter maxilla; this is further discussed by Babu Rao & Jayaswal (in preparation).

60. *Thryssa kammalensis* (Bleeker, 1849) (Fig. 60)

Engraulis kammalensis Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22: 13 (Madura Straits near Kammal and Surabaya).

Engraulis rhinorhynchos Bleeker, 1852, *Nat. Tijdschr. Ned.-Indie*, 3: 434 (Sampit, Batavia, Surabaya, Kammal).

Synonymy: Whitehead *et al.*, 1966 (*kammalensis*, *rhinorhynchos*).

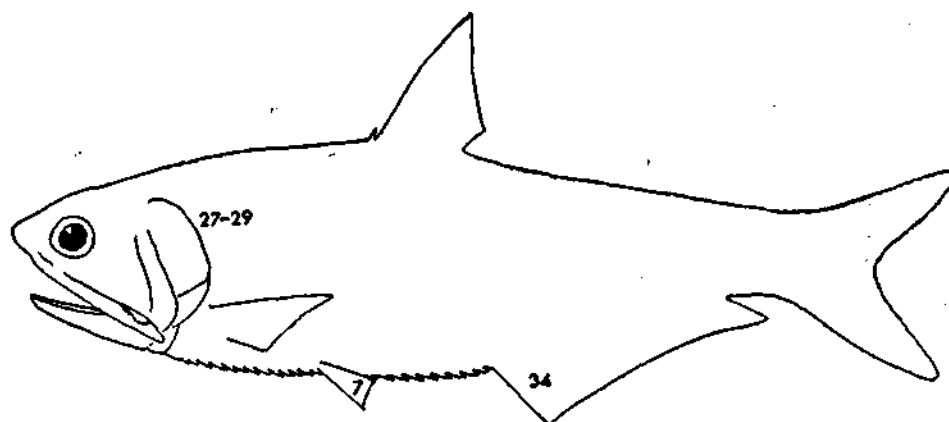


Fig. 60. *Thryssa kammalensis* (Bleeker).

Description: Whitehead *et al.*, 1966 (*kammalensis* type).

Distribution: India (Godavari river—BMNH specimens), Malaysia (Whitehead, 1969b), Indonesia (Bleeker material), Thailand (BMNH specimens), Papua (Munro, 1964).

Note: Larvae believed to be this species were described by Rao (1967).

Setipinna Swainson, 1839

Setipinna Swainson, 1839, *Nat. Hist. Anim.*, 2 : 292 (Type : *Setipinna megalura* Swainson = *Clupea phasa* Ham.-Buch., designated by Swain, 1882, *Proc. Acad. nat. Sci. Philad.* : 280).

Telara Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 54 (Type : *Clupea telara* Ham.-Buch. = *Clupea phasa* Ham.-Buch.).

Synonymy : Whitehead, 1967a (*Setipinna*, *Telara*, the latter first used by Valenciennes and not Günther).

Species : five species are known (Whitehead, 1968b), recorded from India, the Indo-Malayan Archipelago, Cochin China, Hong Kong and possibly Amoy and Korea (Fowler, 1941).

Key to the species *Setipinna*

- I. Dorsal origin nearer to snout than to caudal base ; lower gillrakers 12-18 ; mouth slightly oblique
 - A. Gillrakers 14-16+17-20
 1. Anal with 48-60 rays ; pre-pelvic scutes 18-26 ; gillraker serrae in distinct clumps of longer serrae (Fig. 61a).....*S. taty* (p. 237)
 2. Anal with 72-75 rays ; pre-pelvic scutes 15-16 ; gillraker serrae slightly clumped in smaller fishes (Fig. 62a).....*S. phasa* (p. 238)
 - B. Gillrakers 10-11+12-16 ; gillraker serrae not clumped (Fig. 63a).....*S. godavari* (p. 239)
- II. Dorsal origin at mid-point of body or nearer to caudal base ; lower gillrakers 11-13 ; mouth very oblique, lower jaw projecting
 - A. Anal with 44-50 rays.....*S. melanochir* (Indonesia, Thailand, & Amoy)
 - B. Anal with 60 rays.....*S. breviceps* (? Burma, Indonesia, Cochin China)

61. *Setipinna taty* (Valenciennes, 1848) (Fig. 61)

Engraulis taty Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 60 (Pondicherry).

Engraulis tenuifilis Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 62 (Rangoon).

Engraulis telaroides Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 13 (Madura, near Sampang, Kammal, Surabaya).

Setipinna gilberti Jordan & Starks, 1905, *Proc. U.S. natn. Mus.*, 28 : 194, fig. 1 (Chemulpo, Korea).

Synonymy : Whitehead, 1967a (*taty*, *tenuifilis*) ; Whitehead *et al.*, 1966 (*telaroides*) ; Fowler, 1941 (*gilberti*).

Description : Whitehead *et al.*, 1966 (*telaroides* type) ; Whitehead, 1967a (*taty*, *tenuifilis* types).

Distribution : India (Bombay—BMNH specimens ; Pondicherry—*taty* ; Godavari estuary—Babu Rao, 1962 ; Madras, Orissa, Delhi—BMNH specimens ; Gulf of Mannar—Murty, 1969), Andaman Is., (BMNH specimens), Indonesia (Bleeker

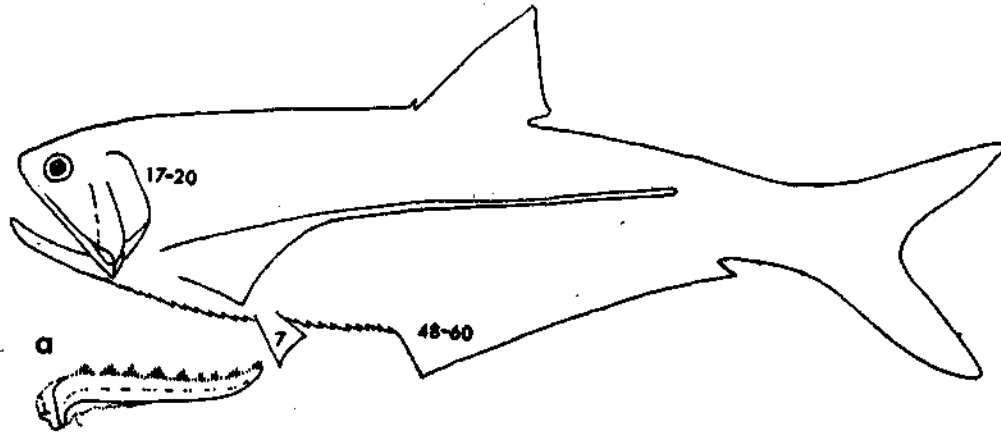


Fig. 61. *Setipinna taty* (Valenciennes), showing clumping of serrae along gillrakers (a).

material), Malaysia, Thailand, Sarawak, Amoy (BMNH specimens), Hong Kong, Korea (Fowler, 1941 and *gilberti*).

Note : Eggs and larvae believed to be of this species were described by Delsman (1932a).

62. *Setipinna phasa* (Ham.-Buch., 1822) (Fig. 62)

Clupea phasa Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 240, 382 (brackish rivers of Bengal).

Clupea telara Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 241, 382 (high up the Ganges).

Setipinna truncata Swainson, 1839, *Nat. Hist. Anim.*, 2 : 292 (on *Clupea telara* Ham.-Buch.).

Setipinna megalura Swainson, 1839, *Nat. Hist. Anim.*, 2 : 292 (on *Clupea phasa* Ham.-Buch.).

Engraulis brevifilis Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 54 (Bengal).

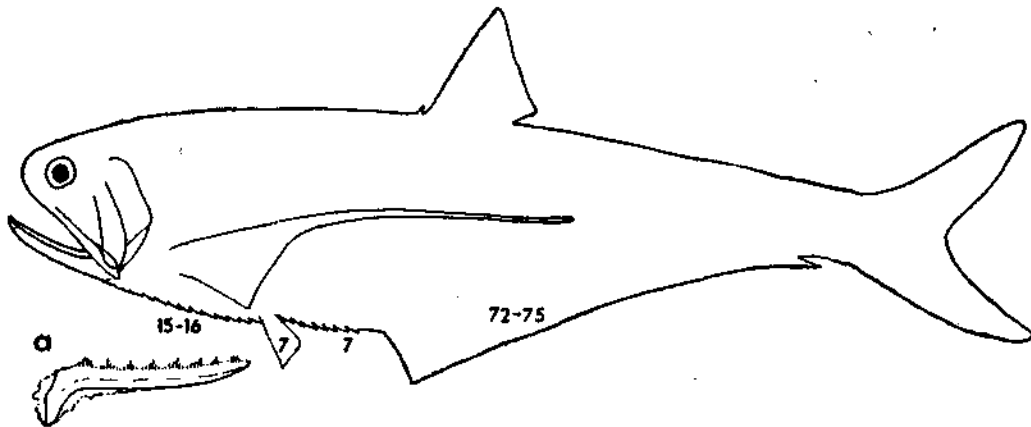


Fig. 62. *Setipinna phasa* (Ham.-Buch.), showing clumping of serrae along gillrakers in small specimens (a).

Synonymy : Fowler, 1941 (*truncata*, *megahura*) ; Whitehead, 1967a (*brevifilis*).

Description : Whitehead, 1967a (*brevifilis* type).

Distribution : India (Allahabad, Orissa, Calcutta, Ganges—BMNH specimens and Jones & Menon, 1950) ; Sittang River, Burma (BMNH specimens).

Note : Breeding biology in this species has been outlined by Jones & Menon (1950) and Jhingran (1963), early stages were described by Nair (1940) and Chandra (1964) and the pituitary was studied by Sathyanesan (1961—as *telara*).

63. *Setipinna godavari* Babu Rao, 1961 (Fig. 63)

Setipinna godavari Babu Rao, 1961, *Proc. Ist. all-India Congr. Zool.*, 1959 : 367 (Godavari estuary).
Setipinna papuensis Munro, 1964, *Papua & New Guinea agric. J.*, 16 (4) : 150, fig. 1 (Port Romilly, Gulf of Papua).

Synonymy : Whitehead, 1968b (distinct from *S. taty* and *S. phasa* ; *papuensis*).

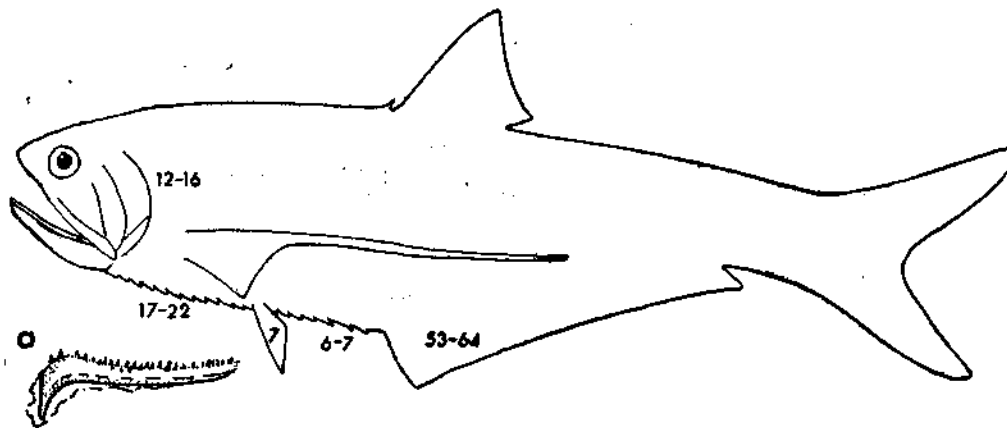


Fig. 63. *Setipinna godavari* Babu Rao, showing uneven but not clumped serrae along gill-rakers (a).

Description : Babu Rao, 1961 (100 specimens, Godavari estuary) ; Munro, 1964 (27 specimens, Papua).

Distribution : India (Godavari estuary—Babu Rao, 1961 ; Bay of Bengal—Whitehead, 1968b and BMNH specimens), Papua (*papuensis*).

Note : The superficial resemblance of this species to *S. taty* suggests that the absence of records between the Godavari estuary and Papua probably results from misidentifications. Babu Rao & Joglekar (1968) made a comparison between specimens from the Hooghly and the Godavari and found slight differences ; they described the species under the cheironym *godavariensis* instead of its first published name *godavari*.

Subfamily COILINAE

The 'rat-tailed' anchovies are quite distinctive. All are placed in a single genus found from India eastwards to Japan.

Coilia Gray, 1831

[*Mystus* Linnaeus, 1754, *Chinensia Lagerströmiana-Dissertatio* : 26, fig. 12 (Type ; *Mystus ensiformis* Linnaeus = *Clupea mystus* Linnaeus) (inadmissible—pre-1758).

Mystus Lacépède, 1803, *Hist. Nat. Poiss.*, 5 : 466 (Type : *Mystus clupeoides* Lacépède = *Clupea mystus* Linnaeus) (pre-occupied by *Mystus* of Gronow, 1763, Klein, 1775, Scopoli, 1777).

Coilia Gray, 1831, *Illustr. Ind. Zool., Hardwicke*, 1 : pl. 85 (2) (caption only) ; *Idem*, 1831, *Zool. Misc.* : 9 (Type : *Engraulis (Coilia) hamiltonii* Gray = *Mystus ramcarati* Ham.-Buch.).

Choetomus McClelland, 1843, *Calcutta J. nat. Hist.*, 4 : 405 (Type : *Choetomus playfairii* McClelland = *Clupea mystus* Linnaeus).

Leptonurus Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 14 (Type : *Leptonurus chrysostigma* Bleeker = *Coilia dussumieri* Valenciennes).

Demicoilia Jordan & Seale, 1925, *Copeia*, No. 141 : 28 (Type : *Coilia quadragesimalis* Valenciennes = *Mystus ramcarati* Ham.-Buch.).

Synonymy : Whitehead, 1967a (*Mystus* of Linnaeus and Lacépède, *Coilia* type, *Thryssa* not a synonym) ; Whitehead *et al.*, 1966 (*Leptonurus*, *Demicoilia*) ; Whitehead, 1968b (*Coilia* type).

Species : Ten species were recognised by Whitehead (1968b) but the genus badly needs revision. *Demicoilia* was based on specimens with amputated and regenerated tails, a not infrequent condition (Jones & Menon, 1952).

Key to the species of Coilia**I. No pearly spots on flanks (light organs)**

A. Pelvic rays i 8-9.....*C. ramcarati* (p. 241)

B. Pelvic rays i 6

I. Maxilla short, not reaching beyond gill opening**a. No pre-pelvic scutes**

i. Pectoral filaments 19.....*C. rebentischii* (Borneo)

ii. Pectorals filaments 11.....*C. polyfilis* (on original description, Sumatra ; no further record).

b. Pre-pelvic scutes present**i. Pectoral filaments 6**

α. Scutes 5-6+8-9.....*C. neglecta* (p. 241)

β. Scutes 17+35.....*C. rendahli* (China)

ii. Pectoral filaments 10-14

α. Scutes 4-6+8-9.....*C. reynaldi* (Rangoon)

β. Scutes 7-10+8-11.....*C. korua* (p. 242)

γ. Scutes 13-14+9-10.....*C. coomansi* (Borneo)

2. Maxilla long, reaching to and beyond gill opening; 6-7 pectoral filaments
 - a. Lower gillrakers 25-30; total scutes 36-41.....
.....*C. mystus* (p. 243)
 - b. Lower gillrakers 21-26; total scutes 46-53
 - i. Depth 4-5 times in S.L.; maxillary teeth of uneven lengths
.....*C. macrognathos* (Borneo, Sarawak)
 - ii. Depth 6-7 times in S.L.; maxillary teeth of even lengths..
.....*C. nasus* (China, Japan).
- II. Longitudinal rows of pearly spots on flanks (light organs); 4-6 free pectoral filaments; scutes 4-6+6-8.....*C. dussumieri* (p. 244)

64. *Coilia ramcarati* (Ham.-Buch., 1822) (Fig. 64)

Mystus ramcarati Hamilton-Buchanan, 1822, *Fishes of the Ganges* : 233, 382 (Ganges estuaries).

Engraulis (Coilia) hamiltonii Gray, 1835, *Illustr. Ind. Zool., Hardwicke*, 1 : pl. 85 (3).

Coilia quadragesimalis Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 83 (Ganges).

Coilia cantoris Bleeker, 1853, *Verh. batav. Genoot. Kunst. Wet.*, 25 : 148, pl. 6 (2) (Calcutta).

Synonymy : Whitehead, 1968b (*ramcarati*, *hamiltonii*) ; Whitehead, 1967a (*quadragesimalis*) ; Whitehead *et al.*, 1966 (*cantis*).

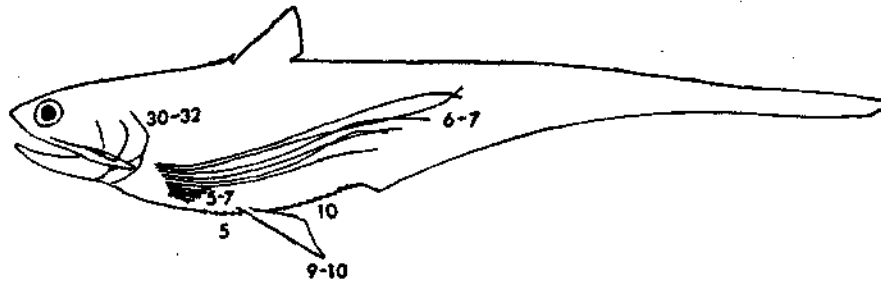


Fig. 64. *Coilia ramcarati* (Ham.-Buch.).

Description : Whitehead *et al.*, 1966 (*cantis* type) ; Whitehead, 1967a (*quadragesimalis* type) ; Whitehead, 1968b (*ramcarati* type).

Distribution : India (Ganges estuaries—BMNH specimens).

65. *Coilia neglecta* Whitehead, 1968 (Fig. 65)

Coilia neglecta Whitehead, 1968b, *J. mar. biol. Ass. India*, 9 (1) : 33 (Arabian Sea, N.W. of Bombay also off Indus, Ganges and Irawaddy deltas).

Synonymy : Whitehead, 1968b (*neglecta* not *C. cantoris* of Bleeker as the description by Fowler (1941) might suggest).

Description : Whitehead, 1968b (11 specimens, Arabian Sea).

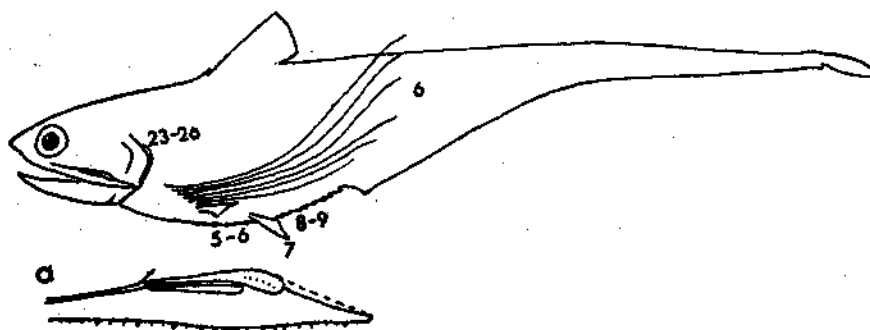


Fig. 65. *Coilia neglecta* Whitehead, showing detail of upper jaw (a).

Distribution : India (off Indus delta southeast to Bombay, Ganges delta—Whitehead, 1968b and BMNH specimens), off Irawaddy delta, Singapore and Thailand (Whitehead, 1968b and BMNH specimens).

66. *Coilia korua* Dutt & Rao, 1973 (Fig. 66)

Coilia korua Dutt & Rao, 1973, *J. Bombay nat. Hist. Soc.*, 69 (1) : 136 (Gollapalem, Andhra).

Coilia whiteheadi Babu Rao, 1973, *J. Bengal nat. Hist. Soc.*, (in press) (Hooghly estuary).

Coilia coomansi : Babu Rao & Jayaswal, 1968, *Adv. Abstr. Contr. Fish. aquat. Sci. India*, 2 (4) : 2, (Hooghly estuary—non *coomansi* Hardenberg).

Synonymy : See below.

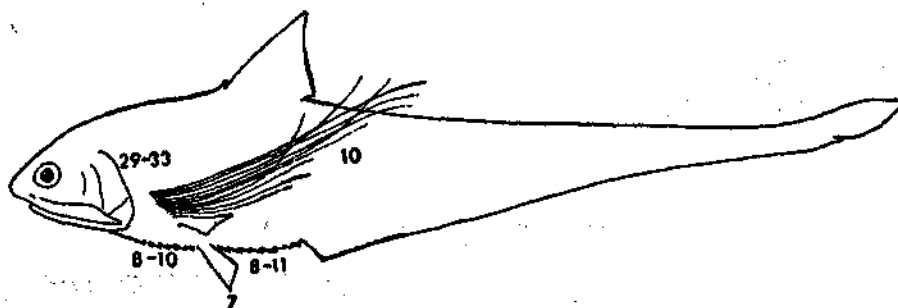


Fig 66. *Coilia korua* Dutt & Rao.

Description : Jones & Menon, 1952 (larvae and juveniles, Chandipur) ; Babu Rao & Jayaswal, 1970 (as *coomansi*) ; Babu Rao, 1971 ; Dutt & Rao, 1973 (types of *korua*).

Distribution : India (Hooghly estuary—Babu Rao & Jayaswal, 1970 ; Babu Rao, 1971 ; at Chandipur, Jones & Menon, 1952 ; ? Palk Bay—Murty, 1969 ; Andhra coast—Dutt & Rao, 1973).

Note : The scute count in this species is intermediate between the counts in *C. reynaldi* and *C. coomansi* (see key). Rather little variation has been found in

pre-pelvic counts in other species. The Chandipur specimens identified as *C. reynaldi* by Jones & Menon (1952) are almost certainly the present species.

67. *Coilia mystus* (Linnaeus, 1758) (Fig. 67)

[*Mystus ensiformis* Linnaeus, 1754, *Chinensia lagerströmiana*—*Dissertatio*: 26, fig. 12] (China, on Lagerström material).

[*Clupea mystus* Osbeck, 1757, *Dagbok Ostind. Resa*: 256] (Canton area).

Clupea mystus Linnaeus, 1758, *Syst. Nat.*, 10th ed.: 319 (on Osbeck and Lagerström material); *Idem*, 1759, *Amoen. Acad.*, 4 (61): 252, fig. 12 (repeat of 1754 descr. and fig.); Cuvier, 1816, *Règne Animal*, 1st ed., 2: 176 (on Linnaeus, 1759); *Idem*, 1829, *ibid.*, 2nd ed., 2: 323 (equated with *Pedda Poorawah* of Russell, 1803—an error).

Mystus clupeoides Lacépède, 1803, *Hist. Nat. Poiss.*, 5: 466, 467 (mers des Indes—chiefly on Osbeck).

Choetomus playfairii McClelland, 1844, *Calcutta J. nat. Hist.*, 4: 405, pl. 24, fig. 3 (China, on Playfair material).

Coilia grayii Richardson, 1845, *Ichthyol. Voy. Sulphur*: 99, pl. 54, Figs. 1-2 (China Seas).

Osteoglossum prionostoma Basilewsky, 1855, *Nov. Mém. Soc. Nat. Moscow*, 10: 244 (Pekin; sinu Tschiliensi et mari orientalis).

Coilia lindmani Bleeker, 1858, *Act. Soc. Sci. Indo-Néerl.*, 3: 48 (Palembang).

Coilia brachygnathus Krayenberg & Pappenheim, 1908, *Sber. Ges. naturf. Freunde Berl.*: 96 (Tungting, Hankow).

Synonymy: Whitehead, 1966a (*ensiformis*, *mystus*, *grayii*, *playfairii*); Whitehead, 1967a (*clupeoides*); Boeseman, 1947 (*nasus*); Whitehead, 1968b (*lindmani*; *ectenés* ? = *macrognathos* of Bleeker); Whitehead *et al.*, 1966 (*lindmani* distinct).

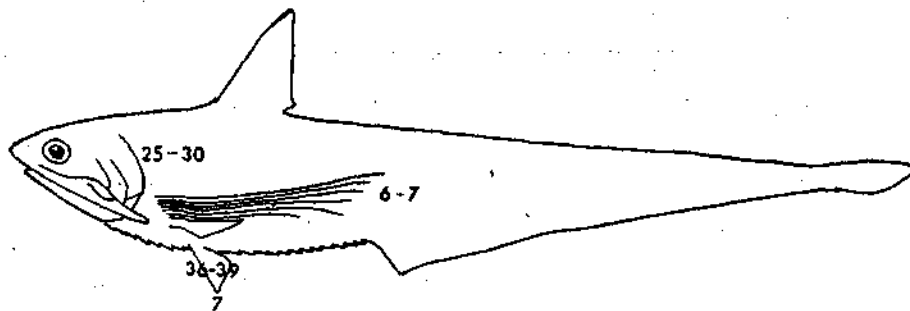


Fig. 67. *Coilia mystus* (Linnaeus).

Description: Whitehead, 1966a (2 specimens, one the types of *grayii*, China); Boeseman, 1947 (*nasus* types); Whitehead *et al.*, 1966 (*lindmani* type).

Distribution: India (see below), Sumatra (*lindmani* type), Borneo, Thailand (BMNH specimens), Hong Kong (Whitehead, 1966a), China, Japan (BMNH specimens).

Note : There are no Indian specimens of *C. mystus* in the British Museum and Indian records have been considered doubtful. Talwar (1973), however, has reported four specimens 104.0-190.0 mm S.L. from Ernakulam (Kerala).

68. *Coilia dussumieri* Valenciennes, 1848 (Fig. 68)

Coilia dussumieri Valenciennes, 1848, *Hist. Nat. Poiss.*, 21 : 81, pl. 610 (Bombay).

Leptonurus chryso stigma Bleeker, 1849, *Verh. batav. Genoot. Kunst. Wet.*, 22 : 14 (Madura, near Kamal and Surabaya).

Coilia quadrifilis Günther, 1868, *Cat. Fishes Brit. Mus.*, 7 : 403 (Penang, Malaya Peninsula, Singapore).

Demicoilia margaritifera Jordan & Seale, 1926, *Bull. Mus. comp. Zool., Harv.*, 67 : 363 (Colombo, Ceylon).

Choetomus playsfairii McClelland, 1844, *Calcutta J. nat. Hist.*, 4 : 405, pl. 24, fig. 3 (China, on Playfair material).

Synonymy : Whitehead, 1967a (*dussumieri*) ; Whitehead *et al.*, 1966 (*chryso stigma*, *margaritifera*) ; Whitehead, 1969b (*quadrifilis*).

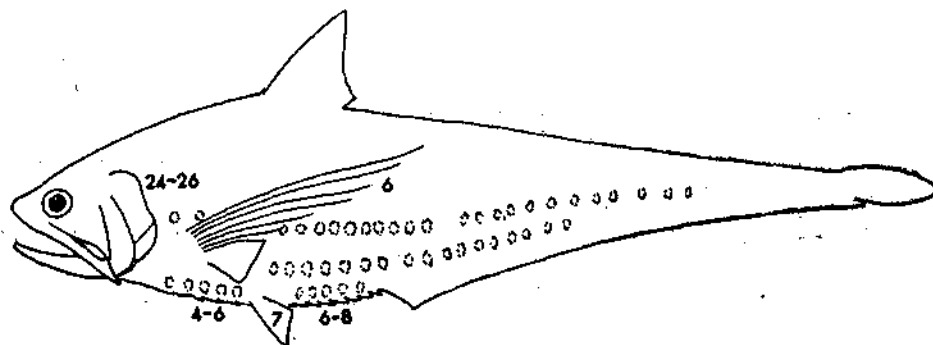


Fig. 68. *Coilia dussumieri* Valenciennes.

Description : Jones & Menon, 1952 (larvae, juveniles, Burhabalang estuary) ; Whitehead *et al.*, 1966 (*chryso stigma* type) ; Whitehead, 1967a (*dussumieri* type).

Distribution : India (Bombay—*dussumieri* ; Calicut—Murty, 1969 ; Jaunput, Chandipur, Burhabalang estuary—Jones & Menon, 1952), Ceylon (*margaritifera*), Malaysia (*quadrifilis*), Bangka, Java, Madura (Bleeker material).

Note : Valenciennes (1848 : 83) listed Mahé for this species but there are no Seychelles specimens in Paris. Smith & Smith (1963) included the species in the Seychelles fish fauna solely on the Valenciennes record. The latter is doubtful since no member of *Coilia* has yet been recorded from the Red Sea region or coasts of Africa (Whitehead, 1965a ; Losse, 1968). The silvery spots along the flanks were identified as light organs by Haneda (1961), but this requires further investigation. Studies on this species include notes on its general biology (Bal & Joshi, 1956 ; Gadgil, 1967), maturation of gonads (Palekar & Karandikar, 1953), eggs and larvae (Delsman, 1932b) and a description of the skull (Moona, 1960).

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