

THE ELOPOID AND CLUPEOID FISHES OF EAST AFRICAN COASTAL WATERS

by

G. F. LOSSE

(*East African Marine Fisheries Research Organization, Zanzibar**)

INTRODUCTION

Fishery statistics show that the herring-like fishes are among the most important in world fisheries of the present day (FAO, 1966). In East African waters, prior to the introduction of commercial pelagic fishing methods (EAMFRO, 1962; Losse, 1964, 1966), these fishes were exploited in very small quantities by a variety of indigenous fishing techniques, and virtually nothing was known of the species; their identity, biology or fishing potential.

During preliminary biological and fishery investigations of fish caught by introduced purse-seine fisheries in the Zanzibar area of East Africa, it was found that accurate descriptions of species were required before these studies could be accomplished successfully. A large collection of clupeoid fish was therefore made during the routine investigations of the East African Marine Fisheries Research Organization (EAMFRO) from March 1963 to June 1966.

Specimens were obtained from commercial purse-seine and stick-held dipnet (*bouke-ami*) catches taken in the Zanzibar Channel; also from catches made by indigenous fishermen with stake traps, castnets, shore-seines and hook and line, along the entire East African coast. Additional material was obtained from catches made by handnet, stick-held dipnet, seine, demersal trawling in estuaries and hand-lining, during cruises on the Organization's (EAMFRO) vessels R L CHERMIN and FRV MANIHINE. This material forms the basis of the descriptions in this paper, in which twenty-three distinct species, including two new distributional records, are described.

The biology of the species is still poorly known and little data is available on species of doubtful commercial value. Observations on the biology and fishery of the species are in preparation.

The present study could not have been completed without the examination of specimens from the clupeoid collection at the British Museum (Natural History) in London during the summer of 1964. The East African collection described here has now been donated to this museum.

MEASUREMENTS

Standard length and all other body measurements cited in the descriptions of clupeoid fish were made with dial calipers on preserved material.

Standard length (S.L.) is measured from the tip of the snout (jaws closed) to the caudal base. All measurements are expressed in percentages of standard length; *depth*, the depth of the body measured at the dorsal origin; *head*, the length from the snout tip (jaws closed) to the most posterior edge of the operculum, i.e. not necessarily a horizontal line; *snout, eye, post-orbital* measured in a horizontal line passing through the centre of the eye; *interorbital*, the bony inter-space between the eyes measured at eye centre; *upper jaw*, measured from the pre-maxillary symphysis to the posterior tip of the maxilla; *lower jaw*, measured from the dentary symphysis to the posterior border of the articular; *pectoral fin, pelvic fin*, the lengths of these fins measured

*Present address: c/o Department of Fisheries, FAO, Rome.

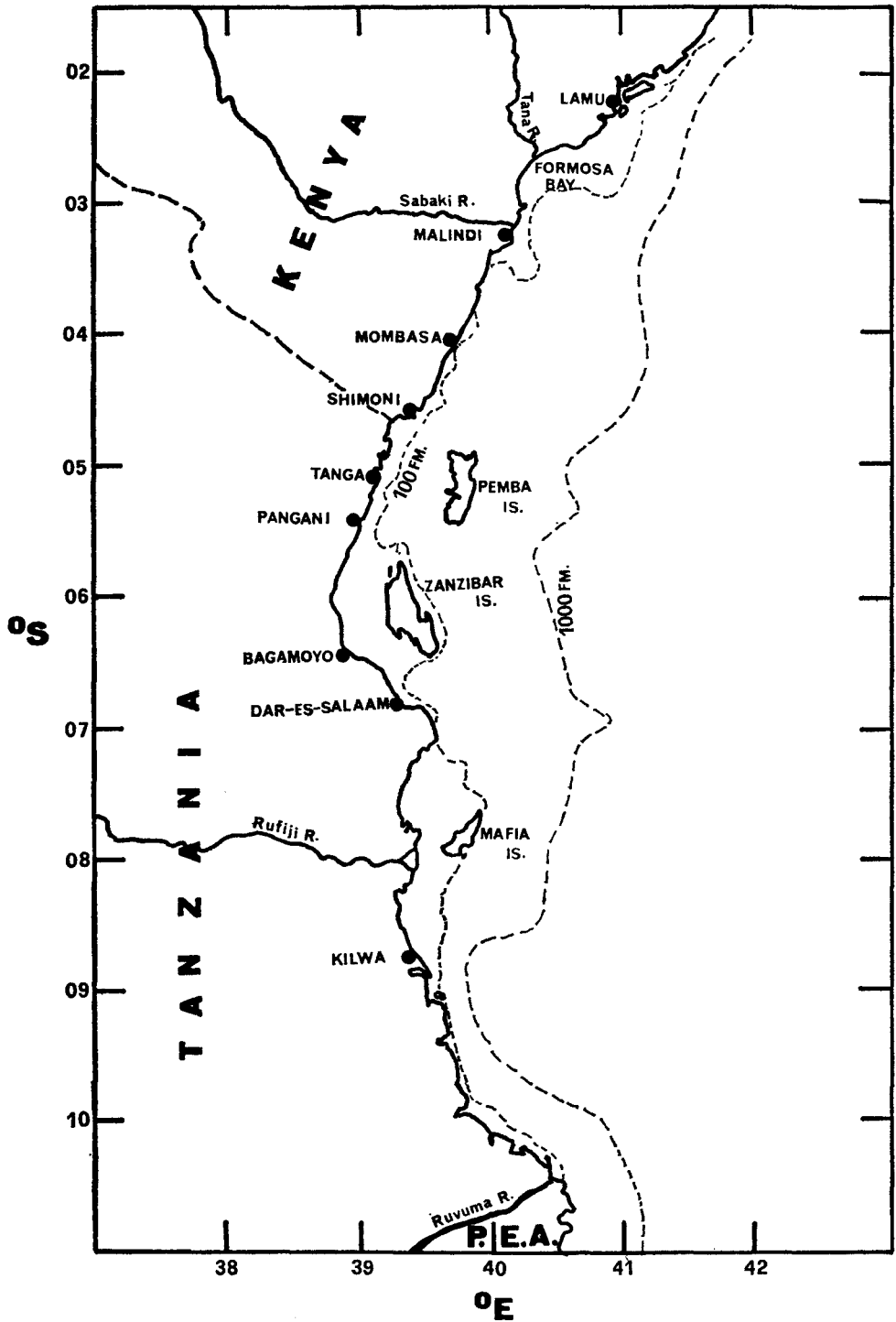


Figure 1 Chart of the coastal waters of East Africa showing the 100 fm and 1000 fm contours and the main localities mentioned in the text.

from the tip of the longest ray to the origin of the respective fins; *pre-dorsal*, *pre-pelvic*, *pre-anal*, these distances measured from the snout tip to the origin of the respective fins; *caudal peduncle*, the minimum depth at the base of the caudal fin.

In *fin counts* simple (unbranched) rays are represented by small (lower case) roman numerals and branched rays by arabic numerals. Spines are shown by large (upper case) roman numerals. In *ventral scute counts* the pre-pelvic count includes the pelvic scute; the first post-pelvic scute lies between the bases of the pelvic fins and lacks ascending arms (Whitehead, 1965b). *Lateral scales* or *scale pockets* are counted at mid-body from the operculum to the caudal base. *Vertebral counts* include the urostyle. Measurements and counts outside the normal ranges are placed in parenthesis.

NOMENCLATURE

Classification to family level is based on Whitehead (1963a).

In the synonymy reference is made to the original description, other subsequent records from East African waters and the more important literature from adjacent areas (i.e. from the Red Sea to Natal and the Oceanic islands); after the date of publication follow page numbers, plates, figures and localities.

Standard common names are introduced here for the first time. These are based on names frequently in use by fishery scientists and fishery officers in East Africa. Vernacular names follow their Swahili rendering and were obtained from the indigenous fishermen of the coast.

East Africa refers throughout only to the coast of Kenya and Tanzania and the offshore islands of Pemba, Zanzibar and Mafia (Fig. 1). Eastern Africa refers to the whole eastern side of the African continent, from the Red Sea to Natal.

Sub-order ELOPOIDEI

Key to the East African Families

- | | | |
|--|--|--------------------|
| 1. Mouth terminal; upper jaw bordered by maxillae and pre-maxillae: | | |
| (i) Last dorsal ray not filamentous; pseudobranch exposed | | Family Elopidae |
| (ii) Last dorsal ray filamentous; pseudobranch not exposed | | Family Megalopidae |
| 2. Mouth inferior; upper jaw bordered by pre-maxillae only | | Family Albulidae |

Family ELOPIDAE

TENPOUNDERS

A single genus widely distributed in tropical seas.

Genus ELOPS

Elops Linnaeus, 1766: 518 (Type: *Elops saurus* Linn.)

Argentina Forskal (*part.*), 1775: 68.

The genus has been revised by Regan (1909), Bertin (1944a) and Whitehead (1962).

A single species in East African waters.

ELOPS MACHNATA (Forsk.)

Plate 1a

Argentina machnata Forskal, 1775: 68 (Type locality: Djedda, Red Sea).

Elops machnata: Rüppell, 1835: (80) 74 (Red Sea); Günther, 1866: 121, fig. (caudal, Zanzibar); Sauvage, 1891: 497, pl. 49a, fig. 4 (Madagascar); Gilchrist & Thompson, 1917: 29 (references); Whitehead, 1962: 321 (Indo-Pacific specimens; revision all *spp.*); Losse, 1964: 12 (Zanzibar Channel); Whitehead 1965b: 231 (Red Sea, Gulf of Aden); Losse, 1966a: 89 (Zanzibar); *Idem*, 1966b: 167 (East Africa; Dar-es-Salaam, Zanzibar, Shimoni, Mombasa, Fundishu, Lamu); *Idem*, 1966c: 50 (Zanzibar Channel). *Elops saurus*: Günther, 1868: 470 (East Africa, Zanzibar); Sauvage, 1891: 497, pl. 49a, fig. 4 (Madagascar); Boulenger, 1909: 25, fig. 17 (Zanzibar, East Africa); Gilchrist & Thompson, 1908-11: 270 (Natal); Gilchrist, 1913: 30, pl. 2 (Algoa Bay, East London, Delagoa Bay); Smith, 1949-1965: 86, fig. 100 (Natal); Baissac, 1951: 124 (Mauritius); Morrow, 1954: 803 (Kenya); Smith, 1955: 306 (Aldabra); Fourmanoir, 1957: 5 (Madagascar); Smith, 1958: 131 (Inhaca, Mozambique); *Idem*, 1963: 8, pl. 44 (Seychelles); Talbot, 1965: 464 (Mafia).

STANDARD COMMON NAME: Tenpounder.

VERNACULAR NAMES: *Ganati* or *Mkami kuoza* (Malindi), *Munyimbi* (Shimoni), *Mkizi* (Zanzibar).

DESCRIPTION: Based on two fishes, 873–890 mm. standard length, from the Mafia Channel, eleven, 169–866 mm., from Zanzibar and one, 410 mm., from Lamu.

Dorsal 21–24 (3–4 of which are simple rays), pectoral i 15–17, pelvic i 12–14, anal 13–15 (2–3 of which are simple rays). Abdominal scutes and pelvic scute absent. Gillrakers 6–9+12–14, total 20–23 on 1st gill arch. The anterior rakers on the upper and lower arch are often reduced to low (movable) tubercles. Branchiostegal rays 29–33. Scales thin, small, firmly adherent, 86–106 in lateral series, plus 6–7 more on caudal. Pre-dorsal scales 43–44 (Mafia specimens), 13 above lateral line and 12 below. Vertebrae 60–63 (nine Zanzibar specimens).

Depth 15.2–20.1, head 18.4–27.2, snout 5.0–6.6, eye 3.9–5.9, post-orbital 12.5–13.9, inter-orbital 3.8–4.8, upper jaw 12.2–15.3, lower jaw 11.0–16.3, maxilla 9.3–12.9, pectoral fin 11.6–14.8, pelvic fin 10.2–14.8, pre-dorsal 49.1–55.3, pre-pelvic 44.5–55.7, pre-anal 76.0–81.7, gular plate, length 7.7–10.0, width 1.5–2.4, pectoral axillary scale 7.1–9.5, pelvic axillary scale 6.6–9.2.

Body elongate, scarcely compressed. Lower jaw variable; either included within the upper and not covering the anterior pre-maxillary toothband or projecting and covering part or whole of the pre-maxillary toothband; this character varied with size, the larger specimens possessing the longest jaws. Mouth large and terminal, scarcely inclined. Maxillary reaching beyond the posterior edge of the orbit. Teeth in villiform bands in jaws, on vomer, palatines and tongue. Gular plate large. Pseudobranch exposed. Adipose eye-lids broad. Lateral line straight with simple tubes. Anal fin far behind dorsal fin base; dorsal and anal fin with scaly sheaths, into which fins can fold completely. Last dorsal ray not elongated.

COLOUR: *Fresh*, dorsal scales bluish, their lateral and posterior borders black. Sides silvery, with a golden sheen or hue in death. Ventral surface white. Top of head dark brown to black with a greenish hue. A greenish spot in front of nares. Sides of head silver with a golden sheen. Black streak at upper posterior edge of operculum. Caudal fin dark brown to black, violet reflections at base. Anal and pelvic fins yellowish. Pectoral and pelvic axillary scales golden yellow, speckled brown.

In alcohol, dorsal surfaces dark brown to black, flanks silvery. Ventral surfaces white. Dorsal and anal fins dark brown, darkest (almost black) at margins, other fins brownish.

SIZE: 890 mm. S.L. (♀, 13 lb., Mafia Channel), weight 14 lb. (♂, 866 mm. S.L., Zanzibar Channel); average 30 in. and 30 lb. in South African seas (Smith, 1949).

DISTRIBUTION: Entire East African coast (recorded from the Mafia Channel, Dar-es-Salaam, Zanzibar, Shimoni, Mombasa, Malindi, Fundishu and Lamu), in estuaries, mangrove areas, lagoons and saline pools (Fundishu, Zanzibar); generally over a muddy or sandy bottom, often together with *Megalops cyprinoides*. The species was rarely found out to sea and apparently shows a preference for euryhaline conditions.

RANGE: Eastern coast of Africa from the Red Sea to Algoa Bay; Seychelles, Aldabra, Comores, Madagascar, Mauritius. Elsewhere, widespread throughout the Indian and Pacific oceans; East Indies, China, Japan and Hawaii (*E. hawaiiensis* is known only from Hawaii and Australia).

REMARKS: Whitehead (1962) recognised two Indo-Pacific species, *E. machnata* (Forsk.) and *E. hawaiiensis* Regan, distinguishing these on vertebral number (63–64 in *E. machnata* c.f. 68–70 in *E. hawaiiensis*) and length of lower jaw (projecting and covering anterior part of pre-maxillary toothband in *E. machnata*, and included, with the whole of pre-maxillary toothband exposed in *E. hawaiiensis*). Zanzibar specimens, which were examined, are characterised by a low vertebral count (60–63) and are therefore referable to *E. machnata*. The lower jaw character is, however, variable and cannot be relied upon in the identification of the species. Morrow (1954) referred a single specimen (1070 mm.) from Shimoni, Kenya, to *E. saurus*, stating that the ranges of meristic characters showed considerable overlap and that the specimen could therefore not be referred to any of Regan's (1909) species, although corresponding closest to *E. hawaiiensis*. Other authors (Fowler, 1940; Smith, 1961) conservatively recognised but a single world-wide species, *E. saurus* Linn.

Future work on Indo-Pacific specimens may demonstrate that *E. machnata* and *E. hawaiiensis* are not specifically distinct, but represent respectively western and eastern components (i.e. subspecies) of a single species.

Family MEGALOPIDAE TARPONS

Genus MEGALOPS Lacepede, 1803

Megalops Lacépède, 1803: 380 (Type: *Megalops filamentosus* Lacépède = *Clupea cyprinoides* Broussonet).

A single species in the Indian Ocean.

MEGALOPS CYPRINOIDES (Broussonet)

Clupea cyprinoides Broussonet, 1782: (no pagination) pl. 9, (Type locality: oceans between tropics). *Megalops filamentosus*: Lacépède, 1803: 289, 290, pl. 13, fig. 3 (Fort Dauphin, Madagascar); Fourmanoir, 1957: 5 (Madagascar).

Megalops indicus: Valenciennes, 1846: 388, pl. 542 (Madagascar, Mauritius).

Megalops setipinna: Bleeker, 1863: 345 (Madagascar).

Elops cyprinoides: Günther, 1866: 122 (East Africa); Martens 1869: 143 (Pangani River, Zanzibar).
Megalops cyprinoides: Günther, 1868: 47 (Zanzibar); Sauvage, 1891: 497, pl. 49a, fig. 3 (Madagascar);
 Gilchrist & Thompson, 1908-11: 270 (Natal); Boulenger, 1909: 28, fig. 19 (Zanzibar, Shire River);
 Gilchrist, 1913: 52 (references); Gilchrist & Thompson, 1917: 292 (references); Barnard, 1925: 104,
 fig. 11 (larva) (Natal); Smith, 1949-1965: 86, fig. 101 (South Africa); Baissac, 1951: 123 (Mauritius);
 Smith, 1955: 306 (Aldabra); *Idem*, 1958: 131 (Inhaca, Mozambique); *Idem*, 1963: 9, p.14E (Seychelles);
 Losse, 1964: 12 (Zanzibar Channel); *Idem*, 1966a: 89 (Zanzibar); *Idem*, 1966b: 168 (East Africa,
 Dar-es-Salaam, Zanzibar, Mombasa, Malindi); *Idem*, 1966c: 50 (Zanzibar Channel).

STANDARD COMMON NAME: Tarpon.

VERNACULAR NAMES: *Pawale* (general), *Kumpangu* (Malindi).

DESCRIPTION: Based on one fish, 413 mm. standard length, from the Mafia Channel; one, 173 mm., from Zanzibar; one, 480 mm., from Tanga and two, 293-373 mm., from Mombasa.

Dorsal iv-v 14-16, total 19-20, pectoral i 14-16, pelvic i 9-10, anal iii-iv 22-23 (25), total 26-27 (28). Gillrakers 14-16+29-33, total 43-49 on 1st gill arch. Scales firmly adherent, cycloid and very large, 34-36 in lateral series, about 4 more on caudal. Branchiostegal rays 24-27.

Depth 26.4-28.6, head 28.2-30.0, snout 4.7-7.7, eye 7.2-7.9, post-orbital 12.6-14.0, inter-orbital 5.1-5.7, upper jaw 13.9-15.9, lower jaw 15.2-15.3, gular plate, length 9.6-11.1, width 1.3-1.8, pectoral fin 17.1-20.2, pelvic fin 11.1-15.4, pre-dorsal 52.3-57.0, pre-pelvic 49.3-55.9, pre-anal 72.4-79.0, last dorsal ray 27.0-30.4.

Body elongate, moderately compressed. Mouth very large, terminal. Maxillary reaching beyond posterior border of orbit. Pseudobranch not exposed. Adipose eyelids well developed, almost covering eyes completely. Lateral line well developed, with branched tubes. Pectoral and pelvic axillary scales about two thirds length of fins. Anal fin behind base of dorsal fin, without basal scaly sheath. Last dorsal ray greatly elongated, filamentous, about equal to head or a little more in length.

COLOUR: *Fresh*, dorsal surfaces dark brown, sides silvery to golden; scales with dark borders. Top of head dark brown. A dark patch on posterior edge of operculum. Fins brownish, caudal and dorsal margins dark. Pectoral and pelvic axillary scales speckled light brown.

In alcohol, dorsal surface dark brown to black, sides silvery or light brown. Ventral surfaces white. Dorsal, anal and caudal fins dusky to light brown, darker (almost black) at margins. Pectoral and pelvic fins with brownish speckles.

SIZE: 480 mm. S.L., weight 5½ lb. (♀, Tanga Bay).

DISTRIBUTION: Entire East African coast (recorded from the Mafia Channel, Dar-es-Salaam, Zanzibar, Tanga, Mombasa and Malindi), in estuaries, lagoons, bays and mangrove areas, often together with *Elops*. The species was rarely found out to sea and apparently shows a preference for euryhaline conditions.

RANGE: East African coast south of Natal; Seychelles, Madagascar, Mauritius. Elsewhere, widely distributed in the Indian and Pacific oceans: India, Ceylon, East Indies, Philippines, China, Japan, Formosa, Australia. Melanesia. Micronesia and Polynesia.

Family ALBULIDAE

LADY FISHES

Genus ALBULA Scopoli, 1777

Albula Scopoli, 1777: 450 (on Gronow) (Type: *Esox vulpes* Linnaeus).

A monotypic genus widely distributed in tropical seas.

ALBULA VULPES (Linnaeus)

Esox vulpes Linnaeus, 1758: 313 (on *Bone Fish* Catesby, 1737: pl. 2, fig. 1; Bahamas).

Albula bananus: Valenciennes, 1846: 345 (Mauritius).

Butirinus glossodontus: Günther, 1866: 120 (Zanzibar).

Butirinus glossodontis: Playfair, 1867: 868 (Seychelles).

Albula conorhynchus: Günther, 1868: 468 (Port Natal, Zanzibar, Red Sea).

Albula conorhynchus: Gilchrist & Thompson, 1908-11: 269 (Natal).

Albula vulpes: Gilchrist, 1913: 53 (Natal); Gilchrist & Thompson, 1917: 293 (references); Barnard 1925: 106 (Natal); Fowler, 1934: 410 (Durban); Smith, 1949-1965: 85, fig. 99 (Natal to Algoa Bay); Baissac, 1951: 124 (Mauritius); Smith, 1955: 306 (Aldabra); Fourmanoir, 1957: 4, pl. 1a (Madagascar); Smith 1958: 131 (Inhaca, Mozambique); *Idem*, 1963: 8 pl. 4A (Seychelles); Whitehead, 1965b: 232 (Red Sea, Gulf of Aden); Losse, 1966b: 168 (East Africa; Zanzibar, Mombasa).

STANDARD COMMON NAME: Bone fish.

VERNACULAR NAMES: *Mnyimbi* (Zanzibar, Shimoni), *Mborode* (Malindi).

DESCRIPTION: Based on a single specimen, 319 mm. standard length, from Zanzibar.

Dorsal iv 13, pectoral i 16, pelvic i 8, anal iii 7. Gillrakers poorly developed, reduced to low tubercles, 12 on lower part of 1st gill arch. Lateral line well developed; scales large, silvery and ad-

herent, from shoulder with three anterior striae, 69 scales in lateral series, 23 pre-dorsal scales, 9½ above lateral line, 7½ below. Branchiostegal rays 12.

Depth 24.5, head 28.0, snout 12.2, eye 4.5, post-orbital 11.5, inter-orbital 7.1, upper jaw 8.4, lower jaw 8.6, projection of snout beyond lower jaw 2.7, pectoral fin 15.6, pelvic fin 11.8, pre-dorsal 50.5, pre-pelvic 59.0, pre-anal 88.1, caudal peduncle 8.0, caudal length 32.4.

Body oblong, moderately compressed, abdomen flattened. Snout pointed, projecting beyond tip of lower jaw. Mouth small, inferior. Maxilla short not reaching eye, just surpassing nares in vertical plane. Gular plate not evident externally. Pseudobranch exposed. Eyes almost completely covered by a thick adipose membrane, only a small oval aperture. Dorsal base nearer to caudal than to the snout; pelvic origin beneath 15th dorsal ray. Dorsal, anal and caudal fins with scaly sheaths at bases. Pelvic axillary scale about half length of fin. Pectoral axillary scale poorly developed. Teeth villiform, on pre-maxilla, lower jaw, vomer and palatines. Maxilla edentulous, upper jaw bordered by pre-maxillae only. Broad patches of granular teeth on parasphenoid, pterygoid and tongue.

COLOUR: *Fresh*, body silvery with about nine dark zigzag lines along dorso-lateral surface. Top of head greenish. A black spot on each side of snout tip. Scattered melanophores on pectoral, pelvic and anal fins. Anterior dorsal rays with black anterior borders; dorsal margins dark. Caudal tips dusky.

SIZE: 318 mm. S.L. (Zanzibar).

DISTRIBUTION: Entire East African coast (recorded from Zanzibar, Dar-es-Salaam, Mombasa and Malindi), in the vicinity of mangrove areas and in shallow bays over a sandy bottom, where it was often abundant.

RANGE: Eastern coast of Africa from the Red Sea to Algoa Bay; Seychelles, Aldabra, Comores, Madagascar, Mauritius and Reunion. Elsewhere, cosmopolitan in tropical seas.

Suborder CLUPEOIDEI

Key to East African Families

1. Abdominal scutes absent:
 - (i) Body highly compressed; jaw teeth large and fang-like; dorsal origin much nearer to caudal base than to the snout Family Chirocentridae
 - (ii) Body rounder, jaw teeth small, not fang-like; dorsal origin about midway between the snout and the caudal base Family Dussumieriidae
2. Abdominal scutes present, keeled or spine-like:
 - (i) Mouth terminal or subterminal, snout not pig-like; upper jaw (maxilla) not extending beyond the posterior border of the eye Family Clupeidae
 - (ii) Mouth inferior, snout pig-like; upper jaw (maxilla) extending beyond the posterior border of the eye Family Engraulidae

Family CHIROCENTRIDAE

WOLF-HERRINGS

A single genus widespread in the Indo-Pacific area.

Genus CHIROCENTRUS Cuvier, 1817

Chirocentrus Cuvier, 1817: 178 (Type: *Clupea dorab* Forsk.).

A single species in East African waters.

CHIROCENTRUS DORAB (Forsk.).

Clupea dorab Forsk., 1775: 72 (Type locality: Djedda, Red Sea).

Chirocentrus dorab: Valenciennes, 1846: 150 (Mauritius, Zanzibar, Red Sea); Peters 1855: 268 (Mozambique); Günther, 1866: 120 (Zanzibar); Günther, 1868: 475 (Port Natal, Zanzibar); Peters, 1876: 445 (Mauritius); Gilchrist & Thomspon 1908-11: 202 (Natal); Barnard, 1925: 120 (Delagoa Bay, Natal); Bonde, 1934: 437 (Zanzibar); Fowler, 1934: 410 (Natal); Smith, 1949-1965: 87, pl. 5, fig. 104 (South Africa); Baissac, 1951: 130 (Mauritius); Morrow, 1954: 804 (Pemba); Smith, 1955: 306 (Aldabra); Fowler, 1956: 78 (Indo-Pacific specimens); Fourmanoir, 1957: 7, pl. 1B (Madagascar); Smith, 1958: 131 (Inhaca, Mozambique); *Idem*, 1963: 8 pl. 4 I (Seychelles); Sanches, 1963: 21, fig. 4 (Inhaca, Mozambique); Losse, 1964: 12 (Zanzibar); Whitehead, 1965b: 233 (Red Sea); Losse, 1966a: 89 (Zanzibar); *Idem*, 1966b: 169 (East Africa); Dar-es-Salaam, Zanzibar, Mombasa, Malindi, Lamu); *Idem*, 1966c: 50 (Zanzibar Channel).

STANDARD COMMON NAME: Wolf-herring.

VERNACULAR NAMES: *Mkonge* (Zanzibar, Tanzania), *Panga* (Kenya, general), *Bahanafu* (Malindi).

DESCRIPTION: Based on six fishes, 190-237 mm. standard length, from the Zanzibar Channel; six, 323-341 mm., from Mombasa and one, 319 mm., from Formosa Bay.

Dorsal iii-iv 12-15, pectoral i 12-13, pelvic i 5-6, anal iii-iv 29-31. Gillrakers 3 + 12-16 on 1st gill arch. Scales minute thin and very caducous; scale pockets obliterated, no lateral count possible. Branchiostegal rays 8.

Depth 13.6-16.0, head 17.7-19.2, snout 4.1-7.2, eye 3.0-3.6, post-orbital 7.2-8.5, inter-orbital 2.4-2.7, upper jaw (8.2) 8.6-9.4, lower jaw (9.3) 9.6-10.3, pectoral fin 12.1-13.6, pelvic fin 2.5-3.2, pre-dorsal 67.9-73.6, pre-pelvic (45.6) 48.0-52.4, pre-anal 68.5-72.0, pectoral axillary scale 7.8-8.9.

Body greatly elongated, strongly compressed. Snout pointed, lower jaw strongly inclined. Mouth moderately large and terminal. Maxilla surpassing the angle of the jaws but not reaching to the anterior border of pre-operculum. Pseudobranch not exposed. Adipose tissue well developed, often obscuring eyes. Abdominal scutes absent; a single, small, crescentic pelvic scute. Dorsal origin much nearer to caudal base than to the snout. Anal fin long, the origin just in front or under first ray of dorsal fin. Pelvic fins very small, with a small axillary flap, far in front of dorsal fin, much nearer to pectoral origin than to the caudal base. Dorsal and anal fin with well developed scaly sheaths. Pectoral axillary scale well developed; two long scales on caudal base. Teeth well developed. Two large upper canines pointing forward, covered dorsally by a loose fleshy flap extending from snout. Small pointed teeth on maxilla. Lower jaw with caniniform teeth which increase in size posteriorly. Mandibular rami elevated inside mouth.

COLOUR: *Fresh*, back blue, midline grey; sides and belly silvery. A large green patch on shoulder. Supra-orbital part of head bluish, post-orbital dark. Snouth bluish-grey. Iris dusky to silver. Anterior rays of dorsal fin dusky. Minute dark spots on anterior pectoral rays. Caudal dusky, darker, almost black, at tips; ventral fins and anal fins colourless.

In alcohol, dorsal surfaces bluish-grey, sides yellowish-white. Snout dark. Sub-orbital part of head and operculum silvery; a dark patch on anterior portion of operculum. Dorsal yellowish at base, dusky, margins darker. First pectoral ray with a black anterior edge, rays 1-5 speckled black. Ventral fins and anal fin colourless. In the single specimen from Formosa Bay the caudal fin and outer half of the pectoral fin are entirely black and anal rays 4-7 are speckled black.

SIZE: Specimens (♀♀) of about 800 mm. have been caught in the Zanzibar Channel (by purse-seine); 341 mm. S.L. (♂, Mombasa). Stead (1906) stated "attains a length of fully 12 feet" (Australian seas). Smith (1949) and Fowler stated the same maximum length without reference.

DISTRIBUTION: Entire East African coast (recorded from the Mafia Channel, Dar-es-Salaam, Zanzibar, Shimoni, Mombasa, Malindi, Formosa Bay and Lamu), in the shallow waters within the 30 fathom contour. Abundant over shallow banks (Zanzibar Channel), in bays, harbours (Mombasa), estuaries and also quite common in and around mangrove areas.

RANGE: Eastern coast of Africa from the Red Sea to Natal; Seychelles, Madagascar, Aldabra and Mauritius. Elsewhere, widely distributed in the Indian and Pacific Oceans; India, East Indies, Philippines, China, Formosa, Japan, Queensland and Melanesia.

Family DUSSUMIERIIDAE

ROUNDHERRINGS

Key to the East African Genera

- | | |
|---|-----------------|
| 1. Branchiostegal rays 14-16; adults large (> 120 mm. S.L.) (Sub-family Dussumieriinae) | DUSSUMIERIA |
| 2. Branchiostegal rays 6-7; adults small (< 80 mm. S.L.) (Sub-family Spratelloidinae) | |
| (i) A single supra-maxilla; pelvic origin in front of dorsal; last two anal rays separated from others by a gap | SPRATELLOMORPHA |
| (ii) Two supra-maxillae; pelvic origin under dorsal base; anal fin entire | SPRATELLOIDES |

Sub-family DUSSUMIERIINAE

Genus DUSSUMIERIA Valenciennes, 1847

Dussumieria Valenciennes, 1847: 467 (Type: *Dussumieria acuta* Val.)

A single species in East African waters.

DUSSUMIERIA ACUTA (Valenciennes)

Dussumieria acuta Valenciennes, 1847: 467, pl. 606 (Type locality: Bombay); Whitehead, 1963b: 312, fig. 1-5 (revision, synonymy; Indo-Pacific specimens); Losse, 1964: 12 (Zanzibar Channel); Whitehead 1965b: 234 (Red Sea, Gulf of Aden); Losse, 1966a: 89 (Zanzibar); *Idem*, 1966b: 170 (East Africa; Dar-es-Salaam, Zanzibar, Kenya); *Idem*, 1966c: 51 (Zanzibar Channel).

Dussumieria hasseltii: Fourmanoir, 1961: 84, fig. 1 (Madagascar).

STANDARD COMMON NAME: Round Herring.

VERNACULAR NAMES: *Dagaa la upapa* (Zanzibar), *Dagaa* (general).

DESCRIPTION: Based on twenty-five fishes, 70-144 mm. standard length, from Zanzibar and one, 124 mm., from Mombasa. Depth measurements and meristic characters on nine further fishes, 87.5-154 mm., from the Zanzibar Channel.

Dorsal iv-v 16-17 (19), pectoral i 12-13, pelvic i 7, anal iii (12) 13-14. Abdominal scutes absent, a single "W" shaped pelvic scute (Whitehead, 1962). Gillrakers, 25-28 on lower part of 1st gill arch. Branchiostegal rays 14-16. Scales caducous, scale pockets virtually all obliterated, no count possible. Vetebrae 54-56 (8 fishes).

Depth 18.5-25.1 (increasing with length of fish), head 26.0-28.4, snout 8.7-9.7, eye 5.9-7.0, post-orbital 8.4-10.4, upper jaw 7.9-8.7, lower jaw 12.6-13.8, pectoral fin 11.9-14.8, pelvic fin 8.1-10.8, pre-dorsal 54.3-58.6, pre-pelvic 58.0-61.9 (62.2), pre-anal (77.4-78.5) 79.0-81.5, anal base 9.2-11.3.

Body oblong, moderately compressed, rounded ventrally. Snout pointed, longer than the eye diameter. Lower jaw projecting slightly in front of upper. Maxilla short, not quite reaching anterior border of orbit. Two supra-maxillae, the second (posterior) not expanded posteriorly. Conical teeth on pre-maxilla, maxilla and mandible. Pelvic origin under dorsal base, nearer to pectoral origin than the caudal base. Dorsal origin nearer to caudal base than to the snout.

COLOUR: *Fresh*, dorsal surface blue-grey. A dark blue mid-dorsal line often with a greenish tinge. Iridescent golden lateral stripe from the operculum to the caudal base. Flanks silver with a golden hue in some fishes. Top of head greenish to golden. Tip of upper jaw black. Tip of mandible dusky. Operculum mainly silvery with a few melanophores on dorsal border; on pre-operculum dark spots form faint lines. A few dark spots on anterior rays of dorsal fin. First ray of pectoral fin dark and a few dark spots on central rays of fin. Caudal dusky, darker at margins, colourless in some (small) specimens. Pelvic fins and anal fin colourless.

In alcohol, dorsal surfaces brownish, flanks light brown to grey. A light lateral band visible in some specimens. Snout dark. First ray of pectoral fin and anterior rays of dorsal fin dark. Caudal darkish at tips in some specimens, otherwise yellowish or colourless.

SIZE: 154 mm. S.L. (♀, Zanzibar Channel), maximum 216 mm. in India (Day).

DISTRIBUTION: Entire East African coast (recorded from Dar-es-Salaam, Zanzibar and Mombasa) in the shallow waters within the 100 fathom contour. A single specimen was taken from the stomach of a sailfish caught in 250 fathoms on longline off Mombasa. Not evident in bays, harbours or estuaries; the species was abundant over shallow water banks (Zanzibar Channel) in depths of 8-18 fathoms principally during the northeast monsoon (October-February).

RANGE: Eastern coast of Africa from the Red Sea to Madagascar. Elsewhere, widely distributed in the Indian and Pacific Oceans, east to Japan. Also as an immigrant species in the Suez Canal and the eastern Mediterranean, from Port Said to Mersin in Turkey (Ben-Tuvia, 1966).

Sub-family SPRATELLOIDINAE

Genus SPRATELLOMORPHA Bertin 1946

Spratellomorpha Bertin, in Angel, Bertin & Guibé, 1946: 473-4 (Type: *Sauvagella madagascariensis binalis* Bertin, ex Madagascar).

A monotypic genus; known from four fishes (types) from Madagascar and ten juvenile specimens recently discovered by the author at the Mombasa fish market. The species has not been recorded previously from East Africa.

SPRATELLOMORPHA BIANALIS (Bertin)

Plate 1b

Sauvegella madagascariensis binalis Bertin, 1940: 300 (ex-Madagascar).

Sauvagella binalis Bertin, 1943: 22, fig. 8; Whitehead, 1936b: 336, fig. 14 (revision; Madagascar).

Spratellomorpha binalis Bertin, 1946: 473-4.

STANDARD COMMON NAME: Estuarine sprat.

VERNACULAR NAMES: *Dagaa* (Mombasa).

DESCRIPTION: Based on seven fishes, 30.2-41.3 mm. standard length from Port Tudor, Mombasa. Dorsal iii 11-12, pectoral i 11-12, pelvic i 7, anal iii (12) 13+2, total (17) 18. Gillrakers 26-28 (three fishes) on lower part of 1st gill arch. Branchiostegal rays 6. Scales caducous, about 41 (pockets) in lateral series.

Depth 17.7-21.8, head 26.3-27.7, snout 6.1-6.7, eye 6.7-7.6, post-orbital 7.3-9.0 (11.3), maxilla 9.2-10.0, lower jaw 11.0-12.2, pectoral fin 15.8-19.2, pelvic fin 11.6-12.7 (13.2), pre-dorsal 54.7-58.1, pre-pelvic 49.4-54.7, pre-anal 69.6-75.6.

Body elongate, laterally compressed, its depth less than the length of the head. Snout pointed, less than eye diameter in length. Abdominal scutes entirely absent, a single pelvic scute with pointed ascending spines. A single supra-maxilla, expanded posteriorly, almost equal to maxilla in depth, with a narrow anterior shaft. A single row of conical teeth on pre-maxilla and maxilla. Maxilla longer than snout, reaching vertical through anterior border of the eye. Dorsal origin much nearer to caudal base than to snout, about equidistant from anterior border of eye and caudal base. Pelvic

origin in front of dorsal, nearer to the anal base than to pectoral origin. Anal origin much nearer to pelvic origin than to the caudal base. Last two rays of anal fin separated from others by a space which equals two or three rays bases.

COLOUR: *Fresh*, mainly translucent; dorsal and lateral surfaces very light brown, peritoneum white. A faint, poorly defined, silvery to golden lateral band from operculum to caudal base, widest behind dorsal base, narrower than pupil of eye. A few brown spots on head between orbits, post-orbital surface of head brown. Two parallel rows of minute black spots on median dorsal surface from the nape to the dorsal origin and continued from the last dorsal ray to the caudal base. Snout and tip of lower jaw faintly yellowish with a few small dark spots. Lower jaw, sides of head and operculum silvery. Bases of dorsal and caudal fin yellowish, caudal rays with minute orange spots and a few scattered melanophores; two black lines on caudal base and a black streak on the upper border of the caudal peduncle. A row of black spots along base of anal and first two rays of pectoral fin with a few melanophores, rest of fins colourless.

In alcohol, light brown with a very faint, poorly defined silvery lateral band from operculum to caudal base, hardly evident in some specimens. Dark markings all retained, rest faded.

SIZE: 41.3 mm. S.L. (Mombasa), 45.5 mm. in Madagascar (Bertin).

DISTRIBUTION: Port Tudor, Mombasa district. The species is probably more widespread than the present record would indicate. The isolated recorded occurrences of specimens at Port Tudor (Mombasa), essentially an area where estuarine conditions prevail, would indicate that the species may be confined to estuaries in East African waters.

RANGE: East Africa (Mombasa). Elsewhere, Madagascar.

REMARKS: The first specimen of *Spratellomorpha bianalis* from the Kenya Coast was discovered by the author at the Mombasa fish market in April 1965. Nine further fishes were obtained from the same locality in December. All were caught in stake traps (*uzio*) at the entrance to Port Tudor, Mombasa, together with wolf-herrings (*Chirocentrus*), herrings (*Herklotsichthys*), sardines (*Sardinella*) and anchovies (*Thryssa* and *Thryssa*). In addition to these ten specimens from Mombasa the only other examples in existence appear to be the four types, 44.0–45.5 mm. S.L., in the Paris Museum (No. A5174), which Bertin described from Madagascar.

TABLE 1

A comparison of proportional measurements and meristic characters of East African and Malagasy *Spratellomorpha bianalis*

	East African material (7 fishes)	Malagasy material (After Whitehead, 1963) (4 fishes)
Standard length	30.2–41.4 mm.	44.0–45.5 mm.
<i>In % of S.L.</i>	<i>mean</i>	<i>range</i>
Body depth	20.40	17.1–18.0
Head length	27.11	25.2–26.5
Snout length	6.40	6.9– 7.1
Eye diameter	7.02	7.2– 7.8
Post-orbital distance	8.80	8.4– 8.6
Maxilla length	9.65	9.7–10.0
Lower jaw length	11.67	–
Pectoral fin length	17.40	–
Pelvic fin length	12.28	–
Pre-dorsal distance	56.71	53.4–56.5 (62.8)
Pre-pelvic distance	52.48	49.4–52.2
Pre-anal distance	73.15	69.0–72.5
Dorsal rays: simple	iii	iii
branched	11–12	12–13
Anal rays: simple	iii	iii
branched	12–13+2	11–12+2
Pectoral rays (total)	12–13	13

Both in meristic characters and body proportions East African *S. bianalis* agree closely with Malagasy material (Table I). The slight differences which are evident may indicate that East African and Malagasy specimens represent distinct populations; assuming that the species is truly estuarine, isolation is probably complete.

Spratellomorpha and other dussumieriid genera placed in the tribe Ehiravini (vide Whitehead, 1963) are of considerable interest as they show close affinities with the true herrings (Clupeidae) in a number of features (Whitehead, *loc. cit.*). Recently it has been suggested that they may be better placed in the sub-family Pellonulinae of the Clupeidae (Poll *et al.*, 1965).

Genus SPRATELLOIDES Bleeker, 1852

Spratelloides Bleeker, 1852: 29 (Type: *Clupea argyrotaeniata*=*Clupea gracilis* Schlegel).

Stolephorus (non Lacépède) Fowler, 1941 : 561.

Two Indo-Pacific species, both of which occur in East African waters.

Key to the East African Species

1. Total anal rays 11–14; a prominent silver lateral band from operculum to the caudal base *S. gracilis*
2. Total anal rays 9–11; no silver lateral band, whole of flanks silvery *S. delicatulus*

SPRATELLOIDES GRACILIS (Schlegel)

Clupea gracilis Schlegel, 1846: 238, pl. 108, fig. 2 (Type locality: Japan).

Spratelloides japonicus: Morrow, 1954: 804 (Mkoani harbour, Pemba).

Spratelloides gracilis: Whitehead, 1963b: 388, fig. 15–18 (revision, synonymy; Red Sea and Pacific specimens, Whitehead, 1965b: 273, figs. 2b, 3b, (Red Sea); Losse, 1966b: 170 (East Africa; Mafia, Zanzibar).

STANDARD COMMON NAME: Silver-striped sprat.

VERNACULAR NAME: *Dagaa* (general).

DESCRIPTION: Based on three fishes, 28.0–56.0 mm. standard length, from the Mafia Channel; seven 40.5–52.0 mm., from Zanzibar and six, 22.1–51.0 mm., from Shimoni.

Dorsal iii 9–10, pectoral i 11–12 (14), pelvic i 7, anal ii 9–12, total 11–14. Scales caducous, no accurate count possible (about 40–50 in Red Sea specimens; Whitehead 1964b). Branchiostegal rays 6.

Depth 12.6–17.4, head 23.8–25.8 (28.0), snout 7.2–9.5, eye 4.8–6.9, post-orbital 8.2–10.9, upper jaw 8.6–9.9, lower jaw 9.8–12.5, pectoral fin 11.4–14.2, pelvic fin 9.7–12.1, pre-dorsal 46.4–50.5, pre-pelvic 53.4–58.8, pre-anal 80.0–84.1.

Body moderately compressed. Snout pointed, slightly longer than the eye diameter. Head longer than the maximum body depth. Maxilla moderately long, the posterior border beneath the anterior third of the orbit, not reaching anterior border of the pupil. Dorsal origin a little nearer to snout than to the caudal base, or about equidistant. Pelvic origin under posterior half of dorsal, slightly nearer to the caudal base than to the snout.

COLOUR: *Fresh*, dorsally pale green with a dark-dorsal line. A prominent silver lateral band from operculum to the caudal base, as wide as eye diameter, edged above and below by a fine blue line. Pupil black, iris silver. A small black mark just behind eye. Head silver with small black markings on lower jaw and snout. Bases of caudal rays and posterior border of caudal peduncle with fine black markings. Fins otherwise colourless.

In alcohol, upper and lower surfaces brownish, a silver lateral stripe prominent in some specimens, but faded in others to a dark band: poorly defined in juvenile specimens. All black markings retained. SIZE: 56 mm. S.L. (Mafia Channel), 93 mm. S.L. in Japan (Whitehead, 1963b).

DISTRIBUTION: East African coast (recorded from Kilwa, Mafia Channel, Zanzibar Channel, Pemba and Shimoni) in the shallow waters, especially in and around coral reef areas. Not observed in estuaries, harbours, creeks or muddy bays. At times abundant, but great fluctuations in abundance were evident from year to year.

RANGE: Eastern coast of Africa from the Red Sea to Kilwa in Tanzania. Elsewhere, widely distributed in the Indo-Pacific, east to Ceylon, Laccadive islands, Japan and Samoa.

SPRATELLOIDES DELICATULUS (Bennett)

Clupea delicatula Bennett, 1831 : 168 (Type locality: Mauritius).

Spratelloides delicatulus: Peters 1876: 445 (Mauritius); Jatjow & Lenz, 1899: 526 (no locality—East African collection); Regan, 1908: 242 (Kosi Bay); Gilchrist & Thompson, 1917: 296 (South Africa); Barnard, 1925: 110 (Zululand); Morrow, 1954: 809 (Mkoani harbour, Pemba); Fourmanoir, 1957: 13 (Madagascar, Comores); Whitehead, 1963b: 345, figs. 16–17, 19, 25, 28a, 30c, 31 (references, synonymy, revisions; Zululand, Seychelles, Red Sea, Gulf of Aden); *Idem*, 1965b: 241, figs. 2a, 3a (Red Sea, Gulf of Aden); Losse, 1966b: 171 (East Africa; Mafia, Zanzibar, Kilifi); *Idem*, 1966c: 51 (Zanzibar Channel).

Stolephorus delicatulus: Smith 1949–1965: 89, fig. 107 (South Africa); Baissac, 1951: 126 (Mauritius);

Smith, 1955: 307 (Aldabra), *Idem*, 1958: 131 (Inhaca, Mozambique); *Idem*, 1963: 8, pl. 4B (Seychelles).
STANDARD COMMON NAME: Common sprat.

VERNACULAR NAME: *Dagaa* (general).

DESCRIPTION: Based on eight fishes, 43.9–51.1 mm. S.L., from Kilifi and five 23.3–48.0 mm., from Shimoni.

Dorsal ii 9–10 (11), pectoral i 10–12, pelvic i 7, anal ii–iii 7–9, total 10–11. Scales moderately caducous, about 32–35 (pockets) in lateral series. Branchiostegal rays 6.

Depth 13.8–20.8, head 25.3–28.8, snout 6.3–8.0, eye 5.5–7.5, post-orbital 9.0–10.4, upper jaw 8.1–10.5, lower jaw 9.8–12.2, pectoral fin 12.5–17.6, pelvic fin 11.0–14.4, pre-dorsal 45.9–48.7, pre-pelvic 53.8–57.0, pre-anal (78.5) 81.4–84.1.

Body moderately compressed. Snout pointed, slightly longer than eye diameter. Maxilla longer than snout, almost reaching pupil. Dorsal origin slightly nearer to snout than to the caudal base. Pelvic origin under posterior half of dorsal fin, slightly nearer to caudal base than to the snout.

COLOUR: *Fresh*, dorsal surface bright blue with darker blue mottlings, sides silvery, belly white. Pupil black, iris silver. Small black marks on upper part of operculum. Tip of snout and lower jaw speckled black. A prominent black mark a little in front and below eye. Two black lines on caudal base and one along the upper border of the caudal peduncle. Fins colourless.

In alcohol, upper surfaces bluish, grey or brown, sides white or silvery, belly white. Top of head, snout tip and lower jaw dark brown to black. A small black spot in front of eye. Fins colourless.

SIZE: 51 mm. S.L. (Kilifi, Kenya), 77 mm. S.L. in Australian seas (Whitehead, 1963b).

DISTRIBUTION: Probably entire East African coast (recorded from Kilifi, Shimoni, Pemba, Zanzibar Channel and Mafia Channel), in the shallower inshore waters; in and around coral reef areas, in bays, inlets, lagoons and estuaries. Often together with *S. gracilis* but more abundant and widespread.

RANGE: Eastern coast of Africa from the Red Sea to Zululand; Seychelles, Aldabras, Comores, Madagascar and Mauritius. Elsewhere, the species ranges widely in the Indo-Pacific, eastwards to Australia.

Family CLUPEIDAE

HERRINGS

Key to the East African Genera

1. Anal fin short, with less than 30 rays; hypomaxillary bone absent:
 - (i) Upper jaw without deep median notch; tip of lower jaw does not fold completely within the upper (Sub-family Clupeinae):
 - (a) Few (3–5) fronto-parietal striae; scale striae complete; last two anal rays not enlarged
 - (b) Many (7–15) fronto-parietal striae; scale striae interrupted; last two anal rays markedly enlarged
 - (ii) Upper jaw with a prominent deep median notch; tip of lower jaw folds completely within the upper (Sub-family Alosinae)
2. Anal fin long, with more than 30 rays; a small toothed hypomaxillary bone present (Sub-family Pristigasterinae)

HERKLOTSICHTHYS

SARDINELLA

HILSA

PELLONA

The genera *Herklotsichthys* and *Sardinella* are frequently confused; detailed diagnostic features of these two genera have been published by Whitehead (1964c).

Hilsa also has been confused in collections with *Sardinella*, generally with a deep-bodied form such as *S. albella*. The single species in East African waters, *H. kelee*, may be distinguished at once by the combination of depth (33–40% in S.L.) and gillraker number (74–177), as all known species of *Sardinella* from East African waters with a deep body (over 30% in S.L.) have fewer gillrakers (less than 60). Further, in *H. kelee* the gillrakers are very long and easily visible when the mouth is opened and the scales are firmly adherent; in *Sardinella* the gillrakers are shorter and the scales are caducous.

Sub-family CLUPEINAE

Genus HERKLOTSICHTHYS Whitley, 1951

Herklotsichthys Whitley, 1951: 67 (proposed to replace *Herklotsella* Fowler, 1934: 246).

Harengula Valenciennes (part., i.e. Indo-Pacific species only), 1847: 201 (Type: *Harengula latulus* Valenciennes = *Clupea macrophthalma* Ranzani).

New world *Harengula* species are characterised by the presence of a toothed hypomaxilla which is absent in Indo-Pacific fishes formerly placed in this genus (Berry, 1964); *Herklotsichthys* replaces *Harengula* for Indo-Pacific species (Whitehead, 1964a).

Previously two species of the genus, *H. punctatus* and *H. vittatus*, were recognised from the extreme western Indian Ocean and adjacent seas (e.g. Smith, 1949; Whitehead, 1965b). The so-called *Sardinella*-like *H. vittatus* (Whitehead, 1964c) however, should now be placed in the synonymy of *Sardinella melanura* (Cuvier) (Whitehead, 1967).

HERKLOTSICHTHYS PUNCTATUS (Rüppell)

Clupea punctata Rüppell, 1837: 78, pl. 21, fig. 2 (Type locality: Red Sea).

Alosa punctata: Günther, 1866: 123 (Aden, Zanzibar).

Clupea venenosa: Günther, 1868: 449 (Zanzibar).

Harengula punctata: Sauvage, 1891: 493 (Madagascar); Regan, 1917 (East Africa); Barnard, 1925: 114 (Natal); Losse, 1964: 11 (Zanzibar Channel).

Sardinella melanura: Smith, 1949-1965: 92, fig. 113 (Natal); *Idem*, 1963: 8, pl. 4 L (Seychelles).

Harengula ovalis: Smith, 1949-1965: 91 (Natal); Baissac, 1951: 126 (Mauritius); Smith, 1955: 307 (Aldabra); Fowler, 1956: 64 (Indo-Pacific specimens); Smith, 1963: 8, pl. 4 G (Seychelles); Sanches, 1963: 20, fig. 3 (Inhaca, Mozambique).

Herklotsichthys punctatus: Whitehead, 1965b: 244 (Red Sea, Gulf of Aden); Losse, 1966a: 89 (Zanzibar); *Idem*, 1966b: 172 (East Africa; Dar es-Salaam, Zanzibar, Tanga, Mombasa, Malindi, Formosa Bay); *Idem*, 1966c: 51 (Zanzibar Channel).

Two distinct forms, which may prove to be distinct species (see REMARKS), are here described.

Key to the East African Forms

- | | |
|--|----------------------------|
| 1. Body deep, depth 29-33% (mean 31.4%) in S.L. (at 48-85 mm.); a prominent black patch on dorsal fin | <i>H. punctatus</i> Form A |
| 2. Body slender, depth 24-29% (mean 26.7%) in S.L. (at 32-120 mm.); dorsal fin dusky, without black patch) | <i>H. punctatus</i> Form B |

HERKLOTSICHTHYS PUNCTATUS Form A

STANDARD COMMON NAME: Spotted herring.

VERNACULAR NAME: *Dagaa* (Zanzibar, Tanzanian coast).

DESCRIPTION: Based on forty-seven fishes, 47.6-84.8 mm. standard length, from the Zanzibar Channel. Vertebral counts only on six fishes, 76.7-83.6 mm., from Shimoni, Kenya.

Dorsal iii-iv (13) 14-15, pectoral i 14-15 (16), pelvic i 7, anal ii-iii (12-13) 14-15 (16), total (14-15) 16-17 (18). Ventral scutes strongly keeled, sharp and exposed, (15) 16-17 pre-pelvic, (10-11) 12-13 post-pelvic, total (27-28) 29-30. Gillrakers, 30-34 (mean 32.39) on lower part of 1st gill arch (at 47.6-84.8 mm. S.L.). Branchiostegal rays 5-6. Scales caducous, about 34-38 (pockets) in lateral series. Vertebrae 41-42 (6 fishes).

Depth 29.0-33.3 (mean 31.39), head 27.8-31.6, snout 6.7-8.3, eye 8.0-10.3, post-orbital 8.9-11.7, upper jaw 12.4-14.0, lower jaw 12.3-13.8 (14.4), pectoral fin (19.0-19.8) 20.1-21.9 (23.0), pelvic fin (11.1-13.9) 14.0-15.8, pre-dorsal 44.8-48.5, pre-pelvic 50.6-55.6, pre-anal 74.5-83.6, caudal peduncle 9.9-11.9. (The means of these values are shown in Table 2.)

Body very strongly compressed; ventral profile deeply convex, dorsal profile almost a straight line. Head as long as the maximum body depth or up to 2% shorter. Snout generally shorter than the eye diameter. Upper jaw much longer than the snout, the maxillary reaching about $\frac{1}{3}$ to $\frac{1}{2}$ into the eye through the vertical. Operculum about twice as long as broad, the lower margin straight. Sub-operculum rectangular, the posterior margin rounded. Dorsal fin base much nearer to snout than to the caudal base. Pelvic origin almost equidistant from the pectoral base and the anal origin. Scales (from shoulder) with 5-6 complete vertical striae; the posterior scale borders very slightly crenulated or indented, without perforations. Very rarely one or two striae are not complete (as in *Sardinella*) but interdigitate; at least four striae are always uninterrupted.

COLOUR: *Fresh*, scales fallen; dorsal surfaces bluish green, back spotted with numerous small, blue, grey or black blotches which become less distinct at later post-mortem and may fade entirely. A bright yellow or orange humeral patch continued in a lateral stripe to the caudal base, demarcating dorsal and lateral colouration. Sides, belly and opercular regions silvery or golden. Snout and lower jaw yellowish, tips dusky, occasionally minutely speckled green. Eye silvery with a broad, dorsal yellow or orange band. Dorsal fin orange at base, the anterior rays bright yellow. A prominent black patch on about the first ten dorsal rays. Caudal yellowish at base, dusky or colourless at margins. Other fins colourless.

Underwater the yellow or orange markings and the black patch on the dorsal fin were particularly striking and at once distinguished this species from other clupeoids of the area.

In alcohol, dorsal surfaces greenish or brown, sides lighter. Black patch on dorsal fin retained and prominent (at all stages of fixation). Caudal yellowish or colourless, margin dusky in some fishes. Snout tip dusky or brown. Rest faded.

SIZE: 88.0 mm. S.L. (Zanzibar Channel): 102 mm. F.L., weight 16 gm. (♂, Shimoni, Kenya).

DISTRIBUTION: East African coast (recorded only from Shimoni, Tanga and the Zanzibar Channel), in the vicinity of coral reef areas where it was occasionally abundant; rare elsewhere. Often observed underwater in shoals of about 40-200 fish, frequently swimming together with small shoals of juvenile *Sardinella sirm.*

RANGE: Eastern coast of Africa, apparently from the Red Sea to Natal depending on the exact identity of this form.

REMARKS: I have designated this species *H. punctatus* form A. Whitehead's (1965b) description of *H. punctatus* from the Red Sea/Gulf of Aden area overlaps the present descriptions of East African *Herklotsichthys* material of this and the following form. Rüppell's (1837) *Clupea punctata* types (57.7–60.6 mm. S.L., Senckenberg Museum No. 567, 6649 and 6650, ex-Red Sea) are characterised by relatively slim bodies (body depth 27.53%, c.f. a mean of 31.39% in S.L. in East African *H. punctatus* form A) and a high gillraker count (35–36, c.f. 30–34 in East African material) and therefore are closer to *H. punctatus* form B (Table 2). But Rüppell's colour notes on *Clupea punctata* are very similar to *H. punctatus* form A. On present evidence Red Sea/Gulf of Aden material does not demonstrate the existence of two forms, whereas East African specimens of *Herklotsichthys* show divergences which clearly demonstrate that two distinct forms exist in this area. The status of form B is discussed below.

TABLE 2

Proportional measurements and meristic characters of *Herklotsichthys punctatus* Form A, *Clupea punctata* Rüppell and *Herklotsichthys punctatus* Form B.

	<i>H. punctatus</i> A. (45 fishes)	<i>Clupea punctata</i> (3 fishes, types *)	<i>H. punctatus</i> B. (44 fishes)
Standard length	47.5–84.8 mm.	57.7–60.6 mm.	54.2–120.0 mm.
<i>In % of S.L.</i>	<i>mean</i>	<i>mean</i>	<i>mean</i>
Body depth	31.39	27.53	26.71
Head length	29.54	29.56	28.49
Snout length	8.48	7.96	7.28
Eye diameter	9.94	10.16	7.97
Post-orbital distance	10.19	9.63	9.45
Upper jaw length	10.13	14.20	12.45
Lower jaw length	13.27	—	11.99
Pectoral fin length	20.76	19.36	19.72
Pelvic fin length	14.59	12.63	13.30
Pre-dorsal distance	46.67	45.60	46.79
Pre-pelvic distance.	53.50	56.30	53.02
Pre-anal distance	78.60	78.63	78.09
Caudal peduncle, depth	11.00	—	8.95
Dorsal rays: simple	iii–iv	iv	(iii) iv
branched	(13)14–15	14	14–15
Anal rays: simple	ii–iii	iii	ii–iii
branched	(12–13)14–15(16)	12–13	14–16(17)
Abdominal scutes	(15)16–17+(10–11)12–13	17–18+11–12	17–18(19)+(12)13–15
Gillrakers	30–34 (mean 32.39)	35–36	31–37 (mean 34.29)
Vertebrae	41–42 (6 fishes)	—	43–44 (6 fishes)

*Senckenberg Museum No. 567 (lectotype), No. 6649 and No. 6650, ex Red Sea.

HERKLOTSICHTHYS PUNCTATUS Form B

Plate 1c

STANDARD COMMON NAME: Common herring.

VERNACULAR NAMES: *Dagaa la upapa* (Tanzania), *Simu* (Kenya coast), *Simu yati* (Mombasa district), *Dagaa* (small specimens, general).

DESCRIPTION: Based on two fishes, 99.6–107.5 mm. standard length, from Malindi, ten, 32.0–82.6 mm., from Mombasa, forty-five, 22.0–110.0 mm., from Zanzibar, and five, 103.5–120.1 mm., from Dar-es-Salaam. Vertebral counts only on six fishes, 87.8–95.2 mm., from Shimoni.

Dorsal iii–iv 14–15 (16), total 18–19 (20); pectoral (13) 14–15; pelvic i 7; anal ii–iii 14–16 (17), total 16–19 (20). Ventral scutes strongly keeled, sharp and exposed, 17–18 (19) pre-pelvic, (12) 13–15 post-pelvic, total (29–30) 31–33. Gillrakers, at 22–32 mm., 23–29; at 36 mm. and above, 31–37 (mean 34.29) on the lower part of 1st gill arch. Branchiostegal rays 6. Scales fairly caducous, about 38–42 (pockets) in lateral series. Vertebrae 43–44 (6 fishes).

Depth, at 22.0–28.6 mm. S.L., 17.0–23.6 (mean 20.23), at 32–120 mm. S.L. 24.2–29.2 (mean 26.71); head (26.0–26.9) 27.4–30.6; snout 6.8–8.1, eye 6.8–8.8, post-orbital 8.5–10.4, upper jaw 11.1–13.7, lower jaw 10.4–12.9, pectoral fin 17.0–21.7, pelvic fin 12.0–14.8, pre-dorsal (41.6) 45.1–49.2, pre-pelvic (46.6) 50.0–56.8, pre-anal 70.1–81.0, caudal peduncle 7.9–10.3. (The means of these values are shown in Table 2.)

Body strongly compressed. Ventral profile rather more convex than the dorsal. Head about 1–3% longer than the maximum body depth. Snout generally shorter than the eye diameter. Upper jaw longer than the snout, the maxilla reaching about $\frac{1}{3}$ to almost $\frac{1}{2}$ into the eye through the vertical. Operculum $2\frac{1}{2}$ – $3\frac{1}{2}$ times as long as broad, the lower margin slightly oblique. Sub-operculum rectangular, the posterior margin straight. Dorsal fin base slightly nearer to snout than to the caudal base; pelvic origin nearer to anal origin than to pectoral origin, or about equidistant. Scales (from shoulder) with 5–6 complete vertical striae; posterior borders slightly crenulate, no perforations. COLOUR: *Fresh*, at about 30–40 mm., dorsal surfaces greenish brown. A narrow blue-black lateral band demarcates dorsal and lateral colours with above it a broad silver band from operculum to caudal base. Peritoneum white. Anterior dorsal rays dusky. Upper jaw black. Top of head greenish. Caudal dusky at tips.

At about 60 mm. and above, dorsal surfaces greenish-blue. Humeral spot yellowish with minute melanophores. Narrow electric blue or greenish dorsal-lateral band from operculum to caudal base, bordered ventrally by a thin black line which demarcates dorsal and lateral colourations. Sides and belly silvery. Two oblique dark bands in post-orbital position. Snout black, without yellow markings. Lower jaw tinged faintly yellow, tip dark or brown or black. Dorsal fin greyish with a yellow tinge, tips darker. Caudal fin dusky, often with black margins. Other fins colourless. The prominent black patch on the dorsal fin and the yellow-orange lateral band of the previous form are absent.

In alcohol, at 24.3 mm., mid-dorsal surface light brown, rest of body yellowish white (scales absent), with an indistinct narrow black line from operculum to caudal base (silvery in life). Snout tip dusky. Sides of head with minute black spots often forming a horizontal row below eye. Posterior dorsal scale pockets brownish. Dorsal fin with a few black spots on anterior rays, caudal similarly coloured; a row of black spots along anal base. Other fins colourless.

At 33–40 mm., dorsal surfaces greenish brown, sides lighter. A narrow dark lateral band (silvery in life) from operculum to caudal base, about eye diameter or a little more in width. Snout tip dusky. Sides of head and lower jaw with brown speckles. Anterior dorsal rays and caudal light brown. Row of black/brown spots along anal base just distinct.

At 50 mm. and above, dorsal surfaces greenish brown or bluish (scales lost), sides yellowish white (due to formalin). A prominent narrow blue-black line from operculum to caudal base is evident in most large specimens. Tip of snout and lower jaw dark brown or black. Dorsal and caudal fins dusky. First rays of pectoral fin often speckled black, other fins hyaline. No prominent black patch on dorsal fin (as in the previous forms); tips of caudal fin evenly dusky.

SIZE: 120 mm., S.L. (Dar-es-Salaam); 137 mm., F.L., weight 42 gm. (♀, Dar-es-Salaam).

DISTRIBUTION: Entire East African coast (recorded from Lamu, Formosa Bay, Malindi, Mombasa, Shimoni, Tanga, Zanzibar Channel and Mafia Channel), mainly in bays, harbours (Mombasa, Dar-es-Salaam) and the shallow waters very close to the shore. A neretic species which rarely extends seawards. Generally most abundant over a muddy substrate, rarely caught in or around coral reef areas. Present throughout the year, but seasonally extremely abundant during the northeast monsoon, also during and shortly following the rainy seasons.

RANGE: Eastern coast of Africa from the Red Sea to Natal; Seychelles, Madagascar. Probably widely distributed in the Indian Ocean.

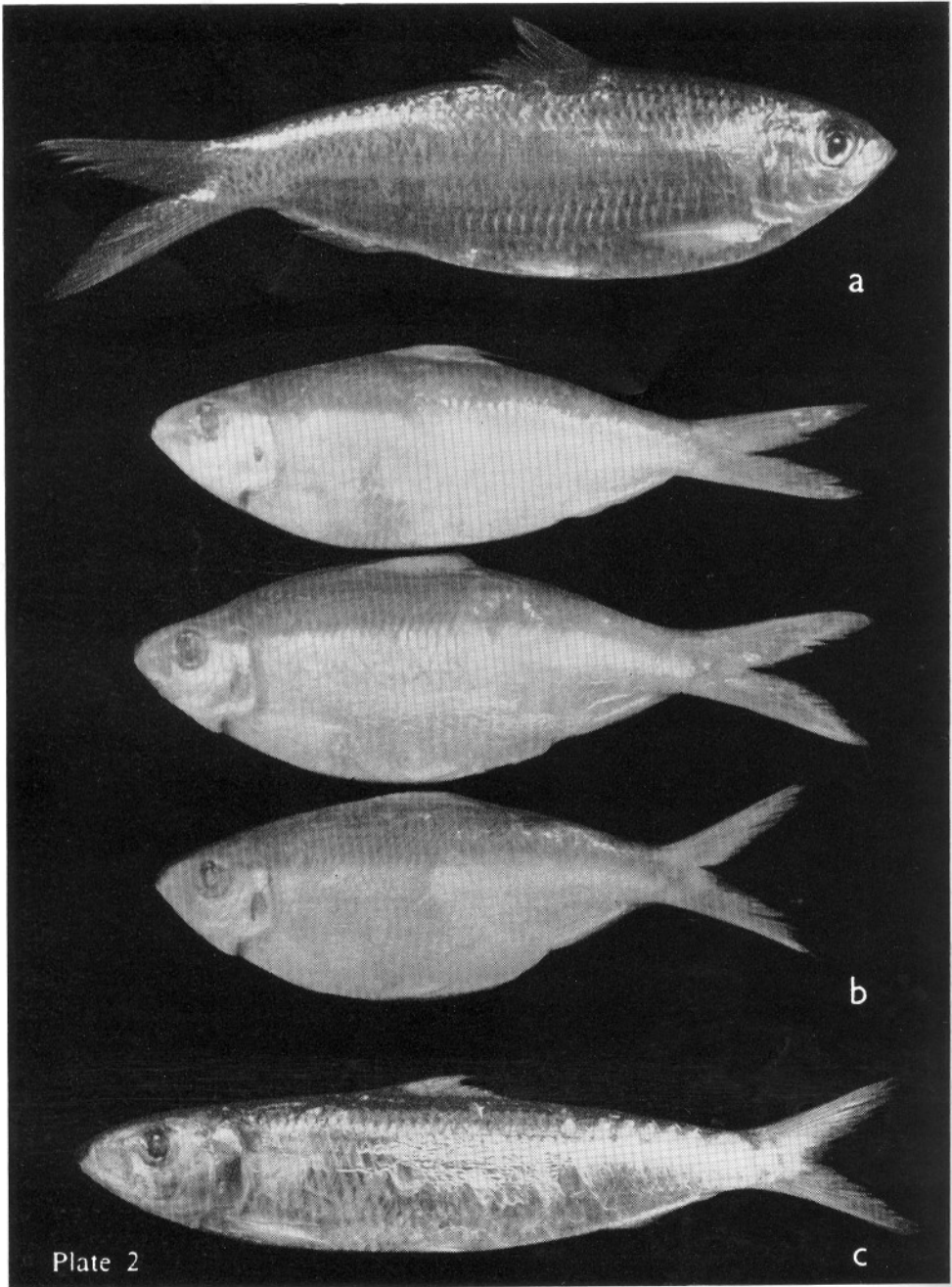
REMARKS. Previously this form has been confused with *H. punctatus* form *A*, but on the basis of East African material it is quite distinct. I cannot at present relate it to any previous description as the literature is too confused. In the field it can be distinguished from *H. punctatus* form *A* by the more slender body (mean body depth 26.71% in S.L., *c.f.* 31.39% in *H. punctatus* form *A*), and colouration (dorsal fin evenly dusky, black patch on dorsal fin and yellow lateral band absent, *c.f.* prominent black patch on dorsal fin and yellow lateral band present in *H. punctatus* form *A*). Further characters which distinguish form *B* from form *A* are the number of gillrakers (Table 3), lateral scales (about 39–42, *c.f.* 34–38), abdominal scutes (total generally 31–33, *c.f.* 29–30) and vertebrae (43–44, *c.f.* 41–42). Meristic characters and mean values for proportional measurements are compared in Table 2. Differences in the biology of these closely allied herrings were evident.

Günther's (1868) specimens of *Clupea venenosa* from Zanzibar are *H. punctatus* form *B*, as also five specimens labelled *Sardinella melanura* from the collection of the Ichthyology Department, Grahamstown (S.A.), sent to me by Professor J. L. B. Smith (No. 816, Delagoa Bay, 108 mm. S.L.; No. 7179, Isipingo, 92.5 mm. S.L.; no number, Mahé, Seychelles, collected on 13.9.54, 96 mm. S.L.; No. 270, Zanzibar, 71 mm. S.L.; No. 607, Pinda, 57.5 mm. S.L.). These specimens fall within the descriptions of East African material. Therefore it also appears very likely that at least some previous records of *Sardinella melanura* (Cuvier) from the Western Indian Ocean were based on *Herklotsichthys*.

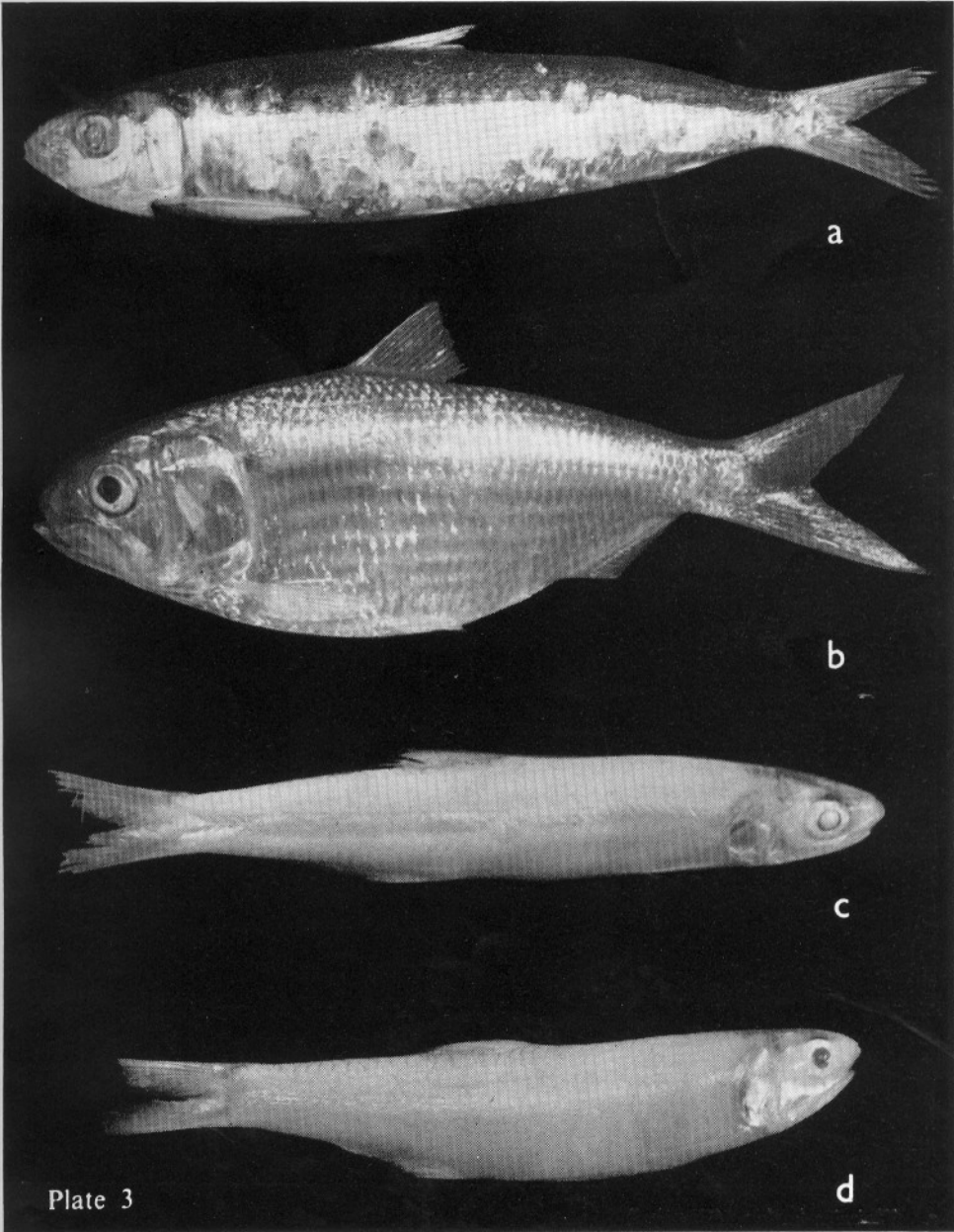
The two forms of *H. punctatus* described would certainly appear to be two distinct species. What has prevented me from describing them as such is that neither can be completely identified with



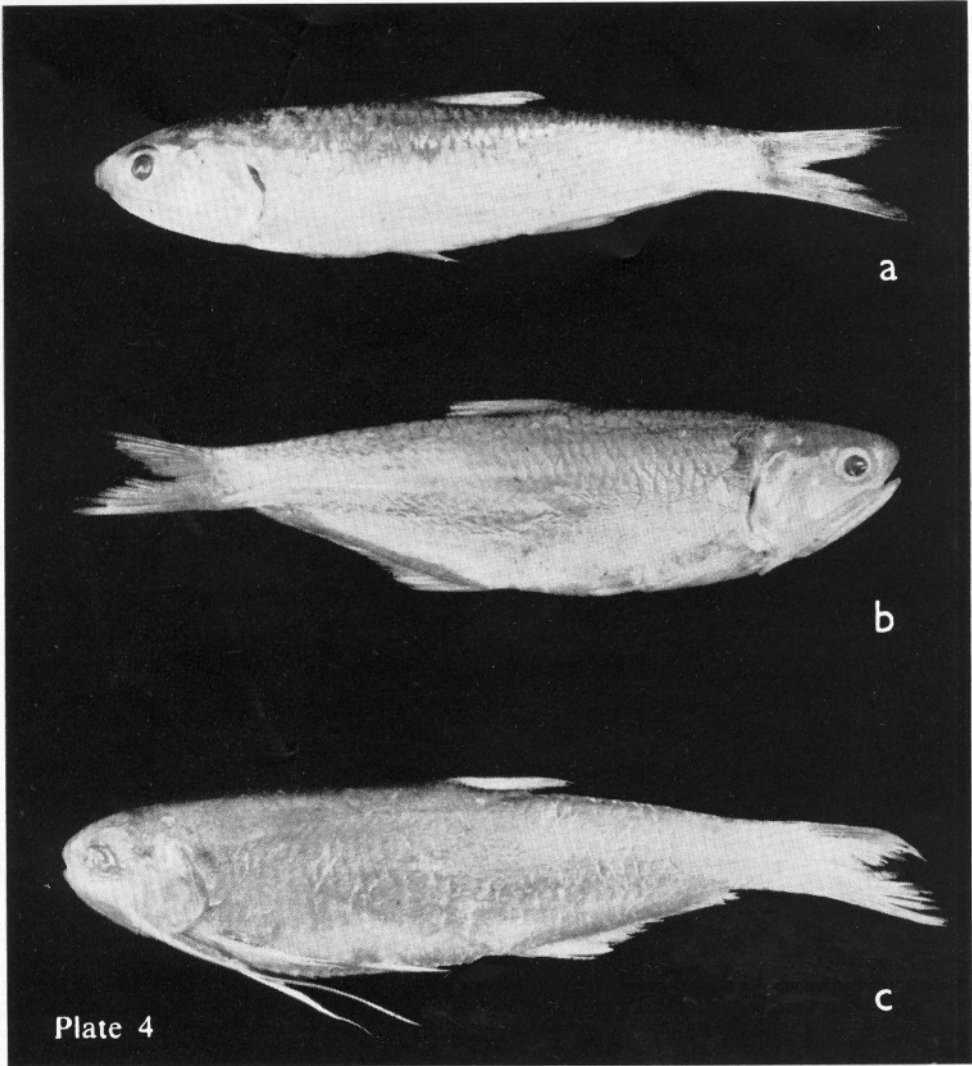
- a *Elops machnata* (Forsskal)
- b *Spratellomorpha bianalis* (Bertin)
- c *Herklotsichthys punctatus*
- d *Sardinella longiceps* Valenciennes



a+b *Sardinella albella* (Valenciennes)
c *Sardinella gibbosa* (Bleeker)



- Plate 3
- a *Sardinella sirm* (Walbaum)
 - b *Hilsa kelee* (Cuvier)
 - c *Stolephorus indicus* (Van Hasselt)
 - d *Stolephorus commersonii* Lacépède



- a *Thrissina baelama* (Forsskal)
b *Thryssa vitirostris* (Gilchrist & Thompson)
c *Thryssa setirostris* (Broussonet)

TABLE 3

A comparison of gillraker number at various lengths in *Herklotsichthys punctatus* Form A and *Herklotsichthys punctatus* Form B

(The mean of the ranges are placed in parenthesis)

Length Group mm.	Number of Gillrakers	
	<i>H. punctatus</i> A. (45 fishes)	<i>H. punctatus</i> B. (44 fishes)
20- 29	—	23-29 (25.80)
30- 39	—	29-31 (30.50)
40- 49	—	—
50- 59	30-33 (31.75)	32-34 (33.00)
60- 69	30-33 (32.05)	32-35 (34.18)
70- 79	31-34 (32.88)	33-35 (34.25)
80- 89	31-34 (32.40)	33-36 (34.41)
90- 99	—	34-36 (35.00)
100-109	—	34-37 (35.37)
110-119	—	34-37 (35.33)

Rüppell's types of *C. punctata*. In the event, I have given greater emphasis to colouration than to other characters (e.g. body depth) and have thus equated *H. punctatus* form A with Rüppell's Red Sea *C. punctata*. I have examined brine-preserved Red Sea (Massawa) specimens in which the orange colouration was well demonstrated. Future work on specimens from other parts of the enormous range of *H. punctatus* may confirm the existence of two distinct species. The two forms share at least three East African localities (Shimoni, Tanga and the Zanzibar Channel), hence there is no significant geographical barrier to interbreeding and it would therefore be unwise to postulate subspecies unless more were known of possible isolating environmental factors.

Genus SARDINELLA Valenciennes, 1847

Sardinella Valenciennes, 1847: 28 (Type: *Sardinella aurita* Valenciennes).

Chan (1965) recognised fifteen Indo-Pacific species; five distinct species are here described from East African waters.

Key to the East African Species

1. Nine pelvic fin rays; more than 150 gillrakers on lower part of 1st gill arch *S. longiceps*
2. Eight pelvic fin rays; not more than 60 gillrakers on lower part of 1st gill arch:
 - (i) Abdominal scutes strongly keeled, sharp and exposed; abdomen highly compressed, not rounded; 43-60 gillrakers on lower part of 1st gill arch (at 51-144 mm. S.L.):
 - (a) Body depth 29.2-39.9% (mean 33.44%) in S.L. (at 51-123 mm S.L.); generally 12-13 (very rarely 14-15) post-pelvic scutes *S. albella*
 - (b) Body depth 19.8-31.6% (mean 26.5%) in S.L. (at 31-144 mm. S.L.); 14-16 post-pelvic scutes *S. gibbosa*
 - (c) Body depth about 28-31% in S.L. (at 75-105 mm. S.L.); 12-13 post-pelvic scutes; tips of caudal fin prominently dark grey to jet black *S. melanura**
 - (ii) Abdominal scutes feebly keeled, hardly exposed; abdomen smooth and rounded; 31-42 gillrakers on lower part of 1st gill arch (at 38.5-216.0 mm. S.L.):
 - (a) Gillrakers 40-42 on lower part of 1st gill arch (at 115-168 mm. S.L.); upper jaw (maxilla) almost or quite reaching the orbit through the vertical; base of dorsal fin about equidistant from snout and caudal base *S. sirm*
 - (b) Gillrakers 33 on lower part of 1st gill arch (at 199-216 mm. S.L.); upper jaw (maxilla) not nearly reaching the orbit through the vertical; base of dorsal fin much nearer to the caudal base than to the snout *S. leiogaster*

*This species is known from adjacent areas but not as yet from East Africa.

SARDINELLA LONGICEPS Valenciennes

Plate 1d

Sardinella longiceps Valenciennes, 1847: (198) 273 (Type locality: Pondicherry); Regan, 1917: 379 (Mombasa); Fowler, 1956: 65 (Indo-Pacific specimens); Whitehead, 1965b: 349 (Gulf of Aden); Losse, 1966b: 173 (Mombasa).

Alausa scombrina: Valenciennes, 1847: 442 (Mahé, Seychelles).

Alose scombrina: Bleeker, 1875: 103 (Seychelles).

STANDARD COMMON NAME: Oil sardine.

VERNACULAR NAMES: *Dagaa la upapa* (Tanzania), *Simu ziwa* (Mombasa district), *Simu* (Kenya), *Dagaa* (small specimens, general).

DESCRIPTION: Based on thirteen fishes, 104.7–130.9 mm. standard length, from Formosa Bay; ten, 101.5–122.0 mm., from Mombasa; two, 106.–108.3 mm., from Zanzibar and two, 113.0–120.4 mm., from Dar-es-Salaam.

Dorsal iii-iv 13–15, total 17–19; pectoral i 14–16, pelvic i 8, anal ii-iii 13–16, total 15–18. Ventral scutes moderately keeled, 17–19 pre-pelvic, generally covered by scales; 14–15 (17) post-pelvic scutes strongly keeled, sharp, and exposed, total 32–34. Gillrakers long and setiform, about 168–250 on lower part of 1st gill arch. Branchiostegal rays 5. Scales moderately caducous, about 43–46 in lateral series.

Depth 20.3–23.5, head 27.3–30.5, snout 7.1–8.6, eye 5.0–6.2, post-orbital 11.9–13.9, inter-orbital 4.2–5.3, upper jaw 10.2–11.3, lower jaw 12.3–14.3, pectoral fin 15.2–17.1, pelvic fin 8.4–9.8, pre-dorsal 44.5–47.5, pre-pelvic 52.5–55.4, pre-anal (73.6) 77.5–79.9, caudal peduncle 7.0–7.8.

Body elongate, moderately compressed, dorsal and ventral profiles equally convex. Head 5–8% longer than the maximum body length. Upper jaw longer than the snout, the maxillary reaching about a third into the eye through the vertical. Operculum more than half as wide as long, the lower margin straight. Sub-operculum rectangular, the posterior border rounded. Dorsal fin slightly nearer to anal origin than to the pectoral base. Gillrakers long, about $\frac{3}{4}$ eye diameter in length. Scales narrowly imbricate, from shoulder with 2–4 incomplete, or more or less interrupted vertical striae, no perforations on posterior part of scales.

COLOUR: *Fresh*, dorsal surfaces bluish green, sides silvery. A yellow humeral patch continued in a narrow yellowish golden lateral stripe to caudal base, demarcating dorsal and lateral colouration. Top of head yellow or greenish yellow. Snout yellowish, dusky at tip. A dark patch at upper hind edge of operculum. Dorsal fin yellowish with dark margin; no dark spot at base of dorsal origin. Caudal yellowish, speckled dark brown to black, margin black. First pectoral ray black, rays 2–5 speckled black for $\frac{3}{4}$ of length. Other fins hyaline. At later post-mortem the yellow colours fade, and the lateral band may become dark or almost black.

In alcohol, dorsal surfaces bluish green or brown, sides silvery or golden. All dark markings retained and generally more pronounced, rest faded except lateral band which may be retained as a light band below dark dorsal colouration.

SIZE: 131 mm. S.L., weight 34.7 gm. (Formosa Bay); 166 mm. in the eastern Indo-Pacific (Li-Kwan-Ming, 1959).

DISTRIBUTION: East African coast south to Dar-es-Salaam (recorded from Formosa Bay, Mombasa, Shimoni, Zanzibar and Dar-es-Salaam), in waters 1–21 fathoms in depth, in bays and over shallow banks, not found elsewhere in this area. Specimens were caught at the beginning of the northeast monsoon (November to December 1965) in the Zanzibar Channel, in Formosa Bay and through the northeast monsoon period (November to January 1964/65) off Mombasa. The maximum abundance of this species in the Indian Ocean is in areas of upwelling and biologically rich waters. The occurrence in East African waters may be associated with the reported inflow of the relatively rich Somalia Current during the northeast monsoon (Williams, 1964). The occurrence of specimens in the Zanzibar Channel, where only four were recorded (Nov./Dec. 1965), is of considerable interest as this species has not been known previously from the south of Mombasa (Lat. 04° South), although large samples of *Sardinella* were previously examined by the author from purse-seine and stick-held dipnet catches made in the Zanzibar area. The occurrence of *S. longiceps* in East African waters may be a useful indicator of the inflow of biologically rich waters. The species generally avoids areas where the thermocline is deep (as off East Africa) and where biologically poor surface waters are piled up along the eastern continental coasts (Rosa & Laevastu, 1960).

RANGE: Eastern coast of Africa from the Gulf of Aden to Dar-es-Salaam; Seychelles. Elsewhere, widely distributed in the Indian and Pacific Oceans; recorded from Arabia, India, Ceylon, Andamans, E. Indies and the Philippines.

SARDINELLA ALBELLA (Valenciennes)

Plate 2a,b

Kowala albella Valenciennes, 1847: 362 (Type locality: Pondicherry).

Alosa kowal: Günther, 1866: 123 (Zanzibar); Sauvage, 1891: 627 (Zanzibar).

Clupea kowal: Günther, 1868: 450 (Zanzibar).

Sardinella perforata: Regan, 1917: 382 (Indian Ocean); Fowler, 1956: 65 (Indo-Pacific specimens); Sanches, 1963: 17, fig. 1 (Inhaca, Mozambique); Losse, 1964: 11 (Zanzibar Channel); *Idem*, 1966a: 89 (Zanzibar).

Sardinella bulan: Whitehead, 1965b: 250 (Gulf of Aden); Losse, 1966b: 173 (East Africa; Zanzibar, Pangani estuary, Tanga, Mombasa); *Idem*, 1966c: 51 (Zanzibar Channel).

The types of *Clupalosa bulan* and *Kowala albella* have been redescribed by Whitehead (1964c; 1967).

STANDARD COMMON NAME: Deep-bodied sardine.

VERNACULAR NAMES: *Dagaa la upapa* (Zanzibar, Dar-es-Salaam), *Simu* (Kenya), *Simu koko* (Mombasa; Swahili *koko* = mongrel, i.e. mongrel sardine), *Dagaa* (small specimens, general).

DESCRIPTION: Based on four fishes, 99.7–123.2 mm. standard length, from Mombasa; two, 58.1–65.3 mm., from Tanga; one, 77.3 mm., from the Pangani estuary and twenty-eight, 51.0–113.3 mm., from the Zanzibar Channel. Depth measurements, scute and gillraker counts on ten further fishes, 79.7–116.5 mm., from the Zanzibar Channel.

Dorsal iv (14) 15–16, pectoral i 13–15 (16), pelvic i 7, anal ii–iii 17–20, total (19) 20–22 (23). Ventral scutes strongly keeled, sharp and exposed, 17–18 pre-pelvic, 12–13 (14–15) post-pelvic, total 30–31 (32–33). Gillrakers, 46–55 on lower part of 1st gill arch (at 51.0–123.2 mm. S.L.), the number increasing slightly with length of fish. Branchiostegal rays 5. Scales caducous, about 39–43 (pockets) in lateral series.

Depth 29.2 (at 51 mm.)–39.9 (at 111 mm.; mean 33.44%), head 23.3–27.6, snout 5.7–8.9, eye 6.1–8.1, post-orbital 8.2–9.9, upper jaw 9.9–11.3, pectoral fin 18.3–21.7, pelvic fin 10.6–12.3, pre-dorsal 42.2–47.5, pre-pelvic 49.2–54.1, pre-anal 75.1–82.1. (For the mean of these values see Table 4).

Body very strongly compressed, much more than in all other East African *Sardinella*. Ventral profile convex, dorsal profile almost a straight line. Head 6% or more shorter than the maximum body depth. Upper jaw longer than the snout, reaching about $\frac{1}{2}$ to almost $\frac{1}{2}$ into the eye, through the vertical. Operculum about $2\frac{1}{2}$ times as long as wide, the lower margin oblique. Sub-operculum rectangular, about twice as long as wide, the posterior border oblique. Dorsal fin slightly nearer to snout than to the caudal base, or about equidistant. Pelvic origin slightly nearer to pectoral base than to the anal origin or almost equidistant. Gillrakers short, about $\frac{1}{2}$ eye diameter in length. Scales (from shoulder) crenulate with 3–4 interrupted vertical striae and numerous round and oval perforations on posterior part of scale.

COLOUR: *Fresh*, dorsal surfaces green, bluish where scales are lost; sides and belly silver. Humeral spot absent, at the most a few minute, scattered black spots are evident. Faint golden lateral stripe present in large specimens (scales lost). Tip of snout dusky. Dorsal fin tinged faintly yellow, mainly grey. A black spot at base of anterior dorsal rays; fin dusky at margins. Caudal fin dusky, darker (almost black in some specimens) at margins. First ray of pectoral fin occasionally with dark markings, generally these are absent. Other fins colourless.

In alcohol, dorsal surfaces greenish-brown, sides silvery. Dark markings retained, rest faded.

SIZE: 123.2 mm. S.L. (Mombasa), weight 34 gm. (♀, 122 mm. F.L.).

DISTRIBUTION: Entire East African coast (recorded from Formosa Bay, Malindi, Mombasa, Kilifi, Tanga, Pangani estuary, the entire Zanzibar and Mafia Channels), in shallow bays (juveniles) in the vicinity of estuaries, but also further offshore (adults only) in waters 20 fathoms in depth (Zanzibar Channel). A neritic species which was the only *Sardinella* frequently caught in estuaries (by trawl) and generally occurred in abundance only in the shallow waters close to the shore. The species was present throughout the year and abundant in the Zanzibar Channel during July, August and shortly following the rainy seasons in April and November.

RANGE: Eastern coast of Africa from the Gulf of Aden to Mozambique (Lourenco Marques and Inhaca Island); Madagascar. Elsewhere, widely distributed in the Indian and Pacific Oceans; recorded from the East Indies, Philippines, Siam, Micronesia and Polynesia.

REMARKS: Three specimens from Mombasa (110.6–123.2 mm. S.L.; Plate 2b) are remarkable for their great body depth (36.0–39.9% in S.L.) and short head length (23.3–24.2% in S.L.). In these characters they resemble previous descriptions of *S. brachysoma* (Bleeker). Chan (1965) however, distinguished *S. brachysoma* by the groove patterns on the scales, the vertical striae becoming continuous across the scale in the posterior scales but remaining incomplete in all scales in *Sardinella albella*. This distinction has been further emphasised by Whitehead (1967, fig. 4) in a comparison of the type of *Kowala albella* with typical specimens of *S. brachysoma*. The three Mombasa specimens have the vertical striae interrupted at the centre of the scale, even in scales from the caudal peduncle, and so conform to the *albella* and not the *brachysoma* pattern illustrated by Whitehead. Whitehead (*loc. cit.*) also showed that the name *albella* had priority over the name *bulan*; in some of the earlier literature the species has been referred to as *Sardinella perforata* (Cantor), but this is also a synonym of *albella*.

These deep-bodied specimens from Mombasa are all females with gonads in a mature condition. This character of extreme depth in large mature females was frequently evident in this and the following species, *S. gibbosa*. Depth generally increased with length and hence it is not always a reliable character for identification of the species.

SARDINELLA GIBBOSA (Bleeker)

Plate 2c

Clupea gibbosa Bleeker, 1849b: (69) 72 (Type locality: Macassar).

?*Clupea tembang*: Jatzow & Lenz, 1899: 526 (Zanzibar).

Sardinella sindensis: Regan, 1916 : 167 (Durban); Gilchrist & Thompson, 1917 : 297 (on Regan, references).

Sardinella gibbosa: Regan, 1917a : 383 (Mombasa, Indian Ocean); *Idem*, 1917b : 458 (Durban); Barnard, 1925: 113 (Natal).

Sardinella jussieu: Bonde, 1933 : 353 (Zanzibar); *Idem*, 1934 : 437, (Zanzibar); Fowler, 1934 : 365, fig. 5 (Durban); *Idem*, 1941 : 67 (Indo-Pacific specimens); Smith, 1949-1965 : 92 (Natal); Baissac, 1950 : 10 (Mauritius); Allfree & Bailey, 1951 : 74 (Kenya); Baissac, 1951 : 128 (Mauritius); Fourmanoir, 1957 : 9 (Madagascar); Sanches, 1963 : 18, fig. 2 (Inhaca, Mozambique); Losse, 1964 : 11 (Zanzibar Channel); Whitehead, 1965b : 252 (Red Sea, Gulf of Aden); Losse, 1966a : 89 (Zanzibar); *Idem*, 1966b : 173 (East Africa; Dar-es-Salaam, Zanzibar, Tanga, Mombasa, Malindi); *Idem*, 1966c : 51 (Zanzibar Channel).

STANDARD COMMON NAME: Common sardine.

VERNACULAR NAMES: *Dagaa la upapa* (Tanzania), *Simu* (Kenya coast), *Simu ziwa* (Mombasa district), *Dagaa* (small specimens, general).

DESCRIPTION: Based on eleven fishes, 98.3-144.0 mm. standard length, from Formosa Bay; fifteen, 53.5-142.6 mm., from Mombasa and forty-two, 31.0-140.6 mm., from the Zanzibar Channel.

Dorsal iii-iv (13) 14-15 (16), total (17) 18-19 (20), pectoral i 14-15 (16), pelvic i 7, anal ii-iii (iv) (15) 16-18, total (18) 19-21. Ventral scutes strongly keeled, sharp and exposed, (16) 17-18 (19) pre-pelvic, 14-15 (16) post-pelvic, total (31) 32-33 (34). Branchiostegal rays 5. Gillrakers of moderate length, half as long as eye diameter, 38-58 on lower part of 1st gill arch (at 31-144 mm. S.L.), increasing in number with length of fish.

Body depth variable, 19.8-31.6 (mean 26.55, at 31-144 mm. S.L.), head 23.4-28.3, snout 6.4-8.8, eye (5.2) 5.6-8.0, post-orbital 8.2-10.2, upper jaw 9.1-11.5, pectoral fin 15.6-19.5, pelvic fin 7.9-11.7, pre-dorsal 42.3-48.0, pre-pelvic 46.3-52.0 (53.6), pre-anal 72.2-80.5 (85.5-87.8), caudal peduncle 7.3-9.4. (The mean of these values are shown in Table 4).

Body strongly compressed but less than in the preceding species, *S. albella*. Ventral profile rather more convex than the dorsal, which is almost a straight line. Head at the most 4% shorter than maximum body depth (large females, *c.f.* preceding species), generally 1-4% longer than the depth of the body. Upper jaw longer than the snout, reaching almost half into the eye through the vertical. Operculum about 2½ times as long as wide, the lower margin straight or slightly oblique. Sub-operculum rectangular, the posterior border oblique. Dorsal fin base about equidistant from the snout and the caudal base. Pelvic origin slightly nearer to pectoral base than to the anal origin or about equidistant. Scales (from shoulder) crenulate, with 4-5 interrupted vertical striae and a number of perforations on the posterior part of the scales.

COLOUR: *Fresh*, (scales fallen), dorsal surfaces greenish blue, sides and belly silvery. A yellowish or dark (almost black) humeral spot continued in a very faint yellowish line to caudal base. Tip of snout yellowish. Lower jaw bright yellow, minutely speckled black. A black spot at base of anterior dorsal rays, dorsal fin yellowish, dorsal third dusky. Caudal fin colourless, yellowish or dusky with darker margins. First ray of pectoral fin speckled black. Other fins colourless.

In alcohol, dorsal surfaces brown, greenish-blue or dark, sides silvery. Black markings retained; humeral spot and spot at dorsal origin often prominent, rest faded. Caudal fin very variable, from colourless and dusky with darker margins to almost entirely black.

SIZE: 144 mm. S.L. (Formosa Bay); 163 mm. F.L., weight 59.5 gm. (♀, Formosa Bay).

DISTRIBUTION: Entire East African coast (recorded from Formosa Bay, Malindi, Mombasa, Shimoni, Zanzibar Channel and Mafia Channel south to Kilwa), in the shallow coastal water within the 100 fathom contour, in bays and harbours (Mombasa). *S. gibbosa* is the most abundant sardine in the East African area and occurred throughout the year. Seasonal abundance was marked during the northeast monsoon and also during and following the rainy seasons.

RANGE: Eastern coast of Africa from the Red Sea to Durban; Madagascar, Mauritius. Elsewhere, widely distributed in the Indian and Pacific oceans.

REMARKS: *Sardinella gibbosa* from E. African waters exhibit a wide range of most meristic characters.

Two populations may occur in this area; one abundant during the southeast monsoon, the other during the northeast monsoon period. These populations appeared to differ slightly in mean body depth and mean gillraker number, but extensive studies of large series will be necessary to clearly define the characteristics.

As in the preceding species, body depth is extremely variable, the greatest depth being recorded in mature females caught offshore during the latter part of the southeast monsoon (September/October) and hence this is not always a reliable character in differentiating *S. gibbosa* from *S. albella*. Values for body measurements (Table 4) demonstrate, however, that the only marked proportional difference between these two species is body depth. In the meristic characters differences are shown

in the number of branched anal rays and the number of abdominal scutes, although there is some overlap.

This species was known as *Sardinella jussieu* (Lacépède) by certain earlier authors. Recently Whitehead (1967) has shown that the name *jussieu* is now almost impossible to identify with certainty, and he recommended that it be suppressed as a *nomen dubium*.

TABLE 4

Proportional measurements and meristic characters of *Sardinella albella* and *Sardinella gibbosa*

	<i>Sardinella albella</i> (39 fishes)	<i>Sardinella gibbosa</i> (73 fishes)
Standard length	51–123 mm.	31–144 mm.
<i>In % of S.L.</i>	<i>mean</i>	<i>mean</i>
Body depth	33.44	26.55
Head length	25.71	25.38
Snout length	7.25	7.55
Eye diameter	7.23	6.57
Post-orbital distance	8.99	9.09
Upper jaw length	10.62	9.91
Pectoral fin length	19.83	17.57
Pelvic fin length	11.43	10.03
Pre-dorsal distance	45.06	45.04
Pre-pelvic distance	51.51	50.19
Pre-anal distance	77.71	78.47
Dorsal rays: simple	iv	iii–iv
branched	(14)15–16	(13)14–15(16)
Anal rays: simple	ii–iii	ii–iii(iv)
branched	17–20	(15)16–18
Abdominal scutes	17-18+12–13(14–15)	(16)17–18(19)+14–15(16)
Gillrakers	46–55	38–58

SARDINELLA MELANURA (Cuvier)

Clupea melanura Cuvier, 1829 : 318 (on var. *du Clupanodon jussieu* of Lacépède, 1803 : pl. 11, fig. 3; locality: Asia).

This species was not recorded from East African waters but it is known from the Red Sea, Gulf of Aden (as *Herklotsichthys vittatus*; Whitehead, 1965b), Mozambique Channel and Natal (Fowler, 1925).

SARDINELLA SIRM (Walbaum)

Plate 3a

Clupea sirm Walbaum 1792 (on Forsskål, 1775 : 17; Arabia); Peters, 1855 : 268 (Mozambique); Günther, 1868 : 425 (Zanzibar); Klunzinger, 1871 : 598 (Mozambique).

Alosa sirm: Günther, 1866 : 123 (Zanzibar); Sauvage, 1891 : 527 (Zanzibar).

Clupea punctata: Günther, 1868 : 412 (Zanzibar).

Sardinella sirm: Regan, 1917 : 385 (Zanzibar, Indian Ocean); Smith, 1955 : 307 (Aldabra); *Idem*, 1963 : 8, pl. 4 K (Seychelles); Losse, 1964 : 11c (Zanzibar Channel); Whitehead, 1965b : 256 (Red Sea, Gulf of Aden); Losse, 1966a : 89 (Zanzibar); *Idem*, 1966b : 174 (East Africa; Dar-es-Salaam, Zanzibar, Mombasa); *Idem*, 1966c : 51 (Zanzibar Channel).

Sardinella leiogaster: Fourmanoir, 1961 : 84 (Madagascar).

STANDARD COMMON NAME: Arabian sardine.

VERNACULAR NAMES: *Dagaa la upapa* (Tanzania), *Simu* (Kenya), *Simu arabuni* (Mombasa district), *Dagaa* (small specimens, general) *Simu dudumi* (Mombasa, very small specimens; may also refer to very small specimens of other *Sardinella*, i.e. Swahili *dudu* = insect).

DESCRIPTION: Based on eighteen fishes, 62.7–167.8 mm. standard length, from the Zanzibar Channel and five, 44.1–62.5 mm., from Mombasa. Depth measurements and gillraker counts on eight further fishes, 38.5–147.4 mm., from the Zanzibar Channel and twelve, 42.3–67.6 mm., from Mombasa.

Dorsal iii–iv 12–15, total (15–16) 17–19, pectoral i 15–17, pelvic i 7, anal iii (iv) (14–15) 16–18, total (19) 20–22. Abdominal scutes feebly keeled, 16–18 pre-pelvic, (8) 13–14 post-pelvic, total (25–29) 30–31 (32). Gillrakers, 31–42 on lower part of 1st gill arch (at 38.5–167.8 mm. S.L.), the number increasing with length of fish (Table 5). The gillraker number does not increase significantly in fish of 160 mm. and above. Whitehead (1965b) recorded 45 gillrakers in a single specimen from the Red Sea/Gulf of Aden area. Scales very caducous, about 39–41 (pockets) in lateral series. Branchiostegal rays 5.

TABLE 5

Gillraker number at various lengths in *Sardinella sirm*

Standard length mm.	Gillraker range East African Material (43 fishes)	Gillraker mean
38.5–39.9	31–32	31.66
40.0–44.1	32–35	33.75
51.0–59.0	36–38	36.55
61.1–69.6	36–40	37.60
78.5	39	39.00
92.1	39	38.00
114.7	40	40.00
143.2–149.8	40–41	40.50
152.0–154.6	41–42	41.50
167.8	42	42.00
	Malagasy Material (EAMFRO. 1966.2.1) (5 fishes)	
157.7–191.5	42–43	42.40

Depth 18.7–23.1, head 23.7–27.4, snout 6.7–9.1, eye 5.8–7.5, post-orbital 8.3–9.7, upper jaw 8.5–11.5, pectoral fin 15.5–17.8, pelvic fin 9.0–11.3, pre-dorsal 44.2–47.6, pre-pelvic 48.0–50.6, pre-anal 72.0–80.6. (The mean of these values are shown in Table 6).

Body elongate, moderately compressed; belly smooth and rounded. Dorsal and ventral profiles equally convex. Head about 2.5–5% longer than the maximum body depth. Upper jaw slightly longer than the snout, the maxillary not quite reaching to the anterior border of the orbit, or rarely, just level with anterior border of the orbit through the vertical. Operculum about $2\frac{3}{4}$ times as long as wide, the lower margin oblique. Sub-operculum rectangular, the posterior border rounded. Dorsal fin base equidistant from the snout and the caudal base, dorsal origin much nearer to snout than to the caudal base. Pelvic origin beneath anterior third of dorsal fin. Scales (from shoulder) with up to 5 interrupted vertical striae, poorly developed in large specimens; posterior scale borders with slight indentation, not markedly crenulate, and a few small perforations.

COLOUR: *Fresh* (scales fallen) at 45–62 mm., dorsal surfaces greenish-blue, sides silvery. Humeral spot greenish-yellow followed by a lateral series of such spots to caudal base. Black spot at base of dorsal origin. Caudal base yellowish, fin minutely speckled black. Snout and lower jaw yellowish, tips dusky.

At 100 mm. and above, dorsal surfaces blue-green, sides and belly silvery. Humeral spot blue-black followed by a series of up to 13 round blue-black lateral spots to caudal base which tend to form a stripe posteriorly. Anterior base of dorsal fin yellowish; a black spot at base of anterior (simple) rays. Caudal dusky, darker at margins. Other fins colourless.

In alcohol, dark markings generally retained, rest faded. In adults the lateral row of blue spots generally becomes indistinct, as also in some juveniles (due to formalin).

SIZE: 200 mm. F.L. and a weight of 109 gm. (♀, Zanzibar Channel); 206 mm. F.L. and 116.8 gm. in Madagascar (Nosy-Bé).

DISTRIBUTION: Entire East African coast (recorded from Formosa Bay, Malindi, Mombasa, Kilifi, Tanga, Zanzibar Channel and Mafia Channel), in bays, harbours (juveniles only) and shallow

waters within the 100 fathom contour. Seasonal abundance occurred during the northeast monsoon; the species was uncommon in the coastal waters for the greater part of the southeast monsoon period. A more offshore species than all other *Sardinella* in this area, it was abundant only over the shallow water banks of the southern portions of both the Mafia and Zanzibar Channels. Adult fish appeared in November and departed before March, juveniles remained in the coastal waters in small numbers.

The species was observed underwater in groups of 8–10 (juveniles) frequently swimming together with *Herklotichthys punctatus* Form A, in and around coral reef areas of the Zanzibar Channel. RANGE: Eastern coast of Africa from the Red Sea to Mozambique; Madagascar, Aldabra, Seychelles. Elsewhere, widely distributed in the Indian and Pacific oceans; East Indies, Philippines, China, Micronesia and Polynesia.

SARDINELLA LEOGASTER Valenciennes

Sardinella leiogaster Valenciennes, 1847 : 270.

? *Sardinella clupeioides*: Fowler, 1941 : 620 (Red Sea).

STANDARD COMMON NAME: Short-jawed sardine, distinguishes this species from the longer-jawed *Sardinella sirm*.

VERNACULAR NAME: *Simu* (Kenya).

DESCRIPTION: Based on two fishes, 199–216 mm. standard length, from Malindi (Kenya).

Dorsal iv–v 14–15, pectoral i 15–16, pelvic i 7, anal 19 (2–3 of which appear to be simple rays; fins damaged), abdominal scutes very feebly keeled, 17 pre-pelvic, 14 post-pelvic. Gillrakers, 33 on lower part of 1st gill arch. Branchiostegal rays 5. Scales very caducous, about 39 (pockets) in lateral series.

Depth 21.6–22.6, head 23.2–23.5, snout 7.2–7.3, eye 5.6–6.0, post-orbital 8.9–9.1, upper jaw 7.0, lower jaw 8.5–8.9, pectoral fin 13.4–14.6, pelvic fin 8.4–8.8, pre-dorsal 49.4–51.4, pre-pelvic 49.4–50.4, pre-anal 77.0–77.6.

Body elongate, very moderately compressed; belly smooth and rounded. Dorsal and ventral profiles equally convex. Head at the most 2% longer than the maximum body depth. Upper jaw shorter than the snout, the maxillary not nearly reaching the anterior border of the orbit through the vertical. Operculum about 2–2½ times as long as wide, the lower margin oblique. Sub-operculum rectangular, the posterior border oblique. Dorsal fin base much nearer to the caudal base than to the snout; dorsal origin slightly nearer to snout than to the caudal base. Pelvic origin slightly in front of, or under origin of dorsal fin. Scales with about 4–5 interrupted vertical striae; posterior scale borders not crenulate and without indentations. A few small, round perforations are present on the posterior part of scales.

COLOUR: *In formalin* (scales fallen), dorsal and dorso-lateral surfaces bluish-brown without a clear demarcation from light grey to whitish ventral and ventro-lateral colouration. No lateral series of spots evident. Snout dark brown, tip of lower jaw blackish. Dorsal and caudal fins evenly dusky. A marked black patch on inner surfaces (axil) of pectoral fins. Other fins colourless.

SIZE: 216 mm. S.L. (Malindi).

DISTRIBUTION. The two specimens described above are the first record of this species from the Western Indian Ocean; they were collected on 23 May 1966 during the heavy rains, from a single catch of 500 lb. sardine (including *Sardinella sirm*) made by shore-seine fishermen. No conclusions can be drawn from this isolated recorded occurrence of the distribution of this species in East African waters.

RANGE: East African coast (Malindi only). Elsewhere, ?Red Sea (see REMARKS), mainly the Pacific and adjacent seas; East Indies, Philippines, Queensland coast of Australia and Japan.

REMARKS: Bertin (1944b), after examining type material, concluded that *S. leiogaster* is identical to and has priority over *S. clupeioides* (Bleeker) 1849. Fowler (1941) listed *S. clupeioides* from the Red Sea on the basis of a single specimen, 126 mm. S.L., and recorded "32?" gillrakers. Whitehead (1965b) tentatively placed Fowler's specimen in the synonym of *S. sirm*. As shown in Table 5, gillraker number increases considerably with size in *S. sirm*, and assuming a similar occurrence in Red Sea specimens, a fish of 126 mm. is large enough to have an adult count (40 or above). Hence it must be concluded that Fowler's specimen may be referred to *S. leiogaster*. Specimens in the O.R.S.T.O.M. collection at Nosy-Bé which Fourmanoir (1961) placed in *S. leiogaster* are *S. sirm*.

This species is clearly differentiated from *S. sirm* by possessing fewer gillrakers (33 *c.f.* 40–42 in *S. sirm* of comparable size), a very short upper jaw (7.0% *c.f.* 9.61% in S.L. in *S. sirm*), which does not nearly reach the anterior border of the orbit through the vertical, and in the position of the dorsal fin. Other differences are the relative lengths of the head, snout, pectoral fin, pelvic fin (Table 6) and colouration.

Both *S. sirm* and *S. leiogaster* have been placed in the subgenus *Amblygaster* by Chan (1965) and other previous workers. *Amblygaster* differs from the subgenus *Sardinella* in the arrangement of the median pre-dorsal scales and in the degree of compression of the ventral keels. In overall appearance the species have a greater resemblance to the pilchards (*Sardina*, *Sardinops*) than to the true sardines (*Sardinella*).

TABLE 6

A comparison of proportional measurements and meristic characters of *Sardinella sirm* and *Sardinella leiogaster*.

	<i>Sardinella sirm</i> (23 fishes) 52–168 mm.	<i>Sardinella leiogaster</i> (2 fishes) 199–216 mm.
Standard length		
<i>In % of S.L.</i>	<i>mean</i>	<i>mean</i>
Body depth	21.19	22.10
Head length	25.66	23.35
Snout length	7.98	7.25
Eye diameter	6.58	5.80
Post-orbital distance	9.04	9.00
Upper jaw length	9.61	7.00
Pectoral fin length	16.54	14.00
Pelvic fin length	10.07	8.60
Pre-dorsal distance	45.76	50.04
Pre-pelvic distance	49.23	49.90
Pre-anal distance	76.78	77.30
Dorsal rays (total)	(15–16)17–19	19
Anal rays (total)	(19)20–22	19
Abdominal scutes	16–18+(8)13–14	17+14
Gillrakers	31–42 (40–42, at 115–168 mm.)	33

Sub-family ALOSINAE

Genus HILSA Regan, 1917

Hilsa Regan, 1917 : 303 (Type: *Paralosa durbanensis* Regan, ex Durban).

Paralosa Regan (non *Paralosa* Bleeker), 1916 : 167 (Type: *Clupea durbanensis* Regan).

Macrura Fowler (non *Macrura* Van Hasselt), 1941 : 623 (Type: *Clupea kelee* Cuvier).

The Indo-Pacific Alosinae have been recently revised by Whitehead (1965a). A single species in East African waters.

HILSA KELEE (Cuvier)

Plate 3b

Clupea kelee Cuvier, 1829 : 320 (name in footnote, based on *Kelee* Russell, 1803 : 75, pl. 195; Type locality: Vizagapatam).

Alosa chapra: Günther, 1866 : 123 (Zanzibar); Sauvage, 1891 : 527 (Zanzibar).

Clupea ilisha: Günther, 1868 : 445 (Zanzibar); Angot, 1950 : 180 (Madagascar).

Clupeonia ilisha: Sauvage, 1891 : 527 (Madagascar).

Clupea durbanensis: Regan, 1906 : 4, pl. 4 (Durban); Gilchrist & Thompson, 1908–11 : 268 (Durban, Natal); Gilchrist, 1913 : 59 (Natal).

Paralosa durbanensis: Regan, 1916 : 167 (Durban); Gilchrist & Thompson, 1917 : 297 (references).

Hilsa kanagurta: Regan, 1917 : 304 (Zanzibar); Fowler, 1935 : 51 (Beira).

Hilsa durbanensis: Barnard, 1925 : 111 (Natal coast); *Idem*, 1927 : 101 (on Fowler, Delagoa Bay);

Fowler, 1934 : 411 (Natal); *Idem*, 1935 : 365 (Durban beach).

Macrura durbanensis: Fowler, 1941 : 628 (Durban).

Macrura kelee: Allfree & Bailey, 1952 : 74 (Kenya); Fowler, 1956 : 69 (Indo-Pacific specimens);

Smith, 1949–1965 : 90, fig. 109 (Natal); *Idem*, 1958 : 131 (Inhaca, Mozambique).

Macrura kanagurta: Fourmanoir, 1957 : 8, fig. 1 (Madagascar); Kiener, 1961 : 356, fig. 56 (Madagascar); *Idem*, 1963 : 81, 85, pl. 49 (Madagascar, west coast).

Hilsa kelee: Whitehead, 1965a : 129, fig. 8 (Revision, synonymy; Sabaki mouth, Zanzibar, Durban);

Idem, 1965b : 257 (Gulf of Aden); Losse, 1966b : 174 (East Africa; Ruvu estuary, Pangani estuary, Mombasa, Malindi, Sabaki estuary).

STANDARD COMMON NAME: River Shad.

VERNACULAR NAMES: *Makrange* (Mombasa), *Pawali* (Kenya coast).

DESCRIPTION: Based on five fishes, 71.5–96.2 mm. standard length, from Formosa Bay; two, 48–78 mm., from the Sabaki estuary (Malindi); three, 158–163 mm., from Mombasa; two, 55.0–55.5 mm., from the Pangani estuary; one, 62 mm., from the Ruvu estuary (at Bagamoyo) and one, 130 mm., from Zanzibar (a skin).

Dorsal iv (13) 14, pectoral i 13–14, pelvic i 7, anal ii–iii 18–20, total 20–22. Ventral scutes strongly keeled, sharp and exposed, 16 (17) pre-pelvic, 13 post-pelvic. Gillrakers long, setiform with very well developed, sharp, conical spines on their inner borders, 74–177 on lower part of 1st gill arch. Gillraker number increases considerably with increase in size (Table 7), a specimen of 231 mm. from Natal (EAMFRO. 1965.2.91) has about 187 gillrakers. Branchiostegal rays 6. Scales adherent, 37–42 in lateral series.

TABLE 7

Gillraker numbers at various lengths in *Hilsa kelee*

Standard length mm.	Gillraker range
(14 fishes)	
50.0– 55.5	74–76
62.0	87
71.5– 78.0	94–103
80.6– 85.9	108–117
96.2	126
158.0–163.0	164–177
*231.0	ca.187

*Specimen from Natal.

Depth 33.2–40.3, head (28.1) 30.9–35.1, snout 7.0–8.9, eye 7.1–9.7, post-orbital 12.4–15.8, inter-orbital 6.6–9.5, upper jaw (12.2) 13.4–16.0, lower jaw (14.2) 16.1–20.2, pectoral fin 61.4–22.0, pelvic fin 10.6–14.0, pre-dorsal 43.6–49.0, pre-pelvic (49.6) 50.4–55.3, pre-anal 73.8–80.5, caudal peduncle 10.5–11.4.

Body very strongly compressed. Ventral profile much more convex than the dorsal. Snout blunt, about eye diameter or a little less in length. Upper jaw with a prominent, deep, median notch. Tip of lower jaw folds completely within the upper. Maxilla large, longer than the snout, reaching one half to two-thirds into the eye through the vertical. Two supra-maxillae, the first large, the second with a short anterior shaft. Teeth absent in adults, a few teeth occasionally present on the tongue in juveniles. Fronto-parietal striae numerous and well developed. Operculum venulose, about twice as high as wide, the lower margin oblique. Pre-operculum and sub-operculum with rounded posterior borders. Dorsal origin nearer to snout than to the caudal base; dorsal fin base about equidistant from the snout and the caudal base. Pelvic axillary scale about two-thirds length of fin; pectoral axillary scale absent. Dorsal and anal fins with scaly sheaths. Pseudobranch exposed, about eye diameter in length. Gillrakers long, about equal to snout in length, easily visible when the mouth is opened. Scales adherent, with up to nine vertical striae. The two posterior striae are often complete, the rest interrupted. Posterior scale border crenulate with oval perforations,

COLOUR: *Fresh*, at 158–163 mm. S.L., dorsal surfaces greenish blue, sides silvery. Shoulder venulose with a prominent black humeral patch. Dorsal surface of head greenish-golden. Iris silver, a green to golden sheen on dorsal border. Dorsal fin yellowish, minutely speckled black; rays i–ii black, other rays black at dorsal fifth of fin. Caudal yellowish, margins black. Other fins colourless.

At 55–62 mm., as above except that a series of up to ten black spots are generally distinct along the side, the humeral spot being the darkest. Dorsal and caudal fins brownish.

In alcohol, dorsal surfaces brown to grey, flanks silvery to light brown (due to formalin). Dorsal and caudal fin with black markings fainter, but generally retained. Humeral spot and lateral series of spots (in juveniles) more or less distinct.

SIZE: 163 mm. S.L. (Mombasa), 231 mm. in Natal (Specimen in EAMFRO collection).

DISTRIBUTION: Entire East African coast (recorded from Formosa Bay, Sabaki estuary, Malindi, Mombasa, Pangani estuary and river, Ruvu estuary at Bagamoyo and Zanzibar), in river mouths and estuaries; not found elsewhere in this area. The species was seasonally abundant (Mombasa district) during and shortly following the light and heavy rains (i.e. November–December and March–April).

RANGE: Eastern coast of Africa from the Gulf of Aden to Natal; Madagascar. Elsewhere, Indo-Pacific to Burma and Siam.

Sub-family PRISTIGASTERINAE

Genus PELLONA Valenciennes, 1847

Pellona Valenciennes, 1847 : (218) 300 (Type: *Pellona orbignyana* Valenciennes).
A single Indo-Pacific species.

PELLONA DITCHELA Valenciennes

Pellona ditchela Valenciennes, 1847: (228) 314 (on *Ditchelee* Russell, 1803: 72 pl. 188; Type locality: Vizagapatam); Fowler, 1941: 648 (Natal); Smith, 1949-1965: 93, fig. 118 (Natal); Allfree & Bailey, 1952: 74 (Kenya); Fourmanoir, 1953: 92 (Madagascar), *Idem*, 1957: 10, fig. 3 (Madagascar); Smith, 1958: 131 (Inhaca, Mozambique); Kiener, 1963: 81, 86 pl. 51 (Madagascar); Losse, 1966b: 175 (East Africa; Ruvu estuary, Zanzibar, Pangani estuary, Mombasa, Malindi, Formosa Bay).

Pellona ditchoa: Günther, 1866: 122 (Kiangani River, East Africa); *Idem*, 1868: 455 (Zanzibar, East Africa); Sauvage, 1891: 527 (Zanzibar).

Pellona indica: Günther, 1868: 455 (Zanzibar); Pfeffer, 1894: 69 (East Africa); *Idem*, 1897: 62 (German East Africa).

Ilisha natalensis: Gilchrist, 1913: 60 (Natal); Gilchrist & Thompson, 1917: 298 (references).

Pellona natalensis: Gilchrist & Thompson, 1908-11: 202 (South Africa); Barnard, 1925: 110, pl. 7, fig. 1 (Natal).

Ilisha indica: Boulenger, 1909: 163, fig. 130 (East coast of Africa).

Ilisha ditchela: Fowler, 1923: 36 (Madagascar).

Neosteus ditchela: Norman, 1923: 17 (East Africa).

Ilisha hoevenii: Fowler, 1925: 195 (Delagoa Bay, Natal).

Pellona hoevenii: Barnard, 1927: 1018 (Natal, Delagoa Bay).

STANDARD COMMON NAME: Ditchela.

VERNACULAR NAMES: *Chaa* (general), *Simu* (Shimoni), *Simu koko* (Malindi; Swahili, *koko* = mongrel).

DESCRIPTION: Based on one fish, 127.0 mm. standard length, from Zanzibar; thirty-five, 30.0-70.0 mm., from the Pangani estuary; one, 125.0 mm., from the Ruvu estuary at Bagamoyo; four, 46.0-98.6 mm., from Mombasa and six, 100.0-125.0 mm., from Formosa Bay.

Dorsal iii 14 (16), pectoral i 14-15, pelvic i 6-7, anal iii-iv (34) 36-37 (38) 39-40 (41-42). Ventral scutes strongly keeled, sharp and exposed, from isthmus to anus, 18-20 pre-pelvic, 8 (9) post-pelvic, total 26-28. Gillrakers, 22-25 on lower part of 1st gill arch. Branchiostegal rays 6. Scales caducous, about 39-41 (pockets) in lateral series.

Depth 28.2-37.8, head (24.6) 28.5-32.8, snout 8.1-10.9, eye 7.7-11.0, post-orbital (8.4) 8.9-10.9 (11.0-11.4), upper jaw (12.0) 13.2-15.7 (16.0-16.9), lower jaw 13.8-16.2, pectoral fin (15.3-17.5) 18.0-21.5, pelvic fin 6.8-10.1, pre-dorsal (41.0-46.4) 47.3-51.6 (53.1), pre-pelvic (39.9) 45.6-54.3, pre-anal (53.5) 59.4-68.6 (73.7), anal base (29.6) 32.4-38.5.

Body very strongly compressed. Ventral profile extremely convex, dorsal profile slightly so. Head always much shorter than maximum body depth (by at least 2%). Upper jaw much longer than the snout, the maxilla reaching about one quarter to half into the eye through the vertical. A small toothed hypo-maxillary bone present, lying between the end of the pre-maxilla and middle of the maxilla. Eye very large, the diameter generally greater than the snout length. Lower jaw prominent, projecting upwards in front of snout. Fronto-parietal striae absent; two raised ridges on either side of head from occiput to snout. Dorsal fin base much nearer to snout than to the caudal base; pelvic fins small, lying just anterior of dorsal origin, much nearer to anal origin than to the pectoral base. Scales (from shoulder) with 5-6 vertical striae, the posterior complete. Posterior scale borders not crenulate, perforations absent.

COLOUR: *Fresh* (scales fallen), dorsal and dorso-lateral surfaces very light brown with an iridescent green tinge. Posterior borders of dorsal scale pockets black; mid-dorsal line black. Sides and belly silvery. Snout brown, speckled black. Lower jaw silvery, the tip brown and speckled black. Anterior rays of dorsal fin brownish, the first 3-4 rays speckled black. Caudal yellowish, rays streaked black or very dark brown; margins of fin dusky. Other fins colourless.

In alcohol, dorsal surfaces light green or brown, sides yellowish or white. Posterior borders of dorsal scale pockets brown. Snout and tip of lower jaw brown. First long ray of dorsal often deep black, fin dusky with dark margins. Caudal dusky, margins black. Rest colourless. A row of black spots along anal base in juveniles.

SIZE: 127 mm. S.L. (Zanzibar), 195 mm. in Natal.

DISTRIBUTION: Entire East African coast (recorded from Formosa Bay, Sabaki estuary, Mombasa, Shimoni, Pangani estuary and river, Ruvu estuary at Bagamoyo, Zanzibar and the Mafia Channel), apparently confined to waters of lowered salinity; in estuaries, mangrove area and occasionally in fresh waters of rivers (Pangani). The species occurred throughout the year but was seasonally abundant during the latter part of the southeast monsoon, also during and following the rainy seasons, when it occurred a little further offshore.

RANGE: East African coast south of Natal; Madagascar. Elsewhere, widely distributed in the Indian and Pacific oceans; India, Siam, East Indies, Philippines and Queensland. Apparently absent from the Red Sea, Gulf of Aden and adjacent regions where *Ilisha indica* (Swainson) is recorded (Whitehead, 1965b).

REMARKS: The genus *Pellona*, primarily composed of new-world species, is characterised by the possession of a small toothed hypo-maxillary bone lying between the end of the pre-maxilla and middle of the maxilla. In the closely allied Indo-Pacific genus *Ilisha* this bone is absent.

Family ENGRAULIDAE ANCHOVIES

The genera *Stolephorus*, *Thrissina* and *Thryssa* occur in East African waters. The known range of the "anti-tropical" genus *Engraulis* has been extended into the tropics (Whitehead, 1964b), and it is known from Aldabra (Smith, 1955) and the Seychelles (Whitehead, *loc.cit.*), but not as yet from East Africa.

Key to the East African Genera

- | | |
|--|--------------------|
| 1. Abdominal scutes confined to pre-pelvic region | <i>STOLEPHORUS</i> |
| 2. Post-pelvic scutes present: | |
| (i) No pre-pectoral scutes; pseudobranch exposed; anal rays 27-30 | <i>THRISSINA</i> |
| (ii) Pre-pectoral scutes present; pseudobranch not exposed; anal rays 32-47. | <i>THRYSSA</i> |

Genus *STOLEPHORUS* Lacépède, 1803

Stolephorus Lacépède, 1803 : 381 (Type: *Stolephorus commersonii* Lacépède).

Anchoviella: Fowler, 1941 : 696 (*non* Fowler, 1911).

Key to the East African Species

- | | |
|---|-----------------------|
| 1. Anal origin under or behind last dorsal ray; muscular portion of isthmus short, not reaching the posterior border of the branchiostegal membrane; urohyal plate present: | |
| (i) Posterior tip of maxilla truncated, hardly projecting beyond 2nd supra-maxilla, not reaching to anterior border of the pre-operculum; mean head length 23% in S.L. | <i>S. buccaneeri</i> |
| (ii) Posterior tip of maxilla pointed, projecting well beyond 2nd supra-maxilla, reaching to posterior border of pre-operculum; mean head length 25% in S.L. | <i>S. heterolobus</i> |
| 2. Anal origin under posterior third of dorsal base; muscular portion of isthmus long, projecting forward beyond the posterior border of the branchiostegal membrane; urohyal plate absent: | |
| (i) Posterior tip of maxilla not projecting beyond the posterior border of the pre-operculum; mean body depth 18% in S.L. | <i>S. indicus</i> |
| (ii) Posterior tip of maxilla projecting beyond the anterior border of operculum and reaching gill opening; mean body depth 21% in S.L. | <i>S. commersonii</i> |

The species of *Stolephorus* in East African waters may be considered in two groups, according to the structure of the isthmus and the position of the anal origin (see key above). In the first group, adults of the two species may be further distinguished in that in *S. buccaneeri* the urohyal plate is a small fleshy lobe lying just anterior to the tip of the muscular isthmus; in *S. heterolobus* it is a small shield-shaped bony plate lying in the same position. These structures are, however, not evident in juveniles of less than about 40 mm. S.L. In the second group it should be noted that in juveniles the muscular portion of the isthmus is relatively short and the urohyal (bone) is exposed, so that juveniles of the two groups cannot be distinguished on these characters. Body proportions and meristic characters of these species are compared in Tables 8 and 9.

STOLEPHORUS BUCCANEERI Strasburg

Stolephorus buccaneeri Strasburg, 1960 : 396, fig. 2 (Holotype; Type locality: Hawaii); Whitehead, 1965b : 268 (Red Sea, Persian Gulf, "Arabia"); Losse, 1966b : 176 (East Africa; Mombasa).

STANDARD COMMON NAME: Round head anchovy; Strasburg (1960) suggested this name for the species to distinguish it from the "nehu" *S. purpureus* Fowler, in which the head is rather more elongate.

VERNACULAR NAMES: *Dagaa uronda* (Zanzibar), *Kumbu* (Kenya).

TABLE 8

A comparison of proportional measurements and meristic characters of *Stolephorus heterolobus* and *Stolephorus buccaneeri*

	<i>Stolephorus heterolobus</i> (48 fishes)	<i>Stolephorus buccaneeri</i> (19 fishes)
Standard length	37.0–80.0 mm.	41.2–85.4 mm.
<i>In % of S.L.</i>	<i>mean</i>	<i>mean</i>
Body depth	15.51	16.74
Head length	25.36	23.34
Snout length	5.62	5.09
Eye diameter	6.20	5.78
Post-orbital distance	12.33	11.16
Upper jaw length	18.17	14.00
Lower jaw length	15.57	15.16
Pectoral fin length	13.03	13.21
Pelvic fin length	9.13	8.51
Pre-dorsal distance	53.65	51.52
Pre-pelvic distance	44.58	45.14
Pre-anal distance	63.61	65.07
Anal base, length	17.27	14.82
Muscular portion of isthmus, length	8.73	10.22
Dorsal rays: simple	ii	ii
branched	11–12 (13)	(11) 12
Anal rays: simple	ii–iii	ii (iii)
branched	15–16 (17)	13–15
Abdominal scutes	4–6	(3) 4–6
Gillrakers	(19) 21–24+25–28	19–20+24–30

DESCRIPTION: Based on one fish, 51.6 mm. standard length, from Formosa Bay; two, 41.2–50.9 mm., from Mombasa; eleven, 48.9–85.4 mm., from the Zanzibar Channel and five, 71.4–78.6 mm., from the Mafia Channel.

Dorsal ii (11) 12, pectoral i (12–13) 14 (15), pelvic i 6, anal ii (iii) 13–15, total 15–17. Abdominal scutes needle-like, (3) 4–6 pre-pelvic only. Gillrakers 19–20+24–30, total 43–51 on 1st gill arch. Branchiostegal rays 12. Scales caducous, about 37–40 (pockets) in lateral series.

Depth 16.0–17.5, head 22.2–25.3, snout 4.6–5.6, eye 5.3–6.6, post-orbital 10.3–12.3, upper jaw 13.0–15.3, lower jaw 14.2–16.8, muscular portion of isthmus 8.8–11.8, pectoral fin 11.8–15.1, pelvic fin (7.4) 7.8–9.3 (10.2), pre-dorsal 50.0–53.7, pre-pelvic (39.9) 43.6–47.3, pre-nal 61.6–68.4, anal base 13.5–16.8. (The mean of these values are shown in Table 8).

Snout rounded at tip, shorter than eye diameter. Tip of lower jaw reaches well in front of the eye, about halfway to snout tip. Inter-orbital flat with a prominent median ridge. Maxilla short, posterior tip truncated, hardly projecting beyond 2nd supra-maxilla, not reaching anterior border of pre-operculum or lower jaw articulation. Muscular portion of isthmus short, the anterior tip not projecting forward to posterior borders of the branchiostegal membrane. Urohyal exposed, with two small fleshy lobes lying on ventral side of urohyal just anterior to muscular tip of isthmus; lobes well developed and visible with the naked eye in fishes of 47 mm. S.L. and above, poorly developed at 39 mm. and not seen in post-larvae of 34 mm. or less. Pseudobranch exposed. Anal origin set just behind dorsal base. Dorsal origin about equidistant from the snout and the caudal base, or slightly nearer snout. Pelvic origin in front of dorsal, about equidistant from pectoral and anal origins, or slightly nearer anal fin.

COLOUR: *In alcohol*, 47.5–85.4 mm. S.L., body whiteish to very light brown with a prominent silvery lateral band (dark in some specimens) from operculum to caudal base, broadest under dorsal base, as wide as eye diameter, bordered dorsally by a thick blue-black line (in some specimens above 51 mm. S.L.). Scale pockets above silver band with dark posterior borders. Sides of head, operculum, branchiostegal membranes, lower jaw and muscular portion of isthmus silvery. Occiput dark. Snout

dusky. Dorsal and anal fin bases with black spots, dorsal and caudal powdered black. Other fins colourless.

SIZE: 85.4 mm. S.L. (Zanzibar Channel).

DISTRIBUTION: Probably entire East African coast (recorded from Formosa Bay, Mombasa, Zanzibar Channel and Mafia Channel), in the shallow waters within the 30 fathom contour, in bays, harbours and lagoons. At times found together with *Stolephorus heterolobus* juveniles (Mombasa) but it is a northeast monsoon species rather less abundant than *S. heterolobus* which occurred throughout the year.

RANGE: Eastern coast of Africa; Red Sea, East African coast, Durban. Elsewhere, Persian Gulf, "Arabia" and Hawaii (Whitehead).

STOLEPHORUS HETEROLOBUS (Rüppell)

Engraulis heteroloba Rüppell, 1837 : 79, pl. 21, fig. 4 (Type locality: Massaua).

Stolephorus heterolobus: Whitehead, 1965b : 266, fig. 4a (isthmus) (Red Sea, Gulf of Aden); Losse, 1966a : 89 (Zanzibar); *Idem*, 1966b : 176 (East Africa; Dar-es-Salaam, Zanzibar, Mombasa, Malindi); *Idem*, 1966c : 51 (Zanzibar Channel).

STANDARD COMMON NAME: Long-head anchovy.

VERNACULAR NAMES: *Dagaa uronda* (Zanzibar), *Kumbu* (Mombasa).

DESCRIPTION: Based on forty-five fishes, 37.0–80.0 mm. standard length, from the Zanzibar Channel and four, 47.1–52.4 mm., from Mombasa.

Dorsal ii* 11–12 (13), pectoral i 11–13, pelvic i 6, anal ii–iii 15–16 (17). Abdominal scutes needle-like, 4–6 pre-pelvic only. Gillrakers (19) 21–24+25–28 on 1st gill arch. Branchiostegal rays 11–13. Scales caducous, about 39–42 (pockets) in lateral series.

Depth 13.9–18.1 (increasing with length of fish), head 23.8–27.1, snout 4.8–6.3, eye 5.1–6.9, post-orbital 10.4–14.1, upper jaw 16.5–20.0, extension of maxilla beyond 2nd supra-maxilla 1.7–2.7 (9 fishes), lower jaw 13.3–17.5, pectoral fin 11.1–14.4, pelvic fin 7.9–10.4, pre-dorsal 41.7–46.2, pre-pelvic 41.7–46.4, pre-anal 61.1–65.5, anal base 14.1–18.9 (19.8), muscular portion of isthmus 8.3–10.0 (22 fishes). (The mean of these values are shown in Table 8.)

Snout pointed at tip, slightly shorter than, or about equal to eye diameter. Tip of lower jaw almost reaches front of eye. Inter-orbital convex with a prominent central ridge. Maxilla moderately long, posterior tip pointed and projecting considerably beyond the 2nd supra-maxilla, reaching anterior border of operculum and just beyond lower jaw articulation. Muscular portion of isthmus short, the anterior tip not projecting forward to the hind border of the branchiostegal membrane. Urohyal exposed, with a flat bony, shield-shaped, ventral plate lying just anterior to the tip of the muscular portion of isthmus; plate well developed and visible with the naked eye in adults above 60 mm., poorly developed at 40 mm. and not seen in post-larvae of 37 mm. or less. Pseudobranch exposed. Anal origin beneath last dorsal ray or, rarely, slightly behind dorsal base. Dorsal origin nearer to snout than to the caudal base. Pelvic origin anterior to vertical from dorsal origin, much nearer to snout than to the caudal base.

COLOUR: *Fresh*, (scales fallen), body translucent, very light brown with a prominent silver lateral band from operculum to caudal base, bordered dorsally by a thin blue-black line. Lateral band widest under dorsal base, as wide or slightly wider than eye diameter. Sides of head, lower jaw, branchiostegal membranes, muscular portion of isthmus, urohyal and peritoneum silvery. Upper part of operculum with a greenish tinge and a patch of melanophores. Dorsal rays darkish, caudal faintly to prominently dusky, colourless in small specimens. A row of minute black spots along base of anal.

In alcohol, light brown to almost white. Lateral band silver, dark in some large specimens. Snout, dorsal and caudal dusky in some specimens.

SIZE: 88.0 mm. S. L. (Zanzibar Channel), specimen from stomach contents of *Euthynnus affinis*.

DISTRIBUTION: Entire East African coast (recorded from the Mafia Channel, Zanzibar Channel, Mombasa and Malindi), in shallow waters within the 100 fathom contour, in bays, harbours and lagoons. The species occurred throughout the year but was seasonally abundant in the surface waters close to the shore during the whole of the northeast monsoon and following the heavy rains in April/May.

RANGE: Eastern coast of Africa from the Red Sea to Madagascar (Nosy-Bé). Elsewhere, Australia, East Indies and the Philippines.

STOLEPHORUS INDICUS (Van Hasselt)

Plate 3c

Engraulis indicus Van Hasselt, 1823 : 329 (Type locality: Java).

Engraulis russellii: Jatzow & Lenz, 1899 : 525 (Zanzibar).

Anchoviella indica: Fowler, 1934a : 404, fig. 1 (Durban); *Idem*, 1934b : 412 (Durban); Smith, 1949-

*The first simple ray is minute and cannot be seen without dissection, hence I have excluded it from the count.

TABLE 9

A comparison of proportional measurements and meristic characters of *Stolephorus indicus* and *Stolephorus commersonii*.

	<i>Stolephorus indicus</i> (33 fishes)	<i>Stolephorus commersonii</i> (22 fishes)
Standard length	44.0–119.0 mm.	32.0–91.0 mm.
<i>In % of S.L.</i>	<i>mean</i>	<i>mean</i>
Body depth	17.82	21.46
Head length	23.54	24.46
Snout length	5.52	5.45
Eye diameter	5.96	6.45
Post-orbital distance	10.77	11.00
Upper jaw length	15.23	19.29
Lower jaw length	14.67	15.98
Pectoral fin length	12.68	15.56
Pelvic fin length	8.25	10.49
Pre-dorsal distance	54.52	53.87
Pre-pelvic distance	44.35	44.95
Pre-anal distance	63.29	63.54
Anal base, length	16.98	20.27
Extension of maxilla beyond 2nd supra-maxilla	1.90	4.55
Dorsal rays: simple	iii	iii
branched	(12) 13	12–13
Anal rays: simple	iii	iii
branched	16–18	(11)17–19
Abdominal scutes	(3)4–5	(3)4–7
Gillrakers	16–18 + (22)23–25	17–19 + 21–26
Vertebrae	43 (6 fishes)	40–41 (8 fishes)

1965 : 94, fig. 118 (South Africa); Allfree & Bailey, 1952 : 74 (Kenya); Smith, 1955 : 307 (Aldabra); Fourmanoir, 1957 : 12 (Madagascar); Morrow, 1964 : 804 (Mkoani harbour, Pemba).

Amentum indicum: Fowler, 1956 : 74 (Indo-Pacific specimens).

Stolephorus indicus: Losse, 1954 : 12 (Zanzibar Channel); Whitehead 1965b : 270, fig. 4b (isthmus) (Red Sea); Losse, 1966a : 89 (Zanzibar); *Idem*, 1966b : 176 (East Africa; Dar-es-Salaam, Zanzibar, Mombasa, Malindi); *Idem*, 1966c : 51 (Zanzibar Channel).

STANDARD COMMON NAME: Indian anchovy.

VERNACULAR NAMES: *Dagaa uronda* (Zanzibar); *Kumbu* (Kenya coast), *Wali wa mpunga* (Mombasa).

DESCRIPTION: Based on three fishes, 92.0–96.0 mm. standard length, from Dar-es-Salaam; seventeen, 44.0–119.0 mm., from Zanzibar, and thirteen, 73.0–96.0 mm., from Mombasa.

Dorsal iii (12) 13, pectoral i 13–14, pelvic i 7, anal iii 16–18, abdominal scutes needle-like, (3) 4–5 pre-pelvic only. Gillrakers, 16–18 + (22) 23–24 (25) on 1st gill arch. Scale caducous, about 39–40 (pockets) in lateral series. Vertebrae 43 (6 fishes, x-ray count).

Depth 15.5–19.8, head 22.3–24.9, snout 4.6–6.5, eye 4.9–6.8, post-orbital 9.7–11.9, upper jaw 14.1–16.7, extension of maxilla beyond 2nd supra-maxilla (1.2) 1.5–2.8, lower jaw 14.1–15.6, pectoral fin 11.7–13.4 (14.8), pelvic fin 7.8–9.5 (10.3), pre-dorsal (52.5) 53.3–56.8, pre-pelvic 42.1–46.2, pre-anal 61.0–65.0, anal base 16.0–17.5 (18.2–18.6). (The means of these values are shown in Table 9.)

Body compressed, ventral profile slightly convex. Inter-orbital almost flat in large specimens, slightly convex in small specimens. Maxilla slender, moderately long, the posterior tip not reaching beyond the posterior pre-opercular border. Muscular portion of isthmus long, the anterior tip projecting forward beyond the hind margin of the branchiostegal membrane; no bony plate or fleshy lobes on urohyal. Pseudobranch exposed, equal to about snout in length. First dorsal ray nearer caudal base than to snout; anal origin beneath posterior third of dorsal base. Scales thin, those on shoulder with many (up to about 10) vertical striae; circuli very fine, vertically parallel.

Adipose tissue well developed, in some specimens obscuring eye, snout, sub-orbital and post-orbital parts of head.

COLOUR: *Fresh* (scales fallen), mainly translucent, body very light brown. Peritoneum whiteish. A prominent silver lateral band from operculum to caudal base, widest under dorsal base, narrower than the eye diameter. Side of head, operculum, branchiostegal membranes, isthmus and lower jaw mainly silvery. Iris silver with a greenish tinge. Base of anterior dorsal rays darkish. Caudal base yellowish, fin speckled black, dusky at margins. Pectoral fin with melanophores. A row of minute black spots along base of anal.

In alcohol, pink, light brown to white (due to formalin), silver band mostly faded to a light coloured band. Shoulder with a dark oval patch. Two dark patches on head. Caudal yellowish, dusky at margins. Other fins colourless.

SIZE: 119 mm. S.L. (Zanzibar Channel).

DISTRIBUTION: Entire East African coast (recorded from the Mafia Channel, Dar-es-es-Salaam, Zanzibar, Mombasa, Malindi and Formosa Bay), in the shallow waters within the 20 fathom contour; in bays, lagoons and harbours (Mombasa). Seasonally abundant during the northeast monsoon when it appeared close to the shore.

RANGE: Eastern coast of Africa from the Red Sea to Natal (Durban); Madagascar, Aldabra. Elsewhere, widespread in the Indian and Pacific Oceans; East Indies, Philippines, China, Formosa, Melanesia, Micronesia and Polynesia.

STOLEPHORUS COMMERSIONII Lacépède

Plate 3d

Stolephorus commersonii Lacépède, 1803 : 381, 382, pl. 12, fig 1 (Mauritius; on Commerson); Losse 1966b : 177 (East Africa; Zanzibar, Ruvu estuary, Pangani estuary, Mombasa, Malindi).

Engraulis brownii: Günther, 1866 : 123 (Zanzibar).

Engraulis commersonianus: Günther 1868 : 388 (Zanzibar).

Anchoviella commersonii: Smith, 1949-1965 : 94, fig. 119 (Durban); Allfree & Bailey, 1952 : 47 (Kenya); Smith, 1958 : 131 (Inhaca, Mozambique).

STANDARD COMMON NAME: Commerson's anchovy.

VERNACULAR NAMES: *Dagaa uronda* (Zanzibar), *Kumbu* (Kenya), *Wali wa mpunga* (Mombasa district).

DESCRIPTION: Based on two fishes, 79.6-82.5 mm. standard length from Formosa Bay; nine, 75.0-90.6 mm., from Mombasa; one, 71.0 mm. from the Ruvu estuary (Bagamoyo); eight, 32.0-91.0 mm., from the Pangani estuary and one, 86.0 mm., from Zanzibar.

Dorsal iii 12-13, pectoral i 12-13, ventral i 6, anal iii (11) 17-19. Abdominal scutes needle-like, (3) 4-7, pre-pelvic only. Gillrakers lanceolate, 17-19 + 21-26, total 39-44 on 1st gill arch. Scales caducous, about 35-37 (pockets) in lateral series. Vertebrae 40-41 (8 fishes, x-ray count).

Depth 20.4-23.0 (18.5 at 32 mm.), head 23.5-26.3 (22.8 at 32 mm.), snout 4.8-6.5, eye 5.4-7.9, post-orbital 9.5-12.5, upper jaw 17.8-21.0, extension of maxilla beyond 2nd supra-maxilla 4.0-4.8 (19 fishes), lower jaw 14.9-16.4, pectoral fin 14.1-17.1, pelvic fin 9.4-11.6, pre-dorsal 51.8-54.5, pre-pelvic 43.3-47.9, pre-anal 60.8-66.8, anal base (9.6—abnormal specimen) 18.3-22.4. (The mean of these values are shown in Table 9.)

Body moderately compressed, ventral profile slightly convex from anal base to snout. Inter-orbital convex with a pronounced central ridge. Maxillary long and slender, the posterior tip reaching to posterior border of operculum and gill opening. Muscular portion of isthmus long, without bony plate or lobes on urohyal, projecting forward beyond the hind margin of the branchiostegal membrane. Pseudobranch exposed. First dorsal ray nearer to caudal base than to the snout. Anal origin beneath posterior third of dorsal base. Scales from shoulder with many (up to 10) vertical striae; anterior striae complete, rest interrupted. Circuli very fine, vertically parallel. Adipose tissue well developed on most specimens, covering greater part of the snout, post-orbital region and almost obscuring eyes. **COLOUR:** *Fresh* (scales fallen), at 79-80 mm., S.L., body largely whiteish, peritoneum silvery. A prominent silver lateral band from operculum to caudal base, bordered above and below by a narrow yellowish or olive line. Lateral band widest behind dorsal base, about half eye diameter in width. Sides of head, operculum, lower jaw and isthmus silvery. Parietal part of head iridescent greenish golden, occiput black. Supra-orbital part of head copper coloured with a bluish patch. Nape dark. Dorsal ray base with black spots; anal base with numerous minute black spots which are continued in a median ventral black line to caudal base. Caudal fin minutely powdered black, margins dark, base with a black dorsal and median streak. Orange reflections on caudal base and fin. Posterior borders of dorsal scale pockets brown to black.

In alcohol, pale brown to white, silver band more or less indistinct in most specimens. Dark patch on shoulder and on occiput. Caudal and dorsal yellowish, some melanophores on rays. Caudal tips dusky, rest colourless. Posterior borders of dorsal scale pockets dark.

At 32 mm., post-orbital part of head brownish; a row of small black spots along anal base, which lie between the ray bases. Caudal rays streaked brown-black, edges dusky.

SIZE: 91.0 mm., S.L. (Pangani estuary).

DISTRIBUTION: Entire East African coast (recorded from Zanzibar, Ruvu estuary at Bagamoyo, Pangani estuary, Port Reitz and Port Tudor at Mombasa, Malindi and Formosa Bay). Entirely confined to estuarine waters and mangrove lagoons, not found elsewhere in this area. The species was seasonally abundant during the northeast monsoon and also following the short and long rains.
RANGE: East African coast south to Durban; Madagascar, Mauritius. Elsewhere, widespread in the Indian and Pacific Oceans; India, Ceylon, East Indies, Philippines, China, Formosa, Korea and Polynesia. Whitehead (1965b) did not record this species from the Red Sea or adjacent areas.

Genus THRISSINA Jordan & Seal, 1925

Thrissina Jordan & Seal, 1925: 30 (Type: *Clupea baelama* Forsk.)

A monotypic Indo-Pacific genus.

THRISSINA BAEALAMA (Forsk.)

Plate 4.a.

Clupea baelama Forsk. 1775: 72 (Type locality: Djedda, Red Sea).

Engraulis boelama (mis-spelt); Valenciennes, 1848: 35 (Seychelles, Mauritius); Günther, 1866: 123 (Zanzibar, Seychelles, Reunion); Playfair, 1867: 868 (Seychelles); Günther, 1868: 393 (Zanzibar); *Idem*, 1871: 671 (Zanzibar); Peters, 1876: 445 (Mauritius); Sauvage, 1891: 491, pl. 49, fig. 1 (Madagascar).

Thrissocles baelama: Baissac, 1951: 129 (Mauritius); Fowler, 1956: 72 (Indo-Pacific specimens); Fourmanoir, 1957: 11 (Madagascar); Smith, 1963: 8, pl. 4c (Seychelles).

Thrissina baelama: Whitehead, 1965b: 271 (Red Sea, Gulf of Aden); Losse, 1966b: 177 (East Africa; Dar-es-Salaam, Zanzibar, Mombasa, Malindi); *Idem*, 1966c: 51 (Zanzibar Channel).

STANDARD COMMON NAME: Short-jaw anchovy.

VERNACULAR NAMES: *Dagaa* (Zanzibar), *Simu* (Kenya), *Makareng* (Mombasa).

DESCRIPTION: Based on seventeen fishes, 64.0–104.0 mm. standard length, from Zanzibar and six, 82.0–92.0 mm., from Dar-es-Salaam. Depth and meristics on four further fishes, 82.0–112.0 mm., from Dar-es-Salaam and two, 86.0–90.0 mm., from Mombasa.

Dorsal ii 11–12, pectoral i 11–13, pelvic i 7, anal iii 29–31. Abdominal scutes (4) 5–7 pre-pelvic + 9–10 post-pelvic, total 13–17, absent in front of pectoral fins. Gillrakers, 17–20 + 23–26, total 40–45 on 1st gill arch. Branchiostegal rays 12–13. Scales caducous, about 35–36 (pockets) in lateral series.

Depth 21.8–26.2, head 25.2–28.0, snout 4.8–5.9, eye 5.5–6.7, post-orbital 11.8–13.8, upper jaw 19.1–20.8, lower jaw (17.6) 18.8–20.6, pectoral fin 16.9–18.8, pelvic fin 12.3–14.5, pre-dorsal (47.3) 48.0–51.9, pre-pelvic 42.0–46.4, pre-anal 64.5–69.0, anal base 25.3–27.8, extension of maxilla beyond 2nd supra-maxilla 1.9–2.5 (17 fishes).

Body compressed, ventral profile slightly convex. Head rather longer than high. Inter-orbital convex. Snout blunt, tip rounded, considerably overhanging lower jaw. Maxilla short and slender, the posterior tip just surpassing angle of jaw. Gillrakers moderately flattened, blunt at tips, slightly longer than gill filaments, shorter than eye diameter. Pseudobranch exposed, about equal to snout or a little less in length. Dorsal origin nearer to snout than to the caudal base. Pelvic origin nearer to snout than to the caudal base. Anal origin nearer to pectoral base than to the anal origin. Anal origin behind dorsal base. Pre-dorsal spine poorly developed, not free.

COLOUR: *Fresh* (scales fallen), upper surfaces bluish-grey, sides silvery with an olive hue. No silver lateral band. A prominent orange-red humeral patch. Post-orbital part of head with orange patch and rays of dorsal fin orange-red, minutely speckled black. Tip of snout and caudal dusky with a reddish hue. Other fins colourless. Gillrakers and opercular cavity pink or grey.

In alcohol, dorsal surfaces brownish, flanks olive with orange hue. Patch of venulose tissue on shoulder with a few faint, dark, horizontal lines. Dorsal fin dusky at tips. Other fins colourless. **SIZE:** 112 mm. S.L. (Dar-es-Salaam).

DISTRIBUTION: Entire East African coast (recorded from Dar-es-Salaam, Zanzibar, Mombasa, and Malindi), in bays, lagoons, harbours, estuaries (Pangani) and mangrove pools of varying salinity (Zanzibar); occasionally in the open sea. The species was seasonally abundant during the northeast monsoon.

RANGE: Eastern coast of Africa from the Red Sea to Madagascar; Seychelles, Mauritius and Reunion. Elsewhere, widespread in the Indian and Pacific Oceans; Philippines, Melanesia, Micronesia and Polynesia.

Genus THRYSSA Cuvier, 1829

Thryssa Cuvier, 1829: 323 (Type: *Clupea setirostris* Broussonet).

Thrissocles Jordan & Evermann, 1917: 98 (Type: *Clupea setirostris* Broussonet).

Key to the East African Species

1. Maxillae relatively short, extending slightly beyond bases of pectoral fins *T. vitirostris*
2. Maxillae very long, extending beyond pelvic fins, often reaching anus *T. setirostris*

THRYSSA VITIROSTRIS (Gilchrist & Thompson)

Plate 4b

Engraulis vitirostris Gilchrist & Thompson, 1908–11: 201 (localities: Natal; inner harbour, Durban); Gilchrist, 1913: 64 (Natal).

Thrissocles vitirostris (mis-spelt): Fowler, 1925a: 413 (Durban, Natal); *Idem*, 1935: 366 (Natal).

Engraulis vitirostris (mis-spelt): Fowler, 1925b: 195 (Delagoa Bay).

Thryssa vitirostris: Barnard, 1925: 118, pl. 6, fig. 5 (East London, Delagoa Bay, Natal); *Idem*, 1927: 1017 (references); Whitehead, 1965b: 274 (Persian Gulf, Gulf of Oman); Losse, 1966b: 177 (East Africa; Zanzibar, Ruvu estuary, Pangani estuary, Mombasa, Malindi, Formosa Bay); *Idem*, 1966c: 51 (Zanzibar Channel).

Thrissocles malabaricus: Smith, 1949–1965: 95, pl. 5, fig. 121 (South Africa); *Idem*, 1955: 307 (Aldabra); *Idem*, 1958: 131 (Inhaca, Mozambique); Fourmanoir, 1961: 84 (Madagascar).

STANDARD COMMON NAME: Mustached anchovy.

VERNACULAR NAMES: None known.

DESCRIPTION: Based on one fish, 142.0 mm. standard length, from Dar-es-Salaam; nine, 35.0–140.6 mm., from the Pangani estuary; one, 119.0 mm., from Mombasa; six, 91.0–146.0 mm., from Malindi, and three, 79.0–102.7 mm., from Formosa Bay.

Dorsal I iii 11, pectoral i 11–12, pelvic i 7 (fin absent in 141 mm. specimen), anal iii–iv 35.38. Abdominal scutes, 18–19 pre-pelvic, 9–11 post-pelvic, total 27–29 (31 in 141 mm. specimen). Gill-rakers 14–15+19–21 (12+21 on 2nd arch in 141 mm. specimen, first arch absent on both sides), total 33–35 on 1st gill arch. Branchiostegal rays 9–10. Scales caducous, about 39–42 (pockets) in lateral series.

Depth 24.0–30.6, head 24.0–28.6, snout 4.4–6.3, eye 5.7–7.0, post-orbital 10.8–13.8, upper jaw 27.6–31.0, extension of maxilla beyond 2nd supra-maxilla 9.7–13.5, lower jaw 17.0–20.0, pectoral fin 16.7–20.9, pelvic fin 8.0–9.9, pre-dorsal 49.4–53.9, pre-pelvic 39.2–44.3, pre-anal 55.6–64.5, anal base 33.0–37.3.

Body highly compressed, dorsal profile convex anterior to dorsal fin (a distinct nape in the larger specimens). Inter-orbital convex with a pronounced central ridge. Snout blunt, slightly compressed. Maxilla moderately slender, posterior tip surpassing pectoral base but not reaching tip of pectoral fin. Gillrakers flattened, slightly shorter than gill filaments. Spines on rakers of 1st gill arch with regular clumps of longer spines—not evident in juveniles. Pseudobranch not exposed. Lower jaw without steeply ascending coronoid. Dorsal origin about equidistant from snout and caudal base. Anal set behind last dorsal ray.

COLOUR: *Fresh* (scales fallen), dorsal surfaces brownish-olive, sides operculum and isthmus silvery. Top of head and snout tip brownish with numerous small melanophores. Shoulder venulose with melanophores forming horizontal lines—a black patch evident. Anterior rays of dorsal yellowish. Caudal yellowish with dark or almost black margins. Other fins colourless. Opercular cavity salmon pink, gillrakers sometimes faintly so.

In juveniles the body is very light brown. Sides of head and operculum silvery extending to anus as a triangular band, widest at shoulder. Dorsal brownish, anal dusky at tips; other fins colourless.

In alcohol, dorsal surfaces brown, sides silver or yellowish-white. First branched ray of dorsal dark, other fins colourless. Juveniles light brown, caudal margins dark. A row of black spots along anal base and a few dark spots on top of head.

SIZE: 146 mm. S.L. (Malindi), 149 mm. in Madagascar (specimen in EAMFRO collection) and 178 mm. in South Africa (Gilchrist & Thompson, 1908–11).

DISTRIBUTION: Entire East African coast (recorded from Dar-es-Salaam, Ruvu estuary, Zanzibar, Mombasa, Malindi, and Formosa Bay), in estuaries and lagoons; occasionally further out to sea during the rainy seasons when waters derived from the outflow of the major rivers extended further offshore.

RANGE: East African coast south to East London; Madagascar, Aldabra. Elsewhere, Persian Gulf and Gulf of Oman (Whitehead, 1965), coasts of India.

THRYSSA SETIROSTRIS (Broussonet)

Plate 4c

Clupea setirostris Broussonet, 1782: (no pagination), pl. 2 (Type locality: Society islands).

Engraulis setirostris: Gilchrist & Thompson, 1908–11: 267 (Natal); Gilchrist, 1913: 64 (Natal); Weber & de Beaufort 1913: 40, fig. 18 (Beira, East Africa).

Thryssa setirostris: Barnard, 1925: 119 (Natal, Portuguese East Africa); Whitehead, 1965b: 275 (Red Sea, Gulf of Aden); Losse, 1966b: 178 (East Africa; Ruvu estuary, Pangani estuary, Mombasa, Malindi, Formosa Bay).

Thrissocles setirostris: Fowler, 1934: 413 (Natal); Smith, 1949–1965: 95, pl. 5, fig. 122 (South Africa); *Idem*, 1955: 307 (Aldabra); Fowler, 1956: 71 (Indo-Pacific specimens); Fourmanoir, 1957: 11, fig. 18 (Madagascar); Smith, 1958: 131 (Inhaca, Mozambique).

STANDARD COMMON NAME: Long-jaw anchovy.

VERNACULAR NAMES: None known.

DESCRIPTION: Based on six fishes, 78.0–106.0 mm. standard length, from the Pangani estuary; one, 90.0 mm., from the Ruvu estuary at Bagamoyo and eleven, 116.0–129.7 mm., from Formosa Bay.

Dorsal I iii 10–12, pectoral i 12–13, pelvic i 6, anal iii–iv 32–34. Abdominal scutes (13) 16–19 pre-pelvic, 8–9 post-pelvic, total (22) 25–27, from gill opening to anus. Gillrakers, 5–6+10–12, total 15–18, on 1st gill arch. Branchiostegal rays 9–10. Scales caducous, about 38–41 (pockets) in lateral series.

Depth 24.4–28.1, head 21.6–23.1, snout 3.3–5.5, eye 5.0–6.1, post-orbital (9.8) 10.8–13.9, upper jaw 51.0 (? broken)–62.0, extension of maxilla beyond 2nd supra-maxilla 46.4–50.9, lower jaw 12.6–14.1, pectoral fin 19.1–22.6, pelvic fin 12.1–14.6, pre-dorsal 49.6–56.5, pre-pelvic 40.6–44.1, pre-anal 57.8–67.5, anal base 29.3–35.0.

Body highly compressed, dorsal and ventral profiles not markedly convex. Head about as high as long. Inter-orbital convex. Snout blunt and rounded, projecting only slightly beyond tip of lower jaw. Maxilla very slender and long, posterior tip surpassing tip of pelvic fin and often reaches anus. Lower jaw with a steeply ascending coronoid process. Pseudobranch not exposed. Gillrakers flattened, of moderate length, only slightly longer than fill filaments. Spines on gillrakers of first arch of even length. Dorsal origin about equidistant from the snout and the caudal base. Pelvic origin nearer to snout than to the caudal base. Anal origin just behind last dorsal ray. Scales large, almost circular with many (about 9) vertical striae; anterior striae interrupted, inter-digitating, posterior striae often complete. Very fine curved teeth on lower jaw and along entire length of maxilla except posterior extremity.

COLOUR: *In alcohol*, dorsal surfaces brownish; sides silvery, olive or orange in some specimens. Venulose patch on shoulder with melanophores forming black horizontal lines. Dorsal fin dusky, a little darker at tips. Caudal with dusky tips, other fins colourless.

SIZE: 129.7 mm. S.L. (Formosa Bay).

DISTRIBUTION: Entire East African coast (recorded from the Ruvu estuary, Pangani estuary and Formosa Bay), in estuaries and lagoons, rarely found out to sea.

RANGE: Eastern coast of Africa from the Red Sea to Natal; Madagascar, Aldabra. Elsewhere, widespread throughout the tropical Indo-Pacific, east to China, Queensland and Polynesia.

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LEGEND TO PLATES

Unless stated otherwise figures are of preserved specimens.

Plate 1

- a *Elops machnata* (Forsk.), 169 mm. S.L., from Chukwani, Zanzibar.
- b *Spratellomorpha bianalis* (Bertin), 38.8 mm. S.L., from Port Tudor, Mombasa.
- c *Herklotsichthys punctatus* Form B, 77 and 99 mm. S.L., from Mombasa (fresh specimens).
- d *Sardinella longiceps* (Val.), 131 mm. S.L., from Formosa Bay.

Plate 2

- a *Sardinella albella* (Val.), 90 mm. S.L., from Mombasa.
- b *Sardinella albella* (Val.), 110.6–123.2 mm. S.L., deep-bodied mature females from Port Tudor, Mombasa.
- c *Sardinella gibbosa* (Blkr.), 136 mm. S.L., from Formosa Bay.

Plate 3

- a *Sardinella sirm* (Walb.), 158 mm. S.L., from the Kenya coast.
- b *Hilsa kelee* (Cuv.), 171 mm. S.L., from Port Tudor, Mombasa (fresh specimen).
- c *Stolephorus indicus* (Van Hass.), 94 mm. S.L., from Port Tudor, Mombasa.
- d *Stolephorus commersonii* Lac., 83 mm. S.L., from Mombasa.

Plate 4

- a *Thrissina baelama* (Forsk.), 101 mm. S.L., from Port Tudor, Mombasa.
 b *Thryssa vitrirostris* (Gilchr. & Thomp.), 124 mm. S.L., from Formosa Bay.
 c *Thryssa setirostris* (Brouss.), 128 mm. S.L., from Formosa Bay.

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