

# Rehabilitation of *Sillago erythraea* Cuvier, and redescription of *Sillago sihama* (Forsskål) (Teleostei: Sillaginidae) from the Red Sea

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## Abstract

The specific identity of the sillaginid fishes of the *Sillago sihama* complex in the Red Sea is examined. The species *Sillago sihama* is considered as restricted to the southern Red Sea. In the northern Red Sea (Gulf of Suez), and (through Lessepsian immigration) in the eastern Mediterranean Sea, another species in the complex is distinguished, *Sillago erythraea*. *Sillago sihama* and *S. erythraea* are redescribed. Populations in the *Sillago sihama*-group from other regions in the Indo-West Pacific differ in several characters, including the shape of the swimbladder and the scale patterns on the operculum. They probably belong to different species.

**Key words:** Fishes, Red Sea, *Sillago*, Sillaginidae, redescription, rehabilitation.

## Zusammenfassung

Die Identität des Artkomplexes *Sillago sihama* im Roten Meer wird untersucht. Die Art *Sillago sihama* ist auf das südliche Rote Meer beschränkt. Im nördlichen Roten Meer (Golf von Suez) und – im Zuge Lessepsischer Einwanderung – im östlichen Mittelmeer wird eine andere Art, *Sillago erythraea*, unterschieden. *Sillago sihama* und *S. erythraea* werden erneut beschrieben. Populationen der *Sillago sihama*-Gruppe aus anderen Regionen des Indo-Westpazifik unterscheiden sich in mehreren Merkmalen, unter anderem in der Form der Schwimmblase und der Beschuppung des Kiemendeckels. Sie gehören vermutlich zu einer oder mehreren anderen Arten.

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## 1 Introduction

The whiting (sillago) family Sillaginidae is a group of fishes living in marine and brackish waters of the Indo-West Pacific. They live on soft bottoms in coastal waters of the continental shelf. Most species are found at shallow depths, while a few occur down to 180 m.

Sillaginids are easily identified as a family by their elongate body, the long snout, and the long soft dorsal and anal fins, as well as the horizontally positioned preopercle. Most species are externally similar and can be distinguished mainly by the shape of the swimbladder, osteological characters, fin ray counts, and small differences in colouration.

The family Sillaginidae was revised by MCKAY (1985), who recognised three genera and 25 species. MCKAY & MCCARTHY (1989) described an additional species, *Sillago arabica*, from the Persian (Arabian) Gulf. In a catalogue of the Sillaginidae of the world, MCKAY (1992) raised some subspecies to species level and recognised three genera and 31 species. KAGA et al. (2010) described another species, *Sillago caudicula*, from Oman, bringing the total number of species in the family to 32.

During the examination of Red Sea material previously attributed to *Sillago sihama*, it became clear that more than one species was involved. The purpose of the present paper is to redescribe *Sillago sihama*, and to establish the specific identity of the other *Sillago* species found in the Red Sea and in the eastern Mediterranean Sea (as a Lessepsian immigrant).

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## 2 Methods and Materials

Methods follow MCKAY (1985: 2–3). In descriptive sections, the data of holotypes or lectotypes are given in parentheses. The genus and species classification follows ESCHMEYER & FRICKE (2010), unless otherwise noted. The museum abbreviations follow FRICKE & ESCHMEYER (2010).

## Abbreviations of museum collections

HUJF	Hebrew University, Fish Collection, Jerusalem, Israel
MNHN	Muséum National d'Histoire Naturelle, Paris, France
SMF	Senckenberg Forschungsinstitut und Naturmuseum, Abteilung Marine Zoologie, Frankfurt am Main, Germany
ZMUC	Københavns Universitet, Zoologisk Museum, Copenhagen, Denmark

## 3 Species accounts

*Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829 (Figs. 1, 2, 5, 8, 10)

*Sillago erythraea* Cuvier in Cuvier & Valenciennes 1829: CUVIER in CUVIER & VALENCIENNES 1829: 409–411 (part, Gulf of Suez).

## Material

Type material: MNHN A-3127 (163 mm SL), lectotype of *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829 [as designated below, see chapter 4], Suez, Egypt, Gulf of Suez, Red Sea, leg. E. GEOFFROY SAINT-HILAIRE, ca. 1799–1801.

Additional material: Gulf of Suez, northern Red Sea, Egypt: HUJF 7134 (1 specimen, 137 mm SL), Abu Zanima, Fish Collection team, 22 Sep. 1967; HUJF 7135 (1 specimen, 144 mm SL), Abu Zanima, Fish Collection team, 30 Apr. 1970. – Mediterranean Sea, Israel: HUJF 8552 (2 specimens, 116–120 mm SL), Haifa, J.H. FISCHTHAL, 27 June 1977; HUJF 10579 (16 specimens, 145–160 mm SL), Haifa, A. BEN-TUVIA, 27 May 1989; HUJF 10860 (2 specimens, 144–185 mm SL), Haifa, A. BEN-TUVIA, 18 May 1982; HUJF 10898 (1 specimen, 158 mm SL), Acre, A. BEN-TUVIA, 11 Aug. 1982; HUJF 10899 (3 specimens, 146–172 mm SL), Haifa, A. BEN-TUVIA, 14 Jan. 1982; HUJF 10962 (5 specimens, 110–140 mm SL), Jaffa, D. GOLANI, May 1980; HUJF 12360 (2 specimens, 168–172 mm SL), Acre, D. GOLANI, 8 May 1987; HUJF 13933 (6 specimens, 131–142 mm SL), Jaffa, D. GOLANI, 18 Oct. 1989; HUJF 19740 (40 specimens, 115–170 mm SL), Haifa, D. GOLANI, 3 Apr. 2008.

## Description

First dorsal fin X–XII (XI); second dorsal fin I, 19–22 (I, 21). Anal fin II, 18–22 (?), 22). Pectoral fin 14–16 (15). Lateral line scales 63–74. Vertebrae 12 (12) [abdominal] + 3 (3) [modified] + 17 (17) [caudal], total 32 (32). Gill rakers relatively large, 3–4 + 8–10 (4 + 9), uppermost raker on upper and lower arch rudimentary. Measurements of the lectotype see Tab. 1.

Upper jaw with a series of very small teeth which are slightly recurved. Anterior teeth slightly larger, posterior teeth gradually smaller. The teeth are similar in the lower jaw, however, there is a narrow gap at the symphysis. Vomer covered with small teeth, similar to those in the jaws. Preoperculum smooth, completely scaleless; operculum with a few scales in the upper part. Nostrils situated at the level of the upper quarter of the orbit; first nostril with a small flap, second nostril (which is situated close to the first) nearly round.

**Tab. 1.** Measurements of the lectotype of *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829, MNHN A-3127.

Measurements	Value [mm]
Standard length	163
Total length	189+
Head length	50.4
Predorsal fin length	61.8
Preanal fin length	98.1
Body depth at origin of first dorsal fin	28.4
Preorbital length	19.2
Upper jaw length	9.0
Orbit diameter	10.9
Interorbital distance	9.8
Caudal peduncle length	16.1
Caudal peduncle depth (minimum)	10.6
First dorsal fin base length	32.4
Second dorsal fin base length	53.1
Anal fin base length	49.6
Pectoral fin length	26.5
Pelvic fin length	25.0

Swimbladder (Fig. 10) with two posterior extensions, two anterior extensions extending forward and diverging to terminate on each side of the basioccipital above the auditory capsule; two lateral extensions commence anteriorly, each sending a blind tubule anterolaterally and then extending along the abdominal wall below the investing peritoneum to just posterior of the duct-like process; two posterior tapering extensions of the swimbladder projecting into the caudal region, both equal in length; the lateral extensions not convoluted, without blind tubules.

Colouration: Body dorsally silvery yellow-brown, silvery white below; a midlateral, silvery, longitudinal stripe usually present; upper part of eye with a reddish brown blotch; dorsal fins dusky terminally with or without rows of dark brown spots on the second dorsal-fin membrane; caudal fin with a faint dark brown blotch each on the dorsal and ventral lobes, fin often terminally dusky; no dark blotch at the base of the pectoral fin; other fins hyaline, pelvic and anal fins whitish.

## Distribution

Northern Red Sea (Gulf of Suez, Egypt). Lessepsian immigrant through the Suez Canal into southeastern Mediterranean Sea including the southeastern Aegean Sea (Egypt, Israel, Turkey).

## Comparison

This species differs from *Sillago sihama* in the absence of scales on the preoperculum and on most of the operculum (completely scaled in *S. sihama*), in the total

number of vertebrae (32 in *S. erythraea*, 34 in *S. sihama*), in the shape of the swimbladder with the lateral extensions each spreading a blind tubule anterolaterally (tubule missing in *S. sihama*), and the position of the nostril tending to be lower than in *S. sihama*.

#### Remarks

The lectotype of *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829 is partly damaged. Scales along the sides of the body are missing, so that the lateral line cannot be counted. Internal organs are missing. The first dorsal fin is abraded and nearly completely missing, but the bases of the spines are still present and can be counted. The second dorsal fin is also nearly completely missing (but fin ray bases are still present), except for the first three and the last two rays which are complete. The anal fin spines are damaged by an extended slit through the belly, but the remainder of the rays are complete (except for a few damaged rays).

McKAY's (1992: 59) illustration of a swimbladder of a Red Sea specimen is probably based on Mediterranean material of *Sillago erythraea*. The unequal length of the posterior extensions of the swimbladder in that illustration is probably erroneous, as all specimens examined were found to have extensions of equal length.

#### *Sillago sihama* (Forsskål in Niebuhr, 1775) (Figs. 3, 4, 6, 9, 11)

*Atherina sihama* Forsskål in Niebuhr, 1775: FORSSKÅL in NIEBUHR 1775: XIII, 70 (Lohajæ/Al-Luhayya, Yemen). BONNATERRE 1788: 78–79. GMELIN 1789: 1396. LACEPÈDE 1803: 371, 373.

*Sillago Sihama*: RÜPPELL 1828: 9–11, pl. 3, fig. 1 (part, Red Sea).

*Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829: CUVIER in CUVIER & VALENCIENNES 1829: 409–411 (part, Massawa, Eritrea; Red Sea [RÜPPELL material]).

#### Material

Type material: ZMUC P.45164 (dry skin), holotype of *Atherina sihama* Forsskål in Niebuhr, 1775, "Lohajæ" (Al-Luhayya/Yemen), P. S. FORSSKÅL, Dec. 1762–Jan. 1763. – MNHN A-3137 (138 mm SL), paralectotype of *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829, Massawa, Eritrea, Red Sea, W. HEMPRICH & C. EHRENBERG, ca. Nov. 1824–May 1825 (data see KLAUSEWITZ 2002: 10). – SMF 324 (4 paralectotypes of *S. erythraea*), Red Sea, E. RÜPPELL, ca. 1826–1827 (data see KLAUSEWITZ 2002: 10).

Additional material: HUJF 18150 (1 specimen, 163 mm SL), Zula Bay, Dahlak Archipelago, Eritrea, A. BENTUVIA, 23 Mar. 1962; HUJF 19716 (4 specimens, 173–184 mm SL), Eritrea, D. GOLANI, Feb. 2005.

#### Description

First dorsal fin XI(XI); second dorsal fin I, 20–21 (I, ca. 21) [second dorsal fin of holotype damaged, count uncertain]. Anal fin II, 21–23 (II, 22). Pectoral fin 14–15

(ca. 15) [anal fin of holotype damaged, count uncertain]. Lateral line scales 70–74 (ca. 71) [lateral line scales of holotype partially missing, count based on scale pockets]. Vertebrae 14 [abdominal] + 2–8 [modified] + 12–18 [caudal], total 34. Gill rakers 4 + 9.

Upper jaw with a series of large teeth which are slightly recurved. Anterior teeth slightly larger, posterior teeth gradually smaller. The teeth are similar in the lower jaw, however, there is a gap at the symphysis. Vomer covered with small, similar teeth. Both preoperculum and operculum completely covered with scales. Nostrils situated at the level of the upper quarter of the orbit, often closer to the upper margin of the orbit or even above; first nostril with a small flap, second nostril (which is situated close to the first) nearly round.

Swimbladder (Fig. 11) with two posterior extensions, two anterior extensions extending forward and diverging to terminate on each side of the basioccipital above the auditory capsule; two lateral extensions commence anteriorly, extending along the abdominal wall below the investing peritoneum to just posterior of the duct-like process, but without anterolateral blind tubules; two posterior tapering extensions of the swimbladder projecting into the caudal region, both equal in length; lateral extensions not convoluted, without blind tubules.

Colouration: Fresh colouration according to RÜPPELL (1828: pl. 3, fig. 1): Body dorsally silvery yellow-brown, silvery white below; eye dorsally reddish brown; a mid-lateral, reddish brown, longitudinal stripe present, bordered by silver lines; first dorsal fin yellowish olive green, second dorsal and anal fins brown; caudal fin terminally dusky; no dark blotch at the base of the pectoral fin; other fins hyaline, the pelvic fins whitish. Preserved colouration similar to *S. erythraea*.

#### Distribution

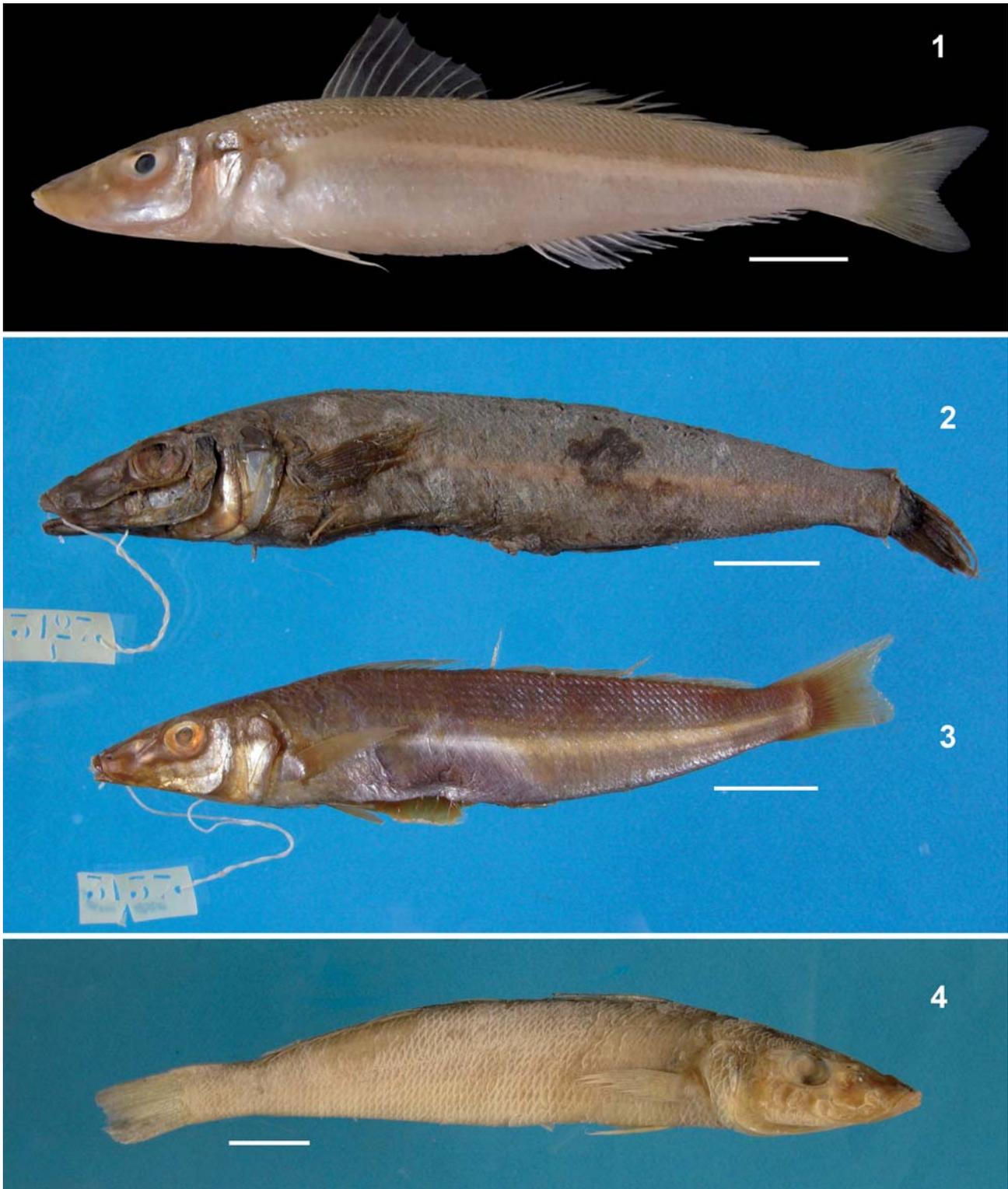
Southern Red Sea (Eritrea; Yemen).

#### Remarks

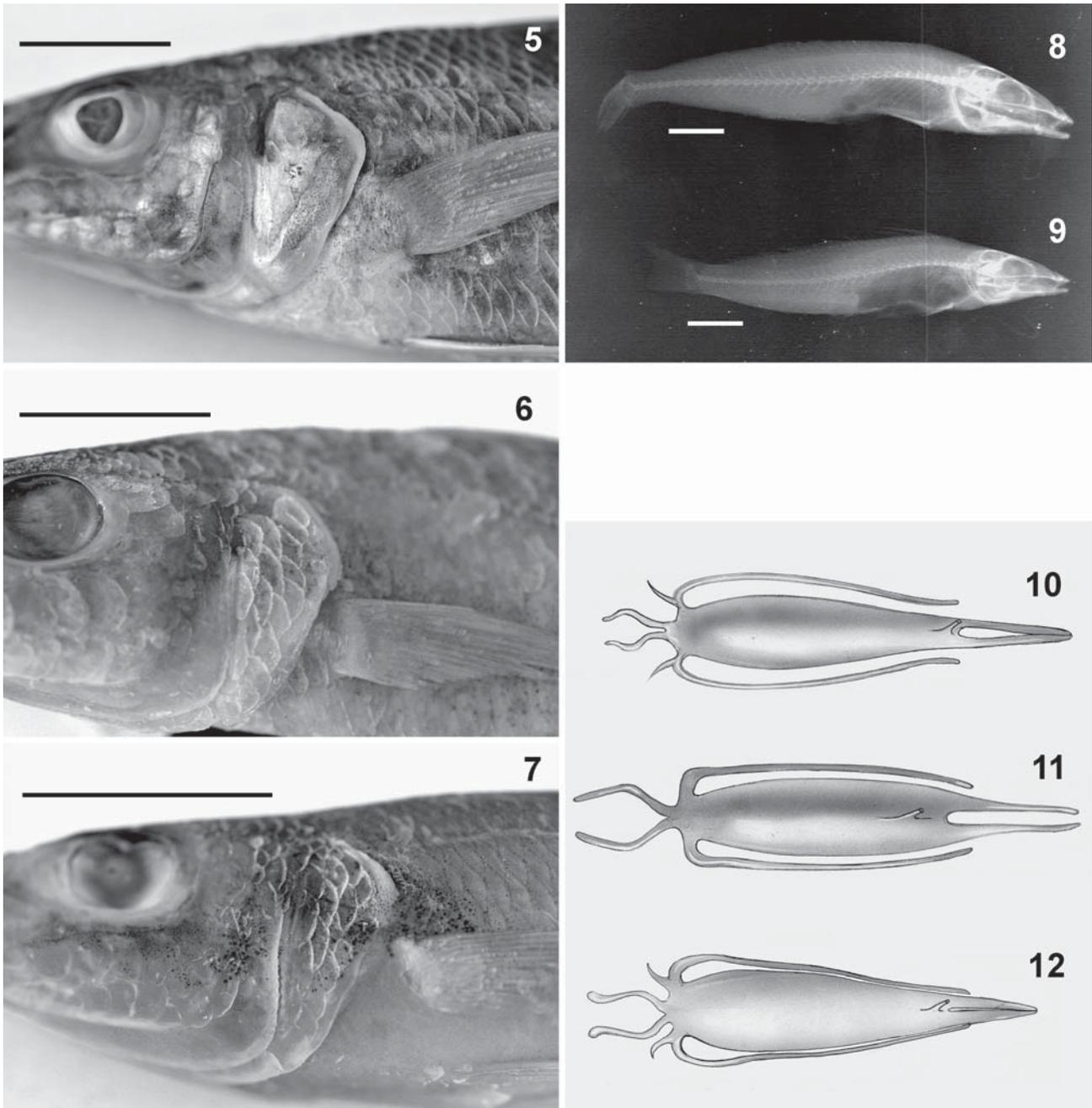
For the time being, we consider *Sillago sihama* to be restricted to the southern Red Sea. Populations from other regions which were previously assigned to this species differ in several characters, including the shape of the swimbladder (see Fig. 12) and the operculum (see Fig. 7); see discussion below. They probably belong to different species.

## 4 Discussion

*Sillago sihama* was first described as *Atherina sihama* as sp. no. 102 by FORSSKÅL in NIEBUHR (1775: XIII, 70). The name was probably authored by FABRICIUS [ex FORSSKÅL] (discussion see FRICKE 2008: 31), and based on a single



**Figs. 1–4.** *Sillago* spp. – 1. *S. erythraea*, Suez, Gulf of Suez, Red Sea (photograph taken by SERGEY BOGORODSKY). 2. *S. erythraea*, lectotype (MNHN A-3127). 3. *S. sihama*, paralectotype of *S. erythraea* (MNHN A-3137). 4. *S. sihama*, Eritrea, southern Red Sea (HUFJ 19716). – Scales: 2 cm.



**Figs. 5–12.** *Sillago* spp. – Operculum (5–7), x-ray (8, 9), and swimbladder (10–12). – 5. *S. erythraea*, Mediterranean Sea (HUJF 10860). 6. *S. sihama*, Eritrea, southern Red Sea (HUJF 19716). 7. *S.* sp. cf. *sihama*, Hong Kong (HUJF 19497). 8. *S. erythraea*, lectotype (MNHN A-3127) 9. *S. sihama*, paralectotype of *S. erythraea* (MNHN A-3137). 10. *S. erythraea*, Mediterranean Sea. 11. *S. sihama*, Eritrea. 12. *S.* sp. (aff. *sihama*), Hong Kong. – Scales: 2 cm.

holotype (ZMUC P.45164, a dry skin). While the holotype agrees with the present usage of *Sillago sihama* (Forsskål in Niebuhr, 1775), the description at least in part may have been based on a different species; it referred in the colour description to the opercle which was anteriorly and posteriorly each bearing a series of green ocelli. We here consider *Sillago sihama* as defined by the above mentioned ZMUC holotype.

BONNATERRE (1788: 178–179) was the first author to treat this species as valid. BLOCH & SCHNEIDER (1801: 60) cited FORSSKÅL in NIEBUHR's description and placed the species in the genus *Platycephalus*. RÜPPELL (1828: 9–11, pl. 3, fig. 1) described and illustrated the species '*Sillago Sihama*' based on material from the Red Sea ("überall im Rothen Meere"). RÜPPELL discussed the synonymy of the species; he followed a broad concept of the species and even synonymised *Sillago acuta* Cuvier in Cuvier & Valenciennes, 1829 (CUVIER in CUVIER & VALENCIENNES 1829: 400–409), *Sciaena malabarica* Bloch & Schneider, 1801 (BLOCH & SCHNEIDER 1801: pl. 19) and the 'Soring' of RUSSELL (1803: pl. 113) from India. RÜPPELL (1828: 11) also referred to an entry of '*Atherina sihama*' in the manuscript catalogue by EHRENBERG (based on MNHN A-3137 from Eritrea). In his description, RÜPPELL (1828: 10) mentioned that the operculum is covered with scales (this character is also shown on his pl. 3, fig. 1), so that his record is apparently in part based on the true *Sillago sihama*.

CUVIER in CUVIER & VALENCIENNES (1829: 409–411) discussed the history of usage of the name. He assumed that *Sillago sihama* of RÜPPELL differed from the *Atherina sihama* of FORSSKÅL in NIEBUHR (1775) (which they doubted to belong to the genus *Sillago* at all) in the above mentioned colouration details, and established the new name *Sillago erythraea* for Red Sea specimens of *Sillago*, based on six syntypes [MNHN A-3127 (1 specimen) from Suez, Egypt; MNHN A-3137 (1 specimen) from Massawa, Eritrea; SMF 324 (4 specimens), the specimens described and illustrated by RÜPPELL (1828: pl. 3, fig. 1)].

CUVIER in CUVIER & VALENCIENNES (1829: 409–411) did not provide a very detailed description of the colour pattern of his *Sillago erythraea*. He only had alcohol preserved specimens available, which already had been 28–30 years in preservative (the Suez syntype), or 4–8 years, respectively (the Massawa syntype). The extant MNHN syntypes of *Sillago erythraea* Cuvier in Cuvier & Valenciennes 1829 were re-examined and found to belong to two different species. While the Massawa specimen well agreed with the *Sillago sihama* of current usage, the Suez specimen was found to represent a separate species. In order to provide a name for the latter species, and to stabilise the usage of the name *Sillago erythraea* Cuvier in Cuvier & Valenciennes, 1829, the specimen MNHN A-3127 (Fig. 2) from Suez is hereby designated as the lectotype of *Sillago erythraea*. This species, which recently immigrated into

the eastern Mediterranean Sea through the Suez Canal, is here treated as valid, and redescribed above.

A study of the mitochondrial cytochrome c oxidase, subunit 1 gene (COX 1) of the Mediterranean Sea, Gulf of Suez (northern Red Sea) and southern Red Sea specimens, confirms that northern Red Sea and Mediterranean populations belong to the same species which has diverged significantly on a specific level from southern Red Sea populations (TIKOCHINSKI et al. in prep.).

GRIFFITH & SMITH (1834: pl. 2 [opposite p. 122], fig. 1) published a drawing misspelled "*Sillago erytheræa*" without any description. Though the drawing was probably based on the Massawa syntype (MNHN A-3137), the colouration is completely incorrect in showing a green colouration of the back, a red and blue eye, and brown streaks on the snout and below the eye. GÜNTHER (1860: 243–244) was the first author to synonymise *Sillago erythraea* with *Sillago sihama*, without comment. Subsequent authors, including MCKAY (1992: 59), followed his decision.

In the Indo-West Pacific, additional, undescribed species are apparently included in the *Sillago sihama* complex (operculum of a Hong Kong specimen see Fig. 7, swimbladder see Fig. 12). The typical pattern of the swimbladder described and illustrated by MCKAY (1992: 59) based on Queensland (Australia) specimens, with the posterior extensions of unequal length and the lateral extensions convoluted and with blind tubules along their length, completely differs from southern Red Sea material of *Sillago sihama*; in addition, several counts are different as well. For the time being, the distribution of *S. sihama* is therefore restricted to the southern Red Sea; Indo-West Pacific materials of the *S. sihama* complex are in need of revision.

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