

**FIRST AND NORTHERNMOST RECORD OF *UPENEUS MOLUCCENSIS*  
(ACTINOPTERYGII: PERCIFORMES: MULLIDAE) FROM THE SEA OF MARMARA**

M. Levent ARTÜZ<sup>1\*</sup> and Ronald FRICKE<sup>2</sup>

<sup>1</sup>*Sevinç-Erdal İnönü Foundation, Marmara Environmental Monitoring Project (MAREM), Department of Marine Sciences, Istanbul, Turkey*

<sup>2</sup>*Lauda-Königshofen, Germany*

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**Abstract.** The goldband goatfish, *Upeneus moluccensis* (Bleeker, 1855), is an Indo-West Pacific species, which has been reported as a Lessepsian migrant from the eastern Mediterranean Sea. The species has expanded its distribution range in the Mediterranean; individuals have been recorded from Israel, Lebanon, Libya, the south coast of Turkey, and the Aegean Sea. The aim of this study was to report the presence of *U. moluccensis* in the Sea of Marmara. The history of the Mediterranean records and the presence in the Sea of Marmara are discussed. A specimen of *Upeneus moluccensis* was collected with a beam trawl at 58 m depth, off Aksaz, the western Sea of Marmara during the MAREM (Marmara Environmental Monitoring) survey, on 21 June 2017. The fish (a female) was subjected to standard descriptive procedures and subsequently deposited in the collection of the MAREM (Marmara Environmental Monitoring) project, with the catalogue number LAR-182. *Upeneus moluccensis* is recorded for the first time from the Sea of Marmara, which expands its distributional range westward in the Mediterranean Sea (Aegean Sea). This new distribution record of *Upeneus moluccensis* also represents the global northernmost record of the species. The previous northernmost record was from 38°53'N in the northern Aegean Sea, and from about 35°12'N in its natural range (southern Japan).

**Keywords:** Mullidae, goldband goatfish, morphometry, expanded distribution

## INTRODUCTION

The family Mullidae includes six valid genera (Fricke et al. 2018), five of which are present in the north-eastern Atlantic and the Mediterranean, *Mulloidichthys*, *Mullus*, *Parupeneus*, *Pseudupeneus*, and *Upeneus*, comprising one, two, one, one, and two species, respectively; the genera *Parupeneus* and *Upeneus* are only represented by Lessepsian migrants. The genera *Upeneus* includes a total of 39 valid species, with 10 species known from the Red Sea (Golani and Fricke 2018). Only *Upeneus moluccensis* (Bleeker, 1855) and *Upeneus pori* Ben-Tuvia et Golani, 1989 have been reported as Lessepsian migrants in the eastern Mediterranean Sea.

The goldband goatfish, *Upeneus moluccensis*, was originally described by Bleeker (1855: 409, *Upeneoides moluccensis*) from Ambon (Maluku, Indonesia). The native distribution range of this species extends from the Red Sea, East Africa, Madagascar and Réunion east to the Caroline Islands and New Guinea, north to southern Japan, south to Western Australia and Queensland (Australia) (Fricke et al. 2018). The western Indian Ocean populations were reviewed and compared with other species by Uiblein and Heemstra (2010).

*Upeneus moluccensis* was first reported from the Mediterranean coast of Israel by Haas and Steinitz (1947) and Ben-Tuvia (1953), misidentified as “*Mulloidichthys auriflamma* (non Forsskål, 1775)”. Since that time, *U. moluccensis* has become a commercially important demersal species, living in shoals in sandy-muddy or muddy habitats at depths between 20 and 130 m. It is very abundant in the eastern Levantine Sea (Golani et al. 2002), and is heavily fished (Erguden et al. 2010).

*Upeneus moluccensis* extends in the Mediterranean Sea from the coast of Israel, Lebanon, Libya, southern coasts of Turkey and to Aegean Sea (Hureau 1986, Golani et al. 2002, Aydın and Akyol 2016). Tikochinski et al. (2013) demonstrated that no significant genetic differences exist between populations of *U. moluccensis* from the Mediterranean Sea, Red Sea, and Japan. Before the presently reported occurrence the northernmost report was from the Gulf of Çandarlı, Aegean Sea (Aydın and Akyol 2016).

The Sea of Marmara is an inland sea within Turkey with a maximum depth of 1272 m.

Due, in large part, to the structural characteristics of the Turkish Straits (the Çanakkale Strait or Dardanelles, and

\* Correspondence: M. Levent Artüz, Sevinç-Erdal İnönü Vakfı, MAREM (Marmara Environmental Monitoring) Proje Lideri, Deniz araştırmaları bölümü, Anadoluhisarı Topoları No: 8, 34810, Istanbul, Turkey, phone +90 532-415-7285, e-mail: (MLA) [levant@artuz.com](mailto:levant@artuz.com), (RF) [ronfricke@web.de](mailto:ronfricke@web.de).

the Boğaziçi or Bosphorus), the Sea of Marmara has unique hydrodynamic features and connects the Mediterranean Sea with the Black Sea.

The Sea of Marmara and the Straits provide an important “acclimatization zone” for transiting species of fishes during their migration from the Black Sea to the Mediterranean Sea and vice versa and works like a biological corridor between those very different seas.

The Sea of Marmara has, in vertical section, two water masses which are distinctly separated from each other by a thermo-halocline interface. The surface water mass consists of low salinity Black Sea water, with a salinity of 19‰–26‰\* according to the season and inflow from the Black Sea, and a temperature varying between 5 and 29°C depending the atmospheric conditions (Okay et al. 2007), extending to an average depth of about 25–30 m.

The lower water mass is originating from the high salinity Aegean and Mediterranean waters which has a constant temperature of 14.2°C, a salinity of 38.5‰ and no seasonal variations (Okay et al. 2007), occupying all depths below 25–30 m in the Sea of Marmara.

## MATERIALS AND METHODS

A single female specimen of *Upeneus moluccensis* was collected with a beam trawl at 58 m depth, off Aksaz, the western Sea of Marmara (Fig. 1) during the MAREM (Marmara Environmental Monitoring) Survey, on 21 June 2017.

The fish, subjected to standard descriptive procedures (Hubbs and Lagler 1947, Uiblein and Heemstra 2010), were identified, measured with a digital calliper, photographed, and dissected for sex determination. It was later fixed in 10% formalin buffered with seawater and subsequently deposited in the collection of the Marmara Environmental Monitoring project (MAREM), with the code of LAR-182. Fin-ray counts follow Fricke (1983). The family classification follows van der Laan et al. (2014), genus and species classification follows Fricke et al. (2018).

## RESULTS

Family Mullidae Rafinesque, 1815

*Upeneus* Cuvier, 1829

*Upeneus moluccensis* (Bleeker, 1855)

Fig. 2, Table 1.

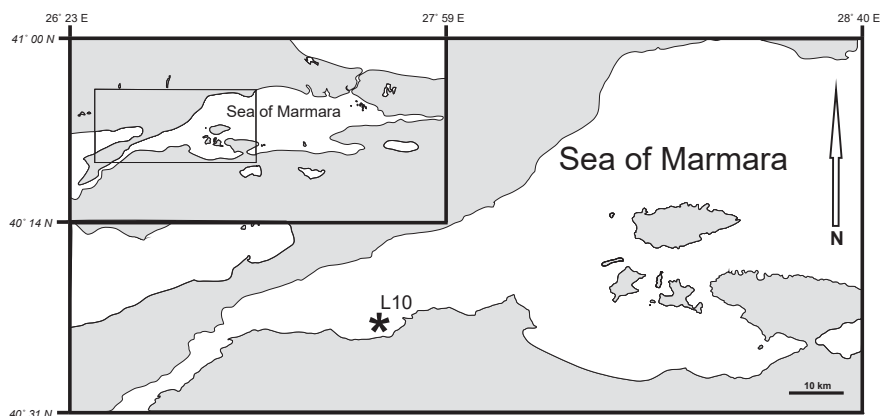
**Material.** MAREM LAR-182, one female, 108.5 mm SL, off Aksaz, western Sea of Marmara, Turkey, 40°25.100'N, 26°59.700'E–40°24.600'N, 26°59.350'E, 58 m depth, Cruise MAREM, beam trawl, St. ALG-7, 21 June 2017.

**Description.** Body moderately elongated, deepest at beginning of first dorsal fin; mouth terminal, snout rounded, pair of small barbels attached to tip of ceratohyal, behind symphysis of lower jaw not reaching posterior part of operculum margin; maxilla slightly exceeding anterior border of eye. Villiform teeth on jaws, vomer and palatine. First spine of first dorsal fin shorter than 2nd. Total lateral line scales 33, with 22 pored scales. Dorsal and anal fins basally with scaled area. Counts, morphometric measurements, and proportions given in Table 1.

Colour in dorsal part of body with golden yellow longitudinal band as wide as pupil, extending from eye to caudal-fin base; head and body silvery reddish above strip, silvery white below, posteriorly with rosy shade; barbels whitish; 3 orange stripes on first dorsal fin, 2 on second; 6 thin red bars on upper caudal-fin lobe, lower lobe of caudal fin with a broad rose longitudinal stripe.

**Distribution.** Red Sea, Indo-West Pacific: East Africa, Madagascar and Réunion east to Caroline Islands and New Guinea, north to southern Japan, south to Western Australia and Queensland (Australia). Absent from the Persian Gulf, where the species is replaced by the similar species *Upeneus doriae* (Günther, 1869). Lessepsian migrant in the eastern Mediterranean, where the species was recorded from Egypt, Libya, Gaza, Israel, Lebanon, Syria, Cyprus, Turkey, and Greece.

**Habitat.** Benthic, on sandy or muddy bottoms from shallow water to depths of 100 m (a single record from 200 m depth) (Golani et al. 2002).



**Fig. 1.** Map indicating the collecting locality of the specimen of *Upeneus moluccensis*, MAREM LAR-182, in the Sea of Marmara, Turkey

\* In the wake of the growing criticism of the Practical Salinity Scale concept (and especially “PSU” as a “unit”), Acta Ichthyologica et Piscatoria is in favour of expressing salinity in parts per thousand (‰), regardless if a direct or indirect method was employed to determine the water salinity.

**Table 1** Morphometric measurements, meristic values, and proportions of the specimen of *Upeneus moluccensis* from the Sea of Marmara (MAREM LAR-182; female, 28.1 g)

Parameter	Morphometric values		Meristic values
	Absolute value [mm]	Relative value [%]	
Total length (TL)	128.9		
Standard length (SL)	108.5	84.2 TL	
Caudal-fin length	21.3	19.6 SL	
Head length (HL)	30.3	27.9 SL	
Head width	14.7	13.5 SL	
Head depth	18.6	17.1 SL	
Body depth	28.4	26.2 SL	
Body width	17.0	15.7 SL	
Caudal-peduncle length	27.1	25.0 SL	
Caudal-peduncle depth	19.3	17.8 SL	
Orbit diameter	10.1	33.3 HL	
Interorbital distance	18.3	60.4 HL	
Upper jaw length	16.6	54.8 HL	
Lower jaw length	15.5	51.2 HL	
Snout length	10.8	35.6 HL	
Postorbital length	12.4	40.9 HL	
Barbel length	17.8	16.4 SL	
Predorsal (1) length	37.2	34.3 SL	
Predorsal (2) length	68.5	63.1 SL	
Prepectoral length	33.4	30.8 SL	
Preanal length	68.6	63.2 SL	
Prepelvic length	33.3	30.7 SL	
Length of 1st D1 spine	18.8	17.3 SL	
Length of 2nd D1 spine	20.6	19.0 SL	
Length of 3rd D1 spine	20.2	18.6 SL	
Length of D2	13.9	12.8 SL	
Length of 1st anal-fin spine	15.0	13.8 SL	
Length of pelvic-fin spine	18.2	16.8 SL	
Pectoral fin length	22.0	20.3 SL	
Pelvic fin length	18.2	16.8 SL	
Length of D1 base	14.7	13.5 SL	
Length of D2 base	8.1	7.5 SL	
Length of anal-fin base	11.0	10.1 SL	
No of lateral line (LL) scales			33
No of transverse scales above LL			3
No of transverse scales below LL			4
Gill rakers			9 + 18
1st Dorsal fin			VIII
2nd Dorsal fin			9

## DISCUSSION

The meristic, morphometric, and colouration characters of the specimen from the Sea of Marmara are in accordance with the descriptions of *Upeneus moluccensis* by Hureau (1986), Golani et al. (2002), and Uiblein and Heemstra (2010). Golani and Ritte (1999) compared Mediterranean and Red Sea populations of *U. moluccensis* genetically but found no discernible genetic distance between those populations.

The geographical distribution of the species in the eastern Mediterranean Sea was reviewed by Ben-Tuvia (1966). The first records from different countries/regions in the Mediterranean Sea are compared in Table 2. Though the Suez Canal was opened in 1869, *Upeneus moluccensis* was first recorded from the Canal by Gruvel (1936). That late discovery may have been due to a lack of scientific research in the area in the decades before, but may also have been real, as the Suez Canal was dug through salt lakes, which were initially very salty. The salt was gradually washed out in the following 50 or 60 years, which only then allowed the passage of some fish species. According to Ben Rais Lasram et al. (2008), *U. moluccensis* had a strong initial dispersal success and had established reproducing populations in Rhodes (Greece) as early as 1948, when the species was reported as a common off the island by Laskaridis (1948). The subsequent westward dispersal was considerably slower; *U. moluccensis* has not yet been observed in Tunisia. The northward dispersal also slowed down considerably; only in 2000 the species was reported from the southern Aegean Sea (Torcu and Mater 2000), in 2016 from the northern Aegean Sea (Aydın and Akyol 2016), and in 2017 from the Sea of Marmara (presently reported study). If *U. moluccensis* should establish reproducing populations in the Sea of Marmara, it is possible that it even might further expand its distribution range to the southern Black Sea in the future. So far, just a single species of a Lessepsian migrant fish is known to have entered the Black Sea, i.e., the carangid fish *Alepes djedaba* (Forsskål, 1775), as reported by Turan et al. (2017), which was recorded three years before from the Sea of Marmara (Artüz and Kubanç 2014).

This is a new global northernmost record of the species, from 40°25'N. The previous northernmost record was from 38°53'N in the northern Aegean Sea (Aydın and Akyol 2016). In its natural distribution range, the Indo-West Pacific, the northernmost record is from 29°32'N in the northern Gulf of Aqaba, Israel (Fowler and Steinitz 1956). The species was not yet recorded from the Gulf of Suez (Golani and Fricke 2018), although it evidently occurs there. In the eastern part of its distribution range, the species occurs north to about 35°12'N (southern Japan).

The Red Sea immigrants entered the Mediterranean from the Suez Canal began to move out continuously towards the north, mainly depending on the water temperature (Boudouresque 1999). In recent years a few of these were encountered in the Sea of Marmara, now including a total of six species (Artüz and Golani 2018) (seven with the presently reported finding).



**Fig. 2.** Female specimen of *Upeneus moluccensis*, MAREM LAR-182, 108.5 mm SL, off Aksaz, western Sea of Marmara, Turkey

**Table 2**

Distribution of Lessepsian migrant populations of *Upeneus moluccensis* in the Mediterranean Sea: first (and second) country (region) records

Country (region)	Record
Egypt (Suez Canal)	Gruvel 1936, as <i>Mulloides flavolineatus</i> Ben-Tuvia 1955
Egypt (Mediterranean coast)	Ben-Tuvia 1955
Gaza	Ben-Tuvia 1955
Israel	Haas and Steinitz 1947, as <i>Mulloides auriflamma</i> Ben-Tuvia 1955
Lebanon	George et al. 1964
Syria	Saad 1998
Cyprus	Demetropoulos and Neocleous 1969
Greece (Rhodes)	Laskaridis 1948, as <i>Mulloides auriflamma</i> Ben-Tuvia 1955
Turkey (Mediterranean Sea coast)	Kosswig 1950
Turkey (southern Aegean Sea)	Torcu and Mater 2000
Turkey (northern Aegean Sea)	Aydın and Akyol 2016
Turkey (Sea of Marmara)	Presently reported study

Regarding the database of the General Directorate of Meteorology between 1970 and 2017 the mean water temperature in the Sea of Marmara was 15°C in the 1970s, subsequently steadily increasing to 16.2°C in the less saline ( $\approx 22\text{‰}$ – $26\text{‰}$ ) and dense ( $\approx \sigma_t$  11–17) surface water mass (Anonymous 2018). On the contrary, the saline ( $\approx 36\text{‰}$ – $38\text{‰}$ ) and dense ( $\approx \sigma_t$  26–29) lower water mass did not increase and still has a constant temperature of 14.2°C (Artüz et al. 2018).

The special hydrographical features of the Sea of Marmara and reduction of species diversity create a suitable environment for invasive and new species due to anthropogenic activities (pollution, overfishing, dense maritime traffic, etc.).

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