

## Lessepsian Fishes Spreading Along the Coasts of the Mediterranean and the Southern Aegean Sea of Turkey

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**Abstract:** The taxonomy and biological characters of 22 Lessepsian fishes living on the coasts of the Eastern Mediterranean and Aegean Sea were examined and 8 species were determined to have commercial importance. Of these, *Upeneus moluccensis* and *Saurida undosquamis* have become economic fishes of the Eastern Mediterranean trawl fisheries, having significant stocks. The species previously misidentified as *Upeneus asymmetricus* was determined to be *Upeneus pori*. It has been pointed out that new species can be added to the recorded ones by the consequent influx of Red Sea biota into the Levant.

**Key Words:** Lessepsian, Mediterranean, southern Aegean Sea, taxonomy.

### Türkiye'nin Akdeniz ve Güney Ege Sahillerinde Yayılış Gösteren Lessepsiyen Balıklar

**Özet:** Akdeniz ve Güney Ege sahillerinde yaşayan Lessepsian balık türlerinin taksonomik konumları ve biyolojik özelliklerinin incelendiği bu çalışmada bulunan 22 türden, 8 türün ekonomik öneme sahip olduğu belirlenmiştir. Bu türlerden, *Upeneus moluccensis* and *Saurida undosquamis* önemli stoklar oluşturarak Doğu Akdeniz trol avının ekonomik balıkları arasına girmiştir. Daha önce *Upeneus asymmetricus* olarak yanlış tanımlanan türün *Upeneus pori* olduğu tespit edilmiştir. Lessepsian balıkların Doğu Akdeniz'e sürekli girişleri ile şimdiye kadar kaydedilen türlere yeni türlerin ilave olabileceği vurgulanmaktadır.

**Anahtar Sözcükler:** Lessepsiyen, Akdeniz, Güney Ege Denizi, taksonomi.

### Introduction

The term Lessepsian migration was first used for the migration of new populations mainly from the Red Sea into the Levant by the opening of the Suez Canal in 1869. The consequent penetration of tropical Indo-Pacific organisms into the subtropical Eastern Mediterranean is still going on.

The first Lessepsian migrant, *A.lacunosos* was recorded off İskenderiye (1–4). After that, 36 Red Sea fishes were added to the local Eastern Mediterranean Sea fish fauna (4). With the addition of 7 new fishes to 48 Lessepsian fishes recently, the total reached 55 (5, 6). This still remains unchanged (Golani, personal communication).

Of these, *S. undosquamis* was first caught from Israel in 1952 (7). Then, it became one of the economic fishes of Mersin and İskenderun Gulfs in 1954-1956 (1, 7–10). *U. moluccensis* invaded İskenderun Gulf in large quantities in the same years (1, 8, 10).

With these two species, *Sargocentron rubrum*, *Siganus rivulatus*, *Siganus luridus*, *Hemiramphus far*, *Pempheris vanicolensis*, *Lagocephalus spadiceus*, *Aterinomorus lacunosus*, *Sphaeroides spadiceus*, *Leiognathus klunzingeri*, *Paraexocoetus mento*, *U. moluccensis* colonized successfully, reaching Samos Island of the northern Aegean Sea following the Asiatic coast (1–4, 8, 11–14).

### Material and Methods

In this investigation carried out for determining Lessepsian fishes in the years of 1991-1994, the pelagic and benthic samples were collected by trawl and local gears at the following stations: İskenderun Gulf (İG), off Karataş (K), Mersin Gulf (MG), off Taşucu (T), Anamur Cape (A), Antalya Gulf (AG), Fethiye Gulf (FG), Gökova Gulf (GG) (Figure 1).

\* This work is a part of PhD thesis named "The investigations of the Indo-Pacific fish species living on the coasts of the Mediterranean and southern Aegean Sea, biology and ecology of *Upeneus moluccensis* (Bleeker, 1855) and *Saurida undosquamis* (Richardson, 1848). It was supported by the research fund of Selçuk University (FEF. 91/052).

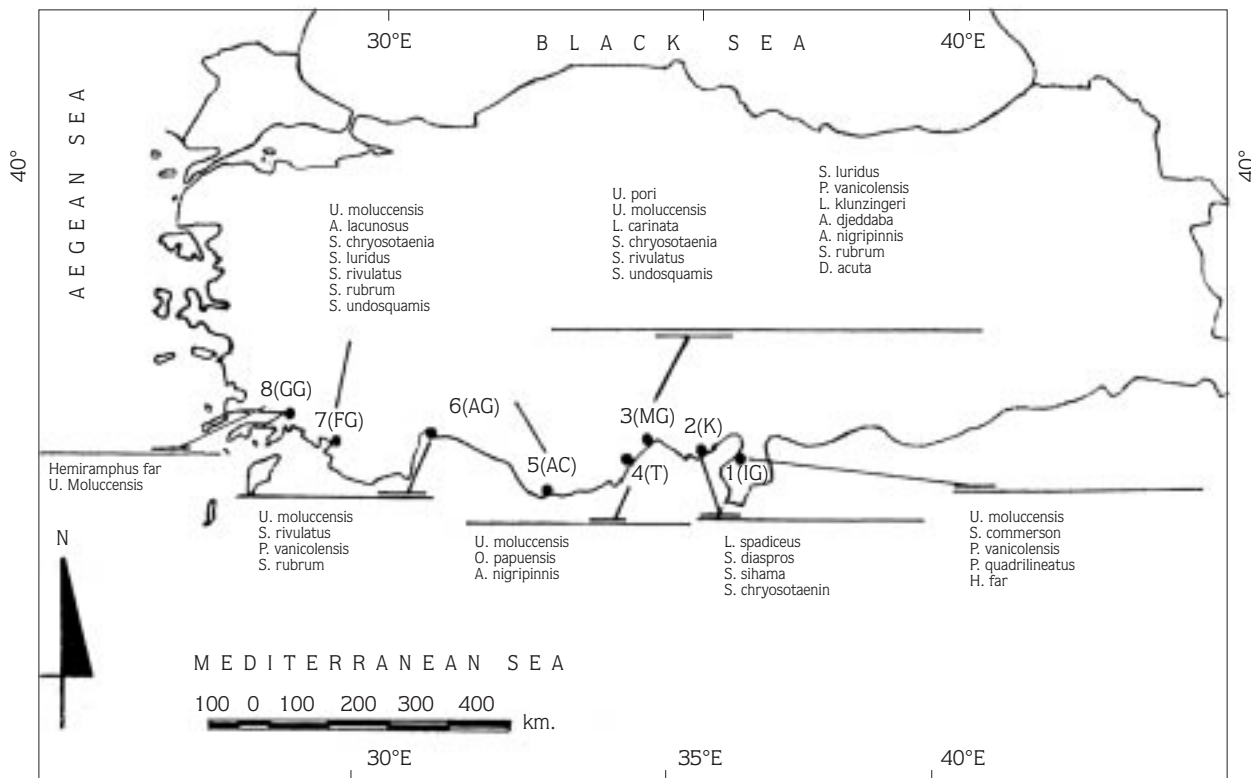


Figure 1. The distribution of Lessepsian migrants at the sampling stations.

The obtained samples were washed with fresh water immediately; after identification, they were kept in 70 % alcohol or 4 % formaldehyde solutions and the morphometric measurements were taken with a dial caliper of 0.05 mm accuracy and all of meristic characters were determined under a binocular microscope.

## Results

In this investigation, a total of 22 species belonging to 1 Classis, 7 Ordo, 17 Familia and 17 Genus were obtained. Systematic categories are given by Hureau et al. (11) and Golani (15).

Phylum: CHORDATA

Subphylum: VERTEBRATA

Superclassis: GNATHOSTOMATA

Classis: OSTEICHTHYES

ORDO: ISOSPONDYL (CLUPEIFORMES)

DUSSUMIERIDAE

*Dussumieria acuta* Valenciennes, 1847

Synonym: *D. productissima* Chabanaud, 1933

Common name: Sardine

Local name: Kalem sardalya

N: 3, ranging 150-158 mm

Morphological Characters

D: 9; A: 14; V: 18

TL/BD: 5.68

BD/HL: 0.68

TL/HL: 5.00

HL/ED: 3.43

Colour: Back iridescent blue-green, fins silvery

Ecological Characters: Specimens of this inshore-pelagic fish were obtained from Mersin Gulf.

ORDO: AULOPIFORMES

SYNODONTIDAE

*Saurida undosquamis* (Richardson, 1948)

Synonym: None

Common names: Red Sea lizardfish, brushtooth lizardfish

Local names: Iskarmoz, zurna, lokum balığı

N: 530, ranging 90-320 mm.

Morphological Characters:

D: II-13; A: 10-13; V: 9; Ll. 45-54; PÇ: 11-18,

Branchiostegal rays: 10-15

TL/HL:  $4.94 \pm 0.21$

TL/BD:  $8.61 \pm 0.37$

BD/HL:  $0.81 \pm 0.03$

HL/ED:  $3.55 \pm 0.15$

Colour: Leading edge of dorsal and upper edge of caudal fin has a row of dark spots, body has 8-10 dark spots along the lateral line.

Ecological Characters: Akyüz (1957) mentioned its distribution toward Çeşme-Alaçatı on the northern Aegean coast (8). It has also been observed at Rhodes and Samos (1, 2, 12-14). The Red Sea Lizardfish is a piscivorous and demersal fish which migrates vertically for feeding. The spawning season is known to be between April and September in the Levant basin (11). It lays between May and September in the Gulf of Mersin (9). Food: sardines (7, 9).

ORDO: SYNENTOGNATHI (BELONIFORMES)

HEMIRAMPHIDAE

*Hemiramphus far* (Forsskal, 1755)

Synonyms: *Esox far* Forsskal, 1755

*H. commersoni* Cuvier, 1829

Common name: Half-beak

Local names: Çomak, yarım gaga balığı

N: 4, ranging 233-282 mm

Morphological Characters:

D: 12-13; V: 17, A: 14-18; V: 6; P: 11-14; Ll. 41-46;

GR: 24-27

TL/BD: 8.70

BD/HL: 0.36

TL/HL: 3.20

HL/ED: 7.43

Colour: Specimen has 3-9 (4-6) prominent vertical bars on the sides of the body, black pigmented areas in dorsal, pectoral and anal fins.

Ecological Characters: This epipelagic fish schools. Spawning occurs in shallow waters in summer. Food: Mainly sea grasses (*Posidonia sp.*), green algae and diatoms (11).

ORDO: BERCYFORMES.

HOLOCENTRIDAE

*Sargocentron rubrum* (Forsskal, 1755)

Synonym: *Holocentrus ruber* Forsskal, 1755

Common names: Red soldier, squirrel fish

Local names: Hindistan, naylon, asker, pijama, sincip balığı.

N: 9, ranging 158-188 mm

Morphological Characters:

D: XI, 12-13; A: III, 9; V: I, 7; Ll. 38-39

TL/HL:  $3.80 \pm 1.26$

TL/BD:  $3.06 \pm 1.02$

BD/HL:  $1.24 \pm 0.41$

HL/GÇ:  $3.0 \pm 1.00$

Scales large and spiny.

Colour: Body and fins have 7-9 longitudinal dark stripes and the edge of the spiny dorsal and caudal fins are blackish.

Ecological Features: *S. rubrum* is a nocturnally active species that was first recorded from the coasts of Israel by (Hass and Steinitz in 1947) and later Turkey by (Kosswig in 1950) (16). It has been common in the rocky substrate at 0-5 m. in the Levant for two decades. The spawning season in the Mediterranean extends from June to September. It feeds primarily on decapod crustaceans (11, 16).

ORDO: PERCIFORMES

TERAPONIDAE

*Pelates quadrilineatus* (Bloch, 1790)

Synonyms: *Holocentrus quadrilineatus* Bloch, 1790

*Therapon cuvieri* Bleeker, 1854

*Therapon quadrilineatus* Jordan and Seale, 1907

Common names: Four-lined terapon, Trumpeter perch

Local name: İspinoz balığı

N: 2, ranging 102-126 mm.

Morphological Characters:

D: XII, 10; A: III, 10; V: I, 5; Ll. 75-80; GR: 44

TL/BD: 4.06

TL/HL: 4.38

BD/HL: 0.93

HL/ED: 0.47

Colour: Back dark silver, yellowish on the sides, longitudinal dark stripes on the body; a dark blotch on the upper part of the operculum.

Ecological Characters: *P. quadrilineatus* which lives in the littoral zone is demersal, carnivorous and euryhaline. Reproduction occurs in summer (11, 17).

APOGONIDAE

**Apogon nigripinnis Cuvier, 1828**

Synonyms: *Apogon (Nectamia) taeniatus* Cuvier, 1828

*Apogon thurstoni* Norman, 1927

Common name: Cardinal

Local names : Kardinal, kral balığı

N: 6, ranging 69-79 mm.

Morphological Characters:

D1: VII; D2: I, 9; A: II, 8; V: I,5

TL/BD: 2.98 ± 0.82

BD/HL: 0.93 ± 0.38

HL/ED: 3.55 ± 1.45

TL/HL: 3.10 ± 1.27

Colour: Body is brownish or silver-grey, it has three darker vertical bands on the sides, the first one including a black ocellus with a white ring, the last one near the base of the caudal fin. It differs from the native species, *A. imperbis* by having a black ocellus with a white ring and three darker vertical bands on each side.

Ecological Characters: This small fish was caught off Taşucu in the sublittoral zone (0-1m) with gears.

CARANGIDAE

**Alepes djeddaba (Forsskal, 1775)**

Synonyms: *Caranx djeddaba* (Tillier, 1902)

*Caranx calla* (Steinitz, 1927)

Common name: Shrimp scad

Local name: Çatal balığı

N: 1, TL: 150 mm

Morphological Characters:

DI: I-VIII, 22-25; D2: I,23; V: I, 5; LI. 41-48

TL/BD: 3.95

BD/HL: 1.17

TL/HL: 4.62

HL/ED: 3.61

Colour: Back greyish-green, lateral silvery to white, a black blotch on the postero-dorsal margin of the opercle, bordered above by a smaller white spot, caudal fin yellowish, margin of the lower lobe dusky.

Ecological Features: It schools in coastal waters. Reproduction occurs in summer. Food: mainly crustacean and fish larvae (11).

LEIOGNATHIDAE

**Leiognathus klunzingeri (Steindachner, 1898)**

Synonym: *Leiognathus mediterraneus* Erazi, 1942

Common name: Pony fish

Local name: Eksi balığı

N: 6, ranging 78-81 mm

Morphological Characters:

D: VIII, 16; A: III, 13-14; V: I, 5; P: 13-16; GR: 15-16

TL/HL: 5.11 ± 2.09

TL/BD: 3.08 ± 1.26

BD/HL: 1.65 ± 0.67

HL/ED: 2.43 ± 1.00

Colour: Back mottled grey with pink patches on the sides, belly silvery, a black line along each side of the dorsal fin.

Ecological Characters: *L. klunzingeri*, a trash fish in trawl hauls, is undoubtedly one of major importance in the food chain of demersal piscivorous fishes such as *S. undosquamis* (7). Food: small benthic invertebrates. It has ripe gonads in summer (11). It was caught off Taşucu with trawl hauls.

MULLIDAE

**Upeneus moluccensis (Bleeker, 1855)**

Synonyms: *Upenoides moluccensis* Bleeker, 1855

*Upenoides dubrus* Krer, 1865

*Mulloidides aurijlamina* Hoces and Steinite, 1947

*Mulloidichthys aurijlamina* Ben-Tuvia, 1953

Common name: Golden-banded goat fish

Local name: Paşa barbunya balığı

N: 1040, ranging 89-170 mm

Morphological Characters:

D1: VIII; D2: I, 8; V: I, 5; A: I, 6; P: 16; LI. 33-40 (35); GR: 22-27 (25)

TL/HL: 4.20 ± 0.01

TL/BD: 5.19 ± 0.05

HL/ED:  $3.56 \pm 0.01$

HL/BL:  $1.73 \pm 0.86$

The barbel length (BL) is  $20.46 \pm 0.42$  and doesn't extend posterior to the operculum.

Colour: Head and back brown-red or bright red, sides and belly white; a distinct bright yellow band from the anterior profile of head through the eyes above the lateral line to the caudal fin; both dorsal fins yellow with 3 red horizontal bars, pectorals colourless, pelvics yellow; upper lobe of the caudal fin whitish, with 5-6 dark oblique bars and the second one extending to the lower part of the fin.

Ecological Characters: It has been observed in the Mediterranean since the 1940's (1-3, 5). It is very common on muddy substrate at depth of 40-70m (5) and in an important component of the Mersin and Iskenderun trawl fisheries (2, 8, 10). Spawning reaches maximum from August to September in the Levant (10). Food: macrurid crustacean and small fishes such as *L. klunzingeri* (5, 6, 11).

**Upeneus pori (Ben-Tuvia & Golani, 1989)**

Synonyms: *U. tragula* Richardson, 1848

*U. asymmetrichus* Lacher, 1954 (original description: Philippines)

Common name: Brown banded-goat fish

Local name: Esmer Nil barbunya balığı

N: 20, ranging 146-153 mm

Morphological Characters:

D1: VII; D2: I-8; A: I, 7; P: 14; V: I, 5; LI. 29-30; GR: 26; Prd scale: 3

TL/BD:  $5.44 \pm 0.13$

TL/HL:  $4.39 \pm 0.09$

BD/HL:  $0.77 \pm 0.01$

HL/ED:  $3.87 \pm 0.11$

Colour: Back and sides mottled, reddish-brown on grey background, belly whitish; red-brown spots scattered below the lateral line; a longitudinal dark red-brown band from the axil of the opercle to the base the of caudal fin on the sides; barbels white; first dorsal fin has 3-5 series of red-brown spots running parallel to the upper margin of the fin; upper lobe of the caudal fin has 3-7 and the lower lobe has about 4-5 oblique red-brown bars; the ventral margin of the lower lobe has 3-8 similar bars perpendicular to the rays; the number of the bars on both lobes increases with the size of the fish; belly silvery.

Ecological Characters: *U. pori* was first reported from the Mediterranean by Kosswig (1950) under the name of *Upenoides tragula*. Ben-Tuvia (1953, 1966) reported it from the coast of Israel as *Upenus sp.* and later as *U. tragula* (1-3). George and Athanissou (1966, 1967) identified the same species found off the coast of Lebanon as *U. asymmetricus* Lachner and this name was quickly accepted by other workers where the Mediterranean specimens all had seven spines in the first dorsal fin whereas *U. tragula* has eight. The same fish was later found in the Red Sea again misidentified as *U. asymmetricus* (18). It spreads from the Red Sea to the Suez Canal, Elat Gulf of Israel, Lebanon and Asiatic coasts, but is Indo-Pacific. The spawning season occurs from May to August in the Eastern Mediterranean (15). Food: benthic crustaceans, especially *Leptocephalo pugnax* (19).

PEMPHERIDAE

**Pempheris vanicolensis (Cuvier, 1831)**

Synonyms: *P. vanicolensis* Cuvier, 1831

*P. moluca* Bleeker, 1850

*P. magula* Kner, 1865

Common name: Sweeper

Local names: Ateş balığı, uçgen balığı

N: 4, ranging 90-154 mm.

Morphological Characters:

D: V, 9-10; A: III, 30-36; P: I, 16; V: I, 5; LI. 55-58

TL/HL: 4.35

TL/BD: 2.98

BD/HL: 1.56

HL/MB: 7.41

HL/ED: 2.12

Its body is laterally compressed and the belly is triangular.

Colour: Back brownish-pink with small spots on the dorsal and anal fins. It is morphologically characterized by a dark area on the tip of the dorsal fin and the presence of a similar projection on the distal edges of the first few anal rays.

Ecological Characters: This small nocturnal species was first recorded off Lebanon. Then, it was reported off the coast of Israel. It has spread westward to the Aegean Sea (Greece) recently (4, 8, 11-15). During daylight hours, this species forms large hovering aggregations in caves and rocks. At dusk, it leaves the caves (20).

SIGANIDAE

**Siganus rivulatus (Forsskal, 1775)**

Synonym: *Ampacanthus rivulata* (Forsskal, 1775)

Common name: Marbled spine-foot

Local name: Beyaz sokar, çarpan balığı

N: 29, ranging 145-185 mm.

Morphological Characters:

D: XIV, 10; A: VII, 9; P: 16; V: I, 3, I

BB/TB:  $4.35 \pm 0.23$

VY/TB:  $3.46 \pm 0.14$

BB/VY:  $1.36 \pm 0.02$

GÇ/BB:  $3.33 \pm 0.12$

Body compressed, snout obtuse; caudal fin slightly forked.

Colour: Body light brown-olive, longitudinal yellow stripes on each side.

Ecological Characters: This species was first recorded in the Levant in the 1950's (1–3). The spawning season was shortened from April to August in the Levant. It feeds on algae and sea grasses (1–3, 12–15, 21, 22).

**Siganus luridus (Rüppell, 1878)**

Synonym: *Ampacanthus luridus* Rüppell, 1878

Common name: Dusky spine-foot

Local name: Siyah sokar, çarpan balığı

N: 15, ranging 118-140 mm

Morphological Characters:

D: XIV, 10; A: VII, 9; V: I, 3, I; GR: 18-21

TL/HL:  $4.93 \pm 0.08$

TL/BD:  $2.88 \pm 0.11$

BD/HL:  $1.70 \pm 0.08$

HL/ED:  $3.07 \pm 0.03$

Body compressed, snout obtuse; caudal fin truncate.

Colour: Body changes from mottled olive-green to dark brown at death. Pectorals yellow; dark crossbars on the caudal fin.

Ecological Characters: It feeds upon sea grasses. The spawning period is between April and August in the Mediterranean (11). It migrates westward to the northern Aegean Sea (1–3, 12–15, 21, 22).

SCOMBRIDAE

**Scomberomorus commerson (Lacepede, 1802)**

Synonyms: *Scomber conam* Russell, 1803

*Cybium commersone* Cuvier, 1829

Common name: Spanish mackerel

Local names: Ceylan balığı, tombak, dişli palamut, ay balığı

N: 2, ranging 501-550 mm

Morphological Characters:

D: XV, 17-18; DP: 10; A: 8-10; AP: 9-10

TL/BD: 6.78

TL/HL: 4.35

BD/HL: 0.74

HL/MB: 2.56

HL/ED: 7.36

Body elongate, laterally compressed; lateral line curves down to the end of dorsal fin and then straight to the base of the caudal fin, has a well developed carina in the middle of the caudal peduncle.

Colour: Back iridescent blue-green, pale silver-grey with slightly wavy vertical bars on the sides; dorsal fin bright blue rapidly fading to blackish-blue; pectorals light grey turning to blackish.

Ecological Characters: This pelagic fish is increasing in commercial fisheries day by day. It has been often reported by the local fisheries of Güllük, Gökova and Mersin Gulfs (8, 10, 23, 24).

GOBIIDAE

**Oxuryichthys papuensis (Valenciennes, 1837)**

Synonym: *Gobius papuensis* Valenciennes, 1837

Common name: Red Sea goby

Local name: Kızıldeniz kaya balığı

N: 2, ranging 107-141 mm.

Morphological Characters:

D: VI, I 12; A: I, 13; P: 22; LI: 12; GR: 4

TL/BD: 10.16

BD/HL: 0.56

TL/HL: 5.72

HL/ED: 4.00

Colour: Body grey-blue, lighter below; snout grey with yellow tint, rest of the head has light purple and yellow bands; a dark triangular blotch in the middle of the caudal peduncle.

Ecological Characters: *O. papuensis*, the first Red Sea goby in the Eastern Mediterranean (25, 26) is now common in trawling grounds on sandy and muddy bottoms at depths of 35-45 m (25). The spawning season occurs in early summer and autumn. Food: The members of Foraminifera, Amphipoda, Isopoda, Ostracoda, Mollusca and Ecinodermata (11, 25). It was caught by trawl hauls off Taşucu at a depth of 40 m.

## SPHYRAENIDAE

**Sphyraena chysotaenia Klunzinger, 1884**

Synonym: *S. obtusata* Cuvier, 1829

Common name: Barracuda

Local name: Zurna balığı

N: 4, ranging 176-255 mm.

Morphological Characters:

D1: II; D2: I, 9; V: I, 5; A: I, 9; GR: 2

TL/BD: 8.62

TL/HL: 3.02

BD/HL: 0.35

HL/ED: 5.70

Colour: Back brown-grey, belly silvery; tips of first dorsal and caudal fins blackish.

Ecological Characters: This pelagic fish lives in the water column. It is one of 11 migrants to the Aegean Sea (1, 3, 8, 11-15, 21). Spawning occurs between June and September. Food: mainly sardines, anchovies and particularly crustaceans (11).

## MUGILIDAE

**Liza carinata Valenciennes, 1836**

Synonyms: *Liza carinata* Ebreberg, 1836

*Mugil carinatus* Valenciennes, 1846

Common name: Roving grey mullet

Local name: Topan, keserbaş kefal

Morphological Characters:

D1: IV; D2: I, 8; A: III, 8; V: I, 5; LI: 39; Pyloric caeca: 5

TL/BD: 6.16

TL/HL: 4.78

BD/HL: 0.78

HL/ED: 4.45

It is characterized by a well developed adipose eyelid covering the most of the pupil. Pectoral fin tip vertical through first dorsal fin origin.

Colour: Back grey-blue, fins and belly pale or silvery.

Ecological Characters: *L. carinata* is a euryhaline species which passes into lagoons and estuaries with thick vegetation in spring, deep coastal waters in winter. Spawning occurs between August and October. Food: benthic algae and small molluscs. Its flesh and caviare are used for food (11, 27).

## ATHERINIDAE

**Atherinomorus lacunosus (Forster in Bloch and Schneider, 1801)**

Synonyms: *Pranesus pinguis* Lacepede, 1803

*Atherinomorus lacunosus* Lacepede, 1803

*Atherina pinguis* Lacepede, 1803

Common name: None

Local name: Aterinöz, çipil balığı

N: 4, ranging 104-116 cm.

Morphological Characters:

D1: V; D2: I, 9-10; A: II, 12; V: I, 5; LI: 40-42; GR: 25-28

TL/BD: 6.34

TL/HL: 4.39

BD/HL: 0.69

HL/ED: 2.52

It has a lateral line reduced to a row of small round pits on each scale.

Colour: Back blue-green, belly dusky white.

Ecological Characters: *A. lacunosus* is the first Lessepsian fish recorded off İskenderiye in the Eastern Mediterranean (1-4) spreading to the Aegean Sea (1-4, 8, 11-15). It forms small schools in the littoral zone. Food: zooplankton and rarely benthic invertebrates (4, 15, 16).

## SILLAGINIDAE

**Sillago sihama (Forsskal, 1775)**

Last revision, McKey (1987)

Synonym: None

Common name: Silver sillago

Local name: None

N: 2, ranging 149-173 mm.

Morphological Features:

D1: XI; D2: I, 20-23; A: II, 21-24; LI: 70-76

TL/BD: 5.98

TL/HL: 3.98

HL/ED: 4.50

It has a flat triangular spine on the opercle.

Colour: Back light brown, ventral flanks and belly silvery without dark blotches, both dorsal fins and caudal fin dusky.

Ecological Characters: *S. sihama* is a Suez Canal migrant recorded in the Eastern Mediterranean (3, 5, 8, 11). It lives in shallow coastal waters close to sandy bottoms. Its food consists of small benthic invertebrates, especially Polychaeta. Reproduction occurs from May to September in the Mediterranean (5,6, 8, 11–15, 21).

MONOCANTHIDAE

**Stephanolepis diaspros Fraser-Brunner; 1940**

Synonym: *S. ocheticus* Fraser-Brunner, 1940

Common name: None

Local name: Dikenli çütre balığı

N: 3, ranging 100-145 mm

Morphological Characters:

D1: I; D2: 30-31; A: 30-31; V: I

TL/BD: 2.55

TL/HL: 3.99

BD/HL: 1.56

HL/ED: 3.60

Scales small and ctenoid (rough) giving a velvety appearance.

Colour: Grey brown or greenish with spots and lines; adults have pale lines on the sides, enclosing dark lozenge shape areas, caudal fin has 2 dark bands.

Ecological Features: It seems to prefer migration westward with sea grasses such as *Posidonia* sp. (8, 11–15, 21). It was caught with a trawl haul at a depth of 40 m off Karataş.

TETRAODONTIDAE

**Lagocephalus spadiceus (Richardson, 1844)**

Synonyms: *Tetradon spadiceus* Richardson, 1844

*T. lunaris* Tillier, 1902

Common name: Pufferfish

Local names: Balon balığı, sigara balığı

N: 3, ranging 134–161mm.

Morphological Characters:

D: I, 8-9; A: I, 7

TL/BD: 7.49

TL/HL: 3.66

BD/HL: 0.49

HL/ED: 3.06

Colour: Back dark green, flanks yellow, belly whitish.

Ecological Characters: This first Red Sea pufferfish (1–3) has been spreading towards the Aegean Sea (8, 11–14, 21); no data about its food or reproduction (11). It was caught with a trawl haul off Karataş.

**Discussion**

In this investigation about Lessepsian fishes living on the Asiatic coasts of Turkey, the results of the examination of the obtained species are as follows:

1- The number of Lessepsian fish species have been increasing in Levant year by year. Of the 22 species determined, 8 are commercial fishes.

2- *D. acuta* first reported from the Eastern Mediterranean was caught at the same location that it was considered to its limit in the Eastern Mediterranean (1–3, 8, 11). Its body ratios are different from the previous reference (8). The small number of samples may be a reason for the difference in body ratios.

3- *H. far* first recorded from the southern Aegean Sea, was also recorded from the Eastern Mediterranean (1–4, 8, 12–14, 21). The fact that its food is sea grasses enables it to migrate fast towards the northern part of the Aegean Sea (11, 12, 14). The body ratios given in this investigation are nearly the same as in the references (8, 11).

4- *P. quadrilineatus*, recorded from the Eastern Mediterranean (8, 17), was reported at the same location. It shows that *P. quadrilineatus* adapts itself to the ecological features of the Levant. It is a non-economic species caught in small quantities. The morphometric and meristic characters confirm the previous references (8, 11, 17).

5- *S. rubrum* which has colonized successfully along the Eastern Mediterranean has been spreading westward to the Aegean Sea (Greece) (1–3, 11, 21). The morphometric and meristic characters confirm the references (5, 8, 11, 28). It can be concluded that abiotic factors in the Western and Eastern Mediterranean haven't caused phenotypic and genotypic variations in the meristical ones (5).

6- It seems that *A. nigripinnis*, recorded from the Eastern Mediterranean (1–3, 8, 11), has been also found to be a successful colonizer. Although it has no commercial value, it forms a part of the food chain. The morphometric and meristical characters seem to be similar to those in the references (8, 11).



7- *A. djeddba* can be distinguished from native Mediterranean species by the presence of an adipose membrane covering the posterior half of the eyes, a black spot on the edge of opercle and lateral line with scutes. The morphometric and meristical characters confirm the references (8, 11).

8- Except for HL/ED (8), the morphometric and meristical characters of *L. klunzingeri* confirm the references (8, 11). It may be a reason for differences in the measurement. It can be considered that adaptation of these small fish to large geographical areas from Port Said to the Aegean Sea can cause some morphological features, but not genotypical ones. This relatively small fish has no commercial value. However, it is included in the diet of piscivorous fishes such as *S. undosquamis* (1, 7, 9).

9- *P. vanicolensis* recorded from the Aegean Sea (Greece) is the best indicator, showing fast westward migration (12, 14). The fact that it has no potential competitors may be a reason for the population explosion in its new habitat. It is still spreading to the Aegean Sea (8, 11, 12, 14). The morphometric and meristical characters seem to be similar to those in the references (8, 11).

10- *S. luridus* and *S. rivulatus*, recorded from Rhodes (1–4, 11, 12, 14) and Samos (12, 14), are seen to adapt to a new habitat faster than the others. The first reason is the quick adaptation of each siganid to macroalgae flora, the second one is that its competition with herbivorous fishes such as *Boops boops* feeding upon animals also doesn't inhibit its colonization in the Southern Aegean Sea. Low salinity enables these species to spread towards the northern part of the Aegean Sea from the Mediterranean (13, 14). It can be concluded that lower body ratios than in the references (8, 11, 22) may be related to sampling in various length groups towards Gökova Gulf. These siganids reported from the Eastern Mediterranean (1–3, 8, 11, 21, 22) have been spreading to westward to the Aegean Sea (12–14)

11- *S. commerson* recorded from Japan and the South China Sea in the Pacific Ocean to South Africa and the Red Sea (11, 23), has been often reported by the local fishermen in İskenderun and Mersin Gulfs in the Eastern Mediterranean and Gökova and Güllük Gulfs in the southern Aegean Sea (8, 24). This pelagic fish has been gaining commercial value year by year.

12- *O. papuensis*, reported from the Eastern Mediterranean (8, 11, 25, 26) was caught with a trawl haul in Mersin Gulf. BD/HL seems to be higher than the reference (26). It may be because of the sampling in

various length groups examined. It shows that it is limited in the Eastern Mediterranean, colonizing in the last 10–15 years. Sharing the same habitat with some Lessepsian fish such as *U. moluccensis* is important in view of its feeding habits (25).

13- *S. chryosotaenia*, reported from the Eastern Mediterranean (1–3, 8, 11) was also obtained from Fethiye Gulf. Although it colonizes successfully in Levant and has commercial value, the decrease in its abundance westward to the Aegean Sea is worth mentioning (8, 12, 14). The morphometric and meristical characters confirm the references (8, 11).

14- *A. lacunosus*, the first Lessepsian fish invading the Eastern Mediterranean (1–4) was caught in Fethiye Gulf.

Except for TL/BD and counts of gill raker, the other morphometric and meristical characters confirm the references (8, 11). It may be because of the large number of samples.

15- The fact that *L. carinata*, obtained from Mersin Gulf was also previously reported from Gökovada and its vicinity (27), shows that this species tolerates variations in temperature and salinity along the coast of Turkey very well and confirms in short that it is euryhaline. The morphometric and meristical characters of the species confirm the references (11, 27).

16- In *S. Sihama* reported from the Eastern Mediterranean in small numbers (3, 5, 8, 11), the lateral line was much longer than in the references (5, 8, 11). It may be because of the smaller number of specimens examined in this investigation.

17- *S. diasporus* rarely reported from the Eastern Mediterranean (1–3, 8, 11) has also been recorded from the Aegean Sea (12–14). This may be an indicator of its preference for sea grasses. The morphometric and meristical characters confirm the references (8, 11).

18- The first Red Sea pufferfish, *L. spadiceus* (1–3, 8, 11), was also reported from islands of Dodacanese and Samos may be thought to live with *S. diaspros* in sea grasses (12–14). It was rarely caught off Karataş. The differences in body ratios of this species from the references (8, 11) may be because of sampling in different length groups.

19- The previously misidentified *U. asymmetricus* (1–5, 8, 11–14, 21) was determined to be *U. pori* (15, 18, 19). *U. pori* differs from *U. moluccensis* in the length of lateral line, the first dorsal fin rays, pectoral fin rays, anal fin rays, gill rakers and the length of barbels. The morphometric and meristical characters of *U. pori* confirm the references (18).

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