

***Arnoglossus nigrofilamentosus* n. sp., a new species of flounder (Teleostei: Bothidae) from off the Mediterranean coast of Israel, probably a new case of Lessepsian migration**

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Summary: The filamentous flounder *Arnoglossus nigrofilamentosus* n. sp. is described from four specimens collected in the southeastern Mediterranean near Tel-Aviv, Israel on 5 May 2017. The new species is characterized as follows: second to sixth dorsal-fin rays elongate and filamentous, dorsal-fin rays 78-84, anal-fin rays 61-66, pectoral-fin rays on ocular side 12-13, on blind side 7-9, caudal-fin rays iii, 11, iii, lateral-line scales 52-54, gill rakers 0 + 4-5, not serrated, interorbital a narrow bony ridge without scales in the middle, interorbital width 11% to 16% of upper orbit diameter, no enlarged teeth anteriorly in upper jaw, and prevomer small, not enlarged, weakly projecting into mouth cavity; body in fresh specimens pale (may have been dark before the epidermis was abraded), head, peritoneum and vertical fins black. The new species is described and compared with similar species. Though the species has not yet been observed in the northern Red Sea, it probably originates from the Gulf of Suez, so this finding represents a probable new case of Lessepsian migration.

Keywords: *Arnoglossus nigrofilamentosus*; Bothidae; new species; distribution; Lessepsian migration; Red Sea.

***Arnoglossus nigrofilamentosus* n. sp., una nueva especie de platija (Teleostei: Bothidae) de las costas mediterráneas de Israel, probablemente un nuevo caso de migración lessepsiana**

Resumen: Se describe una nueva especie de platija filamentosa *Arnoglossus nigrofilamentosus* n. sp. A partir de 4 ejemplares capturados en el SE Mediterráneo cerca de Tel-Aviv, Israel, el 5 de mayo del 2017. La nueva especie se caracteriza por los radios dorsales 2 a 6, largos y filamentosos, 78-84 radios dorsales, 61-66 radios anales, 12-13 radios pectorales en el lado ocular y 7-9 en el lado ciego, iii+11+iii radios caudales, línea lateral con 52-54 escamas, 0+4-5 arcos branquiales, no serrados, una estrecha cresta interorbital, sin escamas en medio, anchura interorbitaria 11-16% el diámetro superior de la órbita, mandibular superior sin dientes alargados anteriormente, y prevomer pequeño, no alargado, débilmente proyectado en la cavidad bucal. En ejemplares frescos, el cuerpo es pálido (quizás oscuro antes de la abrasión de la piel durante la pesca), cabeza, peritoneo y aletas verticales negras. Se describe la nueva especie y se compara con especies próximas. Aunque la especie no se ha observado todavía en el Mar Rojo, probablemente es originaria del Golfo de Suez, lo que supondría un nuevo caso de migración lessepsiana.

Palabras clave: *Arnoglossus nigrofilamentosus*; Bothidae; nueva especie; distribución; migración lessepsiana; Mar Rojo.

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INTRODUCTION

The left-eye flounders of the family Bothidae are a large group of marine fishes living in tropical and temperate waters of all oceans. They are arranged in the order Pleuronectiformes (Nelson et al. 2016), and currently contain a total of 169 valid species (Eschmeyer and Fong 2017). The Bothinae (now classified as the family Bothidae) were characterized by Norman (1934) as left-eye flounders with the pelvic fin on the blind side short-based, that on the ocular side elongate, extending forward to urohyal, supported by a cartilaginous plate placed in advance of the cleithra, its anterior ray well in advance of first ray of that of the blind side, and caudal vertebrae with well-developed apophyses.

The genus *Arnoglossus* Bleeker, 1862 was defined by Amaoka (1969) by having the pelvic fin on the ocular side beginning at the tip of the isthmus, the eyes separated by a bony ridge or a very narrow concave space in the anterior half, interorbital equally wide in both sexes, head large, more than 22% of SL, the scales on the ocular side cycloid or feebly ctenoid, and the mouth large, maxillary longer than eye diameter. The genus is distributed in the eastern Atlantic and the Indo-Pacific; it currently includes a total of 34 valid species (Eschmeyer et al. 2017); a list of these species and their distribution is provided in Table 1.

While examining the catch of R/V *Bilu* collected off Jaffa, Israel in the morning of 5 May 2017, two of the authors (RF and DG) discovered four specimens of an unusual species of *Arnoglossus*, that was subsequently found to be an undescribed species. This species is described herein, and its probable origin is discussed.

MATERIALS AND METHODS

The specimens of the new species were trawled during the night of 4-5 May 2017 by R/V *Bilu* off Jaffa, Israel, eastern Mediterranean Sea, at a depth of approximately 20-40 m judging from the composition of other species contained in the same haul.

Counts and measurements follow Hubbs and Lagler (1947), and descriptive methods follow Arai and Amaoka (1996) except for the caudal-fin ray formula, which follows Fricke (1983); the classification follows Eschmeyer et al. (2017), and the references are according to Fricke (2017). In the description, data of the holotype are presented first, followed by those of the paratypes, in parentheses.

Comparative material. *Arnoglossus arabicus*: HJ 13300 (9, 43.7-84.2 mm SL), Red Sea, Eritrea, 14°18'N 41°38'E (new record for the Red Sea); USNM 109488 (1), Yemen. *Arnoglossus capensis*: MNHN 1967-0506 (8), Liberia. *Arnoglossus dalgleishi*: MNHN 2014-2211 (2), New Caledonia, Chesterfield Islands; SMNS 23571 (1), Loyalty Islands, Lifou. *Arnoglossus grohmanni* (formerly known as *A. kessleri*): HJ 13310 (7), Israel, Haifa; HJ 17039 (1), Israel, Jaffa; HJ 18627 (1), Israel, Zikim Beach; SMNS 11325 (4), Croatia, Cres Island; SMNS 11532 (1), Turkey, Muğla Province; SMNS 12416 (1), Balearic Islands, Formentera; SMNS 15734 (1), Greece, Chalkidiki; SMNS 16088 (1), Croatia, Cres Island; SMNS 16713 (1), Croatia, Cres Island; SMNS 19095 (1), Northern Cyprus, 9 km west Girne; SMNS 24486 (1), Croatia, Cres Island. *Arnoglossus imperialis*: HJ 20600 (3), Balearic Islands, northwest of Menorca, 63-64 m depth; HJ

20638 (1), Balearic Islands, northeast of Mallorca, 144-139 m depth. *Arnoglossus laterna*: HJ 232 (1), Israel, Mediterranean coast; HJ 6575 (3), Israel, Mediterranean coast; HJ 6598 (2), Egypt, northern Sinai, Wadi Hesi; HJ 6609 (1), Egypt, Bardawil, Katib el Galss; HJ 7128 (4), Egypt, Bardawil; HJ 8494 (1), Cyprus, Akrotiri; HJ 8501 (2), Cyprus, Famagusta; HJ 10947 (1), Israel, Tel-Aviv; HJ 11333 (2), Israel, Ashdod; HJ 12135 (6), Israel, Haifa; HJ 13192 (6), Cyprus, Famagusta; HJ 13205 (4), Israel, Mediterranean coast; HJ 13246 (3), Israel, Rubin; HJ 13247 (3), Israel, Rubin; HJ 13295 (1), Cyprus, Famagusta; HJ 13302 (4), Israel, Haifa; HJ 13308 (1), Israel, Rubin; HJ 13309 (1), Israel, Haifa; HJ 13329 (2), Gaza Strip and Egypt, Gaza to Al Arish; HJ 13332 (3), Israel, Rubin; HJ 13333 (1), Israel, Kishon; HJ 13676 (1), Cyprus, southeast of Paphos; HJ 13677 (1), Cyprus, Famagusta; HJ 13695 (1), Cyprus, southeast coast; HJ 13827 (1), Israel, Jaffa; HJ 13963 (3), Israel, Mediterranean coast; HJ 13980 (1), Egypt, Bardawil, Katib el Galss; HJ 13981 (2), Israel, Rubin; HJ 13996 (1), Israel, Haifa; HJ 17906 (2), Spain, Malaga; HJ 20081 (2), Israel, Jaffa; SMNS 8761 (30), Italy, Santa Margherita Ligure; SMNS 9237 (1), Balearic Islands, Mallorca; SMNS 14981 (1), Turkey, Sea of Marmara; SMNS 20571 (4), Italy, Venice; SMNS 20571 (1), Italy, Venice. *Arnoglossus macrolophus*: HJ 5147 (4), Eritrea; HJ 13334 (7), Eritrea, Massawa; HJ 20666 (4), Eritrea; MNHN 2014-1160 (3), Madagascar; MNHN 2014-1690 (3), Madagascar; MNHN 2014-2009 (1), Madagascar; MNHN 2014-2149 (4), Madagascar; SMNHTAU P.2062 (1), Israel, Eilat. *Arnoglossus rueppellii*: HJ 13689 (1), Israel, Haifa; HJ 13692 (1), Gaza Strip to Egypt, Gaza to El Arish; HJ 13693 (1), Gaza Strip, Chan Yunis; HJ 16099 (5), Israel, Hadera to Herzliya; HJ 16508 (1), Israel, Ashdod; HJ 16586 (3), Israel, Ashdod; HJ 19066 (1), Israel, Haifa; SMNS 24438 (1), Madeira Region, Seine Seamount. *Arnoglossus sayaensis*: MNHN 2014-1625 (1), Madagascar; MNHN 2014-2189 (1), Madagascar; USNM 307494 (1), Saya de Malha Bank. *Arnoglossus thori*: HJ 13202 (1), Israel, Mediterranean coast; HJ 13240 (1), Cyprus, Famagusta; HJ 13303 (1), Cyprus, Famagusta; HJ 13322 (1), Cyprus, Famagusta; HJ 13439 (2), Cyprus, Famagusta; HJ 13678 (1), Israel, Tel-Aviv to Herzliya; HJ 13709 (1), Israel, Haifa; HJ 13938 (5), Israel, Hadera; HJ 13986 (2), Israel, Haifa; HJ 14058 (11), Israel, Caesarea; HJ 18337 (1), Greece, Crete Island, Heraklion; HJ 20601 (1), Balearic Islands, northwest of Mallorca, 63-64 m depth; HJ 20610 (5), Balearic Islands, 111-109 m depth; HJ 20612 (1), Balearic Islands, north of Mallorca, 65 m depth; HJ 20622 (1), Balearic Islands, southsoutheast of Mallorca; HJ 20665 (1), Israel, Jaffa; SMNS 9856 (4), Greece, Varkisa; SMNS 11587 (4), Greece, Varkisa; SMNS 15577 (1), Croatia, Cres Island; SMNS 16087 (1), Croatia, Cres Island. *Arnoglossus* sp.: SMNS 25264 (1), São Tomé and Príncipe.

TAXONOMY

Arnoglossus nigrofilamentosus n. sp.
Filamentous flounder
(Figs 1-2, Table 2)

Holotype: HJ 20663, 1 male, 96.6 mm SL, Israel, vicinity of Jaffa, 20-40 m depth, trawl, R/V *Bilu*, 5 May 2017.

Paratypes: HJ 20664, 3 males, 84.4-90.6 mm SL, same data as the holotype.

Diagnosis. A species of *Arnoglossus* with the second to sixth dorsal-fin rays elongate and filamentous, dorsal-fin rays 78-84, anal-fin rays 61-66, pectoral-fin rays on ocular side 12-13, on blind side 7-9, caudal-fin rays iii,11,iii, lateral-line scales 52-54, gill rakers 0 + 4-5, not serrated, interorbital a narrow bony ridge without scales in the middle, interorbital width 11% to 16% of upper orbit diameter, no enlarged teeth anteriorly in upper jaw, and prevomer small, not enlarged, weakly projecting into mouth cavity; body pale (may have been dark before the epidermis was abraded), head, peritoneum and vertical fins black.

Table 1. – Valid species in the genus *Arnoglossus* Bleeker, 1862 and their distribution, arranged according to their mean depth distribution. EA, eastern Atlantic; EI, eastern Indian Ocean; EP, eastern Pacific; MS, Mediterranean Sea; RS, Red Sea; WA, western Atlantic; WI, western Indian Ocean; WP, western Pacific.

Species	Depth range (m)	Geographical distribution	Remarks
<i>A. coeruleosticta</i> (Steindachner, 1898)	shallow	EP: Juan Fernandez and Desaventurados Islands	
<i>A. andrewsi</i> Kurth, 1954	6-38	EI, WP: Bass Strait and Tasmania, Australia	
<i>A. yamanakai</i> Fukui, Yamada and Ozawa, 1988	20-30	WP: East China Sea	
<i>A. grohmanni</i> (Bonaparte, 1837)	1-50	MS: Mediterranean and Black Sea	Junior synonym: <i>A. kessleri</i> Schmidt, 1915
<i>A. fisoni</i> Ogilby, 1898	26-50	WP: New South Wales and Queensland, Australia	
<i>A. micrommatus</i> Amaoka, Arai and Gomon, 1997	5-60	EI: southwestern Australia	
<i>A. bassensis</i> Norman, 1926	10-70	EI, WP: Southern Australia to New South Wales, Australia	
<i>A. aspilos</i> (Bleeker, 1851)	30-71	EI, WP: Persian Gulf east to Philippines and New Guinea	
<i>A. waitei</i> Norman, 1926	16-90	EI, WP: Arafura Sea and Queensland (Australia)	
<i>A. macrolophus</i> Alcock, 1889	18-141	RS, WI, EI: Central Red Sea, Persian Gulf and Madagascar east to Indonesia	Recorded from Eritrea, Red Sea by Dor (1970) as <i>A. tapeinosoma</i> (non Bleeker, 1865)
<i>A. tenuis</i> Günther, 1880	80-100	EI, WP: northern Australia to southern Japan	
<i>A. muelleri</i> (Klunzinger, 1872)	5-200	EI, WP: southwestern to southeastern Australia	
<i>A. japonicus</i> Hubbs, 1915	85-154	EI, WP: southern Japan to northern Australia	
<i>A. laterna</i> (Walbaum, 1792)	45-200	EA, MS: Mediterranean and Black seas; eastern Atlantic from Norway to Angola	
<i>A. dalgleishi</i> (von Bonde, 1922)	50-220	WI, EI, WP: South and East Africa east to Loyalty Islands	
<i>A. capensis</i> Boulenger, 1898	70-200	EA, WI: Mauritania to South Africa, Saint Helena and Ascension Is.	Synonym: <i>A. entomorphynchus</i> Stauch, 1967
<i>A. arabicus</i> Norman, 1939	83-220	RS, WI: southern Red Sea and northwestern Indian Ocean	
<i>A. thori</i> Kyle, 1913	5-300	EA, MS: Mediterranean and Black seas, and eastern Atlantic from Ireland to Sierra Leone	Synonym: <i>A. moltonii</i> Torchio, 1961
<i>A. elongatus</i> Weber, 1913	100-224	EI, WP: Taiwan to Indonesia and northwestern Australia	
<i>A. kotthausi</i> Klausewitz and Schneider, 1986	138-225	WI: northwestern Indian Ocean	Synonym: <i>A. profundus</i> Kotthaus, 1977, preoccupied by <i>A. profundus</i> Weber, 1913
<i>A. imperialis</i> (Rafinesque, 1810)	15-350	EA, MS: western Mediterranean and eastern Atlantic from Scotland to Namibia	Synonym: <i>A. blachei</i> , Stauch 1965
<i>A. sayaensis</i> Amaoka and Imamura, 1990	125-254	WI: Saya de Malha Bank and Madagascar	
<i>A. polyspilus</i> (Günther, 1880)	4-390	EI, WP: India east to New Caledonia, north to Japan	
<i>A. multirastris</i> Parin, 1983	160-265	EP: Nazca Ridge	
<i>A. oxyrhynchus</i> Amaoka, 1969	215	WP: Japan; Chesterfield Islands	
<i>A. brunneus</i> (Fowler, 1934)	187-292	WP: Philippines to Vanuatu	
<i>A. septemventralis</i> Amaoka and Mihara, 2000	240-250	WP: New Caledonia	
<i>A. nigrifrons</i> Amaoka and Mihara, 2000	300	WP: Chesterfield Islands	
<i>A. debilis</i> (Gilbert, 1905)	150-440	WP: Indonesia east to Hawaiian and Line Islands	
<i>A. scapha</i> (Forster, 1801)	4-737	WP: New Zealand	Junior synonym: <i>Pseudorhombus boops</i> Hector, 1875
<i>A. marisrubri</i> Klausewitz and Schneider, 1986	363-383	RS: central Red Sea	
<i>A. rueppelii</i> (Cocco, 1844)	85-897	EA, MS: Mediterranean Sea and eastern Atlantic from Gibraltar to Western Sahara	
<i>A. armstrongi</i> Scott, 1975	?	EI: Tasmania, Australia	
<i>A. tapeinosoma</i> (Bleeker, 1865)	?	EI, WP: Sumatra (Indonesia), China	

Description. Counts and measurements of the holotype and paratypes listed in Table 2 are part of this description.

Body oval, laterally strongly compressed, eyes on the left side of body (the “ocular side”), right side of body without eyes (the “blind side”). Body depth 2.4 (2.3-2.5) in SL [42.3% (40.4%-44.2%) of SL]. Head length 4.0 (4.1-4.3) in SL [24.7% (23.2%-24.2%) of SL]. Snout slightly pointed, completely scaled. Anterior teeth in upper jaw not enlarged, prevomer not enlarged, weakly projecting into mouth cavity. Both nostrils situated anterior to the eyes. Upper orbit diameter 3.4 (3.0-3.3) in head length [7.3% (7.2%-

7.8%) of SL]; lower orbit diameter 3.4 (3.0-3.4) in head length [7.2% (7.1%-8.0%) of SL]. Interorbital a narrow bony ridge, in the middle without scales, interorbital distance 19.9 (16.5-26.2) in head length [1.2% (0.9%-1.5%) of SL]. Scales on orbital and blind sides cycloid. Lateral line arched over pectoral fin (arch formed by anterior 11-12 scales); lateral-line scales 54 (52-53). Caudal peduncle depth 8.4 (8.4-8.5) in SL [11.9% (11.7%-12.0%) of SL]. Precaudal vertebrae 10 (10), caudal vertebrae 30 (30).

Dorsal fin with 83 (78-84) soft rays, the second to sixth rays elongate and filamentous. Anal fin with 66 (61-66) soft rays. Caudal fin distally rounded, caudal-fin



Fig. 1. – *Arnoglossus nigrofilamentosus* n. sp., HUI 20663, holotype, 96.6 mm SL, Jaffa, Israel. A, ocular side; B, blind side. Photographs by D. Golani.

rays iii,11,iii (iii,11,iii). Length of longest caudal-fin ray 5.0 (5.0-5.4) in SL [19.9% (18.6%-20.0%) of SL]. Pectoral fin with 13 (12-13) soft rays on ocular side, with 9 (7-9) rays on blind side. Pectoral-fin length 7.4 (6.0-6.8) in SL [13.5% (14.7%-16.7%) of SL] on ocular side, 10.7 (9.5-10.5) in SL [9.3% (9.5%-10.5%) of SL] on blind side. Pelvic-fin length 7.7 (6.7-11.6) in SL [12.9% (8.6%-15.0%) of SL] on ocular side, 15.8 (12.2-15.5) in SL [6.3% (6.6%-8.2%) of SL] on blind side.

Colour of fresh specimen (Fig. 1). Head and body pale yellowish (may have been dark before the epidermis was abraded), head black, peritoneum dark. Dorsal-fin filaments, rays and membranes black; anal fin black, membranes distal three-fourths of caudal fin black. Pectoral fins yellowish, pelvic fin on ocular side blackish, on blind side pale.

Etymology. In the scientific name *filamentosus* means filamentous, and *niger* means black; the name refers to the black filamentous anterior dorsal-fin rays.

Distribution. So far, this new species is only known from off Jaffa, on the eastern Mediterranean coast of Israel (Fig. 3). However, as this species has not been found in the Mediterranean Sea before, and as it has close similarities with Indo-Pacific species, it is probable that it originally came from the Gulf of Suez (Red Sea), and is another case of Lessepsian migration.

Comparison. *Arnoglossus nigrofilamentosus* n. sp. is compared with other similar species bearing elongate, filamentous rays on the anterior dorsal fin in Table 3; the filament patterns are compared in Figure 4. It is distinguished from the other species of the genus by the presence of filamentous dorsal-fin rays.

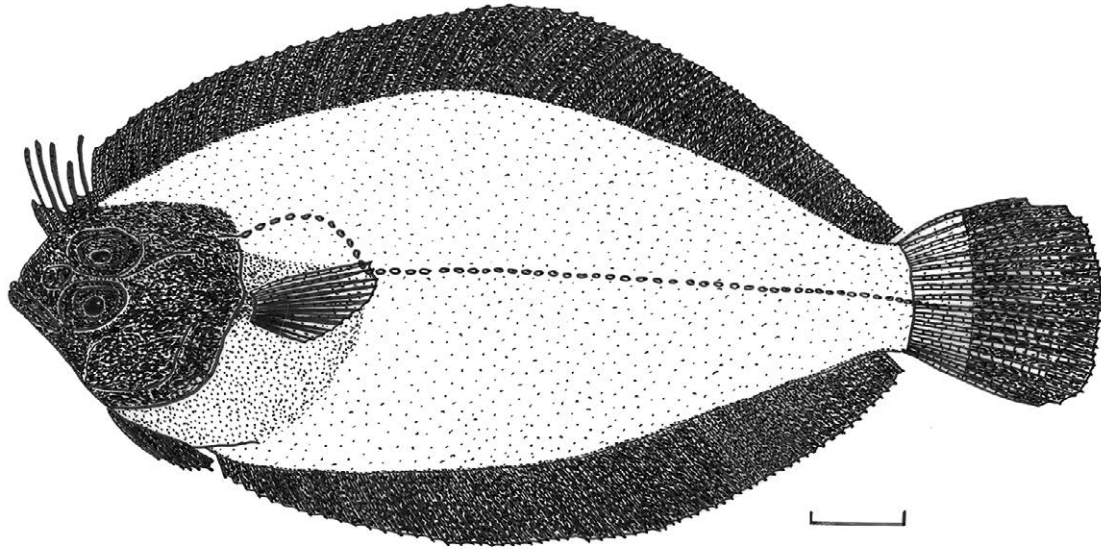


Fig. 2. – *Arnoglossus nigrofilamentosus* n. sp., HUJ 20663, holotype, 96.6 mm SL, Jaffa, Israel. Sketch of ocular side of preserved specimen.

Table 2. – Counts and measurements [mm] of *Arnoglossus nigrofilamentosus* n. sp., HUJ 20663 (holotype, 96.6 mm SL), and HUJ 20664 (3 paratypes, 84.4–90.6 mm SL), Israel, Jaffa, eastern Mediterranean Sea.

	Holotype, HUJ 20663	Spec. 1	Paratypes, HUJ 20664 Spec. 2	Spec. 3
Dorsal-fin rays	83	84	80	78
Anal-fin rays	66	65	61	66
Pectoral-fin rays (ocular side)	13	13	12	13
Pectoral-fin rays (blind side)	9	8	9	7
Caudal-fin rays	iii,11,iii	iii,11,iii	iii,11,iii	iii,11,iii
Lateral-line scales	54	52	53	53
Gill rakers on first arch (ocular side)	0 + 5	0 + 5	0 + 5	0 + 4
Vertebrae	10 + 30	10 + 30	10 + 30	10 + 30
SL	96.6	90.6	88.7	84.4
Head length (ocular side)	23.9	21.0	21.5	20.1
Body depth	40.9	39.7	39.2	34.1
Upper orbit diameter	7.1	7.1	6.9	6.1
Lower orbit diameter	7.0	6.9	6.8	6.0
Interorbital width	1.2	0.8	1.3	1.0
Upper jaw length	7.2	7.4	7.0	6.3
Lower jaw length (ocular side)	6.5	5.5	5.8	4.8
Lower jaw length (blind side)	8.3	6.9	7.8	7.9
Caudal peduncle depth	11.5	10.7	10.6	9.9
Length of longest dorsal-fin ray	10.0	11.4	9.3	10.3
Length of longest anal-fin ray	9.9	10.7	7.9	8.4
Pectoral-fin length (ocular side)	13.0	13.3	14.8	12.6
Pectoral-fin length (blind side)	9.0	9.5	4.9+	8.4
Pelvic-fin length (ocular side)	12.5	7.8	13.3	6.1
Pelvic-fin length (blind side)	6.1	7.2	7.3	5.6
Length of pelvic-fin base (ocular side)	6.3	5.5	6.0	5.1
Length of pelvic-fin base (blind side)	1.6	1.9	1.4	1.5
Length of longest caudal-fin ray	19.2	14.3+	17.7	15.7

Among the Mediterranean species of *Arnoglossus*, this new species is very distinctive in having a low number of 0+4-5 gill rakers (versus 0+7-13 in the other species), the 2nd to 6th anterior dorsal-fin rays elongate and bearing black filaments (versus anterior dorsal-fin rays either not elongate and filamentous, or a single ray elongate and bearing a black filament in male *A. thori*, or else several anterior rays with long white filaments in *A. imperialis*), and the dorsal and anal fins black (versus pale, sometimes with spots or only the anterior rays black). For easy distinguishing of co-occurring species like *A. grohmanni*, *A. laterna*,

A. rueppellii and *A. thori*, a key to the species of *Arnoglossus* of the Mediterranean and eastern Atlantic is provided below.

Compared with the Red Sea and western Indian Ocean species of the genus, the new species is also unique in having a low number of 78-84 dorsal-fin rays (versus 91-110), 61-66 anal-fin rays (versus 70-86) and 0+4-5 gill rakers (versus 0+6-13); it also differs from other species in having the anterior teeth of the upper jaws not enlarged (versus enlarged in *A. dalgleishi*, *A. kotthausi* and *A. sayaensis*), and the prevomer small, barely projecting into the mouth cavity (versus large,

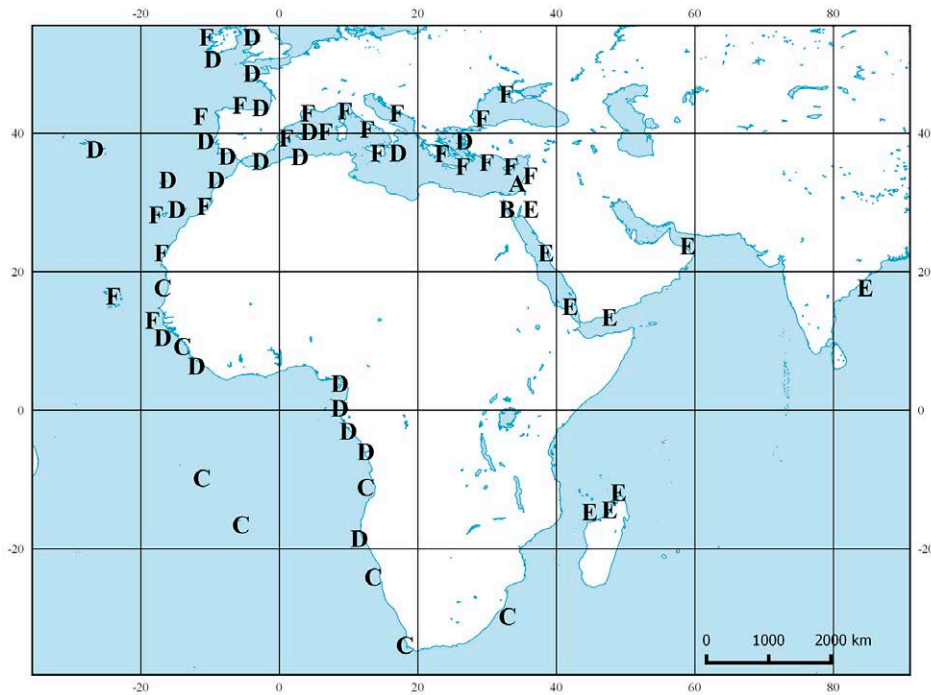


Fig. 3. – Geographical distribution of species of *Arnoglossus* with several elongate and filamentous rays in anterior dorsal fin, eastern Atlantic, Mediterranean and western Indian Ocean. A, *A. nigrofilamentosus* n. sp., type locality. B, *A. nigrofilamentosus* n. sp., presumed original distribution. C, *A. capensis*. D, *A. imperialis*. E, *A. macrolophus*. F, *A. thori*.

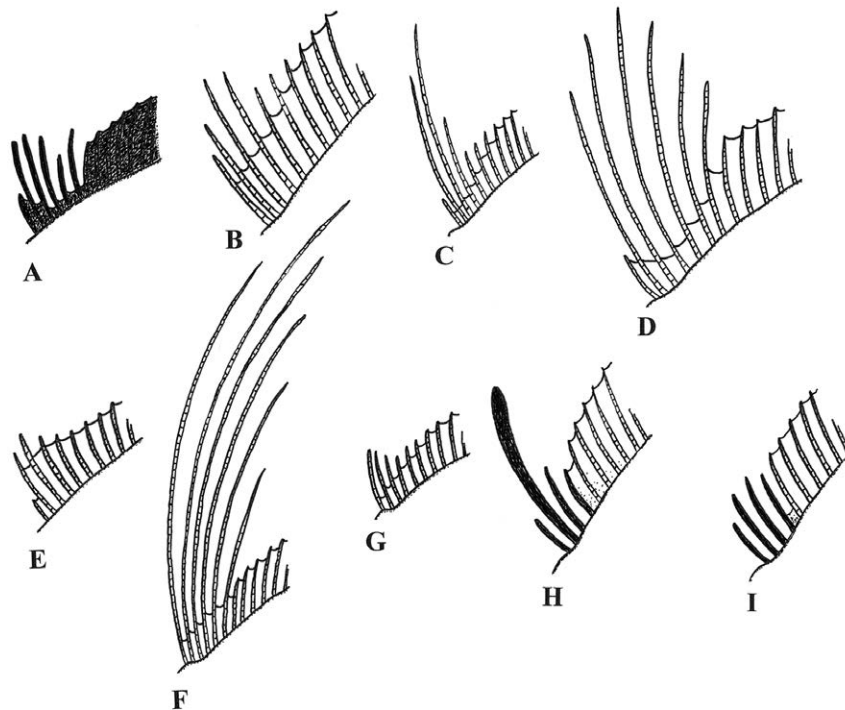


Fig. 4. – Dorsal-fin filaments and anterior dorsal-fin coloration of species of *Arnoglossus* with several elongate and filamentous rays on anterior dorsal fin, eastern Atlantic, Mediterranean and Indian Ocean. A, *A. nigrofilamentosus* n. sp. B, *A. capensis*. C, *A. elongatus*. D, *A. imperialis* (male). E, *A. imperialis* (female). F, *A. macrolophus* (male). G, *A. macrolophus* (female). H, *A. thori* (male). I, *A. thori* (female).

strongly projecting into the mouth cavity in *A. macrolophus*). It is distinguished from *A. marisrubri* by the presence of filamentous rays on the dorsal fin (versus no filamentous rays on the dorsal fin), dorsal-fin rays 78 to

84 (versus 95 to 97), anal-fin rays 61 to 66 (versus 74 to 77), and gill rakers 0+4-5 (versus 0+11-13). A key to distinguishing the species of *Arnoglossus* of the Red Sea and the western Indian Ocean is provided below.

Table 3. – Comparison of the species of *Arnoglossus* with several elongate, filamentous rays anteriorly in the dorsal fin, and the closely related species *A. tapeinosoma* (some values taken from Arai and Amaoka 1996, Hensley and Amaoka 2001, Munroe 2016). Values differing from *A. nigrofilamentosus* n. sp. are printed in bold face.

	<i>A. nigrofilamentosus</i> n. sp.	<i>A. tapeinosoma</i>	<i>A. macrolophus</i>	<i>A. elongatus</i>	<i>A. capensis</i>	<i>A. imperialis</i>	<i>A. thori</i>
Dorsal-fin rays	78-84	91	91-98	100-108	96-105	87-106	81-91
Elongate dorsal fin rays	rays 2 to 6	none	rays 1 to 8 (male), rays 1 to 2 (female)	rays 2 to 4 (male), none (female)	rays 1 to 4	rays 2 to 5-7 (male), rays 2 to 3 (female)	rays 1 to 4 (ray 2 black)
Colour of filaments	black	not applicable (anterior dorsal fin light brown)	brown	light brown	light brown	white	
Anal-fin rays	61-66	69	70-76	78-83	74-81	67-82	61-69
Pectoral-fin rays (ocular side)	12-13	11	12-14	12	10-13	10-12	10-12
Pectoral-fin rays (blind side)	7-9	9	8-11	10	9-12	7-10	8-9
Caudal-fin rays	iii, 11, iii	iii, 11, iii	ii, 13, ii	ii, 14, ii	iii, 14, iii	ii, 14, ii	ii-iii, 13, ii-iii
Lateral-line scales	52-54	53	55-62	63-70	56-67	49-56	49-56
Gill rakers	0 + 4-5	0 + 8	0 + 10-13	0 + 6-7	0 + 10-13	0 + 6-10	0 + 7-9
Condition of gill rakers	not serrated	not serrated	not serrated	not serrated	not serrated	not serrated	not serrated
Vertebrae	10 + 30	10 + 30	10 + 31-32	?	10 + 30-32	10 + 30-32	10 + 27-30
Head length (% of SL)	23-25	23	23-28	27-28	22-28	22-28	26-31
Body depth (% of SL)	40-44	39	36-43	35-36	40-45	36-45	45-62
Interorbital	bony ridge, no scales	bony ridge, no scales	bony ridge, no scales	bony ridge, no scales	broad, scaly, concave	bony ridge, no scales	bony ridge, no scales
Interorbital (% of upper orbit diameter)	11-16	11	10-14	10-14	30-40	15-23	13-25
Prevomeron	small, weakly projecting into mouth cavity	small, weakly projecting into mouth cavity	large, strongly projecting into mouth cavity	small, weakly projecting into mouth cavity	small, weakly projecting into mouth cavity	small, weakly projecting into mouth cavity	small, weakly projecting into mouth cavity
Distribution	[Gulf of Suez?] eastern Mediterranean	Sumatra (Indonesia), China	central Red Sea and Persian Gulf east to Indonesia	Taiwan to Indonesia and northwestern Australia	Mauritania to South Africa	western Mediterranean and eastern Atlantic from Scotland to Namibia	Mediterranean and Black seas, and eastern Atlantic from Ireland to Sierra Leone
Depth	ca. 20-30	?	18-141	100-224	70-200	15-350	5-300

DISCUSSION

The specimens described herein agree well with the generic characters of the genus *Arnoglossus* as defined by Norman (1934) and Amaoka (1969), including the pelvic fin on the ocular side beginning at the tip of the isthmus, the eyes separated by a bony ridge, the head large, more than 22% of SL (23.2%-24.7%), the scales on the ocular side cycloid, and the mouth large, maxillary longer than eye diameter. However, they do not agree with any of the known species of *Arnoglossus* from the Mediterranean/eastern Atlantic, from the Red Sea/Indian Ocean, or from any other region.

This finding of a new species of *Arnoglossus* from off the Mediterranean coast of Israel is quite surprising, as there has been an extensive fishing effort in this habitat for many decades. However, the species was previously not detected and there is no material available in the regional ichthyological collections, so it is unlikely that it was just missed. The close similarity of this new species to other species occurring in the central Red Sea and the northwestern Indian Ocean (*A. arabicus*, *A. macrolophus* and *A. marisrubri*), and the obvious previous absence from the southeastern Mediterranean, makes it likely that this represents another case of Lessepsian migration, and that *A. nigrofilamentosus* n. sp. originates from the Gulf of Suez. Unfortunately, the Gulf of Suez ichthyofauna is incompletely known and under-represented in ichthyological collections, which makes it more likely that the new species was previously missed in that region.

The opening of the Suez Canal in 1869 connected the Red Sea with the Mediterranean, resulting in an almost unidirectional migration of Red Sea organisms into the Mediterranean (“Lessepsian migration”) (Golani et al. 2002). A complete list of species to 2010 was provided by Golani (2010). Fricke et al. (2015) provided a list of additional Lessepsian migrant species, which resulted in a total of 97 migrant species confirmed in the Mediterranean. Galil et al. (2015) discussed the recent widening of the Suez Canal and the probability of increased Lessepsian migration. Russell et al. (2015) discovered that the species previously misidentified as *Saurida undosquamis* (non Richardson, 1848) or *S. macrolepis* (non Tanaka, 1917) from the northern Red Sea and the Mediter-

ranean belonged to a distinct, undescribed species that they named *Saurida lessepsianus* Russell, Golani and Tikochinski, 2015. Subsequently, the following confirmed species were recorded: *Cryptocentrus caeruleopunctatus* (Rüppell, 1830), family Gobiidae (Rothman and Goren 2015); *Mobula japonica* (Müller and Henle, 1841), family Mobulidae (Capapé et al. 2015); *Encrasicholina gloria* Hata and Motomura, 2016, family Engraulidae (Hata and Motomura 2016); *Epinephelus areolatus* (Forsskål, 1775), family Serranidae (Rothman et al. 2016); *Diplogrammus randalli* Fricke, 1983, family Callionymidae (Seyhan et al. 2017). Lessepsian migrant fish species therefore currently stand at a total of 102 species.

Key to the species of *Arnoglossus* of the Mediterranean Sea and the eastern Atlantic

Remark: This key is updated, based on Munroe (2016) and Nielsen in Whitehead et al. (1986).

1. Dorsal-fin rays 110-118; anal-fin rays 86-94
..... *A. rueppellii*
– Dorsal-fin rays less than 110; anal-fin rays less than 85 2
2. Gill rakers 0 + 4-5; dorsal and anal fins plain black
A. nigrofilamentosus n. sp.
– Gill rakers 0 + 7-13; dorsal and anal fins pale, sometimes with dark spots or only anterior rays black...3
3. Dorsal-fin rays 74-80; anal-fin rays 51-57
..... *A. grohmanni*
– Dorsal-fin rays 81 or more; anal-fin rays 61 or more 4
4. Dorsal-fin rays 81 to 93; anal-fin rays 61 to 74.....5
– Dorsal-fin rays 95 to 106; anal-fin rays 74 to 82...6
5. No elongate dorsal-fin rays; no dark markings on ocular-side pectoral fin; no series of dark spots present along base of caudal fin *A. laterna*
– Second dorsal-fin ray of males elongate (more than 60% of head length) with dark-fringed, broad membrane (1st, 3rd and 4th dorsal-fin rays may also be elongate, but these are only about one-third as long as second ray); ocular-side pelvic fin often with dark spot or blotch on posterior rays; a series of dark spots often present along base of caudal fin....
..... *A. thori*
6. Dorsal-fin rays 2 to 5 or 2 to 6 elongate (elongate rays nearly equal to head length in males); eyes separated by a bony ridge; lateral-line scales 49 to 56; 6 to 9 gill rakers on lower limb of first gill arch; males with distinct black spot on posterior ocular-side pelvic-fin rays, females with greyish, sometimes indistinct, spot on posterior ocular-side pelvic-fin rays..... *A. imperialis*
– Anterior 3 or 4 dorsal-fin rays of males noticeably prolonged and of nearly equal length; eyes separated by a concave scaly space; lateral-line scales

56 to 66; 10 to 13 gill rakers on lower limb of first gill arch; no dark markings on ocular-side pelvic-fin rays..... *A. capensis*

Key to the species of *Arnoglossus* of the Red Sea and the western Indian Ocean

Remark: This key is updated, based on Klausewitz and Schneider (1986), Amaoka and Imamura (1990) and Arai and Amaoka (1996); though this species has not yet been recorded from the region, it also includes *A. nigrofilamentosus* n. sp., as this is of putative Red Sea origin.

1. Anterior teeth of upper jaw significantly enlarged compared with those on the sides 2
– Anterior teeth of upper jaw scarcely enlarged or not enlarged 4
2. Dorsal-fin rays 102 to 110; lateral-line scales 72 to 76 *A. savayensis*
– Dorsal-fin rays 91 to 99; lateral-line scales 56 to 70 3
3. Dorsal-fin rays 95 to 99; lateral-line scales 70; gill rakers 0 + 7 *A. dalgleishi*
– Dorsal-fin rays 91 to 96; lateral-line scales 56-60; gill rakers 0 + 11-13 *A. kotthausi*
4. Dorsal-fin rays 78 to 84; anal-fin rays 61 to 66; gill rakers 0 + 4-5..... *A. nigrofilamentosus* n. sp.
– Dorsal-fin rays 91 to 102; anal-fin rays 70 to 78; gill rakers 0 + 10-13..... 5
5. Preopercle large, strongly projecting into mouth cavity; anterior dorsal-fin rays elongate and filamentous in the male; head length 23%-28% of SL.....
..... *A. macrolophus*
– Preopercle small, not much projecting into mouth cavity; anterior dorsal-fin rays not elongate or barely elongate in the male; head length 27%-31% of SL 6
6. Body depth 36%-40% of SL; dorsal-fin rays 95 to 97; anterior dorsal-fin rays with short filaments
..... *A. arabicus*
– Body depth 32%-38% of SL; dorsal-fin rays 96 to 102; anterior dorsal-fin rays without filaments
..... *A. marisrubri*

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