

**NEW RECORD OF ELONGATE LANTERNFISH, *NOTOSCOPELUS ELONGATUS*  
(COSTA, 1844), FROM THE COASTAL WATERS OF AEGEAN SEA, TURKEY,  
WITH NOTES ON SPECIES' MORPHOLOGY AND DISTRIBUTION**

Sezginer TUNCER<sup>1</sup>, Alexei ORLOV<sup>2\*</sup>, Ozcan OZEN<sup>1</sup>, and Sabri BILGIN<sup>1</sup>

<sup>1</sup> Faculty of Fisheries, Canakkale Onsekiz Mart University, Canakkale, Turkey

<sup>2</sup> Department of International Fisheries Cooperation, Russian Federal Research Institute of Fisheries  
and Oceanography, Moscow, Russia

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**Background.** Marine ichthyofauna of the Mediterranean Sea is represented by 712 species, 117 of which are deepwater fishes. During the last decade, this ichthyofauna has been considerably enriched, either by Suez Canal- or Strait of Gibraltar migrations or simply by mariculture escapees. This study is intended to discuss morphology of one of such non-indigenous fish species and its distribution.

**Materials and Methods.** Three specimens of elongate lanternfish, *Notoscopelus elongatus* (Costa, 1844), were captured during a commercial lift net operation in Ece Limani, Aegean Sea, Turkey. The fish were described and illustrated, following commonly accepted procedures.

**Results.** This is the first documented new record of the species from Aegean Sea, Turkey. The described meristic and morphometric features of elongate lanternfish, *Notoscopelus elongatus*, are consistent with the data provided by descriptors of its previous findings (with minor exceptions). The most interesting morphological feature of the presently described material is the presence in the smaller specimen (TL 103 mm) of 4 precaudal photophores (Pr) on the left body side (in contrast to 3 usual ones).

**Conclusion.** This work will undoubtedly enhance our knowledge on newly introduced species on lanternfishes in the Mediterranean and in Aegean Sea in particular.

**Keywords:** elongate lanternfish, *Notoscopelus elongatus*, Aegean Sea, Turkey

## INTRODUCTION

The marine ichthyofauna in the Mediterranean Sea is highly rich and diverse and, according to FishBase (Froese and Pauly 2009), it is represented by 712 species, 117 of which are deepwater fishes. During the last decade, Mediterranean fish fauna as a whole and that of the Aegean Sea in particular has been considerably enriched (Taşkavak et al. 2000, Filiz et al. 2007, Corsini-Foka and Economidis 2007). This process takes place by means of several ways: via Lessepsian migrants penetrating from the Red Sea through Suez channel (Bilecenoglu et al. 2002a, 2006a, Corsini et al. 2005, Kasapidis et al. 2007), via migrants from the Atlantic Ocean through Strait of Gibraltar and via marine aquaculture (Corsini-Foka and Economidis 2007, Filiz et al. 2007). Ichthyofauna of the northern Mediterranean can be enriched furthermore by means of range extension of species, inhabiting coastal waters of the northern Africa (Corsini-Foka and Frantzis 2009), likely due to climatic changes (warming).

New findings of deepwater (Bilecenoglu et al. 2006b, Aydin et al. 2009, Filiz et al. 2007, Özyaydin et al. 2007) and inshore (Ozen et al. 2007, 2009) species contribute to enrichment of the Turkish marine ichthyofauna considerably. The main reasons of recently increasing new records are associated with more extensive fishing efforts, development of deepwater fishery, and intensification of scientific research in the area (Filiz et al. 2007).

The family of lanternfishes (Myctophidae) is represented in the global oceans by almost 250 species, belonging to more than 30 genera (Froese and Pauly 2009) and is one of the largest families among bony fishes (Bekker 1983). Lanternfishes are widely distributed in all world oceans, occurring from the Arctic off Spitsbergen and northern Bering Sea to Antarctic ice shelves (Shust and Orlov 2003). There are 19 myctophid species known from the Mediterranean Sea (Froese and Pauly 2009), 14 of which occur in Turkish waters (Bekker 1983). The genus *Notoscopelus* is represented in the Mediterranean by two

\* Correspondence: Dr. Alexei M. Orlov, Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), 17, V. Krasnoselskaya, Moscow, 107140, Russia, phone: +7(499)2649143, fax: +7(499)2649021, e-mail: orlov@vniro.ru or orlovniro@yahoo.com

species *N. bolini* and *N. elongatus*. Representatives of this genus might be distinguished from congeners by following characters:  $AO_{a1}$  is not elevated, Pol are placed in horizontal line, males have large supracaudal and small infra-caudal glands, females bear small caudal glands, dorsal fin base is much longer as compared to anal fin base, 3 Prc (rare 4), distance  $Prc_{2-3}$  much larger than  $Prc_{1-2}$  (Bekker 1983). Both Mediterranean *Notoscopelus* species differed one from another by the number of gill rakers on the first gill arch; 26–28 (29) in *N. bolini* vs. 24 (23–25) in *N. elongatus* (see: Nafpaktitis 1975). The former species is distributed in the North Atlantic and the entire Mediterranean Sea (Nafpaktitis 1975). It was believed for a long time that the latter species inhabited exclusively the western part of the Mediterranean and that its distribution range reached as Far East as the Strait of Messina (Bini 1970). Recent publications report on the occurrence of *N. elongatus* within Greek waters of the Aegean Sea and in the Sea of Marmara (Labropoulou and Papaconstantinou 2000, Bilecenoglu et al. 2002b, Fricke et al. 2007). Nevertheless, none of these papers provides the data on capture localities, capture depths, sizes of fish, morphological characters, etc.

#### MATERIAL AND METHODS

In April 2009, three specimens of *Notoscopelus elongatus* were caught in Turkish waters of the north-eastern Aegean Sea. The objective of this study is to further document the easternmost record of *N. elongatus* for the Aegean Sea and for Turkish marine ichthyofauna and to provide some morphometric and meristic data on this endemic to the Mediterranean fauna species (Froese and Pauly 2009).

#### RESULTS (Taxonomic account)

*Notoscopelus elongatus* (Costa, 1844)

Synonyms:

*Scopelus elongatus* Costa, 1844

*Scopelus pseudocrocodylus* Moreau, 1891

*Myctophum elongatum* Brauer, 1904

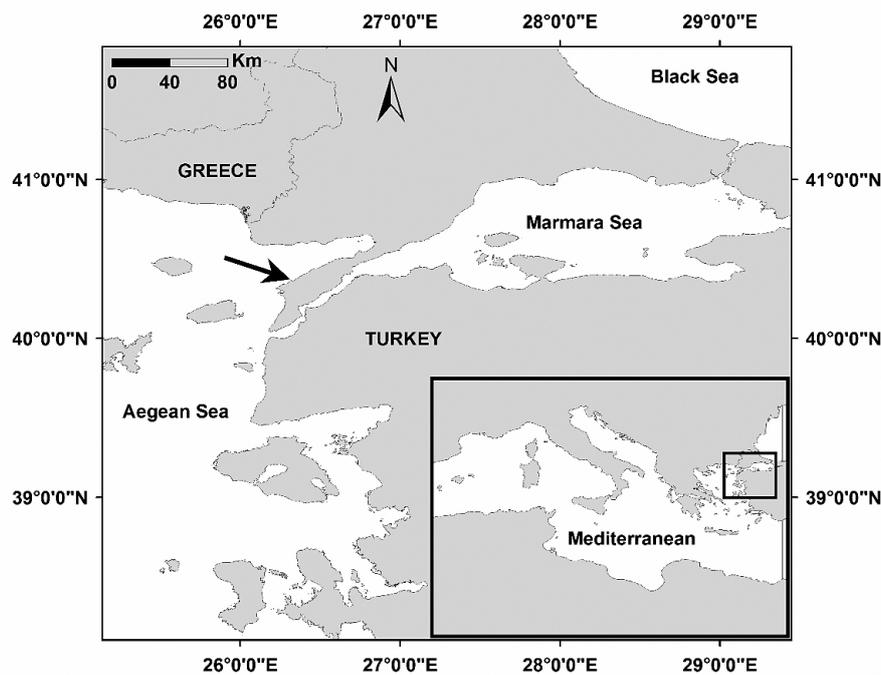
*Lampanyctus elongatus* Tåning, 1918

*Notoscopelus elongatus* Bolin, 1959

*Notoscopelus elongatus elongatus* Nafpaktitis, 1975

**Material examined.** Three specimens: female 108 mm total length (TL), female 126 mm TL, and female 103 mm TL. All specimens were caught on 19 April 2009 during a commercial lift net operation targeting European pilchard, *Sardina pilchardus*, in the Ece Limani (lat 40°22'11"N, long 26°19'16"E), north-eastern Aegean Sea, Turkey (Fig. 1) at a depth of about 30 m at night. Specimens are deposited at Piri Reis Marine Museum, Canakkale Onsekiz Mart University, Canakkale, Turkey, under catalogue number PRM-PIS 2009-0063.

**Diagnosis.** Body elongate and slightly compressed (Fig. 2). Maximum body depth 18.4%–22.6% (mean = 20.7%) of standard length (SL); head length 23.6%–28.2% (mean = 26.1%) of SL; eye diameter 24.2%–27.8% (mean = 26.3%) of head length (Table 1). Maxilla extending far beyond posterior margin of eye. Dorsal fin longer than anal fin. Distance from anal fin origin to caudal fin base equal or nearly equal to distance from rear eye margin to anal fin origin. Insertion of dorsal fin much nearer to snout than to caudal fin origin. Anal fin originating a little behind the middle of dorsal fin. Pectoral fins short, barely reaching origin of pelvic fins. Scales large, cycloid and deciduous as in most Myctophidae.



**Fig. 1.** Map showing the locality of *Notoscopelus elongatus* capture site in the northeastern Aegean Sea, Turkey; arrow indicates the locality of Eco Limani

Dn well developed, consisting of a dorsal, small component in contact with a much larger ventral one extending along anterodorsal margin of orbit. Vn small, lying deep between olfactory organ and anterior margin of orbit. PVO<sub>2</sub> above pectoral fin base. 5 PO, in a 1 + 3 + 1 arrangement, with PO<sub>5</sub> abruptly displaced dorsolaterally. 5 VO, with VO<sub>5</sub> sometimes distinctly raised. SAO forming a very obtuse angle. AO 9 + 6–7, total 15–16. Pol 2, horizontally arranged. 3–4 Prc, in a 2–3 + 1 arrangement. Patches of luminous tissue on trunk and at bases of procurrent caudal fin rays.

Dorsal fin rays 21; anal fin rays 18–19; pectoral fin rays 12–13; pelvic fin rays 8; procurrent caudal fin rays 9 (dorsal) + 10 (ventral), stiff, spine-like. Lateral line pores 43–46; vertebrae 38 (Table 1).

## DISCUSSION

Most of the morphological characters of our specimens of elongate lanternfish agree well with previous descriptions of various material collected in the western Mediterranean (Bolin 1959, Bini 1970, Nafpaktitis 1975, Nafpaktitis et al. 1977, Palomera 1983, Hulley 1984, Costa and Genovese 2009) with minor exceptions. Our specimens differ from those caught in the Strait of Messina (Costa and Genovese 2009) in pectoral fin ray counts (12–13 vs. 10–12). Adults of this species are characterized by 12–13 (Bini 1970, Nafpaktitis 1975, Nafpaktitis et al. 1977, Hulley 1984) or 12–14 (Lo Bianco 1931–1956) pectoral fin rays. Costa and Genovese (2009) most likely examined not only adult but larval characteristics as well. As is well known (Palomera 1983, Costa 1999) counts of fin rays in larvae are considerably less than those in adults.

The majority of differences resulted when comparing original description based on specimen caught off Naples (Costa 1844) with our specimens and published data. The type material had 22 dorsal fin rays (vs. 21 dorsal fin rays in all our specimens) that is typical for Mediterranean *N. elongatus*; 21 and 23 (Bini 1970, Nafpaktitis 1975, Nafpaktitis et al. 1977, Hulley 1984) or 24 (Lo Bianco 1931–1956) occasionally occur. The anal, pelvic, and caudal fin rays were 16, 11, and 18 respectively which does not correspond to the known meristic data of species under consideration. Thus, according to available data, numbers of rays in anal, pelvic, and caudal fins are 18–19, 8, and 19, respectively (Nafpaktitis 1975, Nafpaktitis et al. 1977, Hulley 1984, and presently reported data). Lo Bianco (1931–1956) and Bini (1970) noted that the number of anal fin rays might vary between 17 and 20. The reasons of these differences are not clear and are likely related to the accuracy of counts made during original description. Initial counts may not be re-examined since type specimen is unknown (Eschmeyer 1998).

There are controversial data on the number of lateral line scales. Nafpaktitis (1975) and Nafpaktitis et al. (1977) noted 42–43 scales, while Lo Bianco (1931–1956) and Costa and Genovese (2009) indicated 39–42 scales in lateral line. We could not count the lateral line scales, since elongate lanternfish has deciduous scale typical for most myctophids. The number of pores in lateral line that were counted in the present study (43–46) is slightly higher than published data on number of scales, a fact most likely associated with extending of lateral line to head region, beyond scales.

The most interesting morphological feature of our material is the presence in the smaller specimen (TL 103 mm)



Fig. 2. Specimens of *Notoscopelus elongatus* (PRM-PIS 2009-0063) caught in the northeastern Aegean Sea, Turkey

Table 1

Some morphometric and meristic data for three specimens of *Notoscopelus elongatus* (all females) caught in the Ece Limani, Aegean Sea, Turkey

Character	Specimen			Mean	
	# 1	# 2	# 3		
Morphometrics	Total length [mm]	108	126	103	112.3
	Standard length [mm]	91	105	84	93.3
	Maximum body depth [% of SL]	22.6	18.4	21.8	20.9
	Head length [% of SL]	26.4	23.6	28.2	26.1
	Eye diameter [% of head length]	27.0	27.8	24.2	26.3
Meristics	Dorsal fin rays	21	21	21	21.0
	Anal fin rays	18	19	19	18.7
	Pelvic fin rays	8	8	8	8.0
	Pectoral fin rays	13	12	13	12.7
	Caudal fin rays (total)	9 + 10 (19)	9 + 10 (19)	9 + 10 (19)	9 + 10 (19)
	Gill rakers (total)	7 + 1 + 16 (24)	7 + 1 + 16 (24)	7 + 1 + 16 (24)	7 + 1 + 16 (24)
	Lateral line pores	43	44	46	44.3
	Number of vertebrae	38	38	38	38.0
Photophores (left/right)	PO	5/5	5/5	5/5	5/5
	VO	5/5	5/5	5/5	5/5
	AOa	9/9	9/9	9/9	9/9
	AOp	7/6	6/7	6/7	6.3/6.7
	Prc (arrangement)	3 (2 + 1)/3(2 + 1)	3 (2 + 1)/3 (2 + 1)	4 (3 + 1)/3(2 + 1)	3.3 (2.3 + 1)/3.0 (2 + 1)
	SAO	3/3	3/3	3/3	3/3
	Pol	2/2	2/2	2/2	2/2

of 4 precaudal photophores (Prc) on the left body side. Typically all representatives of the genus *Notoscopelus* are characterized by 3 Prc arranged as 2 + 1 (Nafpaktitis 1975). However, this is not a unique case since it has been previously referred in the literature (Tåning 1918, 1928, 1932, Lo Bianco 1931–1956) but later was not taken in account by Nafpaktitis (1975) in his review of the genus *Notoscopelus*.

We also observed variations in the number of AOp in each individual specimen examined (6–7 on different sides of the body). Previously, such variations in this species were not described but are known for other representatives of the family (Kobayashi 1958, Kubota and Uyeno 1972).

Comparison of our data with those published by Tåning (1918, 1928, 1932) showed considerable differences in most characters examined. The analysis of those data showed that the material was collected not only in Mediterranean but also in the North Atlantic and may represent combination of more than one species and hence was not included herein.

Interestingly, our samples are composed of females only. Life history of elongate lanternfish is poorly understood. However, sexual dimorphism in growth rate, size of maturation, and longevity and predominance of females in older age classes are known for congeneric species *Notoscopelus kröyeri* (see: Filin 1989, Manzhirina and Filin 1992). Females of *N. elongatus* may also attain

older age and larger sizes as compared to males. We speculate that this fact might explain why our samples contain females only.

Data on maximum size of *N. elongatus* is rather controversial. Nafpaktitis (1975) noted that *N. elongatus* is characterized by smaller sizes as compared to *N. kröyeri*. The longest specimen he examined was a 98 mm long female with small granular ovaries (Nafpaktitis et al. 1977). Hulley (1984) reported a maximum length of 106 mm. The largest size of species considered (150 mm) can be found in monographs of Lo Bianco (1931–1956) and likely followed by Bini (1970) who also indicated 150 mm as maximum length of elongate lanternfish. We incline to consider 150 mm as erroneous value since E. Tortonese was both the author of chapter describing *N. elongatus* in the monograph edited by Lo Bianco (1931–1956) and subsequently one of the editors of the book with chapter written by Hulley (1984), who recorded a maximum length of 106 mm. Our largest specimen is 126 mm TL and this should be considered as the biggest documented size of species under question.

**Distribution.** Geographic distribution of *Notoscopelus elongatus* is a complicated and controversial issue that is mainly associated with the uncertain taxonomic status of the species and respective incorrectness of its range definition for many years. *N. elongatus* was described for the first time from the waters off Naples

(Costa 1844). Subsequently, Tåning (1918) suggested that this species inhabits Mediterranean Sea and Atlantic Ocean from Greenland to Cape of Good Hope in South Africa. Later, the same author (Tåning 1928, 1932) restricted the species' distribution range within the Mediterranean and North Atlantic only, as far north as Norway, Iceland, and Greenland. Lo Bianco (1931–1956) noted that *N. elongatus* in spite of Mediterranean Sea and the Atlantic Ocean occurs as well in the Pacific Ocean and Antarctic seas. Restriction of the distribution range of the species in the Mediterranean Sea only appeared in the middle of last century (Bolin 1959). In this regard suggestions of Nafpaktitis (1975) and Nafpaktitis et al. (1977) regarding species' range seem a bit confusing. In the first paper (Nafpaktitis 1975) the range of *N. elongatus* is limited in the western Mediterranean only while in the latter publication (Nafpaktitis et al. 1977) both the Atlantic and Mediterranean distribution was noted. In our opinion, these contradictions are associated mostly with changes in the taxonomic status of the species under consideration since it has been placed from species to subspecies level and vice versa. Since all the Atlantic representatives of the genus *Notoscopelus* are characterized by similar morphological pattern, the elongate lanternfish could be considered by some authors as a combination of two or more different species (*N. elongatus*, *N. resplendens*, and *N. kröyeri*) (see: Nafpaktitis 1975).

Currently, the overwhelming majority of researchers, following Bolin (1959), believe that *N. elongatus* is an endemic of the Mediterranean (Bini 1970, Bekker 1983, Hulley 1984). It is most abundant in the western part of the sea (Bekker 1983, Moreno-Amich and Garcia-Berthou 1985, Sabatés 1990, Sabatés and Masó 1992, Morales-Nin et al. 2001, Sabatés et al. 2007, Fricke et al. 2007) and occurs as far east as the Strait of Messina (Bini 1970, Costa 1999). However, recently *N. elongatus* was discovered off the Canary Islands. This record was represented by juveniles 19–31 mm SL (voucher specimens exist) and most likely is the result of transportation of larvae from the Mediterranean to Atlantic Ocean by eddies (Wienerroither 2005). The presence of elongate lanternfish in the Greek waters of the Aegean Sea was noted by Labropoulou and Papaconstantinou (2000) but there are no voucher specimens that could be used for confirmation. Occurrence of *N. elongatus* in Turkish waters was also noted by Bilecenoglu et al. (2002b) and Fricke et al. (2007), yet remarks in latter paper are slightly controversial. These authors reported the presence of the species in the Sea of Marmara, but are not sure of its occurrence in the Mediterranean and Aegean Sea („Possibly also Aegean Sea and Mediterranean Sea area,, P. 61). Moreover, no voucher specimens that confirm occurrence of *N. elongatus* in Turkish waters exist (Murat Bilecenoglu, pers. comm.). Therefore our capture may be considered as the easternmost documented record of the species. Thus, the known range of *N. elongatus* extends from off Canary Islands to Turkish coastal waters of the Aegean Sea.

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