The distribution of the fathead sculpin species *Cottunculus subspinosus* Jensen, 1902

Ingvar Byrkjedal¹, Gunnar Langhelle¹, Jørgen Schou Christiansen² and Oleg V. Karamushko³


The range of the rarely caught fathead sculpin species *Cottunculus subspinosus* has been considered restricted to the waters off East Greenland and Northeast Iceland. For the first time the species is recorded from the east side of the Norwegian Sea, and also it is found further north in the Greenland Sea than previously known. Mapping all the corroborated specimens known indicates that the species seems confined to the continental slopes of the Nordic Seas, where it is found in waters with a temperature below zero and a depth of more than 900 m. Depth distribution shows almost no overlap with the closely related sympatric *Cottunculus microps*, perhaps as a result of competitive exclusion.


Keywords: Cottoidei; Arctic; range; interspecific competition

1. Department of Natural History, University Museum of Bergen, University of Bergen, N-5020 Bergen, Norway
2. Department of Arctic and Marine Biology, Faculty of Biosciences, Fisheries and Economics, UiT The Arctic University of Norway, Tromsø, Norway
3. Murmansk Marine Biological Institute, Kola Scientific Centre, Russian Academy of Sciences, ul. Vladimirskaya 17, Murmansk, 183010 Russia

Corresponding author: Ingvar Byrkjedal
E-mail: ingvar.byrkjedal@uib.no

INTRODUCTION

The family Psychrolutidae (Scorpaeniformes: Cottoidei) consists of 8 genera and about 38 species, which are more or less tadpole-shaped, limp, and scale-less (Nelson et al. 2016) and live in the benthic zone from shallow waters to 2800 m depth (Fedorov & Nelson 1986). In the North-eastern Atlantic two species occur in the arctic and subarctic part of the ocean, one of which, *Cottunculus microps* Collett, 1875, is common and widespread, while the other one, *Cottunculus subspinosus* Jensen, 1902, is known from only a few specimens (Fedorov & Nelson 1986, Mecklenburg et al. 2011, Byrkjedal et al. 2014). *C. subspinosus* has frequently been placed in the genus *Psychrolutes*, but its inclusion in *Cottunculus* is now strongly supported by DNA sequencing (Mecklenburg et al. 2018).

*C. subspinosus* was first described from four specimens caught off northeast Iceland by the Ingolf Expedition in 1895–1896 (Lütken 1898; Jensen 1902) and these remained the only known specimens until 1989, when additional nine specimens were caught off eastern Greenland by the Shinkai Maru expedition (Møller et al. 2010). Subsequently, the species has been reported from Northeast Greenland, Iceland and near Jan Mayen Island (Christiansen 2003; Fossum et al. 2012; Jónsson & Pálsson 2013).

A few more specimens have been caught by recent research cruises, and especially one of them extends the known distribution of this species in the Nordic Seas considerably. The latest range map published for the species is that of Jónsson & Pálsson (2013). From the new records and a re-examination of the earlier published ones the present paper aims to draw a more complete and accurate picture of the geographic and spatial distribution of *C. subspinosus*. With possible interspecific competition in mind, a comparison of its depth distribution...
is made with that of the morphologically similar sympatric psychrolutid species *C. microps*.

**MATERIAL AND METHODS**

The paper is based on unpublished material recently brought to the University Museum of Bergen, a re-examination of published records (Christiansen 2003; Møller et al. 2010; Fossum et al. 2012; Jónsson & Pálsson 2013), and an online search of records entered in Global Biodiversity Information Facility (GBIF; [http://www.gbif.org/](http://www.gbif.org/)).

The unpublished material was obtained from the TUNU-IV Expedition (R/V ‘Helmer Hanssen’, August 2010) and the MAREANO project (R/V ‘G.O. Sars’, May 2012), the latter a project run by the Institute of Marine Research, Bergen, aiming to map benthic organisms off the Norwegian coast ([www.mareano.no](http://www.mareano.no)). The TUNU expedition used a Campelen 1800/96 NOFI bottom trawl with 49 m wing spread and a cod-end of 22 mm mesh size towed for 22 min at a speed of 2.4 knots, and the fish were frozen on board for final preservation and storage at the University Museum of Bergen. The MAREANO used a beam trawl with an opening of 2x2 m and a 4 mm mesh size, towed on the bottom for 5 min at a speed of 1 knot. The fish caught by this project (one specimen) was fixed in formalin on board, and final species identification was done at the museum as the material was transferred to 75% ethanol for permanent storage.

Circumstances of previously published catches were described by Lütken (1898), Knudsen (1899) and Fossum et al. (2012), and the Shinkai Maru expeditions in Greenlandic waters by Okamura et al. (1995). The species was, however, not mentioned by Okamura et al. (1995), yet it did appear in the Shinkai Maru material brought to the Zoological Museum, University of Copenhagen. 5 = Swedish Museum of Natural History, Stockholm. 6 = Jónsson & Pálsson (2013); Pálsson pers. comm. 7 = this study TUNU-IV Expedition. 8= Fossum et al. (2012). 9 = this study MAREANO project. Further details in Table 1. The Greenland, Iceland and Norwegian Seas comprise the Nordic Seas.

**RESULTS**

*Cottunculus subspinosus* is presently known to science from 14 geographic locations, comprising 48 specimens, of which 28 are permanently preserved and kept in scientific collections (Table 1, Figure 1). A majority of the locations (11) are on the

![Figure 1. Known locations of *Cottunculus subspinosus*. Sources: 1 = Lütken (1898); Knudsen (1899); Jensen (1902). 2 = Zoological Museum, University of Copenhagen. 3 = Zoological Museum, University of Alberta. 4 = Christiansen (2003). 5 = Swedish Museum of Natural History, Stockholm. 6 = Jónsson & Pálsson (2013); Pálsson pers. comm. 7 = this study TUNU-IV Expedition. 8= Fossum et al. (2012). 9 = this study MAREANO project. Further details in Table 1. The Greenland, Iceland and Norwegian Seas comprise the Nordic Seas.](image)

![Figure 2. Depth distribution of *Cottunculus subspinosus* locations (n = 14 locations) compared to that of *C. microps* in northeastern Greenlandic waters (West, ‘W’; n = 23 locations) and in the Barents Sea – Svalbard region (East, ‘E’; n = 80 locations). Data for *C. microps* are from specimens held in the collections of the University Museum of Bergen. Median depths shown by horizontal bar, upper and lower quartiles by boxes, 95 percentiles by whiskers, and extremes by dots.](image)
Table 1. Known specimens of *Cottunculus subspinosus*. ZMUC = Zoological Museum, University of Copenhagen; Univ. Alberta = Museum of Zoology, University of Alberta; ZMUB = University Museum of Bergen; NRM = Swedish Museum of Natural History, Stockholm; HAF = Marine Research Institute, Reykjavik.

<table>
<thead>
<tr>
<th>Coordinates</th>
<th>Date (dd.mm.yyyy)</th>
<th>Depth (m)</th>
<th>Bottom temperature °C</th>
<th>Bottom substrate</th>
<th>Number of preserved specimens</th>
<th>Collection catalogue no.</th>
<th>Project</th>
<th>Sources referred to under following numbers in Figure 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>N 68°08’ – W 16°02’</td>
<td>29.07.1897</td>
<td>1333</td>
<td>-0.8</td>
<td>Brown mud&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2</td>
<td>ZMUC 1-2</td>
<td>Ingolf Expedition</td>
<td>1</td>
</tr>
<tr>
<td>N 66°23’ – W 10°26’</td>
<td>10.07.1896</td>
<td>1372</td>
<td>-0.9</td>
<td>Brown mud&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>ZMUC 3</td>
<td>Ingolf Expedition</td>
<td>1</td>
</tr>
<tr>
<td>N 66°23’ – W 7°25’</td>
<td>10.07.1896</td>
<td>1750</td>
<td>-1.1</td>
<td>Light grey-brown mud&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>ZMUC 4</td>
<td>Ingolf Expedition</td>
<td>1</td>
</tr>
<tr>
<td>N 73°05’ – W 16°22’</td>
<td>13.10.2003</td>
<td>993–975</td>
<td>-0.6 – -0.4</td>
<td>Coral field with <em>Virgularia</em> sp.&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2*</td>
<td>ZMUB 16921</td>
<td>TUNU-I</td>
<td>4</td>
</tr>
<tr>
<td>N 66°57’ – W 10°44’</td>
<td>19.07.2004</td>
<td>1487–1451</td>
<td>-0.77</td>
<td>Gravel and silt&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1**</td>
<td>NRM 60782</td>
<td>BIOICE</td>
<td>5</td>
</tr>
<tr>
<td>N 68°01’ – W 8°34’</td>
<td>19.08.2008</td>
<td>1470–1449</td>
<td></td>
<td></td>
<td>2</td>
<td>HAF 2008-001</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>N 73°09’ – W 16°22’</td>
<td>14.08.2010</td>
<td>1038–1024</td>
<td>-0.86 – -0.94</td>
<td></td>
<td>5***</td>
<td>ZMUB 20992</td>
<td>TUNU-IV</td>
<td>7</td>
</tr>
<tr>
<td>N 70°14’ – W 8°50’</td>
<td>25.10.2010</td>
<td>1339</td>
<td></td>
<td></td>
<td>1</td>
<td>ZMUB 20932</td>
<td>JM OED environm. cruise</td>
<td>8</td>
</tr>
<tr>
<td>N 6°33’ – E 8°34’</td>
<td>07.05.2012</td>
<td>1608</td>
<td>-0.81</td>
<td>Fine-grained compressed substrate&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td>ZMUB 23013</td>
<td>MAREANO</td>
<td>9</td>
</tr>
</tbody>
</table>

<sup>a</sup> Lütken (1898); <sup>b</sup> Christiansen (2003); <sup>c</sup> Swedish Museum of Natural History, Stockholm; <sup>d</sup> Tandberg et al. (2012)

* 9 specimens recorded caught; ** 4 specimens reported caught; *** 15 specimens recorded caught
slopes surrounding the sea north of Iceland (Iceland Sea, sensu Blindheim 2004) while two are on the southwestern slope of the Greenland Sea and one on the eastern slope of the Norwegian Sea.

Depth distributions are known for all locations (Table 1), ranging from about 900 m to 1750 m, with most of the catches between 1300 and 1500 m (Figure 2). The depth distribution of *C. subspinosus* vs. *C. microps* shows a clear-cut segregation in the realised habitat for the two sympatric psychrolutids. *C. subspinosus* inhabits the deeper slopes, whereas *C. microps* is confined to waters of less depths (245 – 1090 m). The depth distribution of *C. microps* in the Greenland Sea region, where it could have gone far deeper, is the same as in the shallower Barents Sea (Figure 2). Bottom temperatures were available for seven of the *C. subspinosus* locations and all of them had sub-zero waters, ranging from -0.4 – -1.1 °C (Table 1).

Information on bottom substrate was available for six locations (Table 1). Fine-grained substrate was generally found, either as soft mud or as more firmly compressed substrate. Mud and gravel was recorded at one location and coral fields (with *Virgularia* sp.) at another. The easternmost location had a bottom fauna dominated by fanworms (Sabellidae) on the more compressed substrate found there.

**DISCUSSION**

The present study substantiates that *C. subspinosus* is distributed in the deep and cold waters along the continental slopes of the northeast Atlantic Ocean. The species has not been documented outside the Nordic Seas, *contra* map shown by Jónsson & Pálsson (2013) which extends the distribution along SE Greenland south of Denmark Strait.

The record on the eastern side of the Norwegian Sea extends the known range of *C. subspinosus* considerably, about 730 km eastward from the previously known locality nearest to it. The Psychrolutidae primarily comprises species with demersal eggs and a sedentary benthic life form (Fedorov & Nelson 1986), and it is unlikely that *C. subspinosus* undertakes long-distance migrations. The occurrence of the species on the Norwegian slopes is therefore probably not due to recent colonisation.

From the present records we would expect *C. subspinosus* to be continually distributed along the deeper slopes surrounding the Norwegian Sea, but to verify that, the species will have to be looked for on the northern slopes of the Iceland-Faroes-Norway Ridge, for which there presently is a hiatus in the documented range. Also, we do not know if the range extends to the deep plains of the Nordic Seas, which do have temperatures below zero (Blindheim 2004). Furthermore, the northern limit of the species’ range has probably not yet been established in spite of many years of fisheries research carried out in the western part of the Barents Sea and around Svalbard (e.g., Wienerroither et al. 2011). Most of that sampling has probably not been deep enough for the species to be obtained. Future sampling deeper than 1000 m in those waters would be needed. However, the species was not observed by Soltwedel et al. (2009) during samplings at the slope from Vestnesa Ridge (1650 m depth) to the Molloy Hole (5500 m depth) at about 79°N west of Spitsbergen.

With almost no overlap, the depth range of *C. subspinosus* succeeds that of the sympatric and common *C. microps*. The two species are morphologically very similar, and the distinct depth segregation could be a result of competitive exclusion. After all, the number of specimens caught on two of the trawl stations off NE Greenland (9 and 15 individuals, Table 1) indicates that *C. subspinosus* might be abundant in places. Usually, *C. microps* occurs in no higher numbers in bottom trawl hauls even in areas where it is considered common: 111 specimens of *C. microps* caught in 60 hauls (gear and towing time similar to the Greenland samplings) distributed over western Barents Sea (Byrkjedal & Høines 2007), gave median, as well as upper quartile numbers, of only 2 specimens per station, and a maximum of 6. However, because *C. subspinosus* is known from so few specimens, details about its feeding ecology and life history are virtually unknown (Fedorov & Nelson 1986). The two species are apparently also adapted to different temperatures, with *C. subspinosus* found solely in sub-zero waters and *C. microps* (Byrkjedal & Høines 2007) chiefly in temperatures above zero, and this could also explain their difference in depth distribution. In the North-western Atlantic *C. microps* overlaps in distribution with *Cottunculus thomsonii* (Günther, 1882) in Baffin Bay – Davis Strait. Here these two species seem not to be depth-segregated, but *C. thomsonii* is found in somewhat warmer water than *C. microps* (Coad & Reist 2018).

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