

Mediterranean *Sepiola aurantiaca* Jatta, 1896, versus the NE Atlantic *Sepiola pfefferi* Grimpe, 1921 (Cephalopoda, Sepiolinae)

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Original descriptions and literature references of *Sepiola aurantiaca* and *S. pfefferi* are compared with 156 NE Atlantic specimens from museum collections and recent collecting from the International Bottom Trawl Survey (IBTS) and the Beam Trawl Survey (BTS). It appears that *Sepiola pfefferi* Grimpe, 1921, is not a synonym of *S. aurantiaca* Jatta, 1896.

Key words: Cephalopoda, *Sepiola*, nomenclature, taxonomy, Mediterranean, Atlantic.

INTRODUCTION

In the National Museum of Natural History, NCB Naturalis (Leiden), we could study since 2004, through the kind cooperation of Imares, Wageningen (Dutch fisheries research station, IJmuiden), many of the Sepiolinae samples collected during the International Bottom Trawl Survey (IBTS) and the Beam Trawl Survey (BTS), under the auspices of the International Council for the Exploration of the Sea (ICES). By means of an initial DNA survey in 2006-2007 it was shown that, as expected, several of the identifications proved to be wrong. This resulted in a wider DNA study and a molecular

phylogeny of the Sepiolinae in the North Sea (Groenenberg et al., 2009). For one of the species we used explicitly the name *Sepiola pfefferi* Grimpe, 1921, instead of the more commonly used name *Sepiola aurantiaca* Jatta, 1896. In this paper we analyze the use of these names in the literature thus far and we compare both descriptions with 156 additional specimens reported here from different localities in the North Sea and the NE Atlantic.

Abbreviations: BMN, University Museum of Bergen, Norway; NMSZ, Royal Scottish Museum, Edinburgh, Scotland; RMNH, NCB Naturalis, Leiden, the Netherlands; ZMA, Zoologisch Museum Amsterdam, now in NCB Naturalis, Leiden.

SEPIOLA SPECIES OCCURRING IN THE NORTH SEA

In the literature we have found four species names of *Sepiola* supposedly occurring in the North Sea: *S. atlantica* d'Orbigny, 1839-1842, *S. pfefferi* Grimpe, 1921, *S. aurantiaca* Jatta, 1896 and *S. rondeletii* Leach, 1834. By far the commonest name is *Sepiola atlantica*. As shown in our most recent paper (De Heij & Goud, 2010) *S. atlantica* in the North Sea consists of two closely related species. One generally living in more coastal shallow conditions, the true *S. atlantica*, and

the newly described *Sepiolo tridens* De Heij & Goud, 2010, living more off shore at depths over 50 m. In De Heij & Baayen (2005) the distribution of *S. atlantica* in the North Sea was described. In fact their material studied consisted of three *Sepiolo* species, mainly of *S. atlantica* and *S. tridens* but also some specimens of a third species, which can be referred to as *S. pfefferi* Grimpe, 1921 or *S. aurantiaca* Jatta, 1896. Both names have formerly been used in literature on cephalopods from the North Sea (Russell, 1909: 454-455, 1922: 28-29; Grimpe, 1925: 19-21; Jaeckel, 1958: 577-578; Nesis, 1987: 128, 132). The occurrence of *S. rondeletii* in the North Sea is only suggested by the distribution maps in Roper et al. (1984: 68) and in Jereb & Roper (2005: 167-168). In the references listed by these FAO guides no data concerning the occurrence of *S. rondeletii* in the North Sea could be found and we also didn't find any *S. rondeletii* in the hundreds of samples we have studied in the past ten years. The distribution of *S. aurantica* seems to be restricted to the Bay of Naples.

LITERATURE STUDIES ON USAGE OF THE NAMES
S. AURANTIACA AND *S. PFEFFERI*

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In 1896 Jatta described the species *Sepiolo aurantiaca* from the Gulf of Naples in the Mediterranean Sea (pp. 130-133, plate 14: 31-46). In Figs 1a-b we reproduce the main figures given by Jatta, 1896: plate 14 figs 34, 36, 38, 40 & 42.

Some of the main characters given by Jatta are: the skin colour of the animals, "nice yellow orange"; the U-shaped ventral mantle curving widely around the funnel (Fig. 1a: 34); the shape of the tentacle club (smooth with equally small suckers) (Fig. 1b: 42); the hectocotylyzation of the male arms (Fig. 1b: 40).

This last character, the most important discriminating character of male cephalopods, is described by Jatta as follows: "Hectocotylyzation involves all the arms (pl. 14 fig. 36). The arms of the first pair are joined to each other at their base for a short extent; the left arm carries on its ventral part two very large leaf-like irregularly shaped expansions, placed close to each other (pl. 14 figs 36, 40). The remaining part of the arm is unchanged, but its suckers are quite larger and are more widely spaced than those on the female arms.

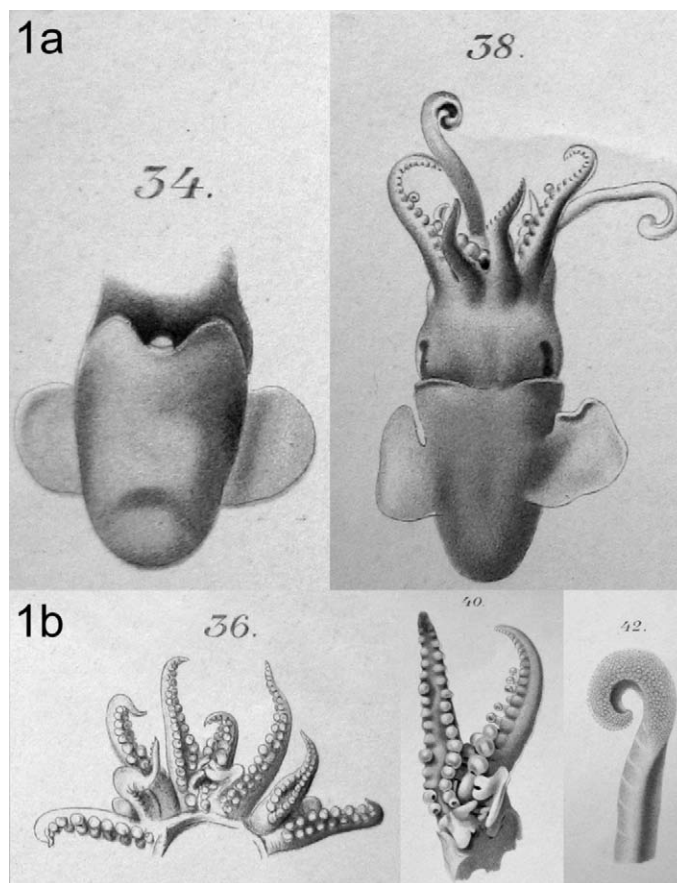


Fig. 1. *Sepiolo aurantiaca* after Jatta, 1896: plate 14. **1a**, ventral view (34), dorsal view (38); **1b**, arm composition (36), hectocotylus (40), tentacle club (42).

The right arm also carries in the first third of its length two leaf-like expansions, which are, however, much smaller than those of the left arm; the remaining part of the arm is unchanged." [translation from Italian by G. Bello]. Jatta described and figured clearly two leaf-like expansions as part of the hectocotylyzation in both first male arms.

Russell (1909) used Jatta's name *Sepiolo aurantiaca* for 20 specimens caught NE of Scotland. He based this identification on the skin colour and the U-shaped ventral mantle around the funnel, but he also recognized the absence of the leaf-like expansions on the first right male arm as described by Jatta. In a subsequent publication (Russell, 1922) he

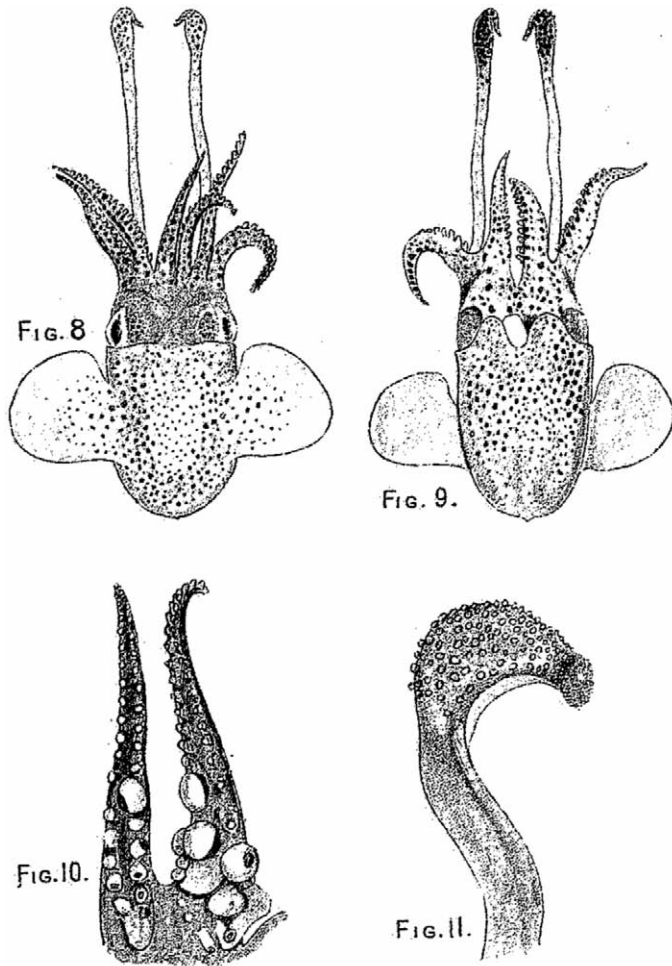


Fig. 2. *Sepiolo aurantiaca* after Russell, 1922: figs 8-11. 8, dorsal side; 9, ventral side; 10, hectocotylus; 11, tentacle club.

figured the ventral and dorsal side of a female specimen (Fig. 2: 8, 9), a tentacle club (Fig. 2: 11) and the male's first arm pair (Fig. 2: 10). We can now point out three characters being different to those of *Sepiolo aurantiaca*. The tentacle shows a club with a clear separation in a manus and a dactylus part whereas Jatta (1896) (Fig. 1b: 42) figured a club without such a 'digit'. Russell figures the first arm pair with only the left arm being hectocotylized whereas Jatta gave a description and a figure of both arms being hectocotylized. Russell's drawing of the first arm pair shows some very

enlarged suckers in both arms much bigger than those in Jatta's drawing (Fig. 1b: 40). Russell apparently did not recognize these 20 specimens as belonging to a different species in spite of the demonstrated differences.

Naef (1912: 271) studied seven specimens of *Sepiolo aurantiaca* in the collection of the 'Stazione Zoologica di Napoli' and briefly redescribed the species referring to the original description of Jatta (1896: 130-133). Naef (1923: 590-593 [612-615 in original edition]) published an additional drawing of the hectocotylus of *S. aurantiaca*. The two expansions at the base of the right arm are drawn very prominently (see Fig. 3). He described these expansions as extended stalks of suckers with, in the case of young males, the suckers sometimes still in place. In later publications it is always this drawing which is reproduced (e.g. Muus, 1963, sheet 94: 2; Nesis, 1987: 135N; Bello, 1995: 47)

In 1921 Grimpe (pp. 4-12) described the catch of three specimens of *Sepiolo* at the east coast of England, south-east of Flamborough Head. These animals, although similar to

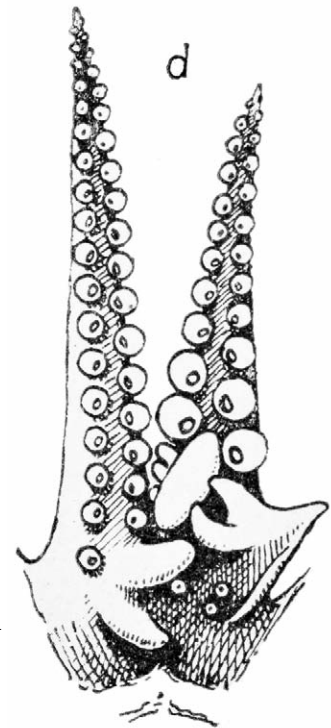


Fig. 3. *Sepiolo aurantiaca* after Naef, 1912: fig. 1d, hectocotylus.

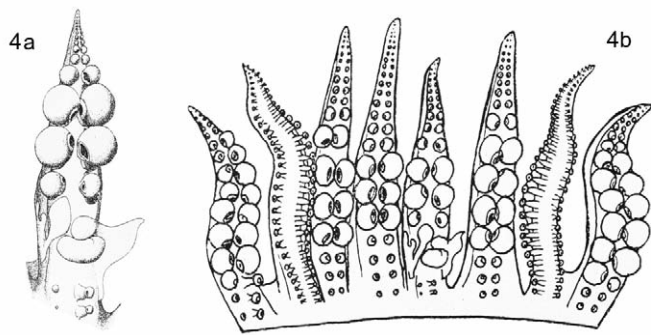


Fig. 4. *Sepiolo pfefferi* after Grimpe, 1921: figs 3, 5. a, hectocotylus; b, male arms with complete sucker composition

Jatta's description, were according to Grimpe not only different in the hectocotylus, with only the first left arm hectocotylized, but they also had a much deeper V-shaped ventral mantle indentation, lying much closer around the funnel (Fig. 5), whereas Jatta (1896) described a wider U-shaped ventral mantle indentation (Fig. 1a: 34). Grimpe (1921: 11) also indicates a difference in the number of sucker rows on the tentacle clubs. He saw 6 clear rows of suckers opposite to Jatta, whose drawing (Fig. 1b: 42) shows 8 rows of small suckers. Grimpe (1921: 4-12) described these three specimens as *Sepiolo pfefferi*.

In his well known cephalopod monograph from 1923 Naef once more describes and figures the hectocotylus of *S. aurantiaca* and comments upon *S. pfefferi*. From the footnote on page 591 (613 in original edition) we learn that Naef studied the type specimens of *S. pfefferi* Grimpe, 1921, and noticed that in *S. pfefferi* "[translated from the German] the funnel indentation is still deeper, almost pointed. The suckers of the male are more enlarged and there are apparently no changes on the base of the dorsal arm. The tentacle clubs are larger and resemble the type because of the distinct six rows and the slightly larger suckers." Despite these clear differences Naef still considered *S. pfefferi* only a variety of *S. aurantiaca*. According to Naef, Grimpe never studied the known specimens and their variation, but simply brought together the specimens reported as *S. aurantiaca* from the North Sea and the Channel and recognized these as *S. pfefferi*. Naef indicates that he has seen the following spec-

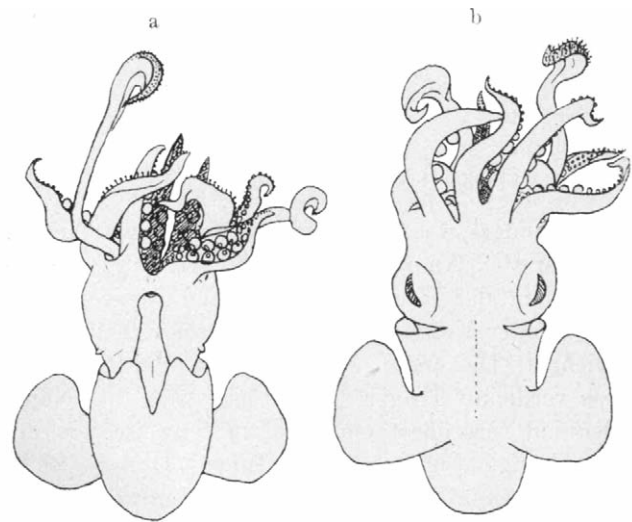


Fig. 5. *Sepiolo pfefferi* after Grimpe, 1921: figs 1a, b; holotype. 5a, ventral side; 5b, dorsal side.

imens: 1 sp. Roscoff (France); 4 sp. Bergen (Norway); 1 sp. Firth of Forth (Scotland) and 3 sp. North Sea, but still considered the clearly described differences as of minor importance and just enough to use the name *S. pfefferi* for a subspecies of *S. aurantiaca*.

In return, Grimpe (1925: 21), also in a footnote, comments upon Naef's opinion by stating that the differences between a newly described species by Naef and its closest relative are even smaller than the differences between his *S. pfefferi* and *S. aurantiaca*. As an example is given the difference between *Sepietta oweniana* Pfeffer, 1908 and *Sepietta neglecta* Naef, 1916. Apart from the bigger size *S. oweniana* differs 'only' in having 32 rows of tiny suckers on the tentacle club against 16 rows in *S. neglecta* and their mature males have a slightly different hectocotylus. (Bello, 1998: 84). We could say the same about *Sepiolo atlantica* d'Orbigny, 1841 and the closely related *Sepiolo tridens* de Heij & Goud, 2010, two species with small, but consistent, morphological differences mainly in the size of the tentacle clubs and the male hectocotylus. Naef saw the differences between *S. aurantiaca* and *S. pfefferi*, but did not agree that these could be indicative for two different species.

The monograph by Grimpe (1925) on the cephalopods of the



Fig. 6. *Sepioloidea pfefferi* after Grimpe, 1925: fig. 5 on photo plate. Ventral side of three specimens. The right specimen can be recognized as the holotype (compare fig. 5); note the difference in depth of indentation in the ventral mantle.

North Sea shows a photo plate with three specimens of *S. pfefferi* (Fig. 6). The right specimen has exactly the same shape as the line drawing given by Grimpe in 1921 with the original description (Fig. 5) and indicated as the holotype. The indentation of the ventral mantle around the funnel is V-shaped, but far less deep as indicated in the line drawing. The specimen left on the photo (Fig. 6) shows an even more shallow U-shaped indentation.

Based on this controversy between Naef and Grimpe we see now that Jaekel (1958: 577-578) and Nesis (1987: 128, 132) report both *S. aurantiaca* as well as *S. pfefferi* as part of the NE Atlantic cephalopod fauna. Nesis indicates (probably after Naef) that *S. pfefferi* might not be a distinct species, but a form of *S. aurantiaca*. In fact Naef and Grimpe were referring to the same specimens under different names. From 1925 on different authors have been using both these two names for specimens occurring in the NE Atlantic area, which obviously do belong to the same species. Grieg (1933: 11-12) used *S. aurantiaca* for specimens from the fjords near Bergen, Norway, whereas Grimpe (1925: 19) listed the same specimens in his monograph on the cephalopods of the North Sea as *S. pfefferi*. Stephen (1944: 254-255) of the Royal Scottish Museum (Edinburgh) called the Scottish specimens *S. pfefferi*, including those collected by Russell (1909), who originally named these

S. aurantiaca. Later on, the same specimens were listed by Heppell & Smith (1983: 15) and by Yau (1994) under the name *S. aurantiaca*. Yau (pers. com.) indicates doing that according to Nesis (1987). Finally Hayward & Ryland (1990: 789) are listing *S. aurantiaca* accompanied by the original drawing of the ventral side of Grimpe's *S. pfefferi*. What started as two different taxa according to Grimpe, or subspecies according to Naef, became finally synonyms without the study of any additional specimens.

SEARCHING FOR THE TYPE SAMPLES

We already analyzed and listed the differences in the descriptions of *S. aurantiaca* and *S. pfefferi*, but we would have liked to compare the type series as well. We have requested the types of *S. aurantiaca* from the Zoological Station Anton Dohrn, Napels (SZN - Stazione Zoologica di Napoli), but even after several searches they have not been able to trace the types in the collection (pers. com. Dr. Andrea Travaglini); Dr. G. Bello informed us, that he has studied the *S. aurantiaca* type samples in the seventies of last century. Why these samples cannot be found nowadays is still a mystery.

Searches for the types of *S. pfefferi* were more elaborate. Felley et al. (2001-2003), indicate that the types probably are in the ZMB (Zoological Museum Berlin). Dr Matthias Glaubrecht informed us, that these types are currently not in the ZMB collection. Grimpe material might be in the Naturkunde Museum Leipzig. Katrin Schniebs informed us, that there are no cephalopod samples collected or donated by Grimpe in their collection. She suggested to check with the University of Leipzig collection. The collection manager of the Leipzig University collection informed us, that there are no Grimpe samples of *Sepioloidea* in their collection.

Grimpe published his monograph on the cephalopods of the North Sea in the Helgoländer Wissenschaftliche Meeresuntersuchungen. We have inquired about the Helgoländer collection with Dr. Heinz-Dieter Franke. He informed us, that the collection at Helgoland was largely destroyed during World War II and that there are no *Sepioloidea* samples from Grimpe remaining. The institute at Helgoland nowadays is part of the University of Kiel. Dr. U. Piatkowski informed



Fig. 7. *Sepiolo pfefferi*, ventral side of male with mantle edge turned over. RMNH.MOL.108846.1, North Sea, E of Scotland, 90m depth; photo J. Goud.



Fig. 8. *Sepiolo pfefferi*, ventral side of female with sharp V-shaped mantle indentation. RMNH.MOL.117755, North Sea, E of Scotland, 51m depth; photo J. Goud.

us, that there are no Grimpe samples in today's University of Kiel collection.

NEOTYPE SELECTION

Since all three syntypes of *Sepiolo pfefferi* Grimpe, 1921 must be considered lost, we here designate a neotype. We have selected a fully grown male (RMNH.MOL.108845), which has been collected on 26.i.2005 at a depth of 38 m, very close to the original type locality (53,11671°N 1,7827°E) and of which a CO1 sequence has been deposited in Genbank: FJ231296.

MATERIAL STUDIED

The studied samples are listed in the table on the next page (abbreviations: f, female; m, male; sp., specimen; y, young).

Sepiolo aurantiaca Jatta, 1896

From the Mediterranean Sea no specimens are found in museum collections. Bello and Boletszky (pers. com.) both long-time researchers on Mediterranean cephalopods and interested in *Sepiolo* in particular have never identified a

specimen as *S. aurantiaca*. Searches in the Zoological Records procured only one recently published specimen. This specimen was used in the molecular studies of Nishiguchi et al., 1998 and a CO1 sequence was deposited in Genbank (AF035708) and was shown to be different from *S. pfefferi* by Groenenberg et al., 2009. The specimen was not available for morphological comparison (pers. com. Nishiguchi).

Sepiolo pfefferi Grimpe, 1921

Different natural history collections: RMNH, Leiden; RSM, Edinburgh; BMN, Bergen, Norway and ZMA, Amsterdam are housing a total of 156 specimens: 61 males, 93 females and 2 juveniles of *S. pfefferi*. Dorsal mantle length (DML) of

identification	revisor	regnr	lotcontent	area	latitude	longitude	depth m	date	genbank
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110095	1 m	Ria de Arosa			18	26.vii.1963	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110096	1 f	Ria de Arosa			50-60	12.viii.1964	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113973	4 f	North Sea	534,407	0,96167	20	26.i.2005	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113657	1 m	North Sea	546,768	257,567	20	9.ii.2005	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110056	1 f	North Sea	537,677	0,9181		15.ii.2006	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110302	5 f	North Sea	572,972	-13,531	94	7.ii.2008	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110303	2 m	North Sea	572,972	-13,531	94	7.ii.2008	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110306	21 f	North Sea	566,668	-16,123	58	8.ii.2008	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110307	9 m	North Sea	566,668	-16,123	58	8.ii.2008	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.117755	2 f	North Sea	567,617	-2,236	51	9.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.117758	1 f	North Sea	563,973	-21,002	54	9.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.119755	1 m	North Sea	577,492	-13,607	95	31.viii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113962	2 f, 2 m	North Sea	578,345	-25,868	83	31.i.2009.	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113964	1 m	North Sea	588,737	-38,178	100	1.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.117319	1 f	North Sea	538,107	0,82733	37	26.viii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.117322	1 f	North Sea	511,833	186,183	39	2.ix.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113758	3 f, 4 m	English Chanal	503,398	-0,6965	52	21.i.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113758.1	1 f	English Chanal	503,398	-0,6965	52	21.i.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113943	1 f, 1 f	Celtic Sea	514,158	-76,084	86	27.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113944	1 m	Celtic Sea	513,418	-74,508	88	27.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113945	1 f, 1 m	Celtic Sea	51,144	-81,529	106	28.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.113946	1 f, 3 m	Celtic Sea	513,523	-81,406	92	28.ii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.121490	1 m	Irish Sea	533,943	-54,109	86-89	4.iii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.121491	1 m	Irish Sea	533,332	-52,564	89-92	4.iii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.121492	1 m	Irish Sea	535,245	-5,589	69-71	5.iii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.121493	1 f	Irish Sea	541,771	-45,387	78-95	6.iii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.121494	6 m, 5 f	Irish Sea	533,118	-41,527	48-53	11.iii.2009	
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.108846.1	1 m	North Sea	5,774,243	-13,547	90	26.viii.2005	FJ231292
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.108846.2	1 y	North Sea	5,774,243	-13,547	90	26.viii.2005	FJ231293
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.105642	1 f	North Sea	5,344,067	0,96167	20	26.i.2005	FJ231294
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110056	1 f	North Sea	534,611	0,9181	38	15.ii.2006	FJ231295
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.108845	1 m	North Sea	5,311,671	17,827	38	26.i.2005	FJ231296
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110050	1 f	North Sea	56,75	-0,5	68	6.ix.2000	+
<i>S. pfefferi</i>	Goud & De Heij	RMNH.MOL.110055	1 m	North Sea	56,75	-0,5	68	6.ix.2000	+
<i>S. aurantiaca</i>	Yau, 1991	NMSZ: 1958045.78b	2 m	North Sea	57°06'N	02°03'W	24-37	4.iv.1931	
<i>S. pfefferi</i>	Stephen, 1944	NMSZ: 1958045.89	1 m, 1 f	North Sea	60°22'N	01°31'W	75	8.ix.1920	
<i>S. pfefferi</i>	Stephen, 1944	NMSZ: 1958045.90	1 m	North Sea	56°05'N	02°32'W	0-40	26.iii.1925	
<i>S. pfefferi</i>	Stephen, 1944	NMSZ: 1958045.91	1 m, 1 f	North Sea	58°09'N	03°27'W	45	14.xi.1926	
<i>S. pfefferi</i>	Stephen, 1944	NMSZ: 1958045.94	1 m	North Sea	56°06'N	02°31.5W	41	20.xii.1928	
<i>S. pfefferi</i>	Stephen, 1944	NMSZ: 1958045.98a	1 m, 2 f	North Sea	56°09'N	02°43'W	40	6.xi.1906	
<i>S. aurantiaca</i>	Yau, 1991	NMSZ: 1979038.41301b	1 m	North Sea	57°42'N	02°30'W	42	6.xii.1978	
<i>S. aurantiaca</i>	RSM, 1980	NMSZ: 1980074.41301	1 m	North Sea	49°28'N	02°27'W	low water	24.ix.1980	
<i>S. aurantiaca</i>	McKay, 1982	NMSZ: 1982043.41319	5 m, 8 f	North Sea	-	-	-	20.xi.1982	
<i>S. aurantiaca</i>	Naef/Grieg, 1933	BMN: 36233	1 m, 2 f	Norway	Bergens	skjærgaard	17 m		
<i>S. aurantiaca</i>		BMN: 36258	1 y	E of Shetlands			110 m	15.vii.1904	
<i>S. aurantiaca</i>	Naef/Grieg, 1933	BMN: 86305	1 f	Norway	Bergen				
<i>S. pfefferi</i>		ZMA.Moll.162435	1 f	Norway	Stavanger	fjord		v.1929	

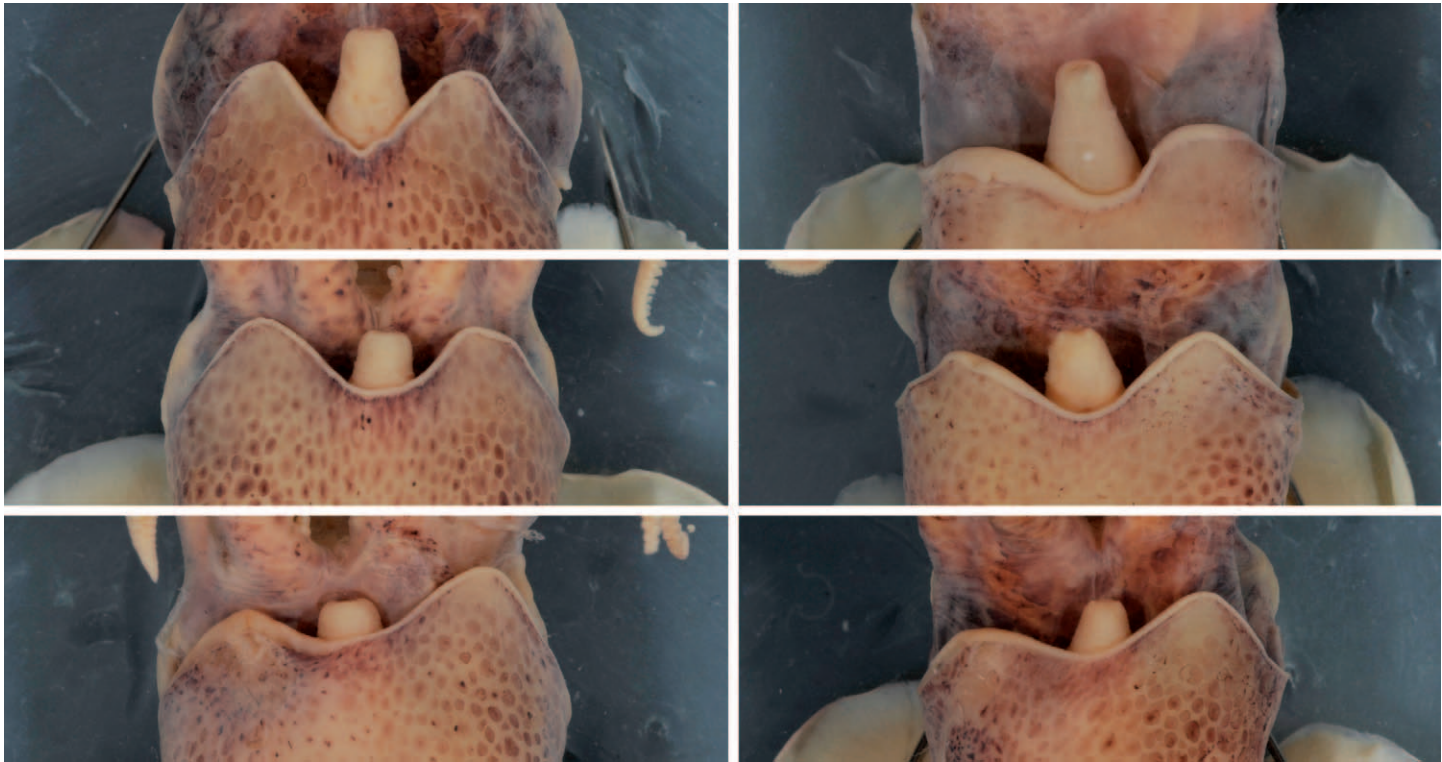


Fig. 9. *Sepiolo pfefferi*, ventral side of females (left) and males (right). All from sample NMZS 1982043-41319, North Sea, E of Scotland; photo J. Goud.

both sexes ranges from 10-15 mm. The geographic distribution ranges from northern Spain (42°N) to east of the Shetlands (60°30'N) and from the Celtic Sea (8°15'W) to southern Norway (5°E). The depth ranges from low water tide mark to 110 m.

RESULTS

The exact relationship between the Mediterranean *S. aurantiaca* and the Atlantic *S. pfefferi* cannot be settled since no type of *S. aurantiaca* could be traced nor could any Mediterranean specimen, identified as such, be found.

Morphological comparison showed that all the Atlantic specimens, which we studied, are conspecific with the description and type figures of *S. pfefferi* Grimpe, 1921. Especially the tentacle clubs (Fig.10), characterized by the broad manus with larger suckers on the inside and the small

dactylus at the top are typical. Russell (1922), probably not aware of the description of *S. pfefferi* by Grimpe in 1921, figured under the name *S. aurantiaca* specimens from the North Sea, off the coast of Scotland. His figure 11 (Fig. 2) shows a tentacle club with a clear separation between manus and dactylus as we have seen in all our *S. pfefferi* samples.

The indentation of the ventral mantle varies more than Grimpe (1921: fig. 5) showed in his figures. In particular the line drawing of the type shows a very deep indentation, although his 1925 publication, on photo plate (Fig. 5) shows a photo of the same specimen (here Fig. 6) with a far less deep indentation. In our specimens the indentation varies from V to U-shaped and from deeper to more shallow (Fig. 9). Remarkable is that the indentation in females (Fig. 9 left) is more pronounced than that in males (Fig. 9 right).

The indentation of the ventral mantle is very characteris-

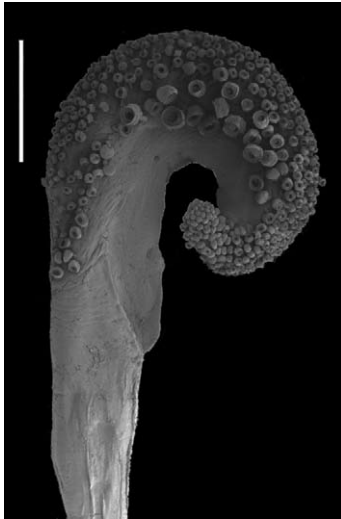


Fig. 10. *Sepiolo pfefferi*, tentacle club, after critical point drying and coating photographed in SEM; scale bar = 1mm. RMNH.MOL. 117322; photo J. Goud.

tic for the species, although not always easily recognizable. The first specimens collected by Imares in the North Sea, that we saw, were frozen after the catch before identification. As shown in Figure 7 we could hardly speak about an indentation, it just seems that there are two white knobs on the edge of the ventral mantle. Now we know that this is an artifact due to the freezing technique. Specimens prepared in ethanol 70% show a normally relaxed mantle with clear indentation (Fig. 8).

We give a photo (Fig. 11) and a drawing (Fig. 12) of two first arm pairs from fully adult males of *S. pfefferi*. The left arm (right on the figures) is hectocotyized and the right arm clearly not. This is in contrast with the situation in *S. aurantiaca* (Fig. 1b: 40 and Fig. 3) where both Jatta and Naef draw two large papillae at the base of the first right arm. A secondary sex difference can be seen in the very large suckers halfway the first, the second and fourth arm pair. About 3 to 5 couples of suckers are much larger than the others. In the drawings of Jatta (Fig. 1b: 36) and Naef (Fig. 3) we see only some larger suckers as part of the hectocotylus arm; all other arms have regularly smaller suckers. The figures of Grimpe (1921) (Fig. 4a, b) illustrate well the situation in our Atlantic samples (43 males) which is shown in Figs 11 and 12. The first arm pair figured by Russell (1922) appears to be juvenile (Fig. 2: 10) and not well preserved.



Fig. 11. *Sepiolo pfefferi*, male arms, top two arms are the first arm pair, with hectocotylus as left arm (right side for the viewer); photo J. Goud.

As a consequence of our observations it is clear that the names *S. aurantiaca* Jatta and *S. pfefferi* Grimpe cannot be regarded as synonyms. All Atlantic specimens that we have seen, should be given the name *S. pfefferi*. Many of the identification guides (Naef, 1923; Jaeckel, 1958; Muus, 1959, 1963; Roper et al., 1984; Jereb & Roper, 2005) refer to these specimens as either *S. aurantiaca* or *S. pfefferi*. Some research papers and a few identification guides however (Grieg, 1933; Hayward & Ryland, 1990; Yau, 1994; Collins et al., 2002; Hastie et al., 2009) call the Atlantic species erroneously *S. aurantiaca*. We here list the references, which in our opinion should have been considered *S. aurantiaca* for Mediterranean specimens or *S. pfefferi* for Atlantic specimens.

Sepiolo aurantiaca Jatta, 1896 (Figs 1-3)

Sepiolo aurantiaca Jatta, 1896: 130-134, figs 31-46. Naef, 1912: 85, fig. 1d; 1923: 612-615, figs 344a, 357-358. Nesis, 1987: 128, 132, fig. 30D, N. Bello, 1995: 47, 50, figs 9♂B, 9♀B; 1998: 84, fig. 3. Nishiguchi, Ruby & McFall-Ngai, 1998: tab. 1, fig. 1. Jereb & Roper eds., 2005: 180.

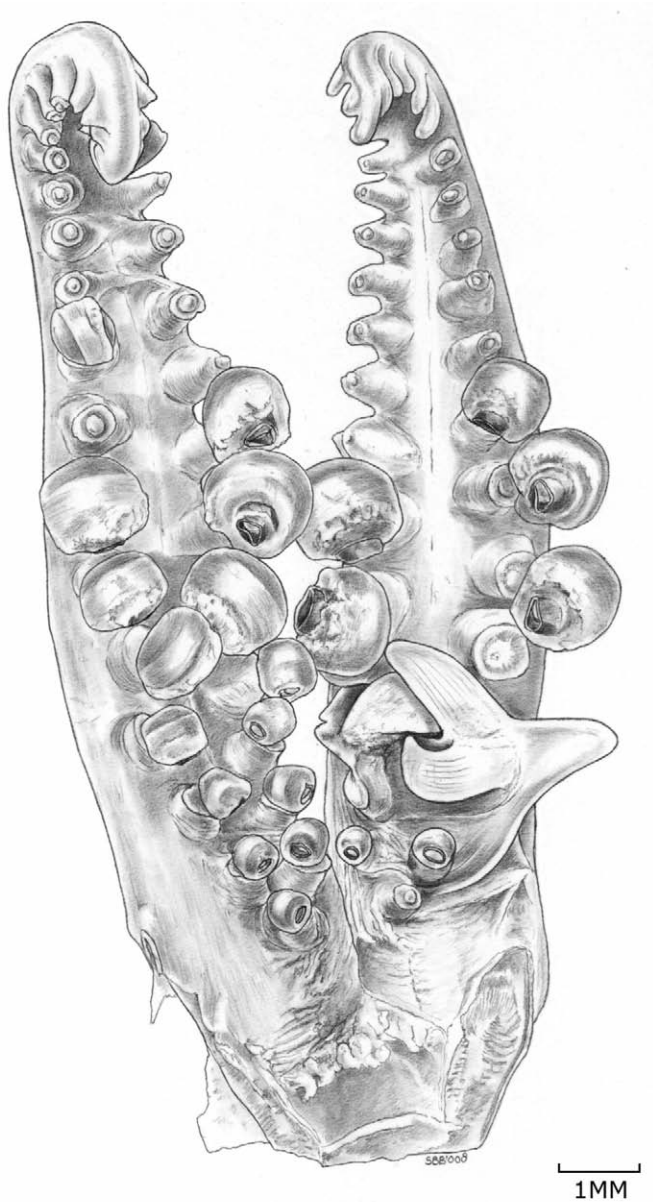


Fig. 12. *Sepiolo pfefferi*, male, first arm pair with hectocotylus; NMZS 1982043-41319; drawing Bas Blankevoort, NCB Naturalis.

Sepiolo pfefferi Grimpe, 1921 (Figs 4-12)

- Sepiolo aurantiaca*; Russell, 1909: 454-455; 1922: 28-29, figs 8-11. Grieg, 1933: 11-12. Jaekel, 1958: 577-578. Heppell & Smith, 1983: 15. Hayward & Ryland, 1990: 788, fig. 13.18. Yau, 1994: 4. Collins, Yau, Boyle, & Piatkowski, 2002: 243, tabs 2-5. Hastie et al., 2009: 140-141. Not Jatta, 1896.
- Sepiolo pfefferi* Grimpe, 1921: 4-12, figs 1-5; 1925: 19-21, photo 5. Stephen, 1944: 254-255. Nesis, 1987: 128, figs 30A-C. Jereb & Roper eds., 2005: 180. Chambers, 2008: 322. Groenenberg, Goud, De Heij & Gittenberger, 2009: 361-369, tabs 1-2, figs 1-4.
- Sepiolo (Hemisepiolo) aurantiaca*; Muus, 1959: 135, fig. 74; 1963: sheet 94: 4, pl. II figs 10a, b.
- Sepiolo (Hemisepiolo) pfefferi*; Muus, 1959: 136, fig. 75; 1963: sheet 94: 4, pl. II fig. 11.

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