

Sepiola tridens spec. nov., an overlooked species (Cephalopoda, Sepiolidae) living in the North Sea and north-eastern Atlantic Ocean

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A recent study of the molecular phylogeny of in the North Sea living Sepiolinae confirmed the occurrence of *Sepietta oweniana*, *Sepietta neglecta*, *Sepiola pfefferi* and *Sepiola atlantica*. Among the *Sepiola atlantica* samples a third *Sepiola* species was recognized for the first time. This undescribed species is genetically closely related to *S. atlantica*. Morphological studies have shown consistent differences in the length of the tentacular clubs, in the hectocotylus and in skin patterns. Ecological differences are mainly found in water depth. The newly recognized species is described here as *Sepiola tridens* sp. nov.

Key words: Cephalopoda, Sepiolidae, *Sepiola*, taxonomy, North Sea, north-eastern Atlantic Ocean.

INTRODUCTION

In 2004 we started an inventory of the Sepiolinae in the North Sea. In spring and autumn samples were obtained from the International Bottom Trawl Survey (IBTS) and the Beam Trawl Survey (BTS) which are under the auspices of the International Council for the Exploration of the Sea

(ICES) and carried out in the Netherlands by Wageningen Imares (Dutch fisheries research station at IJmuiden). By CO1 analyses it was demonstrated that in the North Sea, within the genus *Sepietta* two species, *Sepietta oweniana* (d'Orbigny, 1841) and *S. neglecta* Naef, 1916, can be recognized and that within the genus *Sepiola* three species can be recognized. Apart from *Sepiola pfefferi* Grimpe, 1921, another species, most closely related to *Sepiola atlantica* d'Orbigny, 1841, was discovered (Groenenberg et al., 2009). Identifications were based on the shape of the ventral mantle edge (the part running over the siphon) and the number of suckers on the tips of the 4th arm pair. *Sepiola atlantica* has a more straight ventral mantle edge and arm tips with suddenly 6 to 8 rows of smaller suckers, whereas specimens of *S. pfefferi* have a V- to U-shaped curve in the ventral mantle edge and a 4th arm pair with two rows of suckers, regularly becoming smaller in size towards the end (Grimpe, 1921). DNA of approximately 30 specimens, identified as either *S. pfefferi* or *S. atlantica* was sequenced and the results were analyzed. The specimens initially identified as *S. atlantica* appeared to belong to either *S. atlantica* or an undescribed species (Groenenberg et al., 2009)

Morphological studies afterwards have now shown, minor but consistent, differences in the length of the tentac-



Fig. 1. *Sepiola tridens* spec. nov. (RMNH 113968, paratype), dorsal, ventral and lateral view. Male, 16 mm DML, base colour of the skin very light pink; North Sea, NE off coast of Scotland, 58°21.02'N 00°27.99'E, depth 73 m, 6.ii.2009.



Fig. 2. *Sepioloidea atlantica* (RMNH 117321), dorsal, ventral and side-view. Male, 15 mm DML, base colour of the skin dirty white, pale; southern North Sea, 51°39.55N 1°48.78E, depth 50 m, 2.ix.2009.

ular clubs, in the hectocotylus and in the skin pattern. Ecological differences between the two populations are found in water depth, temperature and salinity. The new species is described in this paper. Holotype, paratypes and additional material studied are housed in the collection of the National Museum of Natural History, Leiden (RMNH) and one sample in the collection of the National Museum of Ireland - Natural History (NMINH).

Abbreviations used: DML, dorsal mantle length; f, female; juv, juvenile; m, male; MNHN, Museum National d'Histoire Naturelle, Paris; NMINH, National Museum of Ireland - Natural History; RMNH, National Museum of Natural History, Leiden.

SYSTEMATICS

Sepiolinae Leach, 1817

Mantle short, broad, sac-like, with large, rounded fins inserted at mid-length. Dorsal edge of mantle fused with head. Eyes covered with corneal membranes. One or both dorsal arms, or one dorsolateral arm, hectocotylized; no protective membranes on arms. Gladius (inner shell) greatly reduced, non-calcified. Colour: generally pinkish to maroon, darkest dorsally.

Sepiola Leach, 1817

Light organs ear-shaped, present on ink sac, located within the anterior part of the mantle sac; on the tentacular clubs 8 transverse rows of suckers.

Sepiola tridens spec. nov. (Figs 1, 3, 4, 5a, 6a, 7a, 8, 9a)

Sepiola atlantica sensu Muus, 1959: 133, figs 72, 73; Muus, 1963: 5, fig. 9a, b; Muus, 1985: 242, fig. 9a, b; Lacourt & Huwae, 1981: fig. 18b (after Muus). The hectocotylus figured by Muus shows the characters of those of *S. tridens*. The tentacle clubs are obviously small in the Muus drawing.

Material examined. — Holotype (= HT): RMNH 110298, male, 5.ii.2008; dorsal mantle length 15.5 mm. Type locality: central part of the North Sea: 55.83367°N 3.35133°E, depth 64 m. Paratypes are listed in tables 1a, b.

Diagnosis. — A *Sepiola* with skin chromatophores forming a honeycomb-like pattern, small tentacular clubs (club length 5 mm), and a hectocotylus with a large crest of 5-8 suckers.

Description. — Total maximum length of the animal (body, head and arms) c. 40 mm, tentacles c. 25 mm extra. Dorsal mantle length 15 to 18 mm. Males and females of the same size (Fig. 1).

Collection / number	sexes	collected by	Locality data
HT: RMNH 110298	1 m	Imares, IBTS (Tridens)	North Sea, haul 14, 55.83367 (N) 3.351333 (E), depth 64m, 5.ii.2008.
RMNH 110299	1 f	Imares, IBTS (Tridens)	North Sea, haul 16, 56.27517 (N) 4.458833 (E), depth 65m, 6.ii.2008.
RMNH 105636	1 m	Imares, BTS 2006 (Tridens)	North Sea, haul 60, 54°77.55'N 0°25.465'E, depth 66m, 8.ix.2006.
RMNH 105650	1 f	Imares, IBTS (Tridens)	North Sea, haul 31, 56,78583(N) -0,23833 (W), depth 79m, 7.ii.2005.
RMNH 108684	6 m and 4 f	Imares, BTS (Tridens)	North Sea, haul 17, 57°52.12'N 3°14.90'W, depth 63m, 26.viii.2005.
RMNH 108938	1 m	Imares, BTS (Tridens)	North Sea, haul 57, 55°13.95'N 0°30.83'W, depth 75m, 12.ix.2005.
RMNH 113954	2 f and 3 m	Oranmore, BSS (C.Voyager)	Atl. Oc., SW of Ireland, haul 29, 51.14400 (N) -8.15292 (W), 106m, 28.ii.2009.
NMINH:2009.83.1/2	1 f and 1 m	Oranmore, BSS (C.Voyager)	Atl. Oc., SW of Ireland, haul 29, 51.14400 (N) -8.15292 (W), 106m, 28.ii.2009.
RMNH 110058	1 m	Imares, BTS (Tridens)	North Sea, haul 4, 55.68268 (N) 0.640243 (E), depth 43m, 23.viii.2007.
RMNH 110301	2 m	Imares, IBTS (Tridens)	North Sea, haul 23, 57.29716 (N) -1.35314 (W), depth 94m, 7.ii.2008.
RMNH 110311	2 m	Imares, IBTS (Tridens)	North Sea, haul 29, 56.09333 (N) 1.199667 (E), depth 83m, 11.ii.2008.
RMNH 114698	1 juv m	N.B. Fisheries, Sweden, IBTS	Kattegat, haul 136, 57°310.504'N 11°39.194'E, depth 74m, 3.ii.2009.

Table 1. A. Specimens of the type series that were sequenced for the molecular phylogeny (Groenenberg et al., 2009). Genbank accession numbers: FJ232305, FJ232306, FJ232307, FJ232313, FJ232315, FJ232319, FJ232320, FJ232321, FJ232323. B. (opposite page) Other paratypes.

RMNH #	sexes	collected by	Locality data
105635.1	1 m	Imares, BTS 2006 (Tridens)	North Sea, haul 75, 51,9325 (N) 2,08617 (E), depth 33 m, 13.ix.2006.
105645.1	1 f and 5 m	Imares, IBTS 2005 (Tridens)	North Sea, haul 20, 56,20317 (N) 4,33667 (E), depth 62 m, 2.ii.2005.
105648	3 m	Imares, IBTS 2005 (Tridens)	North Sea, haul 23, 55,83383 N 2,29783 E, depth 81 m, 3.ii.2005.
105651	1 m	Imares, IBTS 2005 (Tridens)	North Sea, haul 35, 56,21683 (N) -1,404 (W), depth 61 m, 8.ii.2005.
108833	1 m and 1 f	Imares, IBTS 2007 (Tridens)	North Sea, haul 33, 56°23.33'N 0°51.30'E, depth 86 m, 13.ii.2007.
110284	2 m and 4 f	Imares, BTS 2007 (Tridens)	North Sea, haul 107, 58.16715 (N) -0.60180 (W), depth 89m, 27.viii.2007.
110300	2 m	Imares, IBTS 2008 (Tridens)	North Sea, haul 22, 57.13267 (N) -0.539500 (W), depth 83m, 7.ii.2008.
110304	3 f	Imares, IBTS 2008 (Tridens)	North Sea, haul 24, 56.66683 (N) -1.612330 (W), depth 58m, 8.ii.2008.
110305	13 m	Imares, IBTS 2008 (Tridens)	North Sea, haul 24, 56.66683 (N) -1.612330 (W), depth 58m, 8.ii.2008.
110310	2 f and 19 m	Imares, IBTS 2008 (Tridens)	North Sea, haul 28, 56.16200 (N) 0.808333 (E), depth 87m, 11.ii.2008.
113771	2 f and 4 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 54, 53.9513547 (N) 1.2636203 (E), depth 41.2m, 25.i.2009.
113772	1 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 61, 54.4135698 (N) 0.30408 (E), depth 65m, 26.i.2009.
113773	1 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 71, 55.3790198 (N) -0.3457755 (W), depth 67m, 27.i.2009.
113774	3 f and 22 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 72, 55.4207482 (N) -1.0720762 (W), depth 96m, 27.i.2009.
113775	1 f and 3 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 73, 55.5881687 (N) -0.8030067 (W), depth 99m, 27.i.2009.
113776	13 m	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 74, 55.6444257 (N) -1.1282935 (W), depth 97m, 27.i.2009.
113855	1 f and 1 m	Imares, BTS 2008 (Tridens)	North Sea, haul 50, 57.1325 (N) -0.51533 (E), 79m, 4.ix.2008.
113856	1 juv m	Imares, BTS 2008 (Tridens)	North Sea, haul 49, 57.1865 (N) 0.375 (E), 79m, 4.ix.2008.
113864	1 m and 1 f	Ifremar, IBTS 2009 (Thalassa)	North Sea, haul 92, 53.5794213 (N) 2.20992 (E), depth 17m, 29.i.2009.
113875	2 f	Imares, IBTS 2008 (Tridens)	North Sea, haul 25, 56.39667 (N) -1.440167 (W), depth 57m, 8.ii.2008.
113876	1 juv m	Imares, IBTS 1996 (Tridens)	North Sea, haul 29, 53°45'N 01°35'E, 26m, 14.ii.1996.
113877	1 juv m	Imares, IBTS 1996 (Tridens)	North Sea, haul 6, 55°14"N 01°42'E, 39m, 30.i.1996.
113948	1 f and 1 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 4, 52.96292 (N) -9.93783 (W), 102m, 22.ii.2009.
113949	1 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 6, 52.02233 (N) -10.93440 (W), 139m, 23.ii.2009.
113950	1 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 7, 51.82308 (N) -11.00190 (W), 159m, 23.ii.2009.
113951	1 f	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 25, 51.16975 (N) -7.42883 (W), 104m, 27.ii.2009.
113952	1 f and 2 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 27, 50.89992 (N) -7.76208 (W), 107m, 27.ii.2009.
113953	3 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 28, 51.03100 (N) -8.08617 (W), 103m, 28.ii.2009.
113955	5 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 30, 51.35225 (N) -8.14058 (W), 92m, 28.ii.2009.
113956	4 f	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 34, 51.31625 (N) -8.55408 (W), 97m, 01.iii.2009.
113957	2 m	Oranmore, BSS 2009 (C.Voyager)	Atl.Oc., SW of Ireland, haul 35, 51.45150 (N) -8.53300 (W), 92m, 01.iii.2009.
113958	3 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 17, 57°04.76N 01°51.04W, depth 90m, 26.i.2009.
113960	1 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 26, 56°46.02N 02°33.02E, depth 70m, 29.i.2009.
113961	1 f and 2 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 30, 57°50.07N 02°35.21W, depth 83m, 31.i.2009.
113966	1 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 44, 59°04.94N 00°50.80E, depth 130m, 5.ii.2009.
113968	1 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 49, 58°21.02N 00°27.99E, depth 73m, 6.ii.2009.
113969	3 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 50, 57°30.29N 01°21.51W, depth 116m, 8.ii.2009.
113970	1 f	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 52, 58°05.17N 01°08.28W, depth 111m, 9.ii.2009.
113971	1 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 51, 57°47.01N 0°54.36W, depth 94m, 9.ii.2009.
113975	8 f and 9 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 59, 56°43.30N 02°13.55W, depth 58m, 12.ii.2009.
113977	2 f and 4 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 62, 56°12.97N 01°26.28W, depth 60m, 13.ii.2009.
113979	3 m	FRS Mar.Lab.Cruise 0309S (Scotia)	North Sea, haul 65, 57°21.24N 0°39.67W, depth 65m, 14.ii.2009.
508	1 m	T.J.J. Tesch d.	North Sea, Scotland, off Edinburgh, 5.iii.1914.
120478	60 m, 11 f	North-western Spain Shelf Survey	Spain, North-western shelf, haul 31 43.3727°N 9.38517°W, depth 293.5m, 27.ix.2009

The body is sac-shaped, rounded at the posterior end, length of the body somewhat larger than the width. Dorsal mantle edge, fused in the middle with the head over c. 25% of the width.

In lateral view the mantle edge runs from dorsal to ventral a little towards the head and ventrally it curves somewhat backwards along the siphon. The ventral mantle length a little longer (less than 10%) than the dorsal mantle length



Figs 3-4. 3 (left), *Sepiola tridens* spec. nov., holotype (RMNH 110298), male; North Sea, 55.83367°N 3.351333°E, depth 64 m, 5.ii.2008. 4 (right), *Sepiola tridens* spec. nov., female paratype (RMNH 113954.1); Atlantic Ocean, SW off Ireland, Kerry, 51.14400°N 8.15292°W, depth 106 m, 28.ii.2009.

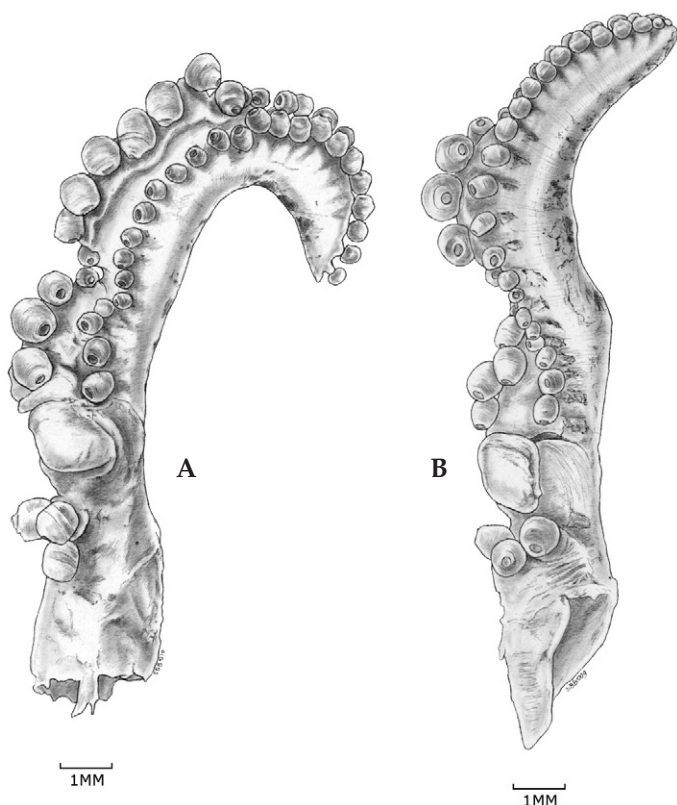


Fig. 5. **A**, *Sepioida tridens* spec. nov., hectocotylus, DML 16 mm, paratype (RMNH 113775.1); North Sea, off Scotland, 55.5881687°N 0.8030067°W, depth 99.1 m, 27.i.2009. **B**, *Sepioida atlantica*, hectocotylus, DML 17 mm (RMNH 113770.1); North Sea, 53.9513547°N 1.2636203°E, depth 41.2 m, 25.i.2009.

(table 2, DML-VML).

Fins attached to both sides of the mantle, somewhat before the mid-length of the body. Length : Width : Attached Length = 9 : 7 : 6 (table 2, FL-FW).

The head is broad, measured across the eyes, wider or as wide as the body width. The lateral situated eyes are relatively big, covered by corneal membranes. The length of the head measured from mantle edge to the beginning of the arms is 35-50% of the DML. During growth the relative head length becomes shorter.

The arm pairs are not very different in length: the arm formula of females is I-II-III-IV = 4 – 1 – 2 – 3, the arm for-

mula of males is I-II-III-IV = 4 – 2 – 3 – 1 (table 2, AL). In adult males the arms are longer than in females. In fully grown males the first arm left (IL) is hectocotylized and can be up to 2 mm longer than the first right (IR). Also in males the first half of both of the third arms is very muscled and twice as heavy as the other arms but halfway abruptly bent inwards and changes to the same thickness as in the other arms. At the inside basis of the 4th arm pairs males have big knee-like knobs. All arm pairs have along the inside two alternating rows of rather large suckers (0.6-0.7 mm), each one placed on a small stalk. In fully grown males the suckers at the middle parts of both the second and third arm pairs are clearly enlarged (1.0-1.1 mm).

Towards the tip of the 4th arm pair two rows of alternating suckers change abruptly to 6 rows of smaller suckers. The length of the tips is variable, they measure 20-35% of the total arm length (table 2, A4lt).

The two tentacles of adult specimens (DML 18 mm) can be up to 40 mm long but are often shorter. They can be withdrawn into pockets situated between the 3^{de} and 4th arms. The club at the end of each tentacle is flattened. In dorsal view the club of the right tentacle is broadened towards the right side and on the left tentacle towards the left side; on the dorsal side of the clubs three tiny lines of chromatophores follow the right or the left club edge, respectively. The largest specimens (DML 18 mm) can have a club length (measured from the first suckers to the tip) up to 7 mm (width 1.7 mm), although usually on average not much more than 5 mm (width 1.5 mm) (table 2, Tcl, Tcb). At the widest part of the club, the very small suckers are arranged in 6 alternating rows.

The base colour of the skin varies from very light pink to very light purple. On the back the chromatophores are arranged to form a pattern with an irregular honeycomb structure, visible over the head onto the dorsal side of the arms and backwards, along the fins onto the ventral side. In particular on the back the chromatophores are dense, resulting in a dark purple colour. The ventral side from the mid to the mantle edge has less and not connected small spots of chromatophores, giving it a much lighter appearance (fig. 1).

The gladius is long arrow shaped, pointing backwards and reaches up to 43-45% of the DML. The shaft of the gladius is V-

shaped and is less than 1 mm wide. The point of the arrow is 1/5 in length of the total gladius and up to 2 mm wide.

In adult males the first left arm is hectocotylized. From the base to the top, the hectocotylus first shows three suckers (0.8 mm), than two sections carry a bi-lobed papilla pointing inwards (towards the first right arm). After the papilla the inner side of the hectocotylus is irregularly enlarged. First a small crest with 3-4 large suckers (0.8 mm) followed by 2-3 small suckers (0.4-0.5 mm), followed by a large crest with 5-8 (depends on the age) large suckers (0.7-0.8 mm) followed by a finger-like tip with 9-12 small suckers (0.5-0.3 mm). The suckers on the outside of the hectocotylus (towards the 2nd arm left) are all equally small. This row of suckers runs from the papilla along the outside of the arm

over the midst below the large crest and along the outside towards the tip (Fig. 3; table 2, hectonum).

The bursa copulatrix in females is situated in the left side of the mantle cavity. It is ear-shaped and runs from below the left photophore to the caudal side of the mantle cavity. In females filled with eggs the bursa copulatrix becomes laterally compressed and the ear shape is hard to recognize (Fig. 6).

The radula of *S. tridens* consists of c. 45-50 rows of teeth. Each row consist of 7 teeth (1+2+1+2+1). The cusp of the rachis is heart-shaped and very pointed. The laterals have also rather long pointed cusps and the marginals have cusps of over 200 µm long. The arrangement of the teeth is very dense (Fig. 7).

RMNH #	♂/♀	Date	Longitude	Latitude	Depth	DML	VML	MW	HL	OHW	FL	FW
110298	♂	5.ii.2008	5,583,367	335,133	64	14.5	14.5	10.5	5.0	12	10.5	8.0
108938	♂	12.ix.2005	5,522,617	0,5083	75	15	16.0	12.0	6.5	13.0	9.0	7.5
108684	♂	26.viii.2005	5,786,787	324,233	63	13.0	13.0	12	6	13	6.5	5.0
105636	♂	8.ix.2006	547,755	0,25465	66	15.0	15.0	13.0	6.0	13.5	8.0	6.0
113954	♂	28.ii.2009	51,144	-81,529	106	13.0	14.5	12	5.5	14.0	10.5	8.5
108684	♀	26.vii.2005	5,786,787	324,233	63	14.5	14.5	12.0	6.5	13.0	8.0	7.0
105650	♀	7.ii.2005	5,678,583	-0,2383	79	14.0	14.0	12.0	5.5	12.0	7.0	5.0
110299	♀	6.ii.2008	5,627,517	445,883	65	17	18.0	12.0	6.0	13.0	10.5	8.0
113954	♀	28.ii.2009	51,144	-81,529	106	15.0	16.5	11.5	5.0	12.5	10.0	7.5

RMNH #	♂/♀	AL1	AL2	AL3	AL4	A4lt	TL	Tcl	Tcb	Sa	Hectonum
110298	♂	15	14.5	15	13.5	3.5	23	4.0	1.5		3 p 4 2 8 12
108938	♂	15	18	15	18	4	34	5.5	1.4	0.6-1.0	3 p 3 3 6 12
108684	♂	9.0	9.5	12.0	12.0	2.0	22	5.0	1.6		3 p 3 2 5 9
105636	♂	17	17	17	21	4.5	27	5.0	1.7	0.6-1.1	3 p 3 2 6 9
113954	♂	14.0	15.0	14.0	16.0	4.5	-	4.5	1.4	0.6-1.0	3 p 3 2 8 11
											remark
108684	♀	-	14.0	-	13.0	2.0	-	6.0	1.6		
105650	♀	10.0	12.0	11.5	11.0	2.0	29	4.5	1.5		
110299	♀	11.5	12.0	13.0	11.0	3.0	32	4.5	1.4	0.6	full of eggs
113954	♀	10	12.0	13.0	11.0	3.5	-	5.5	1.7	0.7	full of eggs

Table 2. Measurements of specimens of the type series of *S. tridens*. Abbreviations: AL, arm length; A4tl, arm 4 tip length; DML, dorsal mantle length; FL, fin length; FW, fin width; Hectonum, sucker arrangement on the hectocotylus; MW, mantle width; OHW, ocular head width; p, papillae; Sa: Diameter arm suckers; Tcb, tentacle club breadth; Tcl, tentacle club length; TL, tentacle length; VML, ventral mantle length.

number of hauls			depth (m)	temp. (°C)	salinity (‰)
177 hauls	overall	average	63.5	6.51	34.823
		STDEV	33.7	1.19	0.512
	<i>Sepiolo tridens</i>	average	81.8	6.82	34.792
18 hauls	92 specimens	STEDV	27.1	0.63	0.225
	<i>Sepiolo atlantica</i>	average	37.4	6.36	34.805
30 hauls	109 specimens	STDEV	16.5	1.08	0.428
	t-test according to				
	Student				
depth	6.44 E-012	<i>S. tridens</i> > <i>S. atlantica</i> P=0,001			
temperature	0.032670008	<i>S. tridens</i> > <i>S. atlantica</i> not significant			
salinity	0.875753987	<i>S. tridens</i> > <i>S. atlantica</i> not significant			

Table 3. Initial analysis of depth distribution, temperature and salinity preference of *Sepiolo tridens* and *S. atlantica*, based on North Sea and Channel data by RV Thalassa, Scotia and Tridens. In a total of 177 hauls *S. tridens* was found at 18 localities and *S. atlantica* at 30 localities.

Etymology. — The species is named *tridens* after the research vessel “Tridens”, referring to the trident of the god of the sea, Poseidon. The name is given in honour of the crew and research staff who supplied us for many years with hundreds of samples of Sepiolineae.

Distribution. — *S. tridens* has been trawled in the deeper parts of the North Sea from 54°N northwards along the east coast of England and from the Scottish coast eastwards until the Skagerak (Fig. 8) at depths between 26 and 140 m. Specimens were also found along the southwest en south coast of Ireland (IBTS 2009, Celtic Voyager) at depths of 92-159 m.

Ecology. — Initial analysis shows that *S. tridens* evidently occurs in deeper water than *S. atlantica* (table 3). *S. tridens* seems to prefer more restricted temperature and salt conditions compared to *S. atlantica*, temperature and salinity showing a much smaller STDEV (table 3).

Yau & Boyle (1996) wrote about the ecology of *Sepiolo atlantica* which indeed compared to our data must have been the true *S. atlantica* because they studied an estuarine shallow water population.

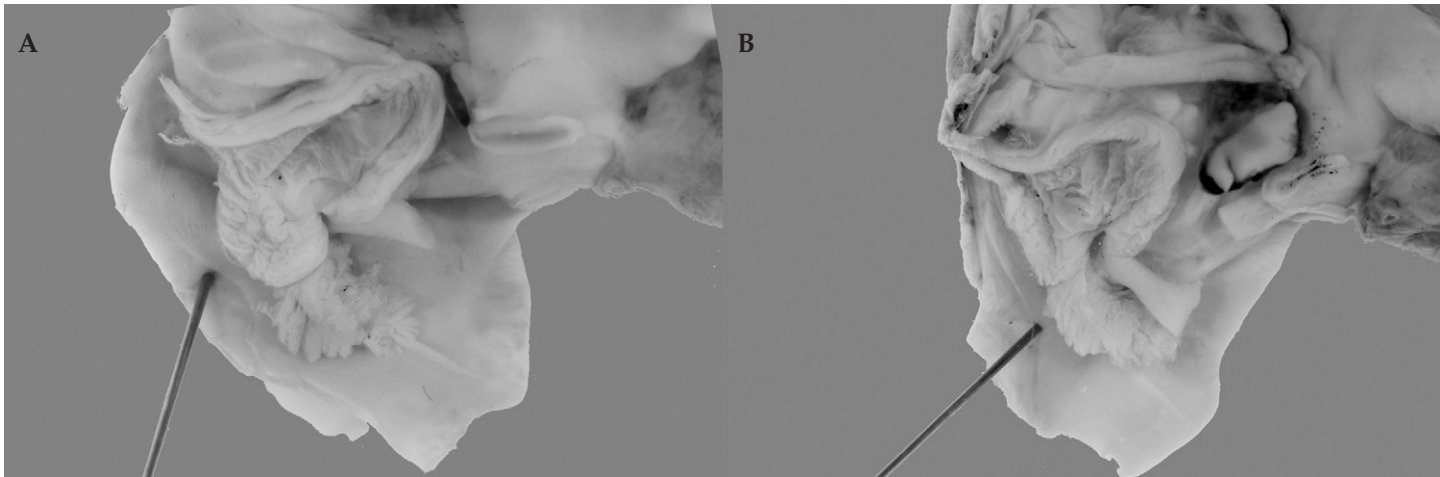


Fig. 6. Female anatomy with bursa copulatrix. **A**, *Sepiolo tridens* spec. nov., paratype, RMNH 113771; **B**, *Sepiolo atlantica*, RMNH 113770; both: North Sea, 53.9513547°N 1.2636203°E, depth 41 m, 25.i.2009; one of the few localities where we found both species together.



Fig. 7. Tentacular clubs of male specimens with 15 mm DML. A, *Sepiolo tridens* spec. nov., paratype (RMNH 113744); North Sea, 55.4207482°N 1.0720762°W, depth 96 m, 27.i.2009. B, *Sepiolo atlantica*; North Sea, 52°21.66N 1°54.77E, depth 30-37 m, 1.ix.2009.

Remarks.— The species of the genus *Sepiolo* can be divided into two groups. First the species with 2 rows of suckers up to the end of the 4th arm pair to which e.g. *S. ligulata* Naef, 1912, *S. rondeleti* Leach, 1834, and *S. pfefferi* Grimpe, 1921, belong. The second group is characterized by 4 to 8 rows of suckers on the tips of the 4th arm pair (Naef, 1916). *Sepiolo steenstrupiana* Levy, 1912 from the Mediterranean Sea has 4 rows and *S. atlantica* and *S. tridens* both have at least 6 rows of tiny suckers on the tips. D'Orbigny (1841) described *S. atlantica*, distributed from the Channel along the Atlantic coast to the north coast of Spain. The available syntype of *S. atlantica* (MNHN 1209) comes from the Channel. Notwithstanding the bad state of the specimen (Lu et al., 1995) we could identify it as a *Sepiolo* with a long tentacular club (over 7 mm in dry state) and conspecific with shallow water specimens in the recent literature being referred to as *Sepiolo atlantica* d'Orbigny, 1841.

The morphological differences between *S. tridens* and *S. atlantica* are small. The most characteristic difference is the length and width of the tentacular club. The club of adult *S. tridens* is shorter (average 5 mm, maximum 7 mm) and narrower (average 1.5 mm, maximum 1.7 mm) than the club of *S. atlantica* with a length of over 7 mm and a width of more than 1.9 mm (Fig. 7). The number of sucker rows on the club of *S. atlantica* is 8 whereas in *S. tridens* there are 6. Juvenile *S. tridens* (DML 11 mm or shorter) have already the same club length as

adults, whereas those of juvenile *S. atlantica* are comparatively shorter than in adults. As a consequence juvenile *S. tridens* and juvenile *S. atlantica* cannot be separated with certainty. Compared to *Sepiolo atlantica* the bursa copulatrix of a mature female of *Sepiolo tridens* has a much larger extension towards the left gill (below the bursa in Fig. 6) and a deeper indentation behind the bursa at the back side of the mantle.

The base colour of *S. tridens* is light pinkish (Fig. 1). The base colour of *S. atlantica* is off-white (Fig. 2). For *S. tridens* the dark back with the connected chromatophores forming a honeycomb-like pattern is most characteristic. In *S. atlantica* this structure may at most be vaguely discernible on the dorsal side.

The hectocotylus of the two species has a different sucker arrangement. On the large crest before the tip, *S. atlantica* has 3 or 4 large suckers, whereas there are 5 to 8 large suckers there in *S. tridens* (Fig. 5).

Guerra (1986: 180) figured the variation in hectocotyli of *S. atlantica* in a dozen slightly different sucker arrangements.

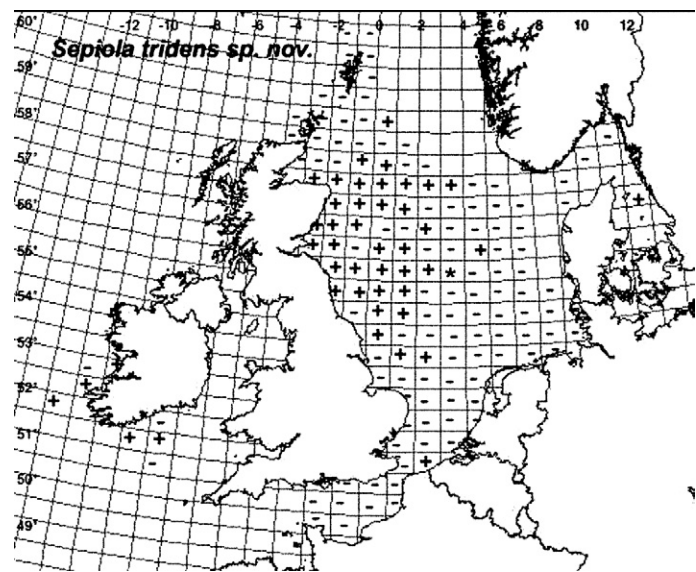


Fig. 8. Distribution of *Sepiolo tridens* spec. nov. (*type locality) of the north-eastern part of the Atlantic Ocean, the North Sea and Skagerrak. +, 1 or more specimens found; -, trawled but no specimens found. Data from surveys during 1996-2009.

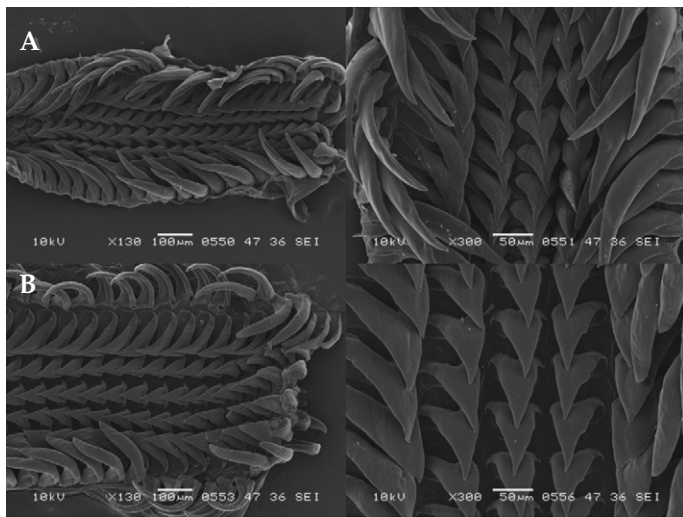


Fig. 9. Radulae, overview (left) and detail (right). **A**, *Sepiola tridens* spec. nov., paratype (RMNH 113775); North Sea, 55.5881687°N 0.8030067°W, depth 99 m, 27.i.2009. **B**, *Sepiola atlantica*; North Sea, 51.5306587°N 1.7565147°E, depth 41 m, 23.i.2009.

None of these represent the characteristic hectocotylus crest with 5-8 larger suckers as are present in *S. tridens*. All *Sepiola* in the study of Guerra were collected in the coastal area of the Ria de Vigo (NW Spain) at depth of 2-40 m. We consider these specimens conspecific with *S. atlantica* from the shallow water of the North Sea and the English Channel.

D'Orbigny (1841) did not recognize the hectocotylus as a male sex organ, he considered it an abnormality probably as the result of a disease. Considering the fact that males develop their hectocotylus only towards adulthood a lot of variation in juvenile, immature and semi mature hectocotylus can be seen. The value of the fully mature hectocotylus as a character is considerable, but larger series of males should definitely be studied.

The radula of *S. tridens* is as long as in *S. atlantica* (Fig. 9), but narrower. The rachys and the lateral teeth of *S. atlantica* are more triangular than heart-shaped and the marginal teeth are broader and less pointed than in *S. tridens*.

Additional data.— After finishing the manuscript we received from Instituto Español de Oceanografía additional

Sepiolinae samples from the North-western continental shelf of Spain and from 250 km W of Ireland. From both areas we recognize *Sepiola tridens*. Off North-western Spain 21 samples were trawled between 102 and 293 m depth. In the Atlantic Ocean 250 km off Ireland as a bycatch among *Sepietta* species we recognized two samples with *S. tridens*, trawled at depths of 265 and 344 m. One additional sample (RMNH 120478) from off North-western Spain is added to the list with paratypes.

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