

First record of Nemertodermatida from Belgian marine waters

Mieke Boone^{1*}, Wouter Houthoofd¹, Wim Bert¹ & Tom Artois²

¹ Ghent University, Department Biology, Nematology Unit, K.L. Ledeganckstraat 35, B-9000 Gent, Belgium

² Hasselt University, Centre for Environmental Sciences, Research Group Zoology: Biodiversity & Toxicology, Agoralaan Gebouw D, B-3590 Diepenbeek, Belgium

*Corresponding author: mlboone.boone@ugent.be

KEY WORDS: Acoelomorpha, Nemertodermatida, new records, Belgium

Nemertodermatida is a small taxon of marine worms, comprising only eight described species. They are characterised by a nemertine-like epidermis (hence the name) and a statocyst containing (mostly) two statoliths (1). The phylogenetic relationships of the taxon have been (and still are) the subject of debate. Initially, they were placed within the acoel Platyhelminthes (2), but Karling (1, 3) considered them to be substantially different from the acoels in morphology of the gut and the statocyst, and placed the taxon Nemertodermatida outside the Acoela (3). In the first phylogenetic analysis of the Platyhelminthes by Ehlers (4), Nemertodermatida formed a sister group relationship with Acoela, together forming the taxon Acoelomorpha, at that time considered to be the sister group of Rhabditophora (4). This view was followed in most subsequent morphological studies (for a review: see 5). Smith et al. (6) suggested the possible polyphyly of the taxon Platyhelminthes, based on the absence of clear synapomorphies, and viewed the Acoelomorpha as one of the three well-defined monophyletic groups within the Platyhelminthes, the two others being Catenulida and Rhabditophora. Recent molecular phylogenetic studies (7; 8) corroborate the polyphyly of the Platyhelminthes and show the Nemertodermatida and the Acoela in a basal position within Bilateria. The presence of the small Hox cluster in both Acoela (9) and Nemertodermatida (10) is concordant with this phylogenetic position. Based on analyses of 18S rRNA and mitochondrial genes (7) and 18S and 28S rRNA sequences (11), the taxon Acoelomorpha was dismissed because it appeared to be paraphyletic; Nemertodermatida and Acoela are separate branches at the base of the Bilateria. A recent phylogeny based on a large number of taxa and multiple nuclear genes, however, provides support for a monophyletic Acoelomorpha, albeit also positioned at the base of the Bilateria (12). Because of this basal phylogenetic position, the study of Nemertodermatida is important for the understanding of the characteristics of the bilaterian ancestor (11) and it makes them important study-objects for morphologists and molecular biologists alike. Note that the latest study on the phylogenetic position of Acoelomorpha (13) challenges their basal position and places them within the Deuterostomia, together with *Xenoturbella*. In the most recent comprehensive taxonomic overview of Nemertodermatida (14), Sterrer revealed considerable intraspecific variation for characters such as size, colour, presence/absence of glands, etc. Hence, species

delimitation is often problematic and also cryptic diversity cannot be excluded, which makes nemertodermatids also interesting from a (molecular) taxonomical point of view. Regrettably, Nemertodermatida are known from a few distinct sampling spots only: the Swedish west coast, the east coast of North America, the Adriatic and the Mediterranean, which suggests that representatives of the taxon are difficult to collect.

The Belgian Continental Shelf, situated in the southern bight of the North Sea and characterised by a mainly sandy substrate, has not previously been sampled for turbellarians specifically, in contrast to the sandy beaches of the Belgian coast, the turbellarian fauna of which is very well known (15; 16). Recently, during a two-year period (2007 – 2009), researchers from the UHasselt and UGent sampled the Belgian continental shelf, in order to investigate the turbellarian fauna of sublittoral sandy sediments. The samples were taken with the research vessel “Zeeleeuw” of the Flanders Marine Institute (VLIZ) in different seasons: autumn (October 2007), winter (December 2007 and January 2008), summer (July 2008 and September 2008) and spring (March 2009). Sublittoral sand samples were collected with a Van Veen grab, after which the samples were left to rest for a few days. Afterwards, subsamples were scooped and animals were extracted from these subsamples following the MgCl₂ method (17). Animals were collected under a stereomicroscope and identified using an Olympus BX 51 microscope.

In these samples, a total of 60 specimens of Nemertodermatida were discovered, occurring in 10 sampling stations (Fig. 1), and three different species representing both families of Nemertodermatida could be discerned (already mentioned in 16): *Sterreria psammicola* (Sterrer, 1970) Lundin, 2000 (fam. Nemertodermatidae), *Nemertinoides elongatus* Riser 1987 (fam. Nemertodermatidae) and *Flagellophora apelti* Faubel & Dörjes 1978 (fam. Ascopariidae). Table 1 gives an overview of the sampling sites showing the number of specimens of each species at each of the sampling sites, depth and date of the sampling. In total, 11 specimens of *N. elongatus*, 2 specimens of *S. psammicola* and 20 specimens of *F. apelti* were found. In addition, 27 specimens were found that could not be identified, either because they were fragmented or not yet (fully) mature. Sterrer (14) also mentioned these same problems concerning species identification.

Despite the fact that the Belgian Continental Shelf is the subject of many scientific studies, this is the first record of Nemertodermatida in this area, thus expanding their known geographical distribution. An overview of the worldwide distribution of each of the three species can be found following these links:

Sterreria psammicola:

<http://maps.google.nl/maps/ms?ie=UTF8&hl=nl&msa=0&msid=100800064963713004739.00046b093b8f2cfa9dfa0&ll=10.983886,-87.553265&spn=173.668929,360&z=1>

Nemertinoides elongatus:

<http://maps.google.nl/maps/ms?ie=UTF8&hl=nl&msa=0&msid=100800064963713004739.00046af8c2fae451945c7&z=3>

Flagellophora apelti:

<http://maps.google.nl/maps/ms?ie=UTF8&hl=nl&msa=0&msid=100800064963713004739.0004694f3788119941f72&ll=10.983886,-87.553265&spn=173.668929,360&z=1>

The obvious explanation for the fact that specimens of Nemertodermatida have not been discovered earlier in the Belgian part of the North Sea is the lack of study on these animals in this area (and many other areas worldwide). Their occurrence in this area is, however, not unexpected, since the investigated sediments are of the same type as of the records elsewhere in the world. All three species have been found earlier in sandy bottoms, ranging from fine sand to coarse sand containing shell gravel (18), and this sediment is the main sediment type on the Belgian Continental Shelf. As to depth (see Table 1), the records for *F. apelti* in Belgium fall in the depth range of 2m to 400m mentioned in earlier literature (14), while we found specimens of *S. psammicola* and *N. elongatus* deeper than was known from earlier records (14). The presence of the genus *Ascoparia* Sterrer, 1998, a genus also occurring in sandy substrates, could not be proven in this study, but given the large fraction of unidentifiable specimens (27

out of 60), we cannot rule out their occurrence in this part of the North Sea. Further research is needed to determine whether the species typical of soft, muddy bottoms (*Nemertoderma bathycola* Steinböck, 1930 and *N. westbladi* Steinböck, 1938) are present on the Belgian Continental Shelf. This present study indicates that nemertodermatids could be present in many more localities than their known distribution suggests.

ACKNOWLEDGEMENTS

This research was funded by an aspirant grant to MB provided by the Research Foundation Flanders (FWO). The authors kindly thank the Flemish Marine Institute (VLIZ), especially Andre Cattrijse, for the use of the research vessel "Zeeleeuw", and would like to acknowledge the help of Nathalie De Hauwere (VLIZ) with the map of the sampling points. The sampling campaigns fit within project G.08.208 financed by the Research Foundation-Flanders (FWO-Vlaanderen).

REFERENCES

- KARLING TG (1974). On the anatomy and affinities of the Turbellarian orders. In: RISER NW & MORSE MP (eds), Biology of the Turbellaria, McGraw-Hill, New York: 1-16.
- STEINBÖCK O (1930-31). Ergebnisse einer von E. Reisinger & O. Steinböck mit Hilfe des Rask-Örsted Fonds durchgeführten Reise in Grönland 1926. 2. *Nemertoderma bathycola* nov. gen. nov. spec., eine eigenartige Turbellarie aus der Tiefe der Diskobay; nebst einem Beitrag zur Kenntnis des Nemertinenepithels. Videnskabelig Meddelende Fra Dansk Naturhistorisk Forening, 90:47-84.

TABLE 1

Overview of the sampling dates, the sampling sites with their depth and the number of each species found at every site. Species A: *Nemertinoides elongatus*, species B: *Sterreria psammicola*, species C: *Flagellophora apelti*, species D: unknown / unidentifiable.

Date	Sampling site	Latitude	Longitude	Depth	Species			
					A	B	C	D
17/10/2007	330	51°26.111	2°48.565	23m	2			
17/10/2007	Bleigh Bank	51°35.475	2°45.120	sublittoral				2
17/10/2007	435	51°34.662	2°47.424	31-33m				1
30/10/2007	UH09	51°26.772	2°49.500	17-19m	4		5	4
30/10/2007	UH07	51°20.272	2°45.641	16m				1
30/10/2007	UH10	51°23.471	2°51.677	15m			3	4
17/12/2008	330	51°26.111	2°48.565	22-24m	2	1		4
21/01/2008	Kwintebank	51°19.635	2°40.737	sublittoral				2
21/01/2008	Middelkerkebank	51°19.411	2°45.509	12m			2	
21/01/2008	Stroombank	51°12.174	2°43.799	10m		1		2
03/07/2008	UH07	51°20.272	2°45.641	16m			3	2
01/09/2008	Middelkerkebank	51°19.411	2°45.509	sublittoral				1
01/09/2008	UH09	51°26.772	2°49.500	20m			2	1
17/03/2009	UH09	51°26.772	2°49.500	21m	2			
17/03/2009	UH07	51°20.272	2°45.641	20-21m	1		3	2
17/03/2009	UH03	51°18.638	2°36.126	18-23m			2	1
Subtotal					11	2	20	27
Total number: 60								

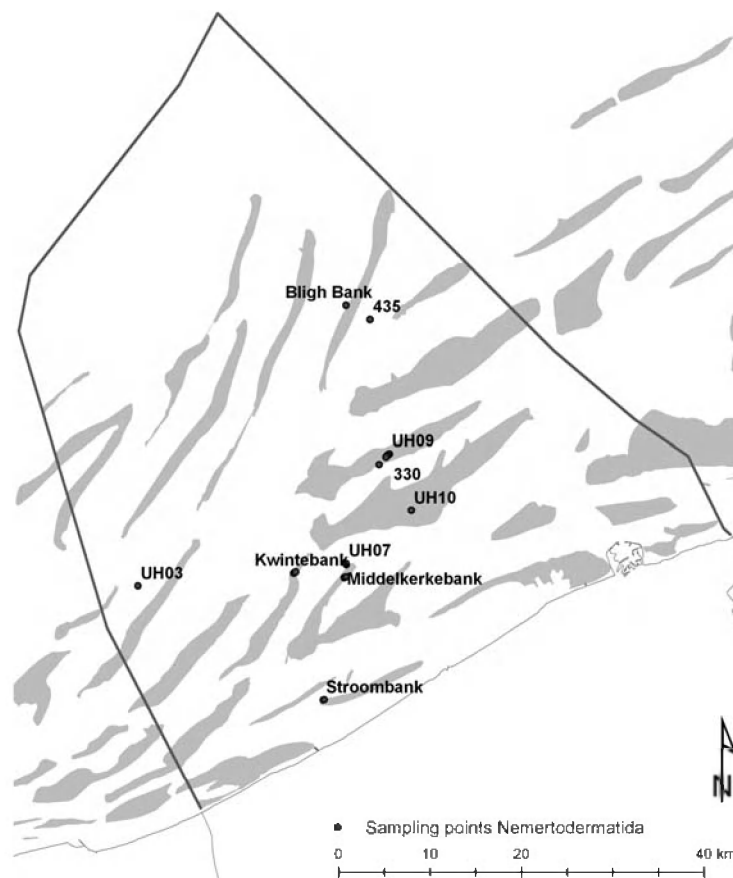


Fig. 1. – Map of the Belgian Continental Shelf and its sandbanks (dark grey) with the locations of the Nemertodermatida records (black dots).

3. KARLING TG (1940). Zur Morphologie und Systematik der Alloecoela, Cumulata und Rhabdocoela Lecitophora (Turbellaria). *Acta Zoologica Fennica*, 26: 1-260.
4. EHLERS U (1985). Das Phylogenetische System der Plathelminthes. Gustav Fischer Verlag, Stuttgart.
5. LUNDIN K (1997). Comparative ultrastructure of the epidermal ciliary rootlets and associated structures in species of the Nemertodermatida and Acoela (Platyhelminthes). *Zoomorphology*, 117: 81-92.
6. SMITH JPS, TYLER S & RIEGER RM (1986). Is the Turbellaria polyphyletic? *Hydrobiologia*, 132: 13-21.
7. JONDELIUS U, RUIZ-TRILLO I, BAGUNA J & RIUTORT M (2002). The Nemertodermatida are basal bilaterians and not members of the Platyhelminthes. *Zoologica Scripta*, 31(2): 201-215.
8. RUIZ-TRILLO I, PAPS J, LOUKOTA M, RIBERA C, JONDELIUS U, BAGUNA J & RIUTORT M (2002). A phylogenetic analysis of myosin heavy chain type II sequences corroborates that Acoela and Nemertodermatida are basal bilaterians. *Proceedings of the National Academy of Sciences of the United States of America*, 99(17): 11246-11251.
9. COOK CE, JIMENEZ E, AKAM M & SALO E (2004). The Hox gene complement of acoel flatworms, a basal bilaterian clade. *Evolution & Development*, 6(3): 154-163.
10. JIMENEZ-GURI E, PAPS J, GARCIA-FERNANDEZ J & SALO E (2006). Hox and ParaHox genes in Nemertodermatida, a basal bilaterian clade. *International Journal of Developmental Biology*, 50(8): 675-679.
11. WALLBERG A, CURINI-GALLETTI M, AHMADZADEH A & JONDELIUS U (2007). Dismissal of Acoelomorpha: Acoela and Nemertodermatida are separate early bilaterian clades. *Zoologica Scripta*, 36(5): 509-523.
12. PAPS J, BAGUNÀ J & RIUTORT M (2009). Bilaterian phylogeny: a broad sampling of 13 nuclear genes provides a new Lophotrochozoa phylogeny and supports a paraphyletic basal Acoelomorpha. *Molecular Biology and Evolution*, 26: 2397-2406.
13. PHILIPPE H, BRINKMANN H, COPLEY RR, MOROZ LL, NAKANO H, POUSTKA AJ, WALLBERG A, PETERSON KJ & TELFORD MJ (2011). Acoelomorph flatworms are deuterostomes related to *Xenoturbella*. *Nature*, 470: 255-258.
14. STERRER W (1998). New and known Nemertodermatida (Platyhelminthes – Acoelomorpha) – a revision. *Belgian Journal of Zoology*, 128(1): 55-92.
15. SCHOCKAERT ER, JOUK PEH & MARTENS PM (1989). Free-living Plathelminthes from the Belgian coast and adjacent areas. In: WOUTERS K (ed), *Proceedings of the Symposium "Invertebrates of Belgium"*: 19-25. Invertebraten van België, Brussels, Belgium K.B.I.N., 25-26 November 1988. Royal Belgian Institute of Natural Sciences: 19-25.
16. VANDEPITTE L, DECOCK W & MEES J (eds) (2010). *Belgian Register of Marine Species*, compiled and validated by the VLIZ Belgian Marine Species Consortium. VLIZ Special Publication, 46. Vlaams Instituut voor de Zee (VLIZ): Oostende, Belgium. 78 pp.
17. STERRER W (1971). Gnathostomulida: problems and procedures. *Smithsonian Contributions to Zoology*, 76: 9-15.
18. TYLER S, SCHILLING S, HOOGE M & BUSH LF (eds) (2006). *Turbellarian taxonomic database* (internet address: <http://turbellaria.umaine.edu/>)

Received: December 2, 2010

Accepted: April 29, 2011

Branch editor: De Troch Marleen