svenska artprojektet

SWEDISH TAXONOMY INITIATIVE PROJECT REPORT
Project period: 2011–2013

Oleksandr Holovachov
Swedish Museum of Natural History

NEMATODES:

Taxonomy and distribution of free-living nematodes of the order Plectida in Sweden 2011–2015

Introduction

Nematodes of the order Plectida are free-living and occur in almost every habitat in oceans, freshwater, on land, in epiphytes, mosses and lichens, and in symbiotic association with protozoans and invertebrates. This order contains over 510 valid species worldwide with most of its species known from Europe and adjacent seas. Only 83 species of Plectida were found in Sweden, and hence, there were good prospects for finding many species new to the fauna of the country and also for discovering species new to science.

Materials and methods

The first year of the project focused on collecting samples from marine habitats, creating a working collection of microscope slides, and examination of slides from the general and type collections of the Swedish Museum of Natural History, including slides from collections of C. Allgén and M. Hendelberg. Samples in terrestrial and marine habitats were collected during the second year of the project. The third and fourth years were dedicated to identification of nematodes, submission of slides with identified specimens to the collection of the Swedish Museum of Natural History, publication of the results. The fifth year completed the project with publication of final manuscripts.

During the first year, I obtained samples from diverse marine habitats: 23 samples were collected in Skagerrak, 45 samples in the Baltic Sea and 15 samples in the Gulf of Bothnia; among terrestrial habitats I sampled extensively in the forest habitats of the Eco-park *Färna*, where 23 samples were collected. Terrestrial habitats were sampled during the second year: 21 samples were collected in Abisko, 22 samples in Fulufjället, 5 samples in Tyresta National Parks. In addition, several samples were collected in Skagerrak during *Inventering*

Bratten project. No samples were collected during the third year, instead I focused on the analysis of already collected samples. During the fourth year, 16 new samples were collected in Skagerrak and Gullmarn Fjord with the purpose of finding additional material of several rare species in order to have sufficient material for their proper identification and description. The total number of samples collected during the entire duration of the project exceeds 280. These samples have not yet been archived in the wet collection storage since all of them are still being actively studied within the ongoing project *Systematics of Swedish free-living nematodes of the orders Desmodorida and Araeolaimida*.

All newly collected specimens for systematic studies were fixed in formalin to provides best quality of morphological preservation. Additional samples were fixed in 95 % EtOH and stored at -20°C for DNA preservation. For morphological studies, nematodes were mounted in glycerine on permanent glass slides. In order to provide long-therm preservation of morphological information, digital images of type specimens were taken, both for publication and to be deposited in the public database (*NeMys* at http://nemys.ugent.be/). Large majority of specimens preserved for molecular studies will be analysed during the ongoing project *Systematics of Swedish free-living nematodes of the orders Desmodorida and Araeolaimida*.

During the entire duration of the project over 1000 slides of more than 150 species of nematodes were deposited in the invertebrate collection the Swedish Museum of Natural History. Furthermore, 96 slides of 35 species are deposited in the type collection of the Department of Zoology of the Swedish Museum of Natural History; these include original new species and types from the collection of C. Allgén. Slides are geotagged with GPS coordinates (if known) and registered in the museum's collection database.

Results

The project proposal lists 83 species of Plectida recorded from the territory of Sweden and adjacent seas. Of them, only 48 species appeared in the literature, 22 species are from an unpublished report, and the remaining 13 are based on unpublished observations (S. Boström and B. Sohlenius). Subsequent analysis of the literature revealed that 16 species were incorrectly included in the Swedish fauna, and need to be removed from the list. Most of them were found in adjacent Baltic countries and may be found in Swedish parts of the Baltic Sea in the future. As a result, the revised list of Swedish species of the order Plectida (including most recent nomenclatorial changes, and excluding records not identified to species level, synonyms and species of uncertain taxonomic status) included 50 species before this project started as reflected in the latest report. Presence of 26 of these species in Sweden was confirmed during the entire project.

The first year added 12 species as new to fauna of Sweden, and 11 species as new to science. During second, third and fourth years of the project respectively ten, seven and six species were recorded for the first time in Sweden, and respectively nine, seven and four species new to science were discovered. The last year added one species new to fauna and one new to science. Thus, during entire duration of the project we discovered altogether 36 species new to Swedish fauna and 32 species new to science, of which three belong to two new genera, making a total of 118 species of the order Plectida found in Sweden so far. Of these, the descriptions of two new genera, 24 new species, 18 species new to Swedish fauna, and six poorly known species were published. The descriptions of remaining 14 new species were will be published during the ongoing project *Systematics of Swedish free-living nematodes of the orders Desmodorida and Araeolaimida*.

Nematode section of the *Dyntaxa* database was completely revised: the classification of nematodes was updated; the list of nematodes found in Sweden was revised to exclude erroneous records and include new findings. Furthermore, all taxonomic changes obtained during current project were incorporated in the *World Register of Marine Species* database (http://www.marinespecies.org/aphia.php?p=taxdetails&id=458811).

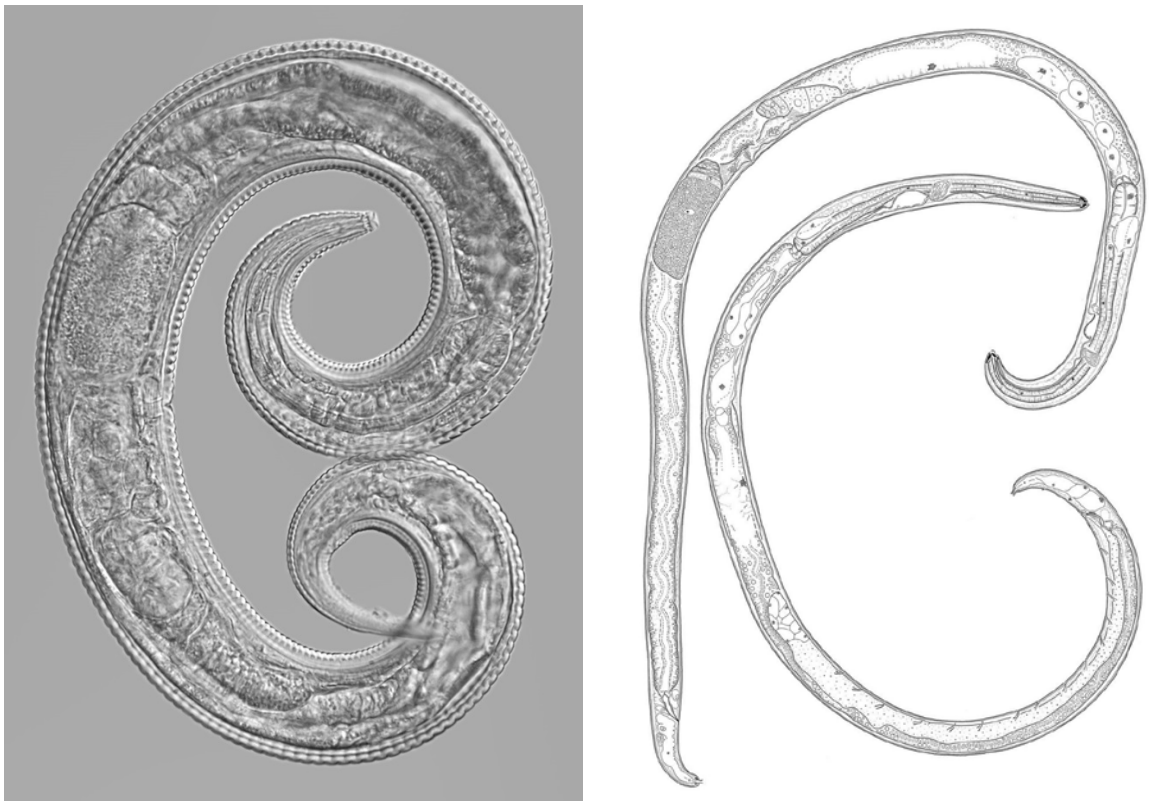
Every publication dealing with the systematics of known nematode genera includes a tabular compendium of diagnostically important morphological characters and a dichotomous key to species of the world fauna [1-2, 4-10]. A combined key to all genera of the suborder Plectina, and keys to species for most of its genera is submitted with the final report.

The results of the project are currently reported in 15 research papers [1-3, 5-11, 14-17], one monograph [4], one book chapter [13], one conference proceedings [18], one popular publication [19] and three web pages [20-22], making a total of 22 publications. Although some papers were not published as Open Access, they are available from the *NeMys* database.

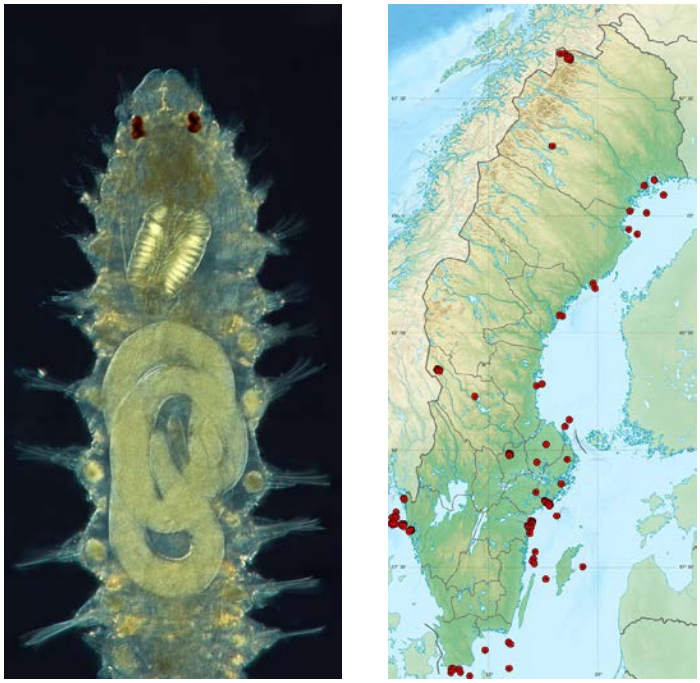
New faunistic discoveries made during this project were mentioned in the *Faunistiskt nytt – marina evertebrater* section of the *Göteborgs Naturhistoriska Museum Årstryck* in 2012-2014. The discovery of an unusual marine parasite *Neocamacolaimus parasiticus* was highlighted in *Metro* (04.06.2014)*, Bohusläningen, Göteborgs-Posten* and *ttela* (15.07.2014).

Discussion

Fauna of Sweden yielded considerable number of unknown species, both new to the fauna of the country, and new to science. All new species were discovered in relatively small area of the west coast: Gullmarn Fjord and Skagerrak, despite the fact that same localities have already been intensively studied by C. Allgen during 1920s-1950s. Samples from terrestrial habitats, on the other hand, did not yield any species new to science, and only few species new to Swedish fauna. This confirms that marine habitats of temperate Europe harbor much higher undiscovered diversity of non-arthropod invertebrates than terrestrial. To find new species and genera of marine invertebrates, one does not need to travel to exotic places or seek unusual habitat – extensive and rigorous sampling in well known and studied localities (such as the area of Gullmarn Fjord in the vicinity of both the *Lovén Centre Kristineberg* and *Klubban Biological Station*) will still bring many faunistic and taxonomic discoveries.



Leptolaimus sextus - New species of the genus Leptolaimus, *Leptolaimus sextus* found in Skagerrak.
Loveninema tubulosa - New genus and species, *Loveninema tubulosa*, found in Skagerrak.



Neocamacolaimus parasiticus - New unique parasitic member of Plectida, *Neocamacolaimus parasiticus*, infesting marine polychaete *Sphaerosyllis* cf. *hystrix*.

Sampling map - Localities sampled during the project.

PUBLICATIONS

1. Holovachov O. (2012). Swedish Plectida (Nematoda). Part 1. *Domorganus suecicus* sp. n. from Skagerrak. *Zootaxa* 3263: 63-68.
2. Holovachov O. (2012). Swedish Plectida (Nematoda). Part 2. The genus *Antomicron* Cobb, 1920. *Zootaxa* 3380: 39-54.
3. Holovachov O. & Boström S. (2012). Swedish Plectida (Nematoda). Part 3. The genus *Loveninema* gen. n. *Zootaxa* 3505: 26-38.
4. Holovachov O. & Boström S. (2013). Swedish Plectida (Nematoda). Part 4. The genus *Leptolaimus* de Man, 1876. *Zootaxa* 3739: 1-99.
5. Holovachov O. & Boström S. (2014). Swedish Plectida (Nematoda). Part 5. *Rhadinema timmi* (Vitiello, 1971) comb. n. *Zootaxa* 3779: 477-486.
6. Holovachov O. & Boström S. (2014). Swedish Plectida (Nematoda). Part 6. *Neocamacolaimus parasiticus* gen. n., sp. n. from Skagerrak. *Zootaxa* 3821: 538-550.
7. Holovachov O. (2014). Swedish Plectida (Nematoda). Part 7. *Setostephanolaimus tchesunovi* sp. n. from the west coast of Sweden. *Zootaxa* 3847: 576-582.
8. Holovachov O. (2015). Swedish Plectida (Nematoda). Part 8. The genus *Onchium* Cobb, 1920. *Zootaxa* 3911: 521-546.
9. Holovachov O. (2015). Swedish Plectida (Nematoda). Part 9. New species from the genera *Antomicron* Cobb, 1920 and *Leptolaimoides* Vitiello, 1971. *Zootaxa* 3955: 83-100.
10. Holovachov O. & Boström S. (2015). Swedish Plectida (Nematoda). Part 10. The genus *Deontolaimus* de Man, 1880. *Zootaxa* 4034: 1-44.
11. Holovachov O. (2013). *Tarvaia allgeni* sp. n. from the Gullmarn Fjord, Sweden (Nematoda: Tarvaiidae). *International Journal of Nematology* 23: 49-53.
12. Holovachov O. (2015). Description of *Aegialoalaimus bratteni* sp. n. from Skagerrak and a review of the genus (Aegialoalaimidae, Nematoda incertae sedis). *Biodiversity Data Journal* 3: e 5738.
13. Holovachov O. (2013). 7.16 Order *Plectida* Gadea, 1973. In: Schmidt-Rhaesa A. (ed.) *Handbook of Zoology. Gastrotricha, Cycloneuralia, Gnathifera. Volume 2: Nematoda.* de Gruyter: 487-535.
14. Holovachov O. (2014). Nematodes from terrestrial and freshwater habitats in the Arctic. *Biodiversity Data Journal* 2: e1165.
15. Holovachov O. (2016). Corrigendum: Nematodes from terrestrial and freshwater habitats in the Arctic. *Biodiversity Data Journal* 4: e7768
16. Holovachov O. & Boström S. (2014). *Yeatesinia barbata* gen. n., sp. n. (Nematoda: Plectida: Plectidae), a most remarkable nematode from New Zealand. *Nematology* 16: 953-962.
17. Holovachov O., Camp L. & Nadler S.A. (2016). Sensitivity of ribosomal RNA character sampling in the phylogeny of Rhabditida. *Journal of Nematology*, in press.
18. Holovachov O. (2013). Taxonomy and distribution of free-living nematodes (Plectida) in Sweden. *Systematikdagarna 2013 program and abstracts*: 8.
19. Holovachov O. & Boström S. (2013). Många nya arter av nematoder i bottenslammet. *Fauna och Flora* 108 (4): 28-34.
20. Testorf M., Holovachov O. & Boström S. (2012). Två nyfunna rundmaskar i Skagerrak. *http://www.nrm.se/forskningochsamlingar/forskningsnyheter/forskningsnyheter2012/tvanyfunnarundmaskariskagerrak.18336.html* (pub. 05.11.2012, accessed 03.01.2014).
21. Testorf M., Holovachov O. & Boström S. (2013). Nya rundmaskar upptäckta i svenska vatten. *http://www.nrm.se/forskningochsamlingar/forskningsnyheter/forskningsnyheter2012/nyarundmaskarupptacktaisvenskavatten.8999732.html* (pub. 29.11.2013, accessed 03.01.2014).
22. Testorf M., Holovachov O. & Boström S. (2014). Ovanliga parasiter på svenska västkusten *http://www.nrm.se/forskningochsamlingar/forskningsnyheter/forskningsnyheter2012/ovanligaparasiterpasvenskavastkusten.9000903.html* (pub. 27.06.2014, accessed 01.03.2015).

Reviewed and approved: 2016-04-27