

Historical review of Dutch Pectinariidae with *Pectinaria belgica* as a new taxon for the Netherlands (Annelida: Polychaeta: Pectinariidae)

by

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Abstract

Two trumpet worms (Pectinariidae), which do not resemble the two known species: *Lagis koreni* Malmgren, 1866 and *Amphictene auricoma* (Müller, 1776), have recently been collected in the Dutch North Sea (Oyster Grounds). Their characteristics match those of *Pectinaria belgica* (Pallas, 1766), a species with a northern distribution. This paper summarizes the current state of knowledge of Dutch Pectinariidae and describes in detail the historical records of trumpet worms recorded in the Netherlands, along with the confusion around the species epithet *belgica*. *Pectinaria belgica* is reported here for the first time from the Dutch North Sea.

Key words: Annelida, Pectinariidae, history, review, diagnostics, distribution, Netherlands

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1. Introduction

Six species of Pectinariidae are known from Northern Europe, but their classification is controversial. In the literature, these species are regarded either as the genus *Petta* Malmgren, 1866 or the genus *Pectinaria* Lamarck, 1818 with subgenera: *Amphictene* Savigny, 1822, *Pectinaria* Malmgren, 1866, *Cistenides* Malmgren, 1866 and *Lagis* Malmgren, 1866, or each subgenus is considered a valid genus. Both alternatives are currently correct, but for the purpose of this paper each is considered a separate genus, as recommended by Hutchings & Peart (2002) and Hutchings et al. (2020). Pectinariidae include five genera with 66 species worldwide (Read & Fauchald 2020) and six species in Northeastern Europe: *Petta pusilla* Malmgren, 1866, *Amphictene auricoma* (Müller, 1776), *Pectinaria belgica* (Pallas, 1766), *Cistenides granulata* (L., 1767), *C. hyperborea* Malmgren, 1866 and *Lagis koreni* Malmgren, 1866. *Petta pusilla* and *C. hyperborea* are not discussed in detail in this paper as there is no problem with the diagnosis or the species has a northern distribution, respectively. However, the diagnosis of the remaining species was inconsistent throughout the literature. Characteristics of genera and species were quite confusing and resulted in misidentifications. This problem was likely started by Fauchald (1977) and has been consequently replicated in a number of more recent studies (e.g. Hutchings & Peart 2002; Gil 2011). Malmgren (1866) described the above-mentioned species in detail and gave generic diagnosis of the five genera. As more species were described, it became apparent that some characters within the generic diagnosis provided by Malmgren (1866) were more variable. When Fauchald (1977) gave the new generic diagnosis, he may have overlooked those described by Malmgren (1866) and Annenkova (1929), for in the latter both *Cistenides* species did not fit within *Cistenides* described by Fauchald (1977). Until recently, only two species of Pectinariidae were known to occur in the Netherlands: *L. koreni* and *A. auricoma*, both easily distinguishable. However, the discovery of two large specimens on the Dutch Oyster Grounds, whose characters do not resemble those of the two known species, revealed that another species occurs in the Dutch North Sea. For these specimens, it proved impossible to determine whether they were *P. belgica* or *Cistenides* when using Fauchald (1977), Hutchings & Peart (2002) or Gil (2011). With the use of other keys, such as Hartman-Schröder (1996), Holthe (1986), Jirkov & Leontovich (2013), Jirkov (2001) and Malmgren (1866), it became clear that the Dutch specimens must belong to *P. belgica* (Pallas). However, many mistakes have been made in the past

with respect to *P. belgica* and *L. koreni*, resulting in mixing of characteristics and a number of false records. This paper focuses on the historical and current state of knowledge about Dutch Pectinariidae.

2. Materials and methods

The records of *L. koreni*, *A. auricoma*, and the 2018 record of *P. belgica* from the Dutch North Sea are based on the material collected in the period of 1991–2019 by Rijkswaterstaat, Eurofins AquaSense (formerly Grontmij and AquaSense), Ecosub, Bureau Waardenburg and NIOZ. During the first years (1991–1994), 25 sites located along five transects perpendicular to the Dutch coast were sampled. This method was revised and, starting from 1995, it has been decided to collect single samples at 100 sites scattered across the DCS (Dutch Continental Shelf). Each site was sampled for benthic fauna and sediment using a Reineck box corer (0.078 m²). Benthic samples were stained with rose bengal, sorted and, whenever possible, the collected specimens were identified to the species level. *P. belgica* collected by NIOZ was sampled with a Triple-D dredge (Bergman & van Santbrink 1994) as part of a sampling campaign in 2019, when the Frisian Front was monitored. Dredge samples (20 cm x 20 cm) were collected over a stretch of exactly 100 m, resulting in a sample of 20 m². A sample was sieved first in a net behind the dredge (mesh size 8 mm), and then with a sieve on board (mesh size 5 mm). Everything that was collected was sorted and identified immediately on board. Species that were questionable or, for example, rare and sought for a reference collection (like *Pectinaria belgica*) were preserved in 4% formaldehyde and brought to the laboratory for additional examination.

2.1. Basic description of Pectinariidae

Pectinariidae, “trumpet worms” or “ice-cream-cone worms” (in Dutch: *Goudkammertjes*), are easily recognizable by their distinctive anterior golden paleae (Fig. 1). They live in a fragile and thin cone-shaped tube consisting of sand, small shells, or other small particles. The diagnosis of the family is presented in Rouse & Pleijel (2002), Zhang & Hutchings (2019) and Hutchings et al. (2020), and some relevant characters of the European species are reproduced below. The anterior-dorsal part of the head (operculum) is marked by two bundles of large golden paleae that extend forward. The dorsal edge of the operculum, the opercular rim, can be either serrated (*Amphictene*) or smooth (other genera).

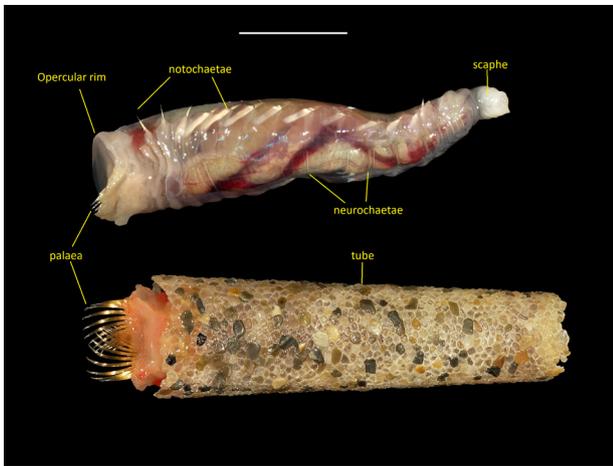


Figure 1

Basic morphology of Pectinariidae (*L. koreni*); outside and inside the tube (photo courtesy of Hans Hillewaert). The white line represents 1 cm.

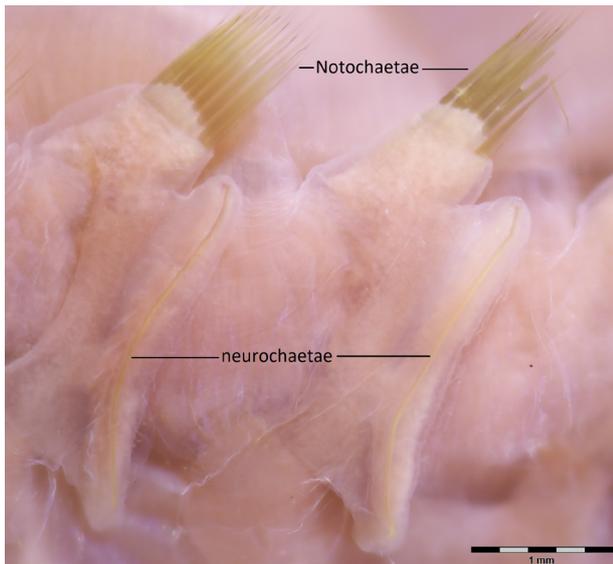


Figure 2

Details of the abdominal segment in *Lagis koreni* showing notopodial hairs and neuropodial uncini (photo courtesy of T. van Haaren)

The thoracic region bears two pairs of branchiae and three segments with notopodial hairs only. The abdominal region has 12 or more segments with both notopodial hairs and transverse rows of neuropodial uncini (Fig. 2). The total number of segments with notochaetae and neurochaetae has been used by Malmgren (1866) as a generic character (Table 1), but with the description of more recent species this number proved to vary within a genus and to be stable within a species. At least in Dutch specimens of *A. auricoma* and *L. koreni*, the number of segments with notochaetae and neurochaetae remains the same as individuals of the species grow (T. van Haaren, unpublished observations). The scaphe, the posterior part of the body, is usually well demarcated from the abdomen, except in *Petta*. The scaphe segments are achaetous, though there may be up to 20 or more pairs of stout spine-like chaetae, called scaphal hooks, around the area where the scaphe joins the abdomen. In most 19th-century taxonomic papers, only the number of palaea, notochaetae and neurochaetae, the shape of the opercular rim (smooth or serrated) or cephalic veil (with or without cirri) are reported (e.g. Savigny 1822; Grube 1851; Johnston 1865; Levinsen 1884). Sometimes the shape of the sand tube is also reported (curved or straight) (Savigny 1822; Johnston 1865; Malmgren 1866 and others), but in the author's opinion it has no diagnostic value. The shape of the tube depends on the size, and often the thinner, fragile end section breaks off, "changing" the shape from a curved to a straight tube. Other research indicates that one has to pay attention to several other characteristics, such as the number of vertical rows of major teeth on the uncinus (e.g. Annenkova 1929; Fauvel 1936; McIntosh 1922; Hutchings & Peart 2002), which was mostly neglected in the 18th and 19th century papers. Nowadays, it is used in the generic diagnosis and regarded as a diagnostic feature to distinguish *Cistenides* from *Pectinaria* (Fauchald 1977; Hartmann-Schroder 1996; Hutchings & Peart 2002; Hutchings et al. 2020).

Table 1

Species characteristics sensu Malmgren (1866)

Species	Number of notochaetae	Number of neurochaetae	palaea	Opercular rim	Cephalic veil	Origin of the material
<i>L. koreni</i>	15	12	14 thin	smooth	with cirri	W coast of Norway and France, 54–91 m
<i>A. auricoma</i>	17	13	11–13 thin	serrated	with cirri	W coast of Sweden and Norway, 21–183 m
<i>P. belgica</i>	17	13	10–12 thin	smooth	with cirri	Bohuslän, 73–128 m
<i>C. granulata</i>	17	12	9(–10) not thin	smooth	with cirri	Greenland, 29–146 m
<i>C. hyperborea</i>	17	12	12–14 thin	smooth	with cirri	Spitsbergen, Greenland, Finnmark, 18–457 m
<i>P. pusilla</i>	17	14	11 thin	smooth	smooth	Bohuslän



3. Results

Historical investigation is necessary to determine whether *P. belgica* has ever been found in the Netherlands before. It is not unlikely that mistakes have been made in the past. After Pallas (1766) described the first two species, including *P. belgica*, the number of Pectinariidae species increased. A literature review for descriptions of Pectinariidae species in Europe and a comparison with the original species of Pallas (1766) is important to determine the actual distribution of this species.

3.1. History of *Pectinaria belgica* (Pallas, 1766)

Peter Simon Pallas (1741–1811) was born in Berlin and studied at the universities of Berlin, Halle, Göttingen, Leiden and London. From 1762 to 1766 he stayed in 's-Gravenhage (The Hague), after which he completed *Miscellanea zoologica* (1766) where he described several vertebrate and invertebrate species new to science, including *Nereis cylindraria* var. *belgica*. Several of his works, including *Miscellanea zoologica*, have been translated by P. Boddaert from Latin into Dutch (Boddaert 1770). In 1767, Pallas became a professor at the St. Petersburg Academy of Science (Russian Kunstkamera at the Academy of Sciences), where he led several expeditions in Russia. He finished his work in Crimea and moved to Berlin, where he died in 1811. His material on *Nereis cylindraria* var. *belgica* is untraceable, or at least not to be found in the St. Petersburg Museum (N. Slepikova, personal communications) or the Naturalis Biodiversity Center (Leiden).

In *Miscellanea zoologica*, Pallas describes two varieties of *Nereis cylindraria*, *N. cylindraria* var. *capensis* (from the Cape of Good Hope, South Africa) and *N. cylindraria* var. *belgica*, based on specimens washed up on Dutch beaches. As Pallas was staying in The Hague at that time, his material of var. *belgica* was most likely from the beaches of Scheveningen. In that period, there was only one main road from Den Haag to Scheveningen (Scheveningse weg), leading to the Oude Kerk (English: old church), so it can be assumed that his material originates from the beach near the Oude Kerk, Scheveningen (52°6'28"N; 4°16'12"E).

Both varieties can be attributed to Pectinariidae. *N. cylindraria* var. *capensis* (as “Kaapsche Verscheidenheid”, the corresponding Dutch vernacular name of this species in Boddaert 1770) differs from *N. cylindraria* var. *belgica* (“Hollandsche verscheidenheid” in Boddaert 1770) in a crenulated dorsal edge behind the head, while in *belgica* this edge is smooth (Pallas 1766; Boddaert 1770). Furthermore, it appears from

the original description of *N. cylindraria* var. *capensis* that *N. cylindraria* var. *capensis* has 13 neurochaetae. In the following description of *N. cylindraria* var. *belgica*, Pallas (1766) writes that this species is the same as the previous one, except for the size (three times smaller; the tube is up to 2.5 duim in *N. cylindraria* var. *belgica* and up to 5 duim in *N. cylindraria* var. *capensis*; 1 duim = 1 inch), the dorsal edge (crenulated in *N. cylindraria* var. *capensis* and smooth in *N. cylindraria* var. *belgica*), and the scaphe (long in *N. cylindraria* var. *capensis* and short in *N. cylindraria* var. *belgica*). Several other details can be derived from the plates. It is clear from Figure 5, Plate IX in Pallas (or Plate IV in Boddaert 1770) that var. *belgica* has 14 or 15 notochaetal bundles posterior to the gills (Fig. 3). The number of neurochaetae is impossible to determine and one can only guess whether Pallas ever saw a difference in the number of neurochaetae between *N. cylindraria* var. *capensis* and *N. cylindraria* var. *belgica*. It cannot be inferred from that paper whether var. *belgica* also has 13 neurochaetae, as does var. *capensis*.

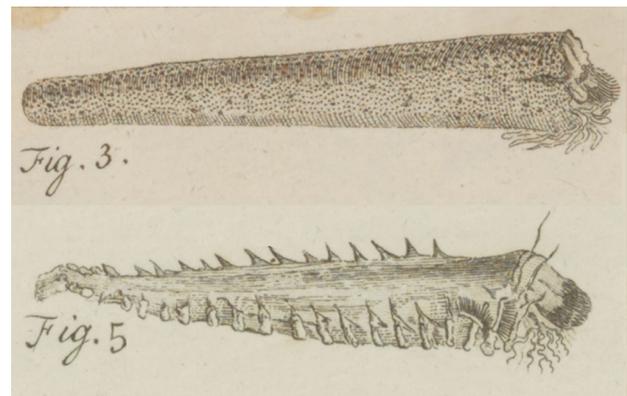


Figure 3

Nereis cylindraria var. *belgica*, Fig. 3 (tube) and Fig. 5 (animal) in Pallas 1766 (source: Iconographia Zoologica)

There is also the question of the etymology of the species epithet “*belgica*”. The Netherlands was formerly divided into two regions, the northern region and the southern region. The northern region, known as the “united provinces of the Netherlands” or in Latin “Belgium Foederatum”, was a federal republic from 1588 until the Batavian revolution in 1795. It largely covered the territory of the present-day Netherlands. The southern region covered the territory of today’s Belgium and was occupied by Spain (1585–1713) and Austria (1714–1795). The latter period is also known as the “Austrian Netherlands” or in Latin “Belgium austriacum”. Thus, when Pallas stayed in The Hague (1762–1766), he actually was in the northern region or Belgium Foederatum, which explains the name

"belgica". Papers from before 1795 in which Belgium or Belgii is reported refer either to the present-day Netherlands or to Belgium, e.g. Linné (1788, p. 3749) says "habitat ad Belgii littora". Later reports of *P. belgica* from Belgium (e.g. Southern 1910, 1914; McIntosh 1922) are either due to this geographical misunderstanding of the name Belgium/Belgii, or to the assumption that Malmgren described the same species as that described by Pallas.

3.2. History of *Cistenides granulata* (Linné, 1767)

In 1767, Linné describes *Sabella granulata*, but his description of the species ["Lives in a curved dark colored sandy tube (...) in deeper parts of the North Atlantic Ocean"] is very scanty.

Houttuyn (1771) provides a Dutch translation of Linnaeus' *S. granulata* (species 809 on pages 611–612) saying that the tube is composed of brown sandy grains and has dark color. Houttuyn (1771) also writes that such tubes of sand and shell debris can also be found on Dutch beaches. According to the current state of knowledge, however, it appears that these tubes, containing shell remains, may represent tubes of *Lanice conchilega* (Pallas, 1766), another common species on the Dutch coast. Furthermore, species with features of the current concept of *C. granulata* have never been found in the (Dutch) North Sea. It is therefore most likely a common mistake in 18th and 19th century papers to name each species with a sandy tube *S. granulata*, *P. belgica*, or perhaps *L. conchilega*. Malmgren (1866) wrote a more detailed description, also adding that the paleae of *P. granulata* lack a thin tip ("apice haud tenui attenuatto"), a character now considered diagnostic.

3.3. History of *Amphitene auricoma* (Müller, 1776)

The description of *Amphitrite auricoma* in Müller (1776) is very scanty. He describes the species as having golden fans of stiff bristles on both sides of the head and living in fragile sand tubes. However, in 1779 and 1788, Müller gave a more detailed description and a very nice color plate (Plate XXVI, Fig. 5) clearly showing the serrated edge of the opercular rim, a characteristic feature of this species at that time. Nowadays, this serrated edge is regarded as a generic feature of the genus *Amphitene*.

It is also interesting that Müller creates a new name for *Sabella granulata* L., as he lists it under the synonymy of *A. auricoma*. Since Fabricius was Müller's student and they were in contact, Müller published some data from Fabricius before the famous book of this author on the Greenland fauna was published

(Fabricius 1780). It seems that Fabricius did indeed find the species in Greenland, and it is possible that Müller is referring to the findings of Fabricius in Greenland. However, Müller (1766) does not make any direct reference to the work of Fabricius, except maybe the use of the Greenlandic (vernacular) name (*Imab Polia*). As Fabricius was a linguist, he used to name each species with a Greenlandic vernacular name as well, and most likely Müller copied that in his 1776 book. The extensive description by Fabricius (1780) in his book "Fauna groenlandica" on *A. auricoma* is therefore interesting. Fabricius writes "Segmenta 3 sequentia utrinque papillo conico setis paucis aureis armato, sursum retroque tendente; 12 sequentia similia, fed fetis pluribus et longioribus (...); translated by the author as: "3 segments papillose with golden hairs, 12 others more or less similar, but with more and longer hairs". The presence of 15 pairs of notochaetae suggests that he actually referred to *L. koreni*, the only NW European species with this character. Grube (1871) suggests that Fabricius' *A. auricoma* is synonymous with *P. granulata*.

3.4. History of *Lagis koreni* Malmgren, 1866

In 1866, a revision on Scandinavian polychaetes was published by Anders Johan Malmgren. In his chapter on the family Amphiteneae, he gives a redescription of *P. belgica* (Pallas) and *A. auricoma* (Müller), describes the genus *Petta* and the type species *Petta pusilla*, the genus *Lagis* with the type species *L. koreni* and the genus *Cistenides* with the type species *Sabella granulata* L. and the new species *C. hyperborea*. The diagnostic features of these species are presented in Table 1.

These features of the European (read: Scandinavian) species were generally followed by subsequent authors, but the number of paleae is more variable. Malmgren's material of *P. belgica* from Bohuslän (Swedish west coast along the Kattegat) is still available for study and has been assigned as the neotype of *P. belgica* (Pallas) by Nielsen et al. (1977). It is present in the Swedish Museum of Natural History, Invertebrate Zoology, type no. 3138. The nomenclatural problem of these European Pectinariidae, and especially *L. koreni* vs *P. belgica*, is extremely complex and results from the accumulation of successive errors and misinterpretations. The main problem was that Malmgren assigned the name *belgica* to an actually new species, and created a new species (*L. koreni*) for what actually was *belgica* Pallas. Morphology, ecology and distribution data clearly show that *Nereis cylindraria* var. *belgica* Pallas must be identical to *L. koreni* Malmgren. It is most likely that Pallas



was collecting Pectinariidae specimens with 15 segments with notochaetae and 12 segments with neurochaetae, as this is the only species on the west coast of the Netherlands (see the next paragraph). On the other hand, faunistic changes over the last 250 years cannot be entirely ruled out. Consequently, Malmgren's material of *P. belgica* (17 notochaetae, 13 neurochaetae) cannot be identical with Pallas' material of *Nereis cylindraria* var. *belgica*. This matter was addressed by Lucas & Holthuis (1975). However, returning to the correct meaning of *belgica* would mean that many contemporary papers would have to change the meaning and create a third name, while suppressing *koreni* (as a junior synonym of *belgica*). To avoid this inconvenience, the committee decided, at the request of Nielsen et al. (1977), to continue using the names sensu Malmgren. This meant announcing the neotype *belgica*. There were objections to codify the misidentification (Holthuis 1978), but the request was supported by a large number of marine biologists (Nielsen & Kirkegaard 1978). The final decision was issued by the ICZN in 1982 (Opinion 1225), putting an end to the discussion. The committee ruled that Malmgren's species of *Pectinaria belgica* Pallas from Bohuslän was to be regarded as a valid type, with *P. belgica* retaining the original author – Pallas. However, it was overlooked at that time that a candidate name for the new species – misidentified by Malmgren as *P. belgica* – was actually available. French Professor Giard (1899, 1913) attempted to solve the problem earlier by introducing *Pectinaria septentrionalis* as an alternative to Malmgren's *P. belgica* and preserving the name *P. belgica* as originally intended by Pallas. Since then the name has been overlooked (or neglected), even by Lucas & Holthuis (1975), and consequently also by the committee. Giard (1899: p. 489) and Giard (1913: p. 122) writes (translated by the author from French): "I have preserved the name *Pectinaria belgica* assigned by Bouchard-Chantereaux for an Amphictenien so common on our sandy beaches. It is indeed the species that Pallas had before his eyes when describing *Nereis cylindrica* var. *belgica*. It is the same species that Malmgren has since called *Lagis koreni*, reserving the name of *Pectinaria belgica* Pallas for a species of the Arctic seas whose presence on the coasts of France and Belgium seems to us very doubtful. To avoid any confusion, it would be advisable to restore the name of *Pectinaria belgica* Pallas to the species from the coasts of Holland, Belgium and France and to give the name *Pectinaria septentrionalis* to the species from Norwège, which does not penetrate the Baltic". This available name *P. septentrionalis* Giard, 1899 does not change the validity of both *L. koreni* and *P. belgica*. The committee

ruled to maintain the prevailing use of *L. koreni* Malmgren, 1866 (type locality Finnmark, Norway) and *P. belgica* (Pallas, 1766) (type locality Bohuslän, Sweden) as valid species.

3.5. History of Pectinariidae from the Dutch west coast

There are numerous reports on Pectinariidae washed up on Dutch shores, especially after SE storms and in spring. They mostly report empty tubes, which cannot be linked to any Pectinariid species, but sometimes they provide some information on the worm itself.

17th century: Dutch biologist Jan Swammerdam (1637–1680) worked until his death on his major work, published posthumously in 1737–1738 by Leiden University Professor Herman Boerhaave as *Bijbel der natuure*. In Volume 2 (1738), Jan Swammerdam describes a trumpet worm (as 'pijpen') from material he found on the beaches of the North Sea. This means that Pectinariidae (in this case most likely *L. koreni*) were already washed up on Dutch beaches in the second half of the 17th century. The material he found, although circumstantial, probably originated from a beach in Zuid-Holland, as he probably made his observations while studying at Leiden University (1661–1667).

1762: In *Natuurkundige Uitspanningen*, Baster writes about *Amphitrite* (translated from Dutch by the author): "When walking along the beaches on the isle of Schouwen in February and March, one may notice a number of small 'blisters' filled with pink or reddish-brown eggs. From these eggs 'zand-aaltjes' hatch, Amphitrite, which hide in the sand immediately after hatching" (Baster 1762, p. 44). It is impossible to tell from his figure (Table V, Figure 1) what species this might be.

1766: Pallas describes *Nereis cylindraria* var. *belgica*, which he collected on the beach at Scheveningen (see above).

1826: Bennet & van Olivier (1826) report three species of tube-dwelling worms from the Dutch beaches, *Amphitrite auricoma* (p. 81), *Sabella chrysdon* (p. 159) and *Sabella belgica* (p. 160). The current status of the *A. auricoma* specimen they reported is not certain, but it is definitely a Pectinariid [translated from Dutch by the author: "slanting head, with 4 palps and with 2 transversely arranged, comb-shaped and gold-colored 'leaves' that glisten very strongly. Body tapering and a

row of brush-shaped nipples on both sides (...) second and third segment with four comb-shaped gills. Length 2–2.5 inches. Tube of fine sand.”]. Since their *A. auricoma* is reported from Dutch beaches, this may be the current concept of *L. koreni*. Their *S. chryson* belongs to the current concept of *Lanice conchilega* (Pallas). *Nereis conchilega* is on their list of synonyms and they describe the typical habitus of *L. conchilega* (e.g. tube of sand and shell debris, flexible). Their *Sabella belgica* is definitely the current concept of *L. koreni*, as they describe it as having a sandy tube and 12 feet. They also write (translated from Dutch by the author): “They live along the Dutch western beaches along the North Sea, especially at Scheveningen, were they can be found among shrimps”. The last sentence, at least, is noteworthy, as this is exactly what Pallas wrote – “(...) among shrimps”. It is worth noting that Bennet & van Olivier (1826: p. 160) gave *Sabella belgica* the vernacular name “Belgische zandkoker”, while the species does not even occur in Belgium. Again a misinterpretation of the species epithet *belgica*.

1851: Maitland (1851: p. 204) reports *Amphitrite auricoma* from the Netherlands with a long list of synonyms, including *Sabella granulata* L. and *Nereis cylindraria* Pallas, and he also refers to the record by Bennet & van Olivier (1826). The species is reported from Schouwen (*Baster*) and Scheveningen (*Bennet & Olivier*). *Baster's* record from Schouwen is probably not a Pectinariid (see above) and the latter record may still refer to the original Pallas record. Maitland also writes (translated from Dutch by the author): “sometimes in spring, the beaches of our coasts are covered with tubes of these animals”. From his very short Latin description it is impossible to tell which Pectinariid he actually described.

1866: In a note on Dutch caddisflies (Fam. Phryganeidae), van Hasselt (1866) compares the beautiful cases with sandy tubes of saltwater annelids he often found on Dutch beaches. He liked the paleae (“gulden lokken”) of our “*Amphitrite Belgica* (Amphictena, ook Pectinaria, auricoma)” (Hasselt, 1866, p. 211). This quotation shows that Hasselt (1866) considered *Amphitrite belgica* and *Pectinaria auricoma* to be the same species.

1898: In Horst’s checklist of Dutch Polychaetes, two species are reported on pages 26–27, *Pectinaria belgica* Pallas and *Pectinaria auricoma* Müll. He writes about *P. belgica* (translated from Dutch by the author): “The ‘belgische zandkoker’ is very common along our coast and sometimes can be found in large numbers on our beaches”. However, in his chapter on *Pectinaria*

auricoma he writes that “Hornell (Report upon the fauna of Liverpool bay) claims that Malmgren’s description of the species having 17 bundles of hairs and 13 comb-brushes is false, and that there are only 15 pairs of hair bundles and 12 pairs of the latter are present, like in *P. belgica*. This is, however, not the case. *P. auricoma* and *belgica* have 17 feet, but in the latter species, the two last segments are without bristles, unlike *auricoma*”. This is interesting as we may conclude from this that Horst’s and Hornell’s *belgica* are in fact *koreni*. Horst’s *P. belgica* can be assigned to *L. koreni* for he describes it as having 15 pairs of notochaetae and 12 neurochaetae. His *P. auricoma* has an extra pair of neurochaetae, so this one probably belongs to *A. auricoma* (see also Horst 1922). *P. belgica* is reported to be common along the Dutch coast and can sometimes be found in large numbers on the beach. *P. auricoma* is rare and was only found in dredge samples from the Zuiderzee at Wieringen.

1913: In a popular book on beach species by Heinsius & Jaspers (1913, p. 7 & Figure 1F), *Pectinaria belgica* is reported as very common, but from the drawings made by these authors it is impossible to tell which species of Pectinariidae they actually described. They even made an erroneous observation by calling the paleae “comb-shaped gills”.

1922: In the chapter on polychaetes in the Zuiderzee (Horst 1922, p. 274), *Pectinaria auricoma* is reported from Wieringen again. In this paragraph, it is very clear that the specimens described are indeed *A. auricoma* (translated from Dutch by the author): “This *Pectinaria* can be distinguished at first sight from *Pectinaria belgica*, common on our coast, by the slightly bent tube that it inhabits, which in the latter species is entirely straight. Furthermore, in *Pectinaria auricoma*, the opercular rim behind the paleae is equipped with fringe-like appendages, while it is smooth in *Pectinaria belgica* (Fig. 17a). There are 17 hair bundles on each side of the body, while the number of rows of combs is 13. The combs (Fig. 17b) are pedunculate, furnished with five to six larger teeth along the free edge and a group of finer teeth and an incision below that. At the base of the tail lobe (scaphe), which ends in a thin tip, there is a row of six anal hooks”. He clearly describes the current concept of *A. auricoma* and confirms the current knowledge about its distribution in the (northern) Dutch North Sea. It was already clear from Horst’s earlier publication (Horst 1898) that his Dutch material of *belgica* is the same as the current concept of *L. koreni*, with 15 notochaetae and 12 neurochaetae.

1939: Hana (1949, pp. 81–84) describes all that is



washed up on the beach after a storm (from the northwest) and spring tide. Based on his story (numerous straight tubes with worms having golden fans of stiff corneous bristles) and a photograph, there is no clear species description to determine which of the Pectinariidae species he may be referring to. An exact copy of his photograph from Hana (1949) is available in the “Nederlands Fotomuseum”. According to the available information, this is the original photograph by Kees Hana taken in April 1939 on the beach at Scheveningen.

1951: Korrynga (1951) reports one juvenile specimen of *Pectinaria koreni* from his culture of experimental oysters in the Eastern Scheldt on 25 June 1941 with an additional comment that “it apparently does not like that habitat”.

1942–1968: In the Dutch magazine “Het Zeepaard”, there are paragraphs entitled “C.S. feuilleton” where enthusiastic biologists could report on interesting marine species they found in the Netherlands. Pectinariidae (or in Dutch “Goudkammetjes”) are reported in large numbers from Dutch beaches. Mass strandings of “Goudkammetjes” were reported on 15 February 1942 (Scheveningen, Katwijk: Bremer 1942), 11 April 1947 (Scheveningen: Leenhouts 1947a), September 1947 (Katwijk-terheijde: Leenhouts 1947b), 9 October 1955 (Toorne, De Beer, Hoek van Holland, Scheveningen, Wassenaarse slag, Katwijk, Bloemendaal, IJmuiden: Swennen 1955), 14 January 1958 (Hoek van Holland : Wolff 1966), 6 February 1960 (Katwijk-Wassenaar: Spaink 1960), 17 November 1963 (Tholen: Compaan 1965), February–March 1965 (Scheveningen, Terheide: Compaan 1965) and 20 January 1968 (between Noordwijk and Noordwijkerhout: Heerebout 1968). These mass strandings are either reported as *Pectinaria* sp., *Pectinaria belgica*, *Pectinaria koreni* or *Pectinaria auricoma*. This seems strange as Bloklander (1947) had already written that specimens from Dutch beaches were in fact *Pectinaria koreni*, not *Pectinaria belgica*. For some reason, however, most reporters neglected this information until Wolff (1970) clarified the issue (again). For example, Wolff (1970) writes (translated from Dutch by the author): “If one now tries to name the ‘Goudkammetjes’ from the Dutch beach using the most common identification keys for polychaetes (Fauvel, 1927; Friedrich, 1940), one always arrives at one and the same species: *Pectinaria koreni* Malmgren 1865. Also all material from Zeeland and from the North Sea off the coast at the Delta area belongs, as far as I have seen, to this species”. As Fauvel (1927) and Friedrich (1938, Wolff incorrectly indicated 1940) are correct

according to the current knowledge about European Pectinariidae, one may conclude that all coastal species from the SW region are indeed *L. koreni*. This is confirmed by more recent findings (this paper).

1957: In his popular book on what can be found on Dutch beaches, Prud’homme van Reine (1957, p. 74) writes about two species of “Goudkammetjes” *Pectinaria auricoma* (Müller) and *Pectinaria koreni* (Malmgr.). He gives a very brief description of both species and depicts them on Plate XXII, Figure 7. It is not possible to tell from the descriptions which species is involved (about 15 tentacles on both sides of the mouth in *P. auricoma* and about 20 in *P. koreni*; the latter also being slightly larger). It is clear from aforementioned Figure 7 that his *P. auricoma* has a crenulated dorsal edge, while *P. koreni* has a smooth one. Apparently Prud’homme van Reine (1957) caught or expected both species on the Dutch beaches, but did not provide any data.

1973: Entrop (1973) writes about *Pectinaria koreni* washed up on the Dutch beaches. His short description (15 segments, 12 with hook shaped chaetae) leaves no doubt as to their identity: *L. koreni*.

1999: Prins (1999) reports on Pectinariidae (with original drawings) living in shallow waters along the Dutch coast, washed up on beaches after storms. According to him, the specimens had 15 fleshy protuberances, each ending in a brush of hairs. The original drawings show a smooth opercular rim, 15 notochaetae and a straight tube. It is impossible to determine as to how many neurochaetae they have, but they are also clearly *L. koreni*.

2002/2019: In two guides on marine species, Leewis (2002) and de Bruyne & Gmelig Meyling (2019) report *L. koreni* from the beaches along the Dutch coast. Since they both mention 15 segments, they clearly refer to *L. koreni*.

3.6. Dutch fauna: Species list and identification key

Based on the material from the Dutch North Sea, especially the descriptions by Malmgren (1866; see also Table 1), which is widely accepted as the correct diagnosis of the European species, the following list of Dutch species of Pectinariidae can be presented, together with a list of synonyms. The list is strictly based on morphological descriptions from the historical papers. *C. granulata* L. is not a Dutch species. It is an amphiboreal-Arctic species (Holthe 1977) and should not to be expected in the Dutch North Sea.

However, due to misinterpretations of the original and subsequent synonymization with other species of Pectinariidae, this species is also included.

At least Malmgren (1866), Levinsen (1884), Meyer (1912), Wollebaek (1912), Hessel (1917), McIntosh (1922), Fauvel (1927), Friedrich (1938), Holthe (1986), Hartmann-Schröder (1996), Kirkegaard (1996), Böggemann (1997) and Jirkov (2001) gave the correct species diagnosis for the NW European species. However, the generic characters need to be revised. Hutchings & Peart (2002, p. 109 + Table 6) are incorrect in claiming that 16 notochaetae is a generic character of the genus *Lagis*. This would be impossible as the type species *L. koreni* Malmgren, 1866 (by monotypy) has only 15 notochaetae. It is therefore worth noting that Icelandic specimens of *L. koreni* (Parapar et al. 2020) have 16 notochaetal bundles, which may suggest another *Lagis* species. Furthermore, Zhang & Hutchings (2019) indicated in their generic diagnosis of *Lagis* that these species should have 13 pairs of neurochaetae, but again *Lagis koreni* (the type species) have only 12 of them. On the other hand, they also write that the neuropodia are present on segments 8–19, i.e. on 12 segments. Furthermore, Fauchald (1977) and Hutchings & Peart (2002) are incorrect about *Cistenides*. At least *C. hyperborea* and *C. granulata* are species that have 12 neurochaetae, while the aforementioned papers report that they should have 13 neurochaetae. The number of neurochaetae in *C. granulata* is not reported in the original paper by Linné (1767), but Malmgren (1866) clearly writes that both species of *Cistenides* have 12 neurochaetae. Thus, it is unclear why Fauchald (1977) considered 13 neurochaetae as a generic character of *Cistenides*. Also the generic characters of *Pectinaria* (including *belgica*) and *Petta* in Hutchings & Peart (2002) are incorrect, as *P. belgica* does not have 14 but 13 neurochaetae, and *P. pusilla* does not have 18 but 17 notochaetae (see Malmgren, 1866). Zhang et al. (2019) corrected the number of notochaetae for *Petta* to 17. The number of vertical rows of the major teeth on the neuropodial uncini is reportedly of diagnostic value for distinguishing between *Cistenides* (1 row) and *Pectinaria* (at least 2 rows; Hutchings & Peart 2002, Hutchings et al. 2020). According to Annenkova (1929), however, *C. hyperborea* has 2–3 vertical rows, which places this species within *Pectinaria*. Thus, the number of vertical rows is not used in the key.

The six (possible) North Sea species can be identified using the information from Table 1 and the following simplified key:

1. Cephalic veil smooth, Scaphe indistinctly separated from posterior segments, 14 neurochaetae.....
.....*Petta pusilla*
- Cephalic veil ciliated, scaphe distinctly separated from posterior segments, 12–13 neurochaetae.....2
2. Opercular rim serrated, 17 pairs of notochaetae, 13 neurochaetae, scapal hook thin with hook-like tip.....*Amphictene auricoma*
- Opercular rim smooth. Scapal hooks straight or curved.....3
3. 15 notochaetae, 12 neurochaetae, scapal hooks thick and slightly curved. Club-shaped papillae on scaphe.....*Lagis koreni*
- 17 notochaetae. Scaphe with rounded or triangular lobes.....4
4. 13 neurochaetae, scapal hooks thick and almost straight.....*Pectinaria belgica*
- 12 neurochaetae (*Cistenides*).....5
5. Paleae blunt tipped, on average 7–10 paleae.....
.....*Cistenides granulata*
- Paleae with thin flexible tip, on average 10–15 paleae.....*Cistenides hyperborea*

Pectinariidae Quatrefages, 1865

Originally as *Pectinaria* on page 327 (Quatrefages, 1865), but according to Nielsen et al. (1977) this was corrected to Pectinariidae by Hartman (1941). However, it was already Hartman (1938: p. 16) who used the family name Pectinariidae and even Perrier (1897) used both Pectinariidae (p. 1556) and Amphictenidae (p. 1640).

Type genus: *Pectinaria* Lamarck, 1818

Species inquirenda

- 1731 *Solen fragilis* Klein, 1731, pp. 6–7 + Plate I.f. 4–5 (spec. 1 = cf *Lanice conchilega*) and spec. 2 = Pectinariidae)
- 1804 *Amphytrite belgica*; Renier 1804, p. XIX
- 1817 *Amphitrite auricoma belgica* Gm. (Pall. Miscell. IX, 3–5); Cuvier 1816: p. 521
- 1818 *Pectinaria belgica* (Pallas); Lamarck 1818: p. 350
- 1874 *Lagis (Pectinaria) koreni* Malmgren 1865; von Marenzeller, 1874: pp. 217–224
- 1884 *Pectinaria robusta* nov. (= *koreni* Marenz.); Levinsen 1884: pp. 156 & 288



- 1895 *Pectinaria belgica* Pall.; Lameere, 1895: p. 185, Figure VIII & p. 192
- 2002 *Cistenides hyperborea* Malmgren, 1866; Hutchings & Peart 2002: p. 109 + Table 2
- Pectinaria* Lamarck, 1818**
- Type: *Nereis cylindraria belgica* Pallas, 1766, subsequent designation by Malmgren, 1866.
- Pectinaria belgica* (Pallas, 1766) sensu Malmgren 1866 (non Pallas)
- Neotype: Swedish Museum of Natural History (Stockholm), SMNH 3138, designated by Nielsen et al. (1977) (type no. verified by curator Lena Gustavsson, 26 June 2020). Holthe (1986: p. 21) wrote wrong type no. 3133.
- Type locality: Bohuslän, Sweden; leg. S. Lovén (Nielsen et al. 1977).
- Please note that Malmgren made his redescription based on material he obtained from the Swedish Kattegat area (Bohuslän, Väderöarne isle and Kosterfjord).
- ? 1780 *Amphitrite auricoma* Müller; Fabricius 1780: pp. 289–291
- 1791 *Pectinaria capensis*, Lamarck V, 350; Bruguiere 1791: Plate 58, Figures 1–9
- ? 1851 *Sabella granulata* L.; Grube 1851, p. 82
- 1866 *Pectinaria belgica* (Pallas); Malmgren 1866: Nordiska Hafs-Annulater, pp. 356–357
- 1871 *Pectinaria (Pectinaria) belgica*, *Nereis cylindraria* var. *belgica* Pall., Malmgr.; Grube 1871, p. 73
- 1871 *Pectinaria (Pectinaria) belgica* Pall.; Leuckart, 1871: p. 31
- 1884 *Pectinaria belgica* (Pall.); Levinsen 1884: p. 155
- 1897 *Pectinaria belgica*; Perrier 1897: p. 1640
- 1899 *Pectinaria septentrionalis* Giard, 1899: p. 489
- 1912 *Pectinaria belgica* (Pall.1766); Meyer 1912: pp. 10–12
- 1912 *Pectinaria belgica* (Pall. 1766); Wollebaek 1912: pp. 39–40
- 1913 *Pectinaria septentrionalis* Giard; Giard 1913: p. 122
- 1914 *Pectinaria belgica* (Pallas); Southern, 1914: p. 47
- 1917 *Pectinaria belgica* (Pallas, 1778); Hessle, 1917: pp. 75–76
- 1922 *Pectinaria belgica* (Pallas, 1766); McIntosh, 1922: pp. 38–42
- 1927 *Pectinaria belgica* Pallas; Fauvel 1927: pp. 220–221
- 1928 *Pectinaria (Pectinaria) belgica* Pallas 1778; Nilsson 1928: pp. 73–75
- ? 1936 *Pectinaria belgica* Pallas; Fauvel, 1936: pp. 89–90
- 1938 *Pectinaria s.str. belgica* (Pallas), 1778; Friedrich 1938: p. 160
- 1941 *Pectinaria (Pectinaria) belgica* (Pallas); Hartman 1941: pp. 329 & 332
- 1955 *Pectinaria (Pectinaria) belgica* (Pallas); Ushakov 1955: p. 359
- 1986 *Pectinaria (Pectinaria) belgica* (Pallas, 1766) sensu Malmgren 1866; Holthe, 1986: p. 21
- 1996 *Pectinaria (Pectinaria) belgica* (Pallas, 1766); Hartmann-Schröder, 1996: pp. 485–486
- 1996 *Pectinaria (Pectinaria) belgica* (Pallas, 1766); Kirkegaard, 1996: pp. 282–283
- 1997 *Pectinaria (Pectinaria) belgica* (Pallas, 1766); Böggemann, 1997: p. 175 + Figure 125
- 2001 *Pectinaria belgica* (Pallas, 1766) sensu Malmgren 1866; Jirkov 2001: pp. 432–433
- 2002 *Pectinaria belgica* (Pallas, 1766); Hutchings & Peart 2002: p. 110 + Table 4
- 2011 *Pectinaria belgica* (Pallas, 1766); Gil 2011: pp. 634, 637
- 2013 *Pectinaria belgica*; Jirkov & Leontovich 2013, p. 220

Material

Oyster Grounds, 54°47'0"N, 4°25'0"E, 9 April 2018, 52 m, Reineck box corer, n = 1, leg. Eurofins AquaSense, det. T. van Haaren. Naturalis Biodiversity Collection RMNH.VER.19971

Oyster Grounds at either 54°8'58"N, 5°7'35"E (appr. 44.3 m) or 53°57'3"N, 4°52'27"E (41.1 m) or 53°51'4"N, 4°52'32"E (39.9 m), last week of October 2019, trawl survey, n = 1, leg. NIOZ (Texel), det. T. van Haaren. Collection NIOZ.

Description of the Dutch species

The specimens match the characters of the genus *Pectinaria* and the species *Pectinaria belgica*. The length of the specimen from the 2018 Reineck box corer is 6.8 cm and the one from 2019 trawl survey is 5.2 cm. In the largest specimen, the cephalic veil is free of the operculum and has 18 cirri, while in the smaller specimen the cephalic veil is damaged medially and has 14 visible cirri. The opercular rim entirely smooth. On both sides with 10 (large specimen) or 11 (smaller specimen) paleae with a fine thin tip. Two pairs of branchiae in 3–4, 17 pairs of notopodia in segments

5–21, neuropodia 13 pairs in 8–20. Scaphe distinctly separated from the posterior body, with small rounded lobes on the lateral edge basally and a short and rounded anal (ventral) flap, which is damaged in the smaller specimen. Seven or eight scaphal hooks, most with a broken tip, but a few whole with an almost straight blunt tip, only very slightly bent. Uncini with about two vertical rows of larger teeth.

Distribution in the Netherlands (Fig. 6)

Although Pallas' *Nereis cylindraria* var. *belgica* is in fact morphologically the same as Malmgren's *Lagis koreni*, the neotype of *P. belgica* (Pallas) from Bohuslän, Sweden is designated as the correct type. Consequently, and ironically, *P. belgica* (Pallas) is a new species for the Netherlands.

Only recently a single, fully grown specimen of *P. belgica* (Pallas) sensu Malmgren (non Pallas) was found in a sample collected at the Dutch Oyster Grounds (9 April 2018; Figs 4–5). Another single, somewhat smaller, specimen was collected in the last week of October 2019 at the Oyster Grounds during a trawl survey by NIOZ, Texel. The exact location and date is not known, but it was collected at three possible locations (see the material section; L. Kleine Schaars, NIOZ, pers. comm.).

There is no evidence that *P. belgica* (Pallas) sensu Malmgren was ever found in the Netherlands prior to this study. It seems likely that the northern part of the Dutch North Sea (north of the Frisian Front) may be the southernmost limit of this species. It is therefore unlikely that *P. belgica* will ever be found washed up on the Dutch coast, also due to the southern current.



Figure 4

Two species of Pectinariidae, *L. koreni* and *P. belgica* (preserved), both from the Dutch North Sea (Oyster Grounds 9 April 2018; photo courtesy of T. van Haaren)

Distribution in Europe

Due to the confusion with other species, the distribution of *P. belgica* is not well determined. Most likely its southernmost limit is around latitude 55 in



Figure 5

Live material of *P. belgica* just after being collected at the Oyster Grounds site (9 April 2018)

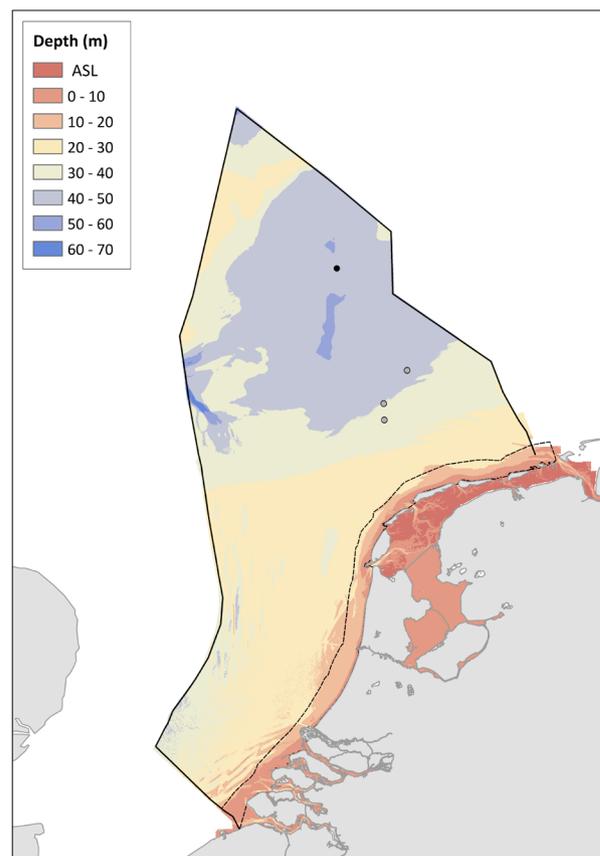


Figure 6

Distribution map of *Pectinaria belgica* in the Dutch North Sea. The record from 2018 is marked with the black dot (•) and the single specimen from 2019 is located in one of the open dots (o; exact location unknown)



subtidal sediments, usually at a depth of 40–50 m. It occurs in the North Sea, the western Baltic (Kattegat, Skagerrak) and Norway up to the North Polar Basin (Holthe 1986; Kirkegaard 1969, Jirkov, pers. comm.). According to Kirkegaard (1969), it is common in all deeper parts of the Danish waters, in the Øresund Region to the Copenhagen coast, but he recorded it only once during his investigation (1950–1955; Dogger Bank, 1952; 55°40'N, 6°31'E; 42 m). Parapar et al. (2020) did not report the species from Iceland. The records from France (Fauvel 1927), the Mediterranean Sea, the Black Sea and the Pacific coast of the USA and Canada (Kirkegaard 1969; Holthe 1986; Gil 2011) require examination of the material. According to Holthe (1977), *P. belgica* is an amphiboreal species.

Cistenides Malmgren, 1866

Type: *Sabella granulata* L., 1767, subsequent designation by Hartman (1941: p. 325)

Cistenides granulata (Linné, 1767)

Type: not designated.

Type locality: Deeper parts of the North Atlantic Ocean (“Oceano septentrionalis, locus profundis”)

- 1767 *Sabella granulata* Linné, 1767, p. 1268, sp. 335
 1771 *Sabella granulata*, Syst. Nat. XII, Gen 335, Sp I (= L., 1767); Houttuyn, 1771, p. 611
 ? 1812 *Sabella granulata*; Pennant 1812: p. 369
 ? 1843 *Amphitrite eschrichtii* Rathke, 1843, footnotes on pp. 119–120
 ? 1851 *Pectinaria belgica* (Pallas) (=syn? *Sabella granulata* L.); Grube 1851, p. 82
 ? 1851 *Pectinaria groenlandica*; Grube 1851, p. 82
 ? 1865 *Pectinaria groenlandica*; Grube; Quatrefages 1865, p. 335
 ? 1865 *Pectinaria groenlandica*; Grube; Johnston 1865: p. 246
 1866 *Cistenides granulata* (L. non Johnston); Malmgren, 1866, p. 359
 1884 *Pectinaria granulata* L.; Levensen, 1884: p. 155
 1912 *Pectinaria granulata* (Linné 1776); Wollebaek 1912: pp. 41–42
 1917 *Pectinaria granulata* (L.?); Hesse 1917: p. 77
 1928 *Pectinaria (Cistenides) granulata* (L.?1767); Nilsson 1928: pp. 28–30
 1929 *Pectinaria (Cistenides) granulata* (L.); Annenkova 1929: pp. 487–488 + Figures 32–35

- 1941 *Pectinaria (Cistenides) granulata* (Linnaeus); Hartman 1941, pp. 328, 330
 1955 *Pectinaria (Cistenides) granulata* (L.); Ushakov 1955: pp. 356–358
 1986 *Pectinaria (Cistenides) granulata* (Linnaeus, 1767); Holthe, 1986: pp. 24–25
 1996 *Pectinaria (Cistenides) granulata* (Linnaeus, 1767); Hartmann-Schröder, 1996: p. 482
 2001 *Pectinaria granulata* (Linné, 1767); Jirkov 2001: p. 433
 ? 2002 *Cistenides granulata* (Linnaeus, 1767); Hutchings & Peart 2002: p. 109 + Table 2
 2011 *Cistenides granulata* (L.1767), Gil 2011, pp. 634–645
 2013 *Pectinaria granulata*; Jirkov & Leontovich 2013, p. 220

Distribution in the Netherlands

It does not occur and is not to be expected in the Netherlands.

Distribution in Europe

C. granulata and *C. hyperborea* are restricted to subtidal sediments in boreal and Arctic regions (north of 65 latitude). According to Igor Jirkov (pers. comm.), *C. granulata* occurs only in the Barents Sea along the Kola Peninsula, while *C. hyperborea* is more widely distributed in the North Polar Basin, but only in the Arctic regions. In the boreal regions, from the southwestern Barents Sea and further to the south, *C. hyperborea* is replaced by *A. auricoma*. In the White Sea, along the coast of Norway and further to the south, *C. granulata* is replaced by *L. koreni*. The original record of *C. granulata* from the deeper parts of the North Atlantic Ocean (Linné 1767) and Greenland (Malmgren 1866) does seem to fit within the current known distribution of this species. Recently, Parapar et al. (2020) reported both *Cistenides* species in cold water of the Greenland Sea along the northern border of Iceland. They were unable to locate any *P. belgica* in Iceland. These studies may indicate that Linné, when describing his *Sabella granulata*, may have had a specimen with characters of the current concept of *Cistenides*. According to Holthe (1986), *C. granulata* and *C. hyperborea* may be more widely distributed in the Arctic regions up to a depth of about 250 m. However, Zhang et al. (2019) concluded, based on molecular studies, that specimens of *Cistenides granulata* from the Pacific (British Columbia) and Atlantic (Manitoba) coasts of Canada belong to different species. Nevertheless, it is unlikely that *Cistenides* will ever be found in the Dutch North Sea.

Amphictene Savigny, 1822

Type species: *Amphitrite auricoma* O.F. Müller, 1776; subsequent designation by Malmgren (1866:p357)

Amphictene auricoma (Müller, 1776)

Type: probably lost or never designated

Type locality: not given. Holthe (1986) says Denmark, but Müller (1776) describes species from Denmark and Norway and the material is probably the same as Linné's *S. granulata* from Greenland (see above). Type locality is therefore most likely Greenland (see history of *Amphictene auricoma*).

- 1776 *Amphitrite auricoma* O.F. Müller 1776: Zoologiae Danicae Prodomus: p. 216, sp. 2622
- 1779 *Amphitrite auricoma*; O.F. Müller 1779: Zoologica Danica 1: pp. 54–55 + Plate XXVI
- 1788 *Amphitrite auricoma*; O.F. Müller 1788: Zoologica Danica 1: pp. 26–27 + Plate XXVI
- 1791 *Pectinaria belgica*, Lamarck V, 350; Bruguiere 1791: Plate 58, Figures 10–15
- 1850 *Pectinaria auricoma* (Müller); Grube 1850: p. 330
- 1851 *Pectinaria auricoma* (Müller); Grube 1851: p. 82
- 1865 *Pectinaria granulata* L.; Johnston 1865: pp. 245–246
- ? 1865 *Pectinaria belgica* (Pallas); Quatrefages 1865: pp. 332–333
- ? 1865 *Pectinaria auricoma* (Müller); Quatrefages 1865: p. 335
- 1866 *Amphictene auricoma* (Müller); Malmgren 1866: pp. 357–358
- 1868 *Amphictene auricoma*; Claparède 1868: pp. 382–384
- 1871 *Pectinaria (Amphictene) auricoma* (O.Fr. Müll.); Grube 1871: p. 72
- 1871 *Pectinaria (Amphictene) auricoma* Müll.; Leuckart 1871: p. 31
- 1884 *Pectinaria auricoma* (Müller); Levinsen 1884: p. 154
- 1897 *Amphictene auricoma*; Perrier 1897: p. 1640
- 1898 *Pectinaria auricoma* Müll.; Horst 1898: pp. 26–27
- 1912 *Pectinaria auricoma* (Müller, 1771); Wollebaek 1912: pp. 37–38
- 1912 *Pectinaria auricoma* (Müller, 1776); Meyer 1912: pp. 8–10
- 1914 *Amphictene auricoma*, O.F. Müller; McIntosh 1914: pp. 86–89
- 1914 *Amphictene auricoma* (Müller); Southern, 1914: p. 46
- 1917 *Pectinaria auricoma* (Müller, 1776); Hessle 1917: pp. 78–79
- 1922 *Amphictene auricoma* Müller, 1776; McIntosh 1922: pp. 43–48
- 1922 *Pectinaria auricoma* (O.F.M.); Horst 1922: p. 274 (coll. Naturalis, RMNH.VER.787)
- 1927 *Pectinaria (Amphictene) auricoma* (Müller); Fauvel 1927: pp. 222–224
- 1928 *Pectinaria (Amphictene) auricoma* (Müller 1776); Nillson 1928: pp. 54–57
- 1929 *Pectinaria (Amphictene) auricoma* (Müller); Annenkova 1929: p. 483 + Plate XXXVII, Figures 1–4
- 1936 *Pectinaria (Amphictene) auricoma* (Müller); Fauvel, 1936: p. 89
- 1938 *Pectinaria (Amphictene) auricoma* (Müller) 1776; Friedrich 1938: p. 160
- 1941 *Amphictene auricoma* (O.F. Müller); Hartman, 1941: p. 326
- 1955 *Pectinaria (Amphictene) auricoma* (O.F. Müller); Uskakov 1955: p. 355
- 1986 *Pectinaria (Amphictene) auricoma* (Müller, 1776); Holthe 1986: pp. 22–24
- 1996 *Pectinaria (Amphictene) auricoma* (Müller, 1776); Hartmann-Schröder 1996: pp. 480–482
- 1996 *Pectinaria (Amphictene) auricoma* (O.F. Müller, 1776); Kirkegaard 1996: pp. 280–281
- 1997 *Pectinaria (Amphictene) auricoma* (O.F. Müller, 1776); Böggemann 1997: p. 175 + Figure 123
- 2001 *Pectinaria auricoma* (O.F. Müller, 1776); Jirkov 2001: pp. 431–432
- 2011 *Amphictene auricoma auricoma* (O.F. Müller 1776); Gil 2011: pp. 634–635
- 2013 *Pectinaria auricoma*; Jirkov & Leontovich 2013: p. 220

Distribution in the Netherlands (Fig. 7)

A. auricoma is more or less restricted to the Northern part of the Dutch North Sea, north of the Frisian Front, with only one recent coastal record near the Wadden Isle Terschelling. The single record from Wieringen originates from Horst (1898, 1922) and even now this would be a fairly rare finding. The Wadden Sea is not its favorite habitat. In the Dutch North Sea, it has its southernmost limit at latitude 53.4.

Distribution in Europe

Amphictene auricoma is more common in the NE Atlantic in subtidal sediments, usually at a depth of more than 20 m to about 500 m (Holthe 1986). It has been recorded from the North Sea, the western Baltic Sea (Kattegat, Skagerrak) and the Norwegian coast up to the North Polar Basin (Holthe 1986) and the Icelandic part of the North Atlantic Ocean (Parapar et



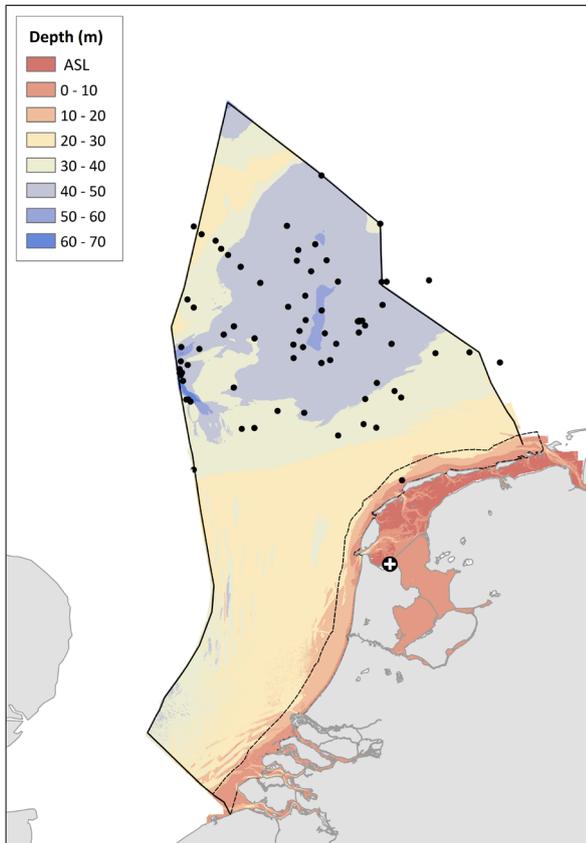


Figure 7

Distribution map of *Amphitrite auricoma* in the Dutch North Sea based on recent records (1991–2019). The original record of *A. auricoma* from Wieringen (Horst 1898, 1922) is shown on the map with another symbol (+)

al. 2020). In the south, the species has been reported from the European Atlantic coast up to Morocco and the Mediterranean (Claparède 1868; Giard 1913; Fauvel 1927; Fauvel 1936; Holthe 1986; Gil 2011; Le Mao et al. 2019). According to Holthe (1977), *A. auricoma* is an amphiboreal species.

Lagis Malmgren, 1866

Type species: *Lagis koreni* Malmgren, 1866 by monotypy

Lagis koreni Malmgren, 1866

Lectotype: Swedish Museum of Natural History (Stockholm) SMNH 3137, designated by Nielsen et al. 1977 (type no. verified by curator Lena Gustavsson, 26 June 2020). Holthe (1986: p. 18) wrote wrong type no. 3132.

Type locality: Finnmark, Kalfjord, 50fv (fathoms), 1861; Goës & A.J. Malmgren (Nielsen et al. 1977). Karlfjord is located at about 69°47'29"N, 18°41'52"E.

Note that Malmgren (1866) originally described *L. koreni* based on the material from three sites along the west coast of Norway (Kalfjord in 1861; Karlsö in 1864 and Stavanger, unknown year) and one site in France (La Rochelle), and the material from Kalfjord was supposedly collected (or published?) by Goës & Ipse 1861, according to Malmgren (1866). Zhang & Hutchings (2020) incorrectly stated that the type locality is Stavanger. All of Malmgren's material is still present in SMNH, including that from France (SMNH176327).

- ? 1738 Pijpken; Swammerdam, 1738, p787–788 + Figure XXXVI
- 1766 *Nereis cylindraria* var. *belgica* Pallas, 1766: *Miscellanea Zoologica*, pp. 121–130 + Pl IX, Figures 3–13
- 1769 Die Hollandische Sandige Wurmrohre; Martini, 1769: pp. 70–71 + Plate IV, Figure 27
- 1779 Ver a Foureau conique; Dicquemare, 1779: pp. 54–55
- 1777 *Sabella tubiformis* Pennant 1777: p. 148 + Plate XCII, Figure 163
- ? 1780 *Amphitrite auricoma* Müller; Fabricius 1780: pp. 289–291
- ? 1803 *Sabella tubiformis* Pennant; Donovan 1802–1803: Plate CXXXIII
- ? 1803 *Sabella granulata* L.; Montagu 1803: pp. 544–545
- ? 1803 *Sabella arenaria*; Montagu 1803: p. 552 (tube only)
- 1806 *Nereis pectinata* Sowerby 1806: pp. 107–108 + Figure 51 (drawn in Oct. 1805)
- ? 1807 *Sabella granulata*; Turton 1807: p. 202 (sp. 625)
- ? 1812 *Amphitrite auricoma*; Pennant, 1812: p. 91
- ? 1812 *Sabella tubiformis*; Pennant, 1812: p. 372
- 1816 *Cistena pallasii* Leach 1816: p. 452
- ? 1822 *Amphitrite auricoma*; Savigny, 1822: pp. 89–90
- 1826 *Amphitrite auricoma* L. sp 4, p. 3111; Bennet & van Olivier 1826, p. 81
- 1826 *Sabella belgica* L. sp 5, p. 3749; Bennet & van Olivier 1826, p. 160
- ? 1845 *Sabella tubiformis* Pennant; Donovan 1845: pp. 88–89 + Plate XXXV, Figures 9–10 (tube only)
- 1851 *Amphitrite auricoma* Müller; Maitland 1851: p. 204
- ? 1865 *Pectinaria belgica* (Pallas); Johnston 1865: pp. 243–245

- 1866 *Lagis koreni* Malmgren, 1866: Nordiska Hafs-Annulater, pp. 360–361.
- 1867 *Lagis koreni* Mgrn.; Malmgren, 1867: p. 104 + Plate XIII, Figure 74
- 1871 *Pectinaria (Lagis) koreni*, *Lagis koreni* Mgn.; Grube 1871, p. 73
- 1873 *Pectinaria belgica* (Pall.); Möbius 1873: pp. 109–110 + Figures 22–24
- 1884 *Pectinaria koreni* Mgr. (non Marenz.); Levinsen 1884: pp. 155–156
- ? 1888 *Pectinaria belgica*, Lamarck (Pallas); Cunningham & Ramage 1888: pp. 656–659
- 1892 *Pectinaria (Amphictene) auricoma*, (Müller); Hornell 1892: p. 162
- 1892 *Pectinaria belgica*, (Pallas); Hornell 1892: p. 163
- 1897 *Lagis Koreni*; Perrier 1897: p. 1640
- 1898 *Lagis koreni* Malmgren; Saint-Joseph 1898: pp. 405–421 + Plates XXII–XXIII: Figures 209–235
- 1898 *Pectinaria belgica* Pallas; Horst 1898: p. 26
- 1898 *Pectinaria koreni* Malmgr.; Michaelsen 1897: pp. 46–49
- 1899 *Pectinaria belgica* Pallas; Giard 1899: p. 189
- 1912 *Pectinaria koreni* (Malmgren, 1865); Meyer 1912: pp. 12–13
- 1912 *Pectinaria koreni* (Mlgrn. 1865); Wollebaek 1912: pp. 40–41
- 1913 *Pectinaria belgica* Pallas; Giard 1913: p. 122
- 1914 *Lagis koreni*, Malmgren; McIntosh 1914: pp. 89–95
- 1914 *Lagis koreni* Malmgren; Southern, 1914: p. 47
- 1917 *Pectinaria koreni* (Mgn.1865); Hessle 1917: pp. 80–81
- ? 1917 *Pectinaria koreni* (Malmgren, 1865); Colgan 1917: pp. 136–138
- 1922 *Lagis koreni* Malmgren 1867; McIntosh 1922: pp. 49–58
- ? 1925 *Pectinaria belgica* Pall; Verhas 1925: pp. 60–61 + Plate VII, Figure 4
- 1927 *Pectinaria (Lagis) koreni* Malmgren; Fauvel 1927: pp. 221–222
- 1928 *Pectinaria (Lagis) koreni* Mgrn., 1865; Nilsson 1928: pp. 11–13 + Figure 1
- 1929 *Pectinaria (Lagis) koreni* (Malmgren); Annenkova 1929: p. 481 + Plate XXXVII, Figures 16–18
- 1938 *Pectinaria (Lagis) koreni* (Malmgren), 1865; Friedrich 1938: p. 159
- ? 1967 *Lagis koreni koreni* Malmgren, 1865; Day 1967: p. 681
- 1973 *Pectinaria koreni* Malmgr.; Entrop 1973
- 1986 *Pectinaria (Lagis) koreni* Malmgren, 1866; Holthe 1986: pp. 18–20
- 1996 *Pectinaria (Lagis) koreni* Malmgren, 1865; Hartman-Schroder 1996: pp. 483–485
- 1996 *Pectinaria (Lagis) koreni* Malmgren, 1866; Kirkegaard 1996: pp. 283–284
- 1997 *Pectinaria (Lagis) koreni* Malmgren, 1866; Böggemann 1997: p. 175 + Figure 124
- 1999 *Pectinaria koreni*; Prins, 1999
- 2001 *Pectinaria koreni* (Malmgren, 1866); Jirkov 2001: pp. 434–435
- 2002 *Lagis koreni* Malmgren, 1866; Hutchings & Peart 2002, pp. 109–110 + Table 3
- 2011 *Lagis koreni* Malmgren, 1866; Gil 2011: pp. 634, 636–637
- ? 2013 *Pectinaria koreni*; Jirkov & Leontovich 2013, p. 220

Distribution in the Netherlands (Fig. 8)

Lagis koreni is widely distributed in the Dutch North Sea. It is very common in the coastal zone and has scattered records north of the Frisian Front. It is rare in the Wadden Sea, the delta area and offshore locations, and has only one record in the North Sea Canal.

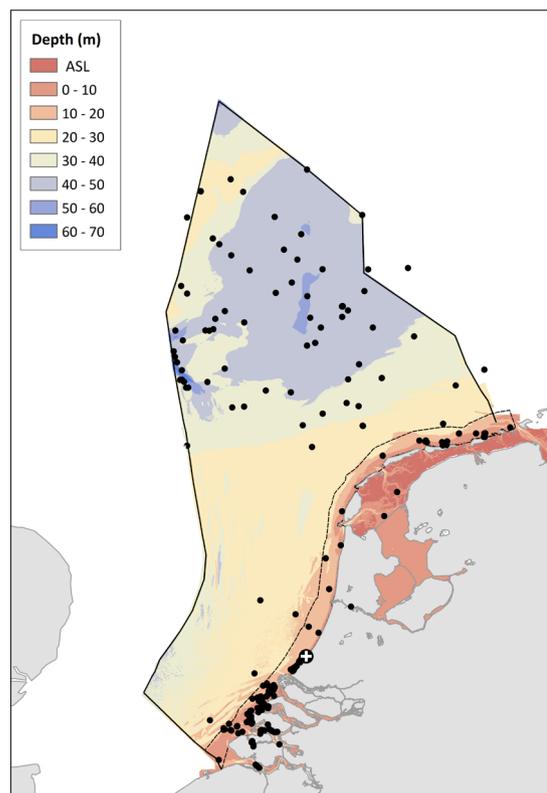


Figure 8

Distribution map of *Lagis koreni* in the Dutch North Sea based on recent records (1991–2019). The original record of *Nereis cylindraria* var. *belgica* from Scheveningen (Pallas 1766) is shown on the map with another symbol (+)



Distribution in Europe

L. koreni is widely distributed in the North Sea and the Baltic Sea and most likely restricted to shallower depths (< 50 m). It reaches the North-East Atlantic along the Norwegian coast up to the Polar Basin (Holthe 1986) and Iceland (Parapar et al. 2020). However, based on the description of these Icelandic specimens with 16 notochaetae (incorrectly written as 16 uniramous segments), these *L. koreni* specimens require further examination. According to Holthe (1977), *L. koreni* is an Atlantic and boreal species. To the south, *L. koreni* is reported from the European Atlantic coast up to Namibia and possibly South Africa, the Mediterranean and the Black Sea (Fauvel 1936; Fauvel 1927; Day 1967; Gil 2011). However, Jolly et al. (2005) suggest that *L. koreni* from Brittany represents another haplotype than specimens from the English Channel, indicating that cryptic diversity exists.

4. Discussion and conclusions

Since the first description of Pectinariidae species in the 18th century by Pallas (1766: *Nereis cylindraria*), Linné (1767: *Sabella granulata*) and Müller (1776: *Amphitrite auricoma*) there have been numerous misinterpretations of characteristics and assumptions in the original and subsequent descriptions. This has led to numerous mistakes in identification and, consequently, incorrectly reported distribution of the species. All specimens originally viewed by their describers (types) are lost, except perhaps *Nereis cylindraria* (var. *capensis* and var. *belgica*), which may turn up somewhere in some hidden part of the collection (Paris, Leiden or Apeldoorn: see Pieters, 1980). About a century later, Malmgren (1866) created *L. koreni* and redescribed *P. belgica*, unaware of the fact that he introduced another error creating an even greater problem. This issue was brought before the committee and it was finally decided that the species descriptions in Malmgren (1866), although false for *L. koreni* vs *P. belgica*, were considered correct and the neotype from Bohuslän (Sweden) was assigned. So far so good. The committee created stability and finally every researcher knew, or thought they knew, how to recognize *P. belgica* and *L. koreni*. The neotype was not a Dutch specimen, but perhaps that was the best thing to do. The discovery of two specimens on the Dutch continental shelf forced the author to clarify the issue. After all, the species epithet “*belgica*” was introduced by Pallas (1766) for Dutch Pectinariids specimens. A review of the literature revealed that specimens of *P. belgica* have never been found in the Netherlands

before, and reports of this species in more southern regions (Belgium, France, and English Channel) need to be re-examined. Old reports of *P. belgica* not only refer to *P. belgica*, but also to *L. koreni* and partly to *C. granulata* and *A. auricoma*. In NW Europe there are now five genera with six species, three of which are also known from the Netherlands. Pectinariidae, however, need to be revised, not only in terms of species diagnosis but also in terms of generic characters. The generic diagnosis of the five genera has changed over time, and in some recent papers the characters of the type species do not match the generic diagnosis, especially for *Lagis* and *Cistenides*. It seems as if the generic diagnosis is based on recent material and new species, neglecting the original descriptions. Furthermore, DNA barcoding is recommended for the European fauna and may prove that more species occur in the North Sea.

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