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Original specimens and type localities of early described polychaete species (Annelida) from Norway, with particular attention to species described by O.F. Müller and M. Sars

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Abstract

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Early descriptions of species from Norwegian waters are reviewed, with a focus on the basic requirements for re-assessing their characteristics, in particular, by clarifying the status of the original material and locating sampling sites. A large number of polychaete species from the North Atlantic were described in the early period of zoological studies in the 18th and 19th centuries. The descriptions were often short or referred solely to general characteristics, which by today's standards are considered inadequate for species discrimination. As a result, a number of taxa among the so-called 'well-known and widely distributed' species have later been confused with morphologically similar species. Close to 100 presently valid species were described from Norwegian waters before 1900. The most prolific contributions were made by O.F. Müller (with about 20 species from 1771–1776) and Michael Sars (with more than 50 species from 1829–1872). Other authors in the 19th century included Anders Ørsted, Heinrich Rathke and Gerhard Armauer Hansen. Descriptions were mostly in Latin (O.F. Müller) or in Norwegian or Danish with the diagnosis in Latin (M. Sars and contemporary naturalists). Original material from O.F. Müller is not known to exist. Original material from M. Sars and contemporary scientists does still exist, but is often not identified as original ('syntypes') and is occasionally spread over several museum collections. Locating original sampling localities ('type localities') has been achieved by combining information from various literature sources, labels of original material (when extant), and knowledge of historic place names.

Keywords

Polychaeta, early-described species, original material, sampling sites, Norway

Introduction

The Nordic countries were central in the early studies of marine fauna and flora in scientific history. In the second half of the 18th century, several scientists, e.g. Johan Ernst Gunnerus, Otto Friderich Müller and Otto Fabricius, corresponded with Carl Linnaeus and contributed to his *Systema naturae*, as well as describing new species in their own publications (Anker, 1950; Wolff, 1994; Moen, 2006). In the 19th century, a large number of species were described from Nordic waters by Michael Sars, Anders Ørsted, Heinrich Rathke, Gerhard Armauer Hansen, Anders Johan Malmgren, Henrik Nikolai Krøyer and Ivar Arwidsson, for example. Typically, many of the species are among the most common and abundant in the areas in which they were described.

A number of the early-described species are insufficiently characterised with regard to present-day requirements in species taxonomy. In numerous cases, species have been confused with morphologically similar species and reported from wide geographic areas. From the late part of the 19th century, there emerged a tradition of lumping polychaete species (Barroso et al., 2010). Fauvel (1959) expressed explicitly a view that polychaete species had a high degree of morphological variation and consequently had a wide geographic distribution. It is presently agreed that the reported wide distribution results from confusing similar species with separate distributions and also different responses to environmental conditions. This has been clear for some time from critical morphological studies (e.g. Williams, 1984;

Mackie and Pleijel, 1995; Koh et al., 2003). Furthermore, recent studies have shown that even in more restricted areas, several morphologically similar but genetically different forms have been demonstrated among common species (e.g. Breton et al., 2003; Nygren et al., 2005; Bleidorn et al., 2006).

In Norway, work has been initiated to trace original material and type localities for early-described species of polychaetes. The main intention is to clarify the status of the species and through this establish a basis for characterisation of species in accordance with present-day standards of taxonomy. The advent of molecular genetic methods presents new challenges in taxonomy, while providing powerful tools to discriminate between confused species. It has long been understood that the knowledge of polychaetes in Norwegian waters is incomplete due to many unresolved systematic problems, particularly among early-described species. Close to 100 presently valid species of polychaetes were described from Norwegian waters during the 18th and 19th centuries. The present paper gives a general overview of the early studies, places of collection, nature of original publications and status of original material. The most influential individuals in the 18th and 19th centuries were Otto Friderich Müller and Michael Sars, respectively, and most of the focus is on their contributions. Part of the present work has been carried out under the framework of the Norwegian Taxonomy Initiative, which is a broad-scale program aimed at mapping species diversity in Norway.

Abbreviations

NHMO Natural History Museum, Oslo

NMWC National Museum of Wales, Cardiff

NNHE Norwegian North-Atlantic Expedition

NTNU-VM Norwegian University of Science and Technology, University Museum, Trondheim

USNM National Museum of Natural History, Washington DC

ZMBI Zoological Museum, Berlin

ZMBN University Museum of Bergen

The need to reassess the characteristics of early-described species

The proper characterisation of early-described species is necessary to resolve complexes of confused species and for discriminating and diagnosing related new species. Without this clarification, species descriptions may confuse characters from similar species. The need for precise species identification is crucial in monitoring and for environmental assessment studies, e.g. the European Water Framework Directive, where the detection of species changes is the very basis for assessing to what degree human influences or climate changes are affecting natural ecosystems. Inaccurate species discrimination reduces the sensitivity of monitoring tools.

There is also a need to clarify which of several species is the originally named species when species complexes are resolved. The rapidly expanding use of molecular genetic methods has demonstrated how cryptic species are common in the marine environment (Knowlton, 2000). From Nordic waters, several examples of cryptic species among early-described phyllodocids have been demonstrated (Nygren et al., 2009, 2010; Nygren and Pleijel, 2011). For the nereidid *Hediste diversicolor* (O.F Müller, 1776) and the orbiniid *Scoloplos armiger* (O.F. Müller, 1776), clear genetic differences between populations have been documented (Breton et al., 2003; Bleidorn et al., 2006; Audzijonyte et al., 2008). Furthermore, in international gene sequencing databases such as the database holding DNA-barcoding sequences, BOLD (Barcode of Life Data System) (Ratnasingham and Hebert, 2007), there are several examples of different molecular sequences being uploaded for the same taxon, reflecting the improper discrimination of related species. For example, recent searches in the BOLD database for *H. diversicolor* and *Cirratulus cirratus* (O.F. Müller, 1776) showed three and four putative species, respectively, indicated by DNA barcoding (access date 3 April 2014). The rapidly expanding use of modern genetic analytical techniques, hence, necessitates that correct genetic information can be obtained for early-described species.

In order to clarify the characters of insufficiently described species, the established practice in taxonomy is to examine the original material (type specimens), or in cases where new material is needed, to collect at the same location where the original material was collected (type locality). These specifications imply that the status of the original material should be known, and the locality for collecting new material (type locality) should be fixed. The International Code of Zoological Nomenclature (ICZN) provides rules governing what constitutes original material and how type localities should be fixed (ICZN, 1999). New material may be collected in cases where the original material has been lost, for critical morphological studies that cannot be performed on original material, and for molecular genetic analyses. Material from type localities (topotypic material) may also be of great help if the original specimens are of poor quality but still in a condition to confirm conspecific status. Genetic sequences from the same samples will provide genetic characterisation of the species in question and provide museum vouchers for specimens used in genetic analyses (Pleijel et al., 2008).

The collection of new material is particularly important for genetic characterisation. Attempts to obtain genetic information from old museum specimens have generally failed. Museum specimens have traditionally been preserved in formalin, which degrades and fragments DNA, and may cause a number of changes to the DNA (Skage and Schander, 2007). Protocols have been tested to accommodate the challenge to extract DNA suitable for sequencing without much success (Schander and Halanych, 2003; Skage and Schander, 2007). The general need for new material in genetically supported taxonomic work underlines the importance of critically selecting the place to sample the material for linking molecular genetics to traditional taxonomy. The type locality can provide a link between modern genetically based taxonomy and traditional morphology-based taxonomy.

Table 1. Summary of valid species named by O.F. Müller. Access number and annotations in 'prodromus' (Müller, 1776) is shown: +, species indicated as found and diagnosed by Müller himself; #, species described by other authors; –, no particular indication. Species described in Zoologia Danica are shown by volume number and locality when stated. See Figure 6 for localities.

Valid name	Prodromus: number/reference	Zoologia Danica	Locality (-ies)	Descriptions/revisions
Originally in *Lumbricus*				
Nephtys ciliata	2607/–	Vol. III	Norway (no precise locality)	Fauchald (1963), Rainer (1991)
Cirratulus cirratus	2608/#	–		
Scoloplos armiger	2610/+	Vol. I	Kristiansand	
Scoletoma fragilis	2611/+	Vol. I	Drøbak in Oslofjord	Frame (1992)
Originally in *Amphitrite*				
Amphitrite cirrata	2617/#	–		Müller (1771)
Pista cristata	2620/+	Vol. II	Kristiansand	
Pherusa plumosa	2621/#	Vol. III	Greenland; Norway (no precise locality)	Fabricius (1780); emended J.C. Abilgaard (Haase, 1915)
Pectinaria auricoma	2622/–	Vol. I	Drøbak and Kristiansand	
Originally in *Nereis*				
Hediste diversicolor	2624/#	–		
Hyalinoecia tubicola	2625/+	Vol. I	Drøbak in Oslofjord	
Syllis armillaris	2626/+	–		Müller (1771), Licher (1999)
Eunice pennata	2630/+	Vol. I	Drøbak in Oslofjord	Winsnes (1989), Fauchald (1992)
Nereimyra punctata	2633/+	Vol. II	Drøbak in Oslofjord	Pleijel et al. (2012)
Glycera alba	2634/+	Vol. II	Norway (no precise locality)	
Procerea prismatica	2637/–	–		Nygren (2004)
Spio filicornis	2640/#	–		Fabricius (1780), Meissner et al. (2011)
Originally in *Aphrodita*				
Pholoe longa	2646/#	–		Fabricius (1780), Pettibone (1992)
Originally in *Dentalium* (Mollusca)				
Ditrupa arietina	2853/+	–		ten Hove and Smith (1990)
Orig in *Tubularia* (Cnidaria part)				
Fabricia stellaris	3065/+	–		Müller (1774), Fitzhugh (1990)
Not in 'prodromus'				
Myrianida prolifera (as *Nereis prolifera*)		Vol. II	Norway (no precise locality)	Nygren (2004)
Scololepis squamata (as *Lumbricus squamatus*)		Vol. IV	Helgoland	Most probably described by J.C. Abildgaard

The earliest described species: O.F. Müller and Zoologia Danica

Otto Friderich Müller (1730–1784) (variant spelling Otto Friedrich) was one of the most important early naturalists and one of the pioneers in marine biology (fig. 1). He was Danish and performed most of his studies in Denmark, but came to work in Norway during the 1770s through marriage to a wealthy Norwegian widow. In Norway, he was based in Drøbak, a small settlement about 30 km south of Oslo (at the time called Christiania), but during summer periods he made travels to the south coast of Norway and Norwegian inland areas to collect animals and plants. He described species from a variety of species groups from fresh water as well as marine habitats. In addition to polychaetes, he described species of molluscs, crustaceans, echinoderms and several parasite groups (Anker, 1950; Wolff, 1994).

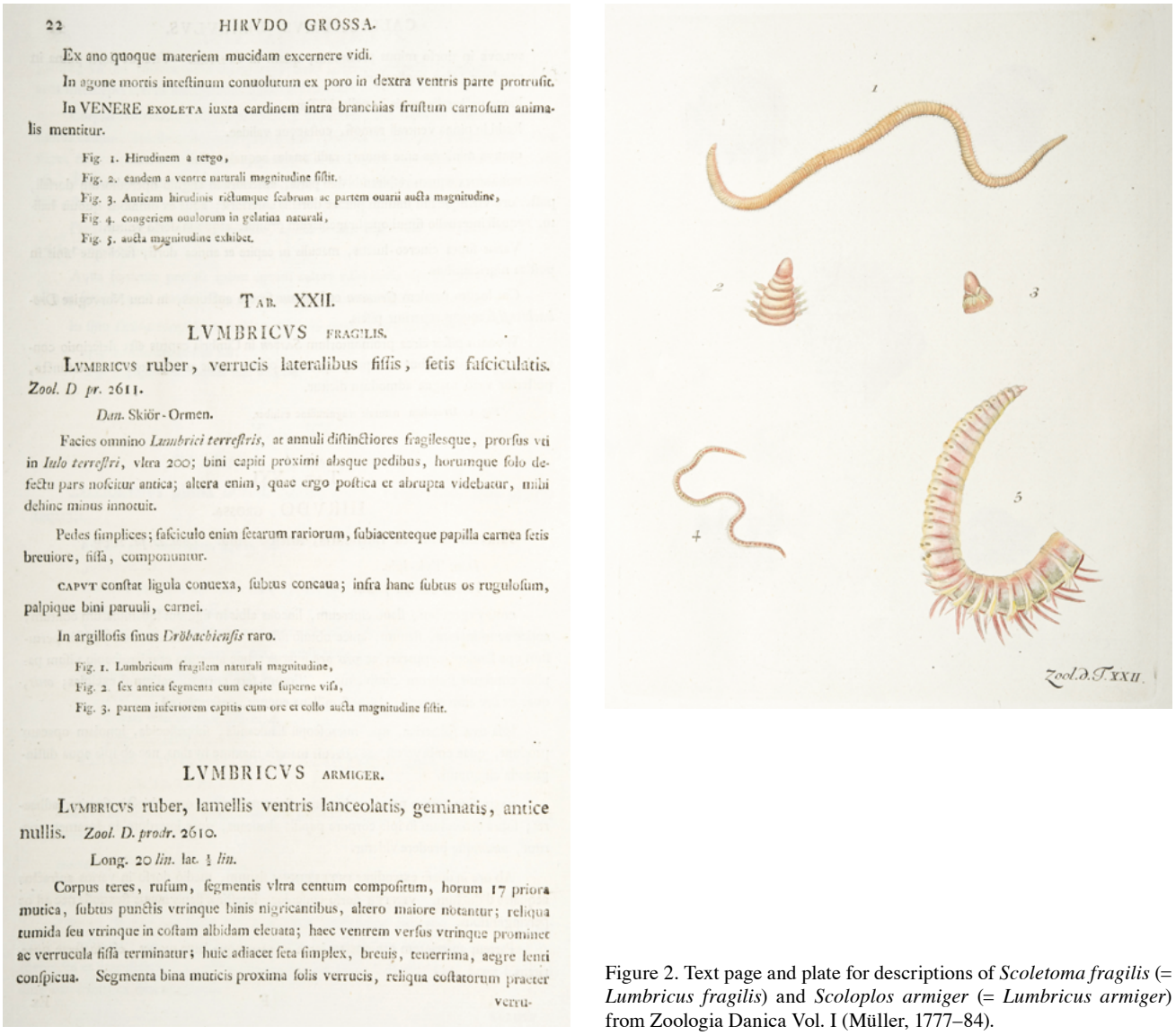
O.F. Müller's most important contribution is the large and ambitious *Zoologia Danica* (complete name *Zoologiae Danica seu Animalium Daniae et Norvegiae rariorum ac minus notorum, Descriptiones et historia* [Descriptions and natural history of the rare and little known animals of Denmark and Norway]), which was intended to include all known animal species in Denmark and Norway. The work was never completed, but four volumes were released (Müller, 1777–84; Müller and Abildgaard, 1789; Müller et al., 1806) before the work was discontinued (Anker, 1950; Wolff, 1994). Müller died soon after the release of the second volume, and the third and fourth volumes were edited and completed by contemporary naturalists in Copenhagen (P.C. Abildgaard, M. Vahl, J. Rathke, H.S. Holten). The text was in Latin, but parallel editions with text in Danish and German were made of the first volume. All species were illustrated by Müller's brother, C.F. Müller, who also edited a new release of the two first volumes in 1788 (Müller, 1788). Fig. 2 presents an example of the quality of the text and illustrations in *Zoologia Danica*.

Prior to the release of *Zoologia Danica*, a so-called forerunner *Zoologia Danica prodromus* was published in 1776 (Müller, 1776). The 'prodromus' is essentially an annotated catalogue of all contemporary known species of animals in Denmark and Norway and the first inventory based on the Linnean classification system. In total, more than 3000 species are included. All species were entered with an access number, scientific name (binomial), brief diagnosis in Latin, references, and vernacular names if appropriate (fig. 3). New species detected by Müller were entered pending a full description in the main work. For several of these, however, no more descriptions were given and the brief and usually very general diagnosis in the 'prodromus' is the only extant information.

For several species described by other authors (e.g. Hans Strøm and Otto Fabricius) and by Müller himself in previous works (Müller, 1771), the scientific name given in the 'prodromus' is the first name published in accordance with the nomenclatural rules and hence the oldest available name of the species. Later, this caused much confusion. One example is the spionid *Spio filicornis* (listed as *Nereis filicornis* in 'prodromus'), which was described by Otto Fabricius from Greenland (Fabricius, 1780). *Spio filicornis* was for a long time considered a European species, but has recently been re-described, based on newly collected material from Greenland (Meissner et al., 2011). This is particularly relevant to determination of type localities for the species, which in several cases are still not settled.

Figure 1. Otto Friderich Müller. From drawing by Cornelius Høyer. Reproduced from Wolff (1994).

A list of valid polychaete species named by O.F. Müller is given in table 1. Müller presented information on sampling localities, mostly as part of the descriptions in *Zoologia Danica*. In some cases details may be found in travel reports and letters. For some species, the sampling locality is exactly specified, but for others, only a general area is indicated. For species cited from other authors, the sampling localities may be found in their descriptions. Tracing type localities may, therefore, be uncertain and requires information from different text sources. For several species, e.g. *Cirratulus cirratus* (Müller, 1776) and *Hediste diversicolor* (Müller, 1776), the type locality has not been clarified. Müller kept a large collection of specimens (Anker, 1950), but no polychaete material is presently known to exist (D. Eibye-Jacobsen, pers. comm.). A more detailed review of the species named by O.F. Müller is in progress and will be published elsewhere.



22 HIRVDO GROSSA.

Ex ano quoque materiem mucidam excernere vidi.

In agone mortis inteſtinum conuolutum ex poro in dextra ventris parte protruſit.

In VENERE EXOLETA iuxta cardinem intra branchias fruſtum carnoſum animalis mentitur.

Fig. 1. Hirudinem a tergo,
Fig. 2. eandem a ventre naturali magnitudine ſiſtit.
Fig. 3. Anticam hirudinis rictumque ſcabrum ac partem ouarii aucta magnitudine,
Fig. 4. congeriem ouulorum in gelatina naturali,
Fig. 5. aucta magnitudine exhibet.

TAB. XXII.

LVMBRICVS FRAGILIS.

LVMBRICVS ruber, verrucis lateralibus fiſſis, ſetis faſciculatis. *Zool. D pr.* 2611.

Dan. Skiör-Ormen.

Facies omnino *Lumbrici terreſtris*, at annuli diſtinctiores fragilesque, prorſus vti in *Iulo terreſtri*, vltra 200; bini capiti proximi absque pedibus, horumque ſolo defectu pars noſcitur antica; altera enim, quae ergo poſtica et abrupta videbatur, mihi dehinc minus innotuit.

Pedes ſimplices; faſciculo enim ſetarum rariorum, ſubiacenteque papilla carnea ſetis breuiore, fiſſa, componuntur.

CAPVT conſtat ligula conuexa, ſubtus concaua; infra hanc ſubtus os ruguloſum, palpique bini paruuli, carnei.

In argilloſis ſinus *Drøbachienſis* raro.

Fig. 1. Lumbricum fragilem naturali magnitudine,
Fig. 2. ſex antica ſegmenta cum capite ſuperne viſa,
Fig. 3. partem inferiorem capitis cum ore et collo aucta magnitudine ſiſtit.

LVMBRICVS ARMIGER.

LVMBRICVS ruber, lamellis ventris lanceolatis, geminatis, antice nullis. *Zool. D. prodr.* 2610.

Long. 20 *lin.* lat. ½ *lin.*

Corpus teres, ruſum, ſegmentis vltra centum compoſitum, horum 17 priora mutica, ſubtus punctis vtrinque binis nigricantibus, altero maiore notantur; reliqua tumida ſeu vtrinque in coſtam albidam eleuata; haec ventrem verſus vtrinque prominet ac verrucula fiſſa terminatur; huic adiacet ſeta ſimplex, breuis, tenerrima, aegre lenti conſpicua. Segmenta bina muticis proxima ſolis verrucis, reliqua coſtatorum praeter verru-

Figure 2. Text page and plate for descriptions of *Scoletoma fragilis* (= *Lumbricus fragilis*) and *Scoloplos armiger* (= *Lumbricus armiger*) from Zoologia Danica Vol. I (Müller, 1777–84).

The second era: Michael Sars and the beginning of systematic descriptions of Norwegian marine fauna

After O.F. Müller, there was a period with few investigations of the Norwegian marine fauna until about 1830, when Michael Sars started his career. From about 1840, several other scientists were active, and the latter half of the century was a very prolific period in the systematic description of the marine fauna (Sakshaug and Mosby, 1996). Michael Sars (1805–1869) was born in Bergen on the west coast of Norway, where he also started his studies of marine animals (fig. 4). He was educated in theology and practiced as a vicar, first in Kinn near Florø (1831–40) and later in Manger near Bergen (1840–54). He was awarded a professorship at the University of Oslo (then Christiania) from 1855, where he remained until his death in 1869 (Økland, 1955; Helle, 2006). Starting in 1849, he made several travels to northern Norway to collect specimens. In Oslo he collected in the Oslofjord with his main focus on the region near Drøbak.

Michael Sars had a broad interest in several marine species groups and early in his career earned an international reputation for studies of the life histories of cnidarians and echinoderms. Throughout his career, he described new species in various groups, among them cnidarians, polychaetes, molluscs and echinoderms. In the 1860s he also sampled, together with his son Georg Ossian Sars, numerous species from the great depths (>800 m) in offshore areas. The deep sea had previously been considered lifeless, and their findings raised a broad international interest in deep-sea expeditions. In Norway the findings contributed to the funding of the Norwegian North Atlantic Expedition, which was carried out in 1876–78 (Sakshaug and Mosby, 1996; Helle, 2006).

Table 2. Chronological overview of polychaete species described by Michael Sars from Norwegian waters. See fig. 6 for localities. NHMO = Natural History Museum Oslo; ZMBN =University Museum of Bergen; ZMBI = Zoological Museum Berlin; NMWC = National Museum of Wales, Cardiff; USNM = National Museum of Natural History, Washington DC.

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
M. Sars 1829				
Flabelligera affinis	*Flabelligera affinis* M. Sars, 1829	Sars 1829: 31–34, pl. 3, figs 16–19	Bergen area	Original material probably lost
Terebella longicornis		Sars 1829: 28–31, pl. 1, figs 7–9	Bergen area	Uncertain status, original material probably lost
M. Sars 1835				
Terebellides stroemii	*Terebellides stroemii* M. Sars, 1835	1835: 48–50, pl. 13, figs 31a–e	Glesvær near Bergen	Original material lost. Neotype NHMO, selected from Manger near Bergen (Parapar and Hutchings, in press)
Amphitrite gunneri	*Amphicteis gunneri* (M. Sars, 1835)	1835: 50–51, pl. 11, figs 30a–d; 1865: 2–6, 9–10 (offprint)	Glesvær near Bergen; Florø	Lectotype and paralectotype, NHMO (Hartley, 1985). Type locality not specified on label of lectotype (Glesvær and Florø).
Sabella? octocirrata	*Ampharete octocirrata* (M. Sars, 1835)	1835: 51–52, pl. 13, figs 32a–g	Glesvær near Bergen; Florø	Possible syntypes, NHMO (Holthe, 1986)
Serpula libera	*Ditrupa arietina* (O.F. Müller, 1776)	1835: 52–54, pl. 12, figs 33a–c; 1851: 84	Bergen area including Glesvær; Florø	Possible syntypes, NHMO. M. Sars (1835) indicates synonymy with *D. arietina*
Chaetopterus norvegus [sic!]	*Chaetopterus norvegicus* M. Sars, 1835	1835: 54–58, pl. 11, figs 29a–h; 1851: 87; 1861b: 86–87; 1861c: 255–256	Bergen area; Florø	Syntypes, NHMO
Nereis virens	*Alitta virens* (M. Sars, 1835)	1835: 58–60, pl. 10, figs 27a–c	Bergen area	Possible syntypes, NHMO
Phyllodoce foliosa	*Notophyllum foliosum* (M. Sars, 1835)	1835: 60–61, pl. 9, figs 26a–e; 1873a: 224–226	Manger near Bergen	Lectotype and 3 paralectotypes, NHMO (Nygren et al., 2010)
Onuphis conchylega	*Nothria conchylega* (M. Sars, 1835)	1835: 61–63, pl. 10, figs 28a–e; 1851: 89	Bergen area; Florø	Lectotype, NHMO, selected from Florø (Fauchald, 1982)
Polynoë gelatinosa	*Alentia gelatinosa* (M. Sars, 1835)	1835: 63–64, pl. 9, figs 25a–c	Bergen area; Florø	Original material probably lost (Loshamn, 1980)
Nais ? clavicornis	*Macrochaeta clavicornis* (M. Sars, 1835)	1835: 64–65, pl. 9, figs 24a–d	Florø	Original material probably lost (Banse, 1969)
M. Sars 1846				
Oligobranchus roseus	*Scalibregma inflatum* Rathke, 1843	1846: 91–93, pl. 10, figs 20–27; 1863: 52; 1873a	Florø	Holotype, NHMO (Mackie, 1991)
M. Sars 1851				
Notomastus latericeus	*Notomastus latericeus* M. Sars, 1851	1851: 79–80; 1856: 9–12 pl. II, figs 8–17	Florø; Komagfjord	Syntypes, NHMO

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
Clymene mülleri	*Proclymene muelleri* (M. Sars, 1851)	1851: 80–81; 1856: 13–15, pl. 1, figs 1–7; 1862a: 91 (21–22 in offprint)	Bergen area	Syntypes. NHMO
Clymene cirrosa	?*Euclymene droebachiensis* (M. Sars in G.O. Sars, 1872)	1851: 81	Tromsø	Holotype, NHMO, originally described based on posterior fragment. Possible synonym of *Euclymene droebachiensis* (Arwidsson, 1906)
Ammochares assimilis	*Owenia assimilis* (M. Sars, 1851)	1851: 81–82	Tromsø; Bergen area	Syntypes, NHMO. Species reinstated by Koh et al. (2003)
Sabella crassicornis	*Bispira crassicornis* (M. Sars, 1851)	1851: 82–83; 1862b: 119–121 (28–29 in offprint)	Tromsø	Lectotype, NHMO; paralectotype, ZMBN (Knight-Jones and Perkins, 1998)
Sabella papillosa	*Euchone papillosa* (M. Sars, 1851)	1851: 83; 1862b: 129–130 (38–39 in offprint)	Øksfjord; Havøysund	Syntypes, NHMO
Sabella neglecta	*Potamilla neglecta* (M. Sars, 1851)	1851: 83; 1862b: 122–123 (31–32 in offprint)	Hammerfest; Tromsø	Possible syntypes, NHMO. Neotype (!) selected, ZMBI (Knight-Jones, 1983)
Serpula polita	*Placostegus tridentatus* (J.C. Fabricius, 1779)	1851: 84	Bergen; Øksfjord; Komagfjord	Syntypes, NHMO
Sabellides cristata	*Melinna cristata* (M. Sars, 1851)	1851: 85–86; 1856: 19–24, pl. II, figs 1–7	Bergen; Havøysund	Original material probably lost. Neotype, NMWC, selected from Hjeltefjord near Bergen (Mackie and Pleijel, 1995)
Nerine cirrata	*Laonice cirrata* (M. Sars, 1851)	1851: 87–88; 1862a: 64–65 (15–16 in offprint)	Ure in Lofoten; Tromsø; Hammerfest	Lectotype, NHMO, selected from Ure (Sikorski, 2011)
Nerine foliosa	Possibly synonym of *Scolelepis foliosa* (Audouin and Milne Edwards, 1833)	1851: 87–88; 1862a: 61–64 (12–15 in offprint)	Bergen area	Syntypes, NHMO
Oniscosoma arcticus	*Spinther arcticus* (M. Sars, 1851)	1851: 90; 1862a: 52–55	Komagfjord	Syntypes, NHMO
Euphrosyne armadillo	*Euphrosyne armadillo* M. Sars, 1851	1851: 91; 1862a: 55–56 (6–7, offprint)	Bergen area	Syntypes, NHMO
M. Sars 1856				
Spiochaetopterus typicus	*Spiochaetopterus typicus* M. Sars, 1856	1856: 1–8, pl. I, figs 8–21	Manger (Helle) near Bergen	Syntypes, NHMO
Clymene quadrilobata	*Pseudoclymene quadrilobata* (M. Sars, 1856)	1856: 15–16, pl. II, figs 18–22	Florø; Manger near Bergen	Syntypes, NHMO. Replaced by *Clymene gracilis* new name by Sars (1861c, 1862a). Redescribed as distinct species by Arwidsson (1906)
Sabellides borealis	*Ampharete borealis* (M. Sars, 1856)	1856: 22–24	Reine in Lofoten; Øksfjord	Possible syntypes, NHMO (Holthe, 1986)

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
Sabellides sexcirrata	*Samytha sexcirrata* (M. Sars, 1856)	1856: 23–24	Manger near Bergen	Possible syntypes, NHMO (Holthe, 1986)
M. Sars 1861a				
Polynoe nodosa	*Eunoe nodosa* (M. Sars, 1861)	1861a: 58–59	Havøysund	Syntypes, NHMO (Barnich and Fiege, 2010)
Polynoe asperrima	*Acanthicolepis asperrima* (M. Sars, 1861)	1861a: 59	Manger and Herdla near Bergen	Syntypes, NHMO C3154 (Barnich et al., 2000)
Polynoe rarispina	*Harmothoe rarispina* (M. Sars, 1861)	1861a: 60	Vadsø	Syntypes, NHMO (Barnich and Fiege, 2009)
Polynoe scabriuscula	*Gattyana cirrhosa* (Pallas, 1766)	1861a: 60–61; 1861c: 252–253; 1869: 254	Kristiansund, Vadsø	Possible syntypes, NHMO. M. Sars (1869) indicates synonymy with *G. cirrhosa*
M. Sars 1861b				
Chaetopterus sarsii	*Chaetopterus sarsii* Boeck in Sars, 1861	1861b: 85–87; 1861c: 255; 1863: 50–51; 1873a: 261–262	Beian in Trondheimsfjord	Syntypes, NHMO. Boeck, 1860: 252 *nomen nudum*
M. Sars 1861c				
Ophiodromus vittatus	*Ophiodromus flexuosus* (delle Chiaje, 1828)	1861c: 255; 1862a: 87–88 (18–19 in offprint); 1873a: 229	Kristiansund, Molde, Manger, Åsgårdstrand in Oslofjord	Type probably lost on loan
Clymene gracilis	*Praxillella gracilis* (M. Sars, 1861)	1861c: 256; 1862a: 91–92 (22–23 in offprint)	Bollærne in Oslofjord; Molde; Kristiansund; Grøtøy and Slåttholmen in Lofoten; Ramfjord near Tromsø; Vadsø	Syntypes, NHMO. *Clymene gracilis* introduced as new name for *Clymene quadrilobata* Sars, 1856. Redescribed as distinct species by Arwidsson (1906)
Clymene biceps	*Chirimia biceps* (M. Sars, 1861)	1861c: 256–258; 1862a: 93–95 (24–25 in offprint)	Bollærne in Oslofjord; Kristiansund; Tromsø; Øksfjord; Vadsø	Syntypes, NHMO
M. Sars 1862a				
Euphrosyne cirrata	*Euphrosyne cirrata* (M. Sars, 1862)	1862a: 56 (7 in offprint); 1863: 50	Manger near Bergen	Possible syntypes, NHMO
Eurythoe borealis	*Pareurythoe borealis* (M. Sars, 1862)	1862a: 58–59 (9–10 in offprint)	Manger near Bergen	Material lost; original description based on notes only (Sars 1862a)
Nerine oxycephala	*Aonides oxycephala* (M. Sars, 1862)	1862a: 64 (15 in offprint)	Florø	Syntypes, NHMO
Castalia aurantiaca	*Hesiospina aurantiaca* (M. Sars, 1862)	1862a: 90 (20 in offprint)	Florø; Manger near Bergen	Lectotype, NHMO, selected from Manger (Pleijel, 2004)
Castalia longicornis	*Hesiospina aurantiaca* (M. Sars, 1862)	1862a: 90 (21 in offprint)	Manger near Bergen	Original material lost. Neotype = lectotype of *H. aurantiaca* (Pleijel, 2004)

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
M. Sars 1862b				
Dasychone decora	*Branchiomma infarctum* (Krøyer, 1856)	1862b: 124–125 (33–34 in offprint)	Tromsø; Hammerfest; Vadsø	Syntypes, NHMO
Dasychone argus	*Branchiomma bombyx* (Dalyell, 1853)	1862b: 125–126 (34–35 in offprint); 1863: 67–68	Glesvær and Manger near Bergen; Åsgårdstrand in Oslofjord	Syntypes, NHMO
Chone Kröyerii	*Chone kroyerii* M. Sars, 1862	1862b: 126–128 (35–37 in offprint)	Manger near Bergen; Tromsø; Vadsø	Possible syntypes, NHMO. Type material not indicated (Tovar-Hernandez, 2007)
Chone rubrocincta	*Euchone rubrocincta* (M. Sars, 1862)	1862b: 128–129 (37–38 in offprint); 1863: 66–67	Florø; Manger	Syntypes, NHMO (Banse, 1972, Tovar-Hernandez, 2007)
M. Sars 1863				
Polynoë nivea	*Leucia nivea* (M. Sars, 1863)	1863: 39–42	Beian in Trondheimsfjord	Holotype, NHMO (Loshamn, 1980; Chambers, 1989; Barnich and Fiege, 2010)
Polynoë clavigera	*Harmothoe clavigera* (M. Sars, 1863)	1863: 42–46	Kristiansund	Holotype, NHMO (Barnich and Fiege, 2009)
Polycirrus trilobatus	*Amaeana trilobata* (M. Sars, 1863)	1863: 53–58	Slåttholmen in Lofoten, Kristiansund	Syntypes, NHMO
Terebella artifex	*Lanice conchilega* (Pallas, 1766)	1863: 58–66	Beian in Trondheimsfjord	Syntypes, NHMO
M. Sars 1865a				
Amphicteis finmarchica	*Ampharete finmarchica* (M. Sars, 1865)	1865a: 10–14 (6–10 in offprint)	Ramfjord near Tromsø	Syntypes, NHMO
Polycirrus arcticus	*Polycirrus arcticus* M. Sars, 1865	1865a: 14–16 (10–13 in offprint)	Tromsø; Vadsø	Possible syntypes, NHMO (Holthe, 1986)
Terebella ebranchiata	*Leaena ebranchiata* (M. Sars, 1865)	1865a: 16–20 (13–16 in offprint)	Varangerfjord	Possible syntypes, NHMO (Holthe, 1986)
M. Sars 1867 (*nomina nuda*)				
Clymene laeviceps				
Lophosyllis maculata				
M. Sars 1869 (*nomina nuda*)				
Maldane? pellucida				
Eumenia? erucaeformis				
Trophonia pallida	Possibly synoym of *Diplocirrus glaucus* (Malmgren, 1867)			Synonymy indicated by M. Sars (1869)
Trophonia pilosa				
Pygophelia singularis				

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
Polynoe abyssicola	*Harmothoe abyssicola* Bidenkap, 1894		Skråva in Lofoten, Oslofjord	Syntypes, NHMO. Described by Bidenkap (1894). Revised Barnich and Fiege (2009) on specimens from Oslofjord
M. Sars in G.O. Sars 1872a				
Paramphinome pulchella	*Paramphinome jeffreysii* (McIntosh, 1868)	1872a: 45–49, pl. 4, figs 19–35.	Lofoten, Oslofjord, Ålesund near Molde	Possible syntypes, NHMO. M. Sars, 1869: *nomen nudum*
Umbellisyllis fasciata	Possibly synonym of *Odontosyllis gibba* Claparède, 1863 (Nygren 2004)	1872a: 41–43, pl. 4, figs 12–18	Flekkefjord near Kristiansand, Lofoten, Hardangerfjord, Kristiansund	Type material not confirmed. M. Sars 1869: *nomen nudum*
M. Sars in G.O. Sars 1872b				
Laenilla mollis	*Austrolaenilla mollis* (M. Sars in G.O. Sars, 1872)	1872b: 406–407; 1873a: 207–214, pl. 14, figs 1–16	Drøbak in Oslofjord	Type probably lost. Extended description (1873a) includes specimens from Lofoten
Eteone fucata	Possibly synonym of *Eteone flava* (Fabricius, 1780) (Pleijel 1993)	1872b: 407; 1873a: 226–229, pl. 15, figs 1–6	Drøbak in Oslofjord	Syntypes, NHMO. M. Sars 1867: *nomen nudum*
Onuphis quadricuspis	*Paradiopatra quadricuspis* (M. Sars in G.O. Sars, 1872)	1872b: 407–408; 1873a: 216–222, pl. 15, figs 7–19	Drøbak and Åsgårdstrand in Oslofjord; Skrova in Lofoten	Lectotype, NHMO, selected from Drøbak (Fauchald, 1982). M. Sars, 1867: 291; 1869: *nomen nudum*
Aricia norvegica	*Phylo norvegica* (M. Sars in G.O. Sars, 1872)	1872b: 408; 1873a: 236–240, pl. 16, figs 1–8	Bolærne and Drøbak in Oslofjord; Lofoten	Syntypes, NHMO. M. Sars 1867: 291 *nomen nudum*
Trophonia flabellata	*Pherusa flabellata* (M. Sars in G.O. Sars, 1872)	1872b: 409; 1873a: 249–252, pl. 17, figs 1–12	Drøbak in Oslofjord; Skrova and Brettesnes in Lofoten	Syntypes, NHMO. M. Sars 1869: *nomen nudum*
Chloraema pellucidum	*Flabelligera affinis* M. Sars, 1829 (fide Støp-Bowitz 1948)	1872b: 409–410; 1873a: 252–261, pl. 16, figs 9–20	Not specified, whole coast	Holotype, NHMO (Støp-Bowitz, 1948). M. Sars 1867: 291: *nomen nudum*, as *Siphonostomum pellucidum;* 1869: *nomen nudum*, as *Chloraema pellucidum*
Prionospio plumosus	*Prionospio plumosa* (M. Sars in G.O. Sars, 1872)	1872b: 410; 1873a: 263–268, pl. 17, figs 13–29	Drøbak in Oslofjord	Types, USNM (Sigvaldadottir, 1998). M. Sars 1867: 291 *nomen nudum*, as *Ctenospio plumosus*
Spiophanes cirrata	Possibly synonym of *Spiophanes kroyeri* Grube, 1860 (Söderström 1920; Meissner 2005)	1872b: 410–411; 1873a: 268–273, pl. 18, figs 1–16	Drøbak in Oslofjord; Skrova in Lofoten	Type probably lost (Meissner, 2005)
Clymene planiceps	*Isocirrus planiceps* (M. Sars in G.O. Sars, 1872)	1872b: 411–412	Drøbak in Oslofjord, Terøy in Hardanger	Syntypes, NHMO

Original name	Valid name	References, including later descriptions	Original localities	Type material and remarks
Clymene Dröbachiensis	*Euclymene droebachiensis* (M. Sars in G.O. Sars, 1872)	1872b: 412	Drøbak in Oslofjord	Syntypes, NHMO
Clymene affinis	*Praxillella affinis* (M. Sars in G.O. Sars, 1872)	1872b: 412	Bolærne in Oslofjord	Syntypes, NHMO
Lumbriclymene cylindricauda	*Lumbriclymene cylindricauda* M. Sars in G.O. Sars, 1872	1872b: 413	Drøbak in Oslofjord	Syntypes, NHMO. M. Sars 1867: 291 *nomen nudum*, as *Clymene cylindricauda*
Streblosoma cochleatum	*Streblosoma bairdi* (Malmgren, 1866)	1872b: 414	Drøbak in Oslofjord	Possible syntypes, NHMO
Streblosoma intestinale	*Streblosoma intestinale* M. Sars in G.O. Sars, 1872	1872b: 414	Drøbak in Oslofjord; Odvær in Lofoten	Possible syntypes, NHMO
Thelepodopsis flava	*Thelepus cincinnatus* (Fabricius, 1780)	1872b: 415	Drøbak in Oslofjord	Possible syntypes, NHMO
Chone longocirrata	*Chone longocirrata* M. Sars in G.O. Sars, 1872	1872b: 415–416	Drøbak in Oslofjord	Type probably lost (Tovar-Hernandez, 2007)
Dasychone inconspicua	*Branchiomma inconspicuum* (M. Sars in G.O. Sars, 1872)	1872b: 416	Drøbak in Oslofjord	Syntypes, NHMO. M. Sars 1867: 291 *nomen nudum*
Protula borealis	uncertain, possibly synonym of *Protula tubularia* (Montagu, 1803)	1872b: 417	Not specified, whole coast	Syntypes NHMO. M. Sars 1865b: *nomen nudum*; 1866: *nomen nudum*; 1869: *nomen nudum*

Table 3. Summary of polychaetes described from Norwegian waters in the 19th century by several authors: Heinrich Rathke, Anders Ørsted, Georg Ossian Sars, Lauritz Esmark, Gerhard Armauer Hansen and Wilhelm Storm. See tables 1 and 2 for species described by O.F. Müller and Michael Sars. NNHE, Norwegian North-Atlantic Expedition 1876–78; NHMO, Natural History Museum Oslo; NTNU-VM, Norwegian University of Science and Technology, University Museum Trondheim; ZMBN, University Museum of Bergen. See fig. 6 for localities.

Original name	Localities	Remarks
Rathke 1843		
Sigalion idunae	Molde	Synonymised with *Sthenelais boa* (Johnston, 1833)
Nereis grandifolia	Kristiansund	Synonymised with *Nereis pelagica* Linnaeus, 1758
Nereis sarsii	?	Synonymised with *Hediste diversicolor* (O.F. Müller, 1776)
Syllis cornuta	Kristiansund	Accepted
Syllis tigrina	Molde	Synonymised with *Syllis armillaris* (O.F. Müller, 1776)
Halimede venusta	Molde	Synonymised with *Nereimyra punctata* (O.F. Müller, 1776)
Ephesia gracilis	Molde	Synonymised with *Sphaerodorum flavum* (Ørsted, 1843)
Aricia muelleri	Molde	Synonymised with *Scoloplos armiger* (O.F. Müller, 1776)
Arenicola boeckii	Trondheimsfjord	Synonymised with *Arenicolides ecaudata* (Johnston, 1835)
Scalibregma inflatum	Molde	Accepted; neotype from Molde (Mackie, 1991)
Ammotrypane aulogaster	Drøbak in Oslofjord; Molde and Namsenfjord	Synonymised with *Ophelina acuminata* Ørsted, 1843
Ammotrypane limacina	Molde	Accepted as *Ophelia limacina*
Ammotrypane oestroides	Molde	Synonymised with *Travisia forbesii* Johnston, 1840
Siphonostoma vaginiferum	Kristiansund	Accepted as *Flabelligera vaginifera*
Siphonostoma villosum	Molde	Accepted as *Brada villosa*
Siphonostoma inhabile	Molde	Accepted as *Brada inhabilis*
Clymeneis stigmosa	Kristiansund and Molde	Accepted
Ørsted 1845		
Sigalion tetragonum	Drøbak in Oslofjord	Accepted as *Neoleanira tetragona*
Syllis longocirrata	Drøbak in Oslofjord	Accepted as *Syllides longocirrata*
Notophyllum polynoide	Drøbak in Oslofjord	*Nomen dubium*, original material lost (Nygren et al., 2010)
Goniada norvegica	Drøbak in Oslofjord	Accepted
Spione trioculata	Drøbak in Oslofjord	?
G.O. Sars 1873b		
Nychia globifera	Storegga, off Western Norway	Accepted as *Harmothoe globifera*. Type lost (Barnich and Fiege, 2010)
Hermadion? hyalinus	Storegga, off Western Norway	Accepted as *Adyte hyalina*; holotype, NHMO (Bock et al., 2010)
Esmark 1874		
Eteonopsis geryonicola	Oslofjord	Accepted as *Ophryotrocha geryonicola*, syntypes NHMO
Hansen 1879a		
Polynoë aspera	NNHE stn 48	Accepted as *Harmothoe aspera*; type ZMBN
Polynoë (Eunoë) islandica	NNHE stn 48	Synonymised with *Eunoe nodosa* (M. Sars, 1861); type ZMBN
Nephthys atlantica	NNHE stns 18, 31 and 87	Synonymised with *Aglaophamus malmgreni* (Théel, 1879); type ZMBN

Original name	Localities	Remarks
Typhlonereis gracilis	NNHE stn 40	Accepted: lectotype, ZMBN 2183 (Bakken, 2003)
Onuphis hyperboräa	NNHE stn 18 and 48	Accepted as *Nothria hyperborea*; lectotype, ZMBN 2210, NNHE stn 18 (Fauchald, 1982)
Scalibregma (?) abyssorum	NNHE stn 18	Nomen dubium (Bakken et al., 2014), type ZMBN
Scalibregma parvum	NNHE stns 18 and 31	Accepted as *Pseudoscalibregma parvum;* lectotype ZMBN, NNHE stn 31 (Bakken et al., 2014)
Ammotryphane cylindricaudatus	NNHE stns 31 and 87	Accepted as *Ophelina cylindricaudata;* lectotype ZMBN, NNHE stn 87 (Kongsrud et al., 2011)
Späerodorum abyssorum	NNHE stn 33	Accepted as *Ephesiella abyssorum*: type ZMBN
Trophonia hirsuta	NNHE stns 18 and 31	Accepted as *Diplocirrus hirsutus*; type ZMBN
Cirratulus abyssorum	NNHE stn 87	Uncertain status; type ZMBN
Cirratulus abranchiatus	NNHE stn 31	Accepted as *Chaetozone abranchiatus*
Clymene Koreni	NNHE stn 87	Accepted as *Maldane koreni*; type ZMBN
Myriochele Sarsii	NNHE stn 38, 40 and 51	Synonymised with *Myriochele heeri* Malmgren, 1867; type ZMBN
Potamilla Malmgreni	NNHE stn 40 and 51	Accepted as *Potamethus malmgreni*; type ZMBN
Protula arctica	NNHE stn 51	Accepted as *Protis arctica*; type ZMBN
Hansen 1879b		
Polynoë arctica	NNHE stn 223, 224, 237	Synonymised with *Eunoe oerstedi* Malmgren, 1866; type ZMBN
Aricia arctica	NNHE stn 224, Jan Mayen	Accepted as *Scoloplos arctica*; type ZMBN
Storm 1879		
Lænilla violácea	Røberg in Trondhjemsfjord	Accepted as *Leucia violacea*; syntypes NTNU-VM (Barnich and Fiege, 2009)
Lænilla oculinarum	Galgenes in Trondhjemsfjord	Accepted as *Harmothoe oculinarum*. Type specimens in NHMO and NTNU-VM (Fiege and Barnich, 2009).
Hansen 1880		
Polynoe assimilis	NNHE stn 363	Synonymised with *Harmothoe globifera* (G.O. Sars, 1873), (Barnich and Fiege, 2010); type ZMBN
Polynoe spinulosa	NNHE stn 363	Synonymised with *Eunoe nodosa* (M. Sars, 1861); type ZMBN
Polynoe foraminifera	NNHE stn 338	Synonymised with *Eunoe nodosa* (M. Sars, 1861); type ZMBN
Polynoe glaberrima	NNHE stn 366	Accepted
Trophonia borealis	NNHE stns 270, 275	Synonymised with *Pherusa plumosa* (O.F. Müller, 1776); type ZMBN
Trophonia rugosa	Spitzbergen, Magdalenabay	Accepted as *Brada rugosa*; type ZMBN
Trophonia arctica	Spitzbergen, Magdalenabay	Synonymised with *Brada rugosa* (Hansen, 1880)
Brada granulosa	NNHE stn 337	Accepted; type ZMBN
Myriochele danielsseni	NNHE stn 192	Accepted; type ZMBN
Storm 1881		
Leodice gunneri	Trondhjemsfjord	Synonymised with *Eunice norvegica* (Linnaeus, 1767)

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* Ore forcipato.

2623. NEREIS *noctilucae* orpore vix conſpicuo. Gr. *Ignerolak.*

2624. N. *diverſicolor* ſubdepreſſa, pedibus acuminatis ſetiferis. *Würm.* 104. t. 6. Str. S. 1. p. 198, 2?

2625. N. *Tubicola* ſubdepreſſa, pedibus ſubcirratis, globoſis. * +

2626. N. *armillaris* ſubdepreſſa pedibus conicis cirris lenticularibus. *Würm.* 150. t. 9. * +

2627. N. *fimbriata* ſubdepreſſa pedibus cirratis lentigeris. *Würm.* 144. t. 8. * +

2628. N. *verrucoſa* convexa, pedibus cirratis verrucoſis. D. *Söe-Skol-Orm. Würm.* 140. t. 7. Aph. 7, 284. Isl. R. 900. D. Act. Havn. 10. p. 9. b. t. IV. Act. Havn. p. 169. t. e, f. 10. N. *pelagica* Linn.

2629. N. *pinnata* convexa, pedibus cirratis pinnigeris. * +

2630. N. *pennata* convexa, pedibus cirratis pennigeris. Act. nidr. 4. p. 51. t. 2. f. 7 - 12. At tubulus alienus eſt. N. *norvegica* Linn.

2631. N. *puſilla* depreſſa, pedibus cirratis, filamentis articulatis. * +

** Ore proboſcideo.

2632. N. *ſtellifera* depreſſa, lamellis pedum ellipticis. * +

2633. N. *punctata* ſubdepreſſa, pedibus longiſſime cirratis. *+

2634. N. *alba* ſubconvexa, fronte cornuta, pedibus muticis bifidis. * +

2635. N. *maculata* convexa, lamellis pedum ſubcordatis. *Würm.* 156. t. 10. †

2636. N. *viridis* depreſſa, lamellis pedum lanceolatis. *Würm.* 162. t. 11. †

Ee 2637.

Figure 3. Example of text page from *Zoologia Danica prodromus* for polychaetes with armed mouth ('ore forcipato') and with eversible pharynx ('ore proboscideo'). From Müller (1776).

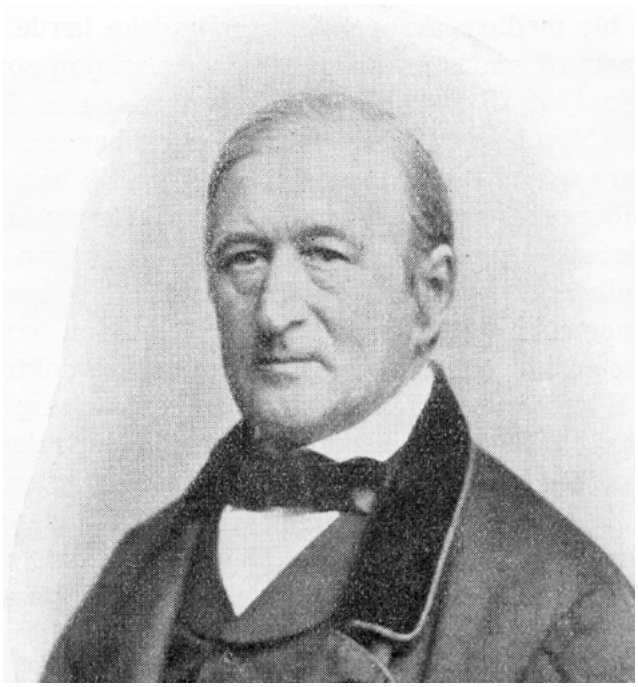

Figure 4. Michael Sars. Photography by P.M. Thomsen. Reproduced from Økland (1955).

Michael Sars described nearly 80 species of polychaetes, of which 54 are considered valid (table 2). The descriptions generally had a standardised form, with a diagnosis in Latin followed by an extended description with morphological details in Norwegian. In some few cases, descriptions were given in either German (Sars, 1846) or French (Sars, 1856). Some of the works were re-edited and translated into German, French or English and published in international journals (see Sars, 1829, 1835, 1856, 1869). From about 1860, most new species were published as contributions from the newly established scientific society of Christiania (Det norske Videnskaps-Akademi [The Norwegian Academy of Science and Letters]). His latest descriptions of new species were published after his death in three papers edited (without changes) or revised by his son Georg Ossian Sars (Sars, 1872a, 1872b, 1873a). Altogether, there are 14 publications with descriptions of new species of polychaetes (table 2).

The correct reference to the descriptions needs attention. Several contributions from the scientific society were published both in an annual periodical and as separate offprints. The offprints had separate pagination (starting at p. 1) and usually a different title (e.g. Sars, 1862a, 1862b). The periodical was published the year after the presentations, e.g. contributions for 1861 were published in 1862. It may also cause problems that several species were described more than once. This was the case for some species for which the first publication was rather short and Michael Sars then presented a more complete description in a later publication. The use of illustrations varied. The earliest publications were illustrated (Sars, 1829, 1835, 1846, 1856), but later publications were generally not. The last species descriptions (Sars, 1873a) contained detailed illustrations of some of the species made by G.O. Sars, who was an extremely skilled illustrator.

Contemporary with Michael Sars, several foreign naturalists visited Norway for fauna studies. In approximately 1840, new species were described by the Danish naturalist Anders Ørsted and the German–Polish naturalist Heinrich Rathke (table 3). Ørsted visited Drøbak, having been inspired by the works of O.F. Müller (Ørsted, 1845), whereas Rathke visited several places in the middle part of Norway (Rathke, 1843). No material from Ørsted's polychaetes from Drøbak is known to exist (Wolff and Petersen, 1991). The existence of the material of Rathke is uncertain. A couple of decades later,

the most important contribution to the knowledge of the polychaete fauna was recorded by Gerhard Armauer Hansen in his treatment of the material collected during the Norwegian North-Atlantic Expedition (NNHE), 1876–78. In total 27 polychaete species were described as new species from the expedition, of which 16 are considered valid (table 3). All species descriptions were originally published in Norwegian (Hansen, 1879a; 1879b; 1880), but the descriptions were later repeated with parallel text in English in a comprehensive expedition report (Hansen, 1882).

Museum collections of original material

In general the material collected by the early naturalists were kept in their own private collections or donated or sold to museum collections (Anker, 1950; Økland, 1955). In the museums, collected specimens were placed in common collections. Specimens and samples used for species descriptions were generally not specifically indicated. The degree to which original specimens have been identified and catalogued as 'types' at some later stage varies among museums. All too often, however, it seems that original materials have been forgotten and/or overlooked in the collections and consequently been reported as missing when asked for in modern taxonomic studies. For most early-described species, the identification of original material (holotype or syntypes) today is, therefore, totally dependent on information on sample labels (site, date, collector) and knowledge of the original sampling sites. The present principles of designating and cataloguing a type series as specified in the Zoological Code (ICZN) did not come into force until much later (ICZN, 1999).

In Norway, there are four natural history museums that maintain scientific marine collections. The first to be established was the collections of the Royal Norwegian Society of Sciences and Letters in Trondheim, which was founded in 1760 (Moen, 2006; Bakken et al., 2011). The other museums, in Oslo (then Christiania), Bergen and Tromsø, were founded in 1812, 1825 and 1872, respectively. In their first periods of activity, the museums concentrated on local fauna and flora, but gradually the museums also built up collections of specimens from other parts of Norway, and, starting in the 1870s, from expeditions to the Nordic Seas and Arctic areas and more distant destinations (see e.g. Sakshaug and Mosby, 1996). Some specimens have been distributed among the museums as early curators seemed to share or split samples between the museums (Bakken, 1999).

In the present study, efforts have been made to identify original materials from Michael Sars in Norwegian museums that have not yet been identified as 'types'. Most of the material is located in the collections of the Natural History Museum, University of Oslo (NHMO), but some is also found in the University Museum, University of Bergen (ZMBN). During his research, Michael Sars also sent specimens to other European museums, e.g. in Copenhagen (information from letters, see Økland, 1955). Potentially, original material (syntypes) may, therefore, have been distributed among several museums. In the present study, original material from 25 species has been identified in the collections of the museum in Oslo (see table 2). Original labels with Michael Sars' characteristic hand-writing (fig. 5) and corresponding information on sampling sites from labels and species descriptions have been taken as evidence for the status of the material. These specimens have now been catalogued and transferred to a separate type collection. Material of somewhat uncertain status, e.g. lacking original labels, has been registered as possible types (table 2) and catalogued.

Type localities

The Zoological Code (ICZN) states that all sampling localities for a collection of syntypes are to be regarded as type localities (ICZN, 1999). When a lectotype has been designated, or a neotype in the case of missing original material, the locality of the designated specimen is the sole type locality, and localities for other previous syntypes lose their status. These specifications imply that a uniquely defined type locality (one locality only) will be the case only for species originally described from one locality or when a lectotype or neotype has been designated in later revisions. For modern taxonomy, and for molecular studies of species complexes in particular, the precise location of one type locality is crucial. With regard to the species described by O.F. Müller, some species included in *Zoologia Danica* were described from one locality, which then fixes the type locality (e.g. Drøbak in the Oslofjord for *Scoletoma fragilis*, *Eunice pennata* and *Hyalinoecia tubicola*: table 1). For Müller's other species, especially those that referred to other authors in the 'prodromus', the identification of sampling localities may be more obscure. As Müller in the 'prodromus' often referred to several authors and publications, the first step is to decide which of them constitutes the original description; then information may be extracted on localities, which are often rather inaccurately reported. The matter is also complex for poorly characterised species that essentially have been diagnosed by later authors, e.g. *Glycera alba* by Ørsted (1843), based on specimens from sampling localities outside of the area indicated by Müller.

The naturalists of the 19th century generally reported their sampling localities, but often rather roughly, with little more than place name and depth. The studies of Ørsted (1845) and Rathke (1843) were restricted to one or a few places. Michael

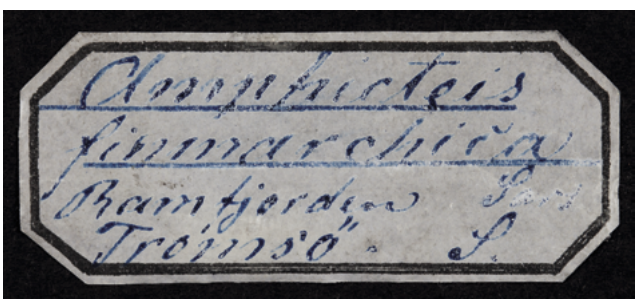

Figure 5. Original label written by Michael Sars for *Ampharete finmarchica*. Original text reads: 'Amphicteis finmarchica Sars. Ramfjorden Tromsö S.' Natural History Museum, Oslo.

Sars, however, often reported several localities for his species, especially in the late publications, when he had collected material from all parts of Norway (table 2, fig. 6). In the descriptions, he did not indicate whether material from one or several localities had been used. Therefore, it should be a task in connection with revisions to critically examine all syntypes and select lectotypes that are in accordance with the species descriptions. Until today this has only been done for seven of the species of Michael Sars (table 2). Presently, there is one specified type locality for only about half of the species that he described as new, either by original designation (one locality) or by subsequent selection of a lectotype or neotype by later authors.

Conclusions

The correct taxonomy of the species is the key to biological knowledge and the very basis for documenting biodiversity. Taxonomy requires a thorough knowledge of past research, even if that means beginning with old, poorly preserved and labelled specimens. It is acknowledged that modern research is hindered by the inaccessibility of older taxonomic literature, poor descriptions of early-described species, and the uncertain existence and location of type material (Glasby and Read, 1998). The present rapidly increasing use of molecular genetic methods for species characterisation reinforces the need to clearly assess the identity of the species. Any information on original material, their repositories and sampling localities is therefore urgently needed. In Norway, correct taxonomy is critical for biodiversity mapping (e.g. the MAREANO seabed mapping program: Buhl-Mortensen et al., 2012), environmental surveillance monitoring at offshore petroleum installations, and studies of the effects of climate changes. Furthermore, recent studies of selected polychaete families have revealed considerable species shifts from offshore shelf to deep-water areas in the Nordic Seas (Kongsrud et al., 2011; Bakken et al., 2014).

The present study is intended to facilitate access to descriptions, material and localities of the early-described species from Norway. Most of the old literature is in Danish or Norwegian, with place names that often are obsolete or very local. Native knowledge is therefore essential, as is knowledge of the history of science, reading descriptions in the original language, tracing unpublished field notes and letters that may be kept as part of collections, and access to museum catalogues to supplement more precise data on sampling localities. Knowledge of local geography is also of paramount importance, especially when place names have changed over time with the development of language and change of local administrative systems.

Basic taxonomy incorporating revisions of early-described species is tedious work. It is a real challenge to do revisions fast enough to keep up with molecular studies. In cases where molecular data are needed at the first instance, the best practice will be to collect specimens from original localities or within the geographical range where the original material may have been collected, which implies that information on original sampling and material must be known. The documentation of material and sampling localities of the early-described species is thus a basis for the advancement of taxonomy and biodiversity mapping using new techniques and methods.

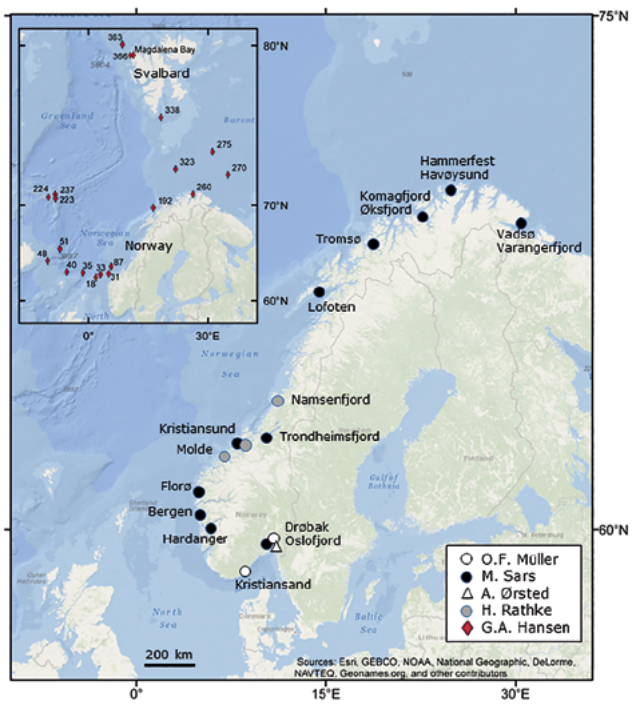

Figure 6. Localities for polychaetes described by Otto Friderich Müller, Michael Sars, Anders Ørsted, Heinrich Rathke and Gerhard Armauer Hansen from Norwegian waters. Upper left map inset shows stations sampled by the Norwegian North-Atlantic Expedition (NNHE) 1876–1878.

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