Polar Biol (1999) 22: 322–328 © Springer-Verlag 1999

ORIGINAL PAPER

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Five Recent *Mya* species, including three new species and their fossil connections

Accepted: 2 May 1999

Abstract Three new species of *Mya* Linné are described from Greenland. *Mya eideri* sp. nov. is figured and compared with boreal and fossil species with which it has been confused, and the known distribution of the species is indicated. The validity in Recent faunas of the fossil species *M. pseudoarenaria* and *M. uddevallensis* is discussed; two new Recent species, *M. neoovata* sp. nov. and *M. neouddevallensis* sp. nov., from Ikka Fjord, southwest Greenland, and Scoresbysund, East Greenland, respectively, are described for Recent material of the comparable two fossil taxa.

Introduction

The purpose of this paper is to describe and name the bivalve material collected with van Veen grabs in Ikka Fjord, southwest Greenland. It became obvious that the Recent material first identified as *Mya truncata* Linné, 1758, together with the material from Disko Bugt, northwest Greenland (Petersen 1978), formerly identified as *M. truncata*, was not *M. truncata*, which turned out to be a boreal North Atlantic species. The other used names, *M. pseudoarenaria* and *M. uddevallensis,* are based on fossil specimens that deviate from Recent material and are part of the stratigraphy and phylogeny. Hence holotypes for the Recent arctic species with soft parts preserved, *M. eideri* sp. nov., *M. neoovata* sp. nov. and *M. neouddevallensis* sp. nov., from Ikka Fjord, southwest Greenland, and Scoresbysund, East Greenland are herein described.

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Materials and methods

The unique Ikka Fjord, southwest Greenland has, since 1995, been intensively studied by geologists, botanists and zoologists. General descriptions of the Ikka Fjord are given in Buchardt et al. (1996, 1997), Petersen et al. (1998) and Seaman and Jenner (1996). The Ikka Fjord contains a forest of columns, up to 20 m high, produced when underground freshwater springs meet seawater and create the mineral "Ikait", which is stable only below 6°C. The epifauna on the Ikka columns is treated in Thorbjørn (1996). The infauna around the columns was collected by 0.1 m^2 van Veen in 1995 and 1996 and also with 0.02 m^2 van Veen in 1996. The *Mya* material from Ikka Fjord was at first identified from the fossil *M. pseudoarenaria* (see Bernard 1979), with a few *M. eideri* sp. nov. T. Schiøtte (personal communication) noted the similarity between a valve from northeast Greenland and the fossils from Uddevalla. It became obvious that most (probably all) of the Greenlandic (arctic?) material (see Ockelmann 1958; Petersen 1964, 1978) hitherto identified as *M. truncata* belong to three species: *M. eideri* sp. nov., *M. neoovata* sp. nov. and *M. neouddevallensis* sp. nov. Abbreviations used in the text are: ZMUC (Zoological Museum University of Copenhagen) and GMUC (Geological Museum University of Copenhagen).

Results

Systematics

Mya eideri sp. nov.
Mya truncata forma b

Jensen (1900).

Mya truncata

Ockelmann (1958) (synonymy, part). MacGinitie (1959), from Point Barrow. Petersen (1964); (1978) (part). MacNeil (1965) [not Linné 1758].

Material examined

Holotype (ZMUC BIV-318)

West Greenland, Godhavn Havn, 0.1 m^2 van Veen, st. 123, 30 April 1959, 6 m depth, sand, collector G.H. Petersen. Other material included specimens from Disko Bugt studied for population parameters (Petersen 1978), originally identified as *M. truncata*, and two specimens with soft parts plus a few shells from the Ikka Fjord. ca. 5–20 m, mixed sediment, in 1995 and 1996 (G.H. Petersen, unpublished work).

Diagnosis

A *Mya* in which the pallial sinus first follows the pallial line then goes up against the anterior muscle scar to a point just below the posterior hinge, where the pallial sinus bends at an acute angle of ca. 65° in a first straight, then curved, line to the posterior muscle scar.

Description

The holotype with siphons (photograph, Fig. 1A) and inside of right valve (drawing, Fig. 1B) is shown. Length 52.1 mm, height 34.5 mm, width 21.9 mm. Adults truncate, obvious truncation starting at length of about 15 mm, when ventral edge decreases in growth posteriorly. Siphonal opening narrow. Siphons not retractable. Umbonal region not very inflated. Growth lines present, some of which are winter rings. Periostracum well developed and reddish to brownish. The best characters of the shell interior are the pallial sinus and the pallial line, see diagnosis. The hinge is not easy to use, as it is often incomplete and worn.

Remarks

Jensen (1900) shows photographs of three different *M. truncata* forms: "a. from the Faroes (forma *typica* autt.)", "b. from Greenland", "c. from glacial layers (forma *uddevallensis*)". Jensen's form "b. from Greenland" is *M. eideri* sp. nov. MacNeil (1965) treats 17 *Mya* species, mainly fossil. His photographs (MacNeil 1965) of a Recent shell from Kodiak Island, Alaska, are of *M. eideri* sp. nov.

M. eideri sp. nov. is superficially buried in the bottom and is very common in 0.1 m^2 van Veen grab samples from Greenland (Petersen 1978) and also washed up on the beach (Petersen 1964). It is an important food item for eiders (Frimer 1997) and walrus together with, for example, *Serripes groenlandicus* (Bruguière 1789), and *Hiatella byssifera* Fabricius 1780).

To date, *M. eideri* sp. nov. is known from a preliminary search around Greenland from Thule in northwest Greenland down along the coast of West Greenland to the East Greenland fjords and also from Alaska. According to Leifur Simonarson (personal communication), *M. eideri* sp. nov. may be related to the fossil *M. gudmunduri* Strauch, 1972 and the photograph (Strauch 1972) of the holotype from Coralline Crag, Ramsholt, United Kingdom supports this suggestion.

Etymology

The species name *eideri* refers to the eider ducks, which are predators on the species. As a reference to the Latin name for eider, *Somateria*, has been used for a metacercaria (*Gymnophallus somateriae*) from *Hiatella byssifera*, which may occur together with *M. eideri* sp. nov. (see Petersen 1978, 1984), I prefer to use another version of the name.

Systematics

Mya neoovata sp. nov.
Mya truncata forma *ovata*

Jensen 1900 (part).

Material examined

Holotype (ZMUC BIV-319)

Southwest Greenland, Ikka Fjord, 5 July 1995, 16 m depth, 0.1 m^2 van Veen grab sample, st. 005, clay-sand, collector G.H. Petersen.

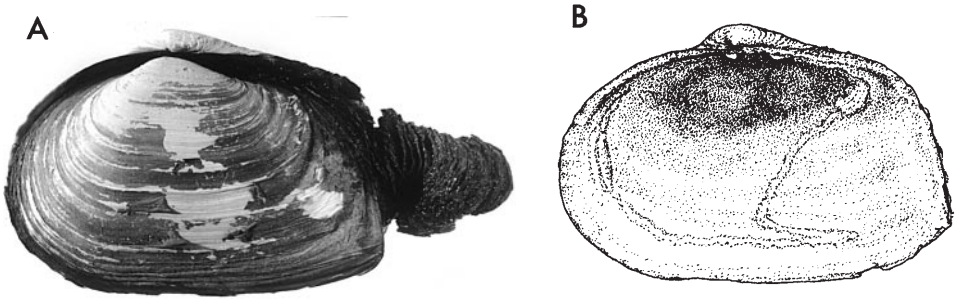


Fig. 1A, B *Mya eideri* sp. nov. Holotype from Godhavn, W Greenland (ZMUC BIV-318). Length 52.1 mm, height 34.5 mm, width 21.9 mm. **A** Photograph of entire specimen with siphons. **B** Drawing of inside of right valve

Diagnosis

A *Mya* species with pallial sinus following pallial line to a point just below umbo from where it swings in a curved line backwards to posterior muscle scar.

Description

Length 36.8 mm, height 24.3 mm, width 14.6 mm. Posterior end flattened, not truncate. Periostracum well developed and greyish. Siphons retractable into shell (Fig. 2).

Remarks

M. neoovata sp. nov. burrows superficially and is common in grab samples from Ikka Fjord. It appears to be restricted to the inner parts of the fjords.

The species was first recognized as a distinct form by Jensen (1900), who used the name "*Mya truncata* f. *ovata*" for Recent and fossil shells from several arctic localities, among them West Greenland, Spitsbergen, North Siberia, and Iceland (Jensen 1900). Schlesch (1931) erected the new species *M. pseudoarenaria* with description and photograph of a subfossil shell from North Iceland and suggested that the species was extinct. Actually there is a nomenclatural problem. Schlesch (1931) wrote "n. nom." after the name. However, in the paper he first correctly erected a new fossil species *M. pseudoarenaria* and then synonymized it with Jensen's forma *ovata*. Hence *M. pseudoarenaria* is not just a new name, as Schlesch wrote, but a name for a new species. Schlesch discussed Jensen's material of *M. truncata* var. *ovata* Jensen, 1900, and showed that *ovata* was preoccupied by *M. ovata* Donovan, 1802. He included Jensen's (1900) drawings of a left shell from West Greenland (Schlesch 1931). Schlesch's photograph of the fossil holotype for *M. pseudoarenaria* is not easy to interpret, and Lauersen (1966) questioned the name and suggested it not be used. Schlesch donated his material to the Swedish Museum of Natural History (Naturhistoriska Riksmuseet) in Stockholm. Jensen did not select a holotype for "*Mya truncata* f. *ovata*"; his material at ZMUC and GMUC has been searched for a possible lectotype without success. MacNeil (1965) assumed that Jensen's material was in ZMUC and that the holotype was a fossil shell in Jensen's material. I have seen some of it, but not all; some is in GMUC and some is in the Geological Museum in Stockholm, and probably also at other institutions with which Jensen corresponded. MacNeil's (1965) photographs of "*Mya pseudoarenaria*" (Recent, from Point Barrow, Alaska) are in good agreement with my material. I suggest that his Recent (living) species be referred to *M. neoovata* sp. nov. Bernard (1979) gave drawings of *M. pseudoarenaria*, *M. truncata* and *M. uzenensis* Nomura and Zinbo, 1937. However, the text is not in accordance with the figures, which are difficult to identify. *M. uzenensis* is also established on fossil material.

Systematics

Mya neouddevallensis sp. nov.

Material examined

Holotype (ZMUC BIV-325)

East Greenland, Scoresby Sund area: Hurry Inlet, 10 fathoms, 21 August 1900, collector Søren Jensen, East Greenland Expedition 1900.

Diagnosis

A Recent *Mya* where the posterior muscle scar is the posteriormost corner in the angle of ca. 90° between the dorsal edge and the siphonal opening. Hence the shells are "overtruncated". The pallial sinus goes in a fairly straight line from the posterior muscle scar to the pallial line.

Description

Length 43.3 mm, height 33.0 mm, width 18.4 mm. Siphons not retractable into the shells (Fig. 3).

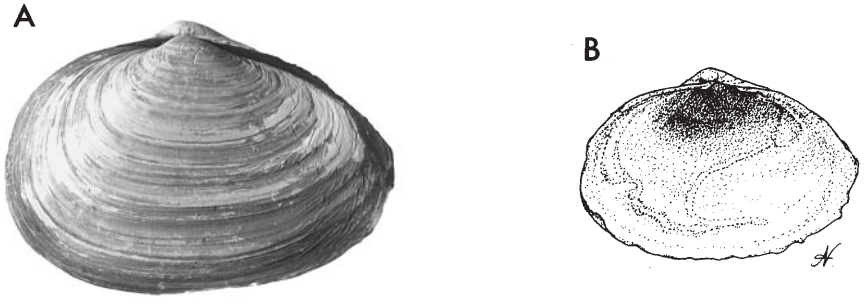


Fig. 2A, B *Mya neoovata* sp. nov. Holotype from Ikka Fjord, SW Greenland (ZMUC BIV-319). Length 36.8 mm, height 24.3 mm, width 14.6 mm. **A** Photograph of entire specimen, siphons just visible. **B** Drawing of inside of right valve

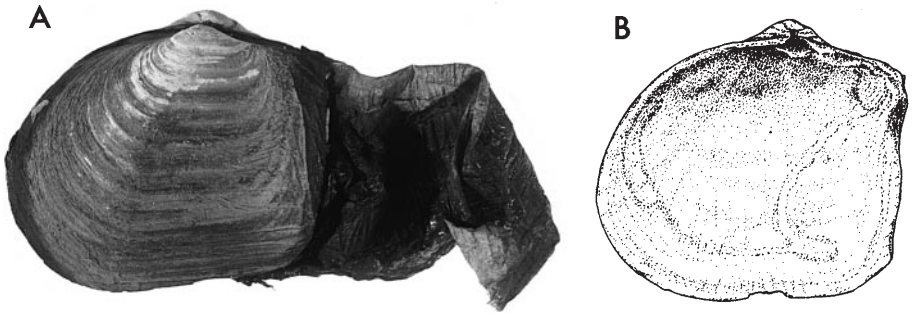


Fig. 3A, B *Mya neouddevallensis* sp. nov. Right valve of holotype with soft parts, from Hurry Inlet, Scoresby Sund area, E Greenland (ZMUC BIV-325). Length 43.3 mm, height 33.0 mm, width 18.4 mm

Remarks

During the search in the ZMUC collection of material identified as *M. truncata*, I discovered one large specimen of *M. neouddevallensis* sp. nov. with soft parts in a sample together with two small *M. eideri* sp. nov. Shells of "living" *M. neouddevallensis* sp. nov. are only from East Greenland; it was not found in the West Greenland material.

M. uddevallensis Forbes, 1846 is based on fossil material. The few fossil shells from the "typelocality" Uddevalla in the ZMUC collection are heavier and more elongate than the Recent one and the pallial sinus is more curved. Figure 4 is a drawing of a right valve from the fossil material from Uddevalla. Living material has been identified as belonging to this fossil species following, e.g. Bernard (1979) and Lubinsky (1980). MacGinitie (1959) discussed the Alaskan *Mya* species and gave photographs. The shells she identified as *M. japonica* Jay and *M. intermedia* Dall are unknown to me. Her Fig. 2 on plate 25 is *M. eideri* sp. nov. I accept the other identifications of *Mya* in her plates 19 and 25.

The fossil species *M. uddevallensis* was first recognized as a variety of *M. truncata* from shells in British and Swedish glacial layers, and the authorship has been attributed to several different persons; Jensen (1900) treats Hancock [no year given] as the author of *M. uddevallensis*, and Ockelmann (1958) has Forbes [no year given]. Smith (1839) mentions that Sowerby identified the fossil shells as a species different from *M. truncata* and that "Mr. Lyell informs me he found it at Uddevalla, and that it occurs both Recent and fossil in the St Lawrence". The latter refers to Lyell (1839, 1842), where an unnamed variety of *M. truncata* is reported from fossil and Recent Canadian shells; Lyell's drawings (1842) are of *M. uddevallensis* Forbes, 1846. Although Lyell (1842) differentiated the species from *M. truncata*, he did not name it and indicated that it was identical with that found by Smith (1839) at Bute. Forbes (1846) named it as a variety from fossil material from Uddevalla, the Swedish west coast and Recent Canadian material. Hancock (1846) accepted this as a species and gave a good description, and he and King (1846) both cite Forbes as the author. Forbes and Hanley (1853) wrote (in brief): "A variety with extremely short posterior end, *Mya uddevallensis* of some authors, is the most frequent form and still lives in Greenland and Boreal America".

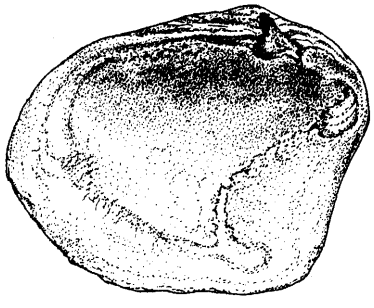


Fig. 4 *Mya uddevallensis* Forbes. Right valve from sample of fossils from Uddevalla, Sweden. Collector Rothe, (1863). Length 48.0 mm, height 39.4 mm (ZMUC BIV-328)

Systematics

Mya truncata Linné, 1758
Mya truncata

Jeffreys (1853). Tebble (1966).

Description

A specimen from a Danish fjord is shown in Fig. 5. *M. truncata* becomes truncate at a length of ca. 15 mm. Siphonal opening tubelike. Periostracum well developed, dark greyish. Siphons not retractable into shell. Pallial sinus follows pallial line to a point ca. two-thirds of distance to a point just below the umbo, from where the pallial sinus comes up against the anterior muscle scar to a point just below the umbo, and then goes straight up against umbo and swings into a line almost parallel with the pallial line. There is more space for the siphons in *M. truncata* than in *M. eideri* sp. nov. *M. truncata* from Danish waters digs deeply and cannot be sampled with a grab.

Remarks

M. truncata Linné, 1758 is based on English material (Foster 1946), with a shell believed to be the holotype in the Linnean Collection (Dodge 1952; MacNeil 1965).

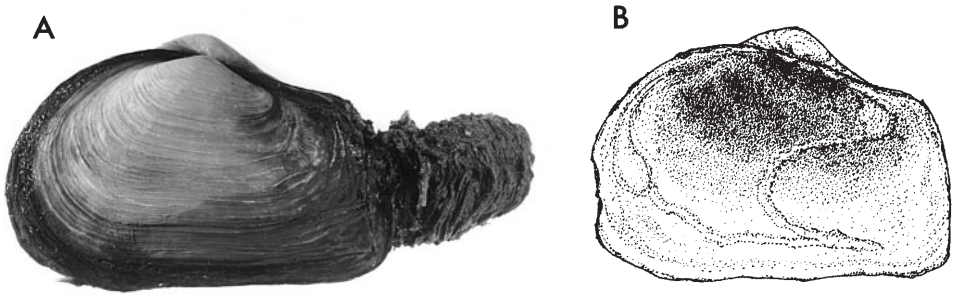


Fig. 5A, B *Mya truncata* Linné. Thisted Bredning, Limfjord, Denmark, 1917. Length 50.0 mm, height 33.2 mm, width 22.8 mm (ZMUC BIV-326). **A** Photograph of entire specimen with siphons. **B** Drawing of inside of right valve

Dr. Anders Warén informed me (June 1998) that Dodge was unaware that there are also "types" of *M. truncata* in Uppsala. However, Dodge (1952) designated the "lectotype". This will preserve the widespread concept of the species found in many identification books (e.g. Jeffreys 1853; Tebble 1966).

Strauch (1972) gives a photograph of a Recent, typical *M. truncata* from the North Sea. The Recent material from Maine shown in Foster (1946) is also typical *M. truncata*. MacNeil (1965) gave photographs of so-called "*Mya truncata*". None of them correspond to my figure and material of *M. truncata*. MacNeil's (1965) photographs of "*Mya truncata*" on his plate 9 (Figs. 1 and 6 of the same shell, Recent, from Kodiak Island, Alaska) are of *M. eideri* sp. nov. His photographs of "*Mya truncata*" on plate 8 (Figs. 11, 12, Recent, Excursion Inlet, Southeast Alaska) are unknown to me. It is not Recent material, which is shown by the growth of a calcareous polychaete tube on the inside of the shell. Note the similarities to the figures in MacGinitie (1959) of *M. japonica* Jay, 1856, and the lectotype of *M. intermedia* Dall, 1898 (preoccupied, by MacGinitie 1959 referred to *M. japonica*), both of which (two species may be involved) are also unknown to me. *M. truncata* is boreal in the North Atlantic.

Mya arenaria *Linné, 1758*

A specimen of *M. arenaria* from the Kattegat near Frederikshavn, Denmark is shown in Fig. 6A, B. The species is figured here because it was discussed by Jensen (1900) and Schlesch (1931) in connection with the different Recent and subfossil forms of *M. truncata* sensu lato, and eventually was accepted as an immigrant from North America to Europe. It took a century and many studies to remove this species name from the Arctic fauna.

Discussion

Species-specific characters

The characters given above are based on the shell, and they reflect several anatomical differences. The important different characters in ecology and population parameters are often neglected in preference for simple morphological characters that may divide the species into morphs, varieties, etc. I agree with Bernard (1979) when he said that "(in) the majority of molluscs from high latitudes, the external morphology is variable, making identification difficult". What appears to be morphological variation may be differences between distinct species, at first recognized from their life history, position in the ecosystems, etc.

Distribution and origin

At present it is not possible to give accurate information on the distribution of the species. From a preliminary study of the material in ZMUC and from Schmid and Piepenburg (1993), it appears that *M. eideri* sp. nov. prefers open shores and *M. neoovata* sp. nov. prefers sheltered fjords. *M. truncata* has only been found in the North Atlantic boreal zone. Jensen (1900) stated that *M. truncata* forma *typica* is a southern form. *M. eideri* sp. nov., *M. neoovata* sp. nov. and *M. neouddevallensis* sp. nov. are all arctic species.

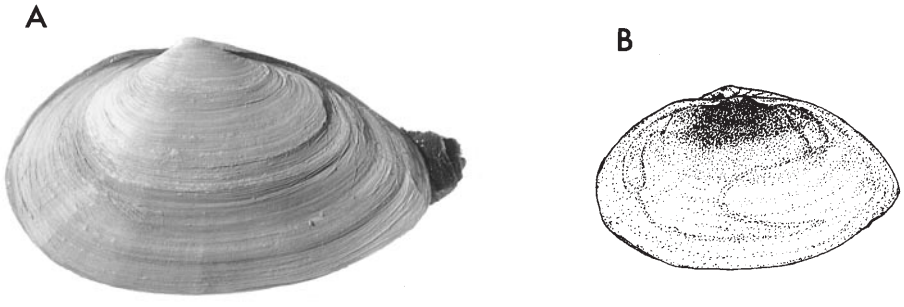


Fig. 6A, B *Mya arenaria* Linné. Kattegat at Rønnerne, Frederikshavn, Denmark, 26 August 1966, shallow water, sand. Length 40.4 mm, height 24.6 mm (ZMUC BIV-327). **A** Photograph of entire specimen, siphons almost totally retracted. **B** Drawing of inside of right valve

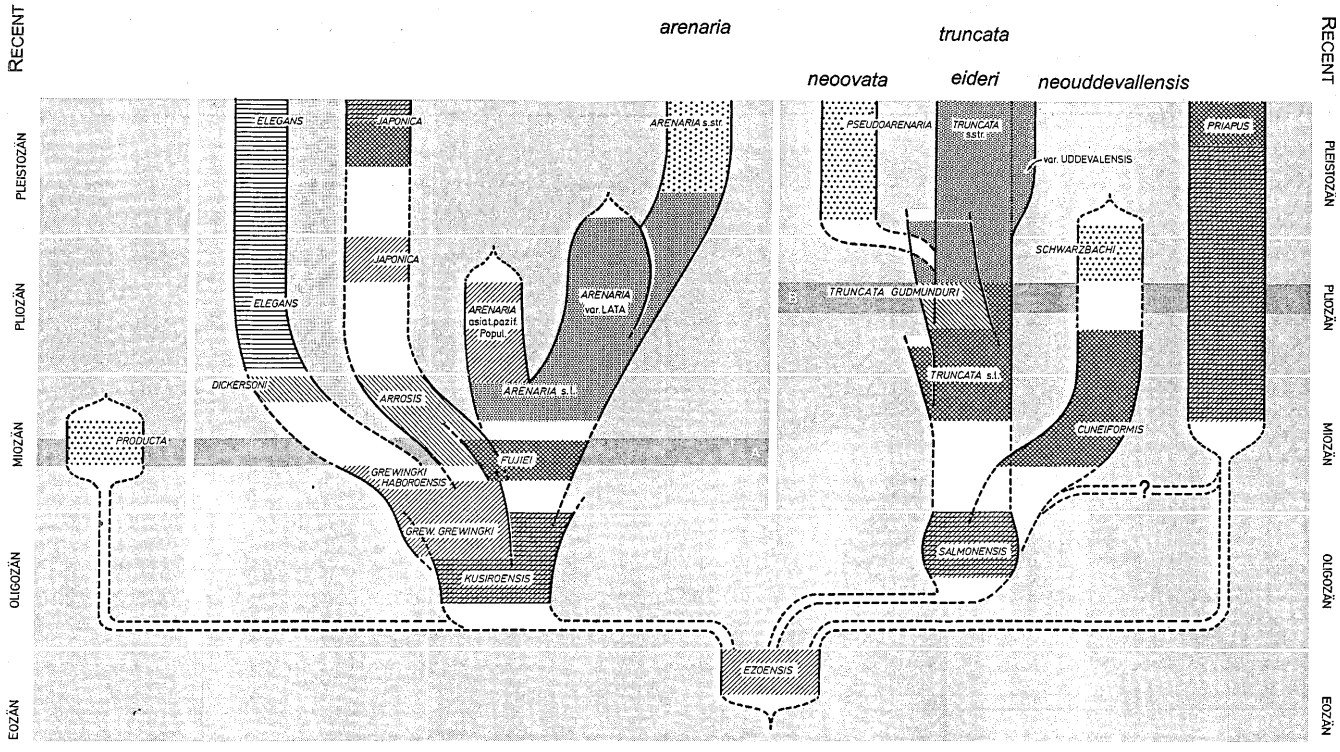
Evolution, species concept, nomenclature

This paper was intended to be a short note on the two species of *Mya* living in the Ikka Fjord and a third species that may arrive with the East Greenland current. However, the referees suggested further comments on the implications for palaeontology, taxonomy and nomenclature. These are interesting questions, especially as *Mya* species were among the most important for developing the theories on ice ages and "Northern drift" in the beginning of the eighteenth century (Forbes 1846, Lyell 1835), and still are (Simonarson et al. 1998). An introduction to the misunderstandings due to the mixing of fossil and Recent shells is found in Strauch (1972). The lumping or splitting of very similar species, both Recent and fossil, into either a few genera or into many subspecies or varieties, all followed by an extensive but questionable synonomy list, does not make things easier. Figure 7, reduced from Strauch (1972) with the Recent species added at the top, demonstrates the problems with phylogeny, stratigraphy and morphological changes. The papers by MacNeil (1965) and Strauch (1972) both treat 17 species, but not exactly the same ones, and both give their bids on phylogeny, origin and possible routes between the North Atlantic and the North Pacific. I consider all varieties as species, and only the species relevant for this paper are discussed.

I cannot here enter a long discussion on these matters, but only make my position clear. "Dead" shells are discarded from my samples and only specimens with soft parts are studied. I sort the material into species I can recognize and later identify. I will not identify a living species from types based on a fossil shell. It is a problem when species were first recognized in fossil material and later Recent species were considered to be conspecific with the fossil. The living species are the final results of evolutionary lines that can be demonstrated in the stratigraphic layers. The lines of evolution from one form to another have been based on morphology, but modern chemical methods may give further information on the genetic relationships. This also makes it imperative to distinguish between living and fossil material. I suggest here a solution, with the prefix "neo-" for the nomenclature when a neontologist distinguishes Recent species which traditionally were named from fossil material.

When it comes to theories and explanations for evolution, extinction, migrations, etc., all intensively discussed by palaeontologists, there are some disagreements. Jensen (1900), Schlesch (1931), Soot-Ryen (1951), Lauersen (1966), Strauch (1972), Bernard (1979) and many others have discussed the distributions, migrations, fossils, climatic conditions and possible effects on evolution and extinction. A popular explanation for variability in many arctic species is that the Arctic Ocean is a geologically young sea with an ongoing speciation. Many palaeontologists consider temperature as the most important environmental parameter (MacNeil 1965).

I consider temperature to be of secondary importance. The most important parameters are the food supplies and the seasons, etc. Extinction and evolution are controlled by the energy resources available, and the species' abilities to follow the changes. My explanation is that the new, late Tertiary, polar environments created



new food webs and speciations for certain lifestyles in, for example, benthos and icebiotas. Many boreal and tropical lifestyles starved. A further explanation (Petersen 1977) is that the northern seas have often been split up into smaller parts, for instance in connection with the opening and closing of the Bering Strait, and by the ice ages that forced some populations into smaller areas along the eastern and western shores of the North Atlantic and North Pacific.

Some palaeontologists (e.g. MacNeil 1965; Strauch 1972) consider waterways, land bridges and larval dispersal, etc. to be important parameters. I consider the most important parameters to be the species' affiliation to certain water masses, water currents and limitations by water fronts. The "purpose" of reproduction is – irrespective of mode – to reinvade the parents' habitats and not to invade new territories.

Acknowledgements I am indebted to Geert Brovad and Annie Vedelsby, both of ZMUC, for taking the photographs and making the drawings. Dr. Mary E. Petersen, ZMUC, revised the text and provided helpful suggestions. I am also grateful to Drs. Anders Warén, Swedish Museum of Natural History, Stockholm, and Svend Funder, Geological Museum, University of Copenhagen, who suggested including a review of the nomenclature and the fossil material.

References

Bernard FR (1979) Identification of the living *Mya* (Bivalvia: Myoida). Venus Kyoto 38:185–204

Buchardt B, Düwel L, Kristiansen Aa, Petersen GH, Stockmann G, Thorbjørn L, Westergaard D (1996) A columngarden created by Nature in Ikkafjord, SW-Greenland (in Danish). Nat Verden 7:241–250

Buchardt B, Seaman P, Stockmann G, Vous M, Wilken U, Düwel L, Kristiansen Aa, Jenner J, Whiticar MJ, Kristensen RM, Petersen GH, Thorbjørn L (1997) Submarine columns of Ikaite tufa. Nature 390:129–130

Dodge H (1952) A historical review of the mollusks of Linnaeus. Part 1. The classes Loricata and Pelecypoda. Bull Am Mus Nat Hist 100:1–263

Forbes E (1846) On the connexion between the distribution of the existing fauna and flora of the British Isles, and the geological changes which have affected their area, especially during the epoch of the Northern Drift. Mem Geol Surv UK 1:336–432

Forbes E, Hanley S (1853) A history of British Mollusca, and their shells, vol I. van Voorst, London

Foster RW (1946) The genus *Mya* in the Western Atlantic. Johnsonia 2:29–35

Frimer O (1997) Diet of moulting king eiders *Somateria spectabilis* at Disko Island, West Greenland. Ornis Fenn 74:187–194

Hancock A (1846) A list of shells dredged on the west coast of Davis's Strait; with notes and descriptions of eight new species. Ann Mag Nat Hist 18:323–338

John van Voorst, Jeffreys JG (1853) British conchology, vol 2.

Jensen AS (1900) Studies on Nordic molluscs I (in Danish). Vidensk Medd Dan Naturhist Foren London 52:133–158

King W (1846) An account of some shells and other invertebrate forms found on the coast of Northumberland and of Duram. Ann Mag Nat Hist 18:233–251

Lauersen D (1966) The genus *Mya* in the Arctic region. Malacologia 3:399–418

Lubinsky I (1980) Marine bivalve molluscs of the Canadian Central and Eastern Arctic: faunal composition and zoogeography. Can Bull Fish Aquat Sci 207:1–111

Lyell C (1835) On the proofs of a gradual rising of the land in certain parts of Sweden. Philos Trans R Soc Edinb 1835:1–37

Lyell C (1839) Remarks on some fossil and recent shells, collected by Capt. Bayfield, R.N., in Canada. Q J Geol Soc Lond 3:119–120

Lyell C (1842) Remarks on some fossil and recent shells, collected by Captain Bayfield, R.N., in Canada. Trans Geol Soc Lond 6:135–141

MacGinitie N (1959) Marine Mollusca of Point Barrow, Alaska. Proc US Natl Mus 109:59–208

MacNeil FS (1965) Evolution and distribution of the genus *Mya*, and Tertiary migrations of Mollusca. Geol Surv Prof Pap 483-G:i-iv, 1–51

Ockelmann KW (1958) Marine Lamellibranchiata. Medd Grøn 122:1–256

Petersen GH (1964) The hydrography, primary production, bathymetry and "Tagsâq" of Disko Bugt, West Greenland. Medd Grøn 159:1–45

Petersen GH (1977) The density, biomass and origin of the bivalves of the Central North Sea. Medd Dan Fisk Havunders 7:221–273

Petersen GH (1978) Life cycles and population dynamics of marine benthic bivalves from the Disko Bugt area in West Greenland. Ophelia 17:95–120

Petersen GH (1984) Parasitism in bivalves from an Arctic ecosystem. Helgol Wiss Meeresunters 37:201–205

Petersen GH, Kristensen RM, Thorbjørn L (1998) Ikacolumns, the submarine calcareous reefs in SW-Greenland (in Danish). Dyr i Natur og Mus 1:11–14

Schlesch H (1931) Kleine Mitteilungen VII. 1. Beitrag zur Kenntnis der marinen Molluskenfauna Islands. Arch Molluskenkd 63:133–137

Schmid MK, Piepenburg D (1993) The benthos zonation of the Disko Fjord, West Greenland. Medd Grøn Biosci 37:1–21

Seaman P, Jenner C (1996) Frozen warriors. Geogr Mag February:12–14

Simonarson LA, Petersen KS, Funder S (1998) Molluscan palæontology of the Pliocene-Pleistocene Kap København Formation, North Greenland. Medd Grøn Geosci 36:1–103

Smith J (1839) On the last changes in the relative levels of land and sea in the British Islands. Mem Werner Nat Hist Soc 8:49–113

Soot-Ryen T (1951) New records on the distribution of marine molluscs in northern Norway. Astarte 1:1–11

Strauch F (1972) Phylogenese, Adaptation und Migration einiger nordischer mariner Molluskengenera (*Neptunea*, *Panomya*, *Cyrtodaria* und *Mya*). Abh Senckenb Naturforsch Ges 531:1–211

Tebble N (1966) British bivalve seashells. British Museum, London

Thorbjørn L (1996) Macrofauna related to the Ikkacolumns, SW-Greenland (in Danish). MSc Thesis, Zoological Museum, University of Copenhagen