Canadian Bulletin of Fisheries and Aquatic Sciences

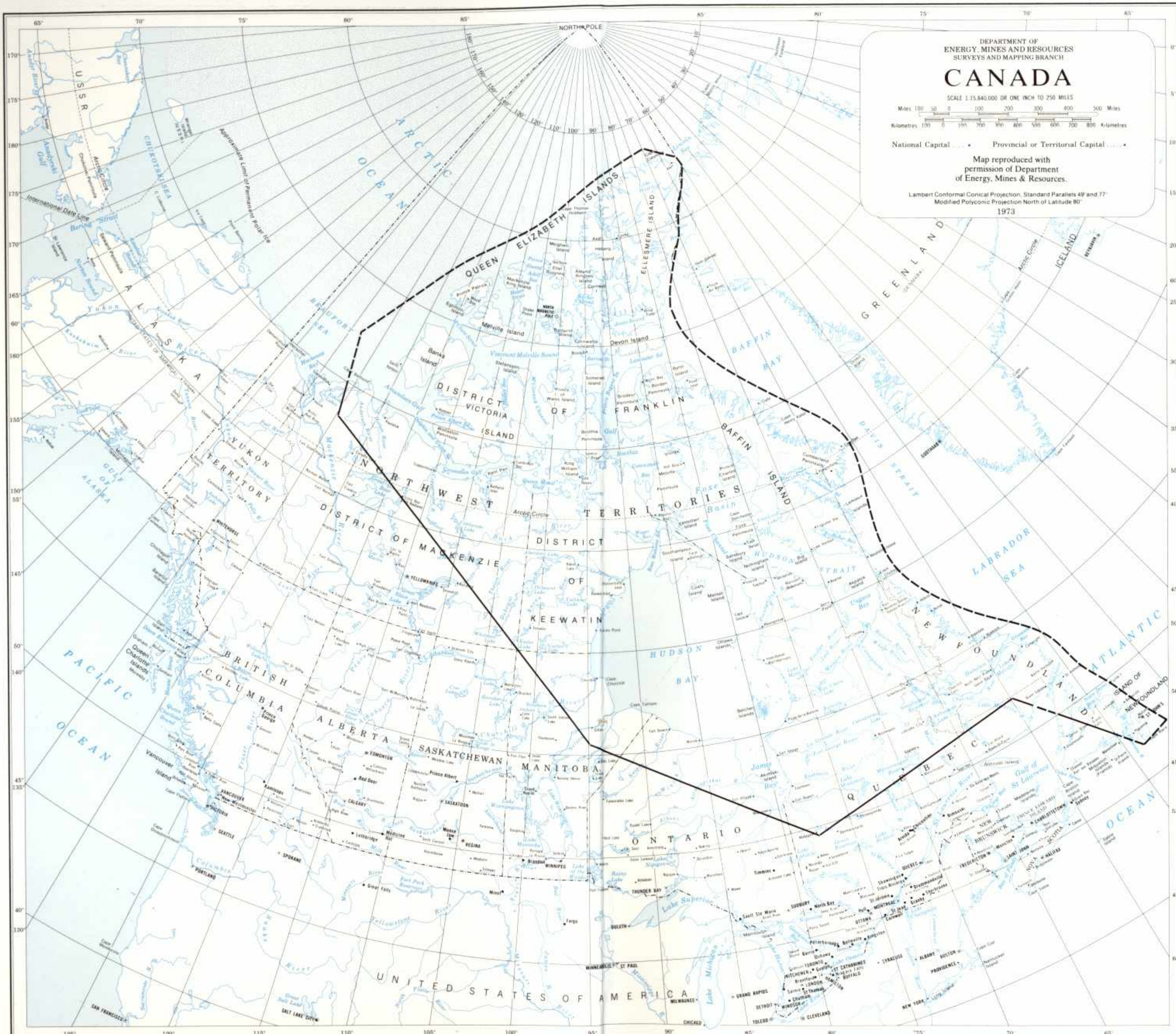
Marine Bivalve Molluscs of the Canadian Central and Eastern Arctic: Faunal Composition and Zoogeography

Irene Lubinsky

BULLETIN 207
Ottawa 1980

Government of Canada Fisheries and Oceans
Gouvernement du Canada Pêches et Océans

Canada



MCR 18

Produced by the Surveys and Mapping Branch, Ottawa, 1973. Copies may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, or your nearest map dealer.

Marine Bivalve Molluscs of the Canadian Central and Eastern Arctic: Faunal Composition and Zoogeography

The *Canadian Bulletins of Fisheries and Aquatic Sciences* (formerly *Bulletins of the Fisheries Research Board of Canada*) are designed to interpret current knowledge in scientific fields pertinent to Canadian fisheries and aquatic environments. Recent numbers in this series are listed at the back of this Bulletin.

The *Canadian Journal of Fisheries and Aquatic Sciences* is published in annual volumes of monthly issues. *Canadian Special Publications of Fisheries and Aquatic Sciences* are issued periodically. These series are available from authorized bookstore agents and other bookstores, or you may send your prepaid order to the Canadian Government Publishing Centre, Supply and Services Canada, Hull, Que. K1A 0S9. Make cheques or money orders payable in Canadian funds to the Receiver General for Canada.

Department of Fisheries and Oceans
Scientific Information and Publications Branch
Ottawa, Canada
K1A 0E6

BULLETIN 207

Marine Bivalve Molluscs of the Canadian Central and Eastern Arctic: Faunal Composition and Zoogeography

Irene Lubinsky
Department of Zoology
University of Manitoba
Winnipeg, Man. R3T 2N2

DEPARTMENT OF FISHERIES AND OCEANS
Ottawa 1980

Available from authorized bookstore agents and other bookstores,
or you may send your prepaid order to the
Canadian Government Publishing Centre,
Supply and Services Canada, Hull, Que. K1A 0S9.

Make cheques or money orders payable in Canadian funds
to the Receiver General for Canada.

A deposit copy of this publication is also available
for reference in public libraries across Canada.

Canada: $ 9.75
Other countries: $11.70

Catalog No. Fs 94-207E
ISBN 0-660-10719-8
ISSN 0706-6503

Price subject to change without notice

Ottawa

Printed in Canada
by
Tri-Graphic Printing (Ottawa) Ltd.

Correct citation for this publication:

LUBINSKY, I. 1980. Marine bivalve molluscs of the Canadian central and eastern Arctic: faunal composition and zoogeography. Can. Bull. Fish. Aquat. Sci. 207: 111 p.

Contents

ABSTRACT / RÉSUMÉ vi

INTRODUCTION 1

History of Faunistic Exploration 2

Published records 2

The Canadian Archipelago 2

The Canadian eastern Arctic 4

Foxe Basin 4

Hudson Bay, Hudson Strait, and Ungava Bay 4

Western shores of Baffin Bay 6

Labrador coast 6

Molluscs identified by author 6

Canadian Archipelago 7

Canadian Eastern Arctic 7

Labrador 7

MARINE SHALLOW-WATER REGION 7

Systematic Description of the Fauna of Bivalve Molluscs 9

Zoogeography of Marine Bivalve Fauna in the Central and Eastern Canadian Arctic 50

PATTERNS AND ORIGINS OF DISTRIBUTION 50

Distribution of bivalves and late-Wisconsin events 51

Distribution of bivalves and the marine waters of the Canadian Arctic 54

MOLLUSC DISTRIBUTION AND MARINE FAUNISTIC ZONATION IN THE CANADIAN ARCTIC 56

Arctic faunistic zone 57

High-Arctic faunistic subzone 57

Low-Arctic faunistic subzone 57

Subarctic faunistic zone 57

Distribution not connected to recent extension of marine waters: relict areas 57

Areas of endemic species 59

Canadian endemics 59

North Atlantic endemics 59

Pacific endemics 59

ZOOGEOGRAPHIC SUBDIVISIONS OF CANADIAN ARCTIC FAUNA 59

Fauna of the Arctic zone 60

Fauna of the high-Arctic subzone 60

Fauna of the low-Arctic subzone 61

Fauna of the Subarctic zone 61

RELATION OF CANADIAN ARCTIC FAUNA TO THAT OF THE NORTHWEST ATLANTIC 62

RELATIONS OF CANADIAN ARCTIC FAUNA TO NEIGHBORING ARCTIC FAUNISTIC REGIONS 64

Bivalve fauna of the Canadian Arctic and Greenlandic shallow-water regions 64

Bivalve fauna of the Canadian Arctic and Eurasian seas 65

Fauna of Canadian and western North American Arctic regions 65

ACKNOWLEDGMENTS 66

REFERENCES 67

MAPS 1–42 74

PLATES I–XI 95

INDEX OF SCIENTIFIC NAMES 106

Abstract

LUBINSKY, I. 1980. Marine bivalve molluscs of the Canadian central and eastern Arctic: faunal composition and zoogeography. Can. Bull. Fish. Aquat. Sci. 207: 111 p.

Composition of marine bivalve fauna of the shallow-water region of the Canadian central and eastern Arctic, and distributions of species are discussed. The data are based on reports of expeditions to the Canadian Arctic since 1819 and on collections (identified by the author) of expeditions to this region by the Arctic Biological Station, Fisheries Research Board of Canada, Ste. Anne de Bellevue, Qué. (now Department of Fisheries and Oceans), the National Museums of Canada, and museums of the USA. The shell morphology of individuals and populations of 64 species and their areas of distribution are described. The zoogeography of bivalves in the Canadian Arctic is discussed and illustrated on the basis of the Wisconsin glaciation of the region and present characteristics of arctic and subarctic marine waters.

Key words: Arctic, marine benthos, bivalve molluscs, fauna, zoogeography

Résumé

LUBINSKY, I. 1980. Marine bivalve molluscs of the Canadian central and eastern Arctic: faunal composition and zoogeography. Can. Bull. Fish. Aquat. Sci. 207: 111 p.

Le présent Bulletin examine la composition de la faune bivalve marine des eaux peu profondes du Centre et de l'Est de l'Arctique canadien, ainsi que la répartition des espèces. Les données sont fondées sur les comptes rendus d'expéditions dans l'Arctique canadien depuis 1819 et sur les collections d'expéditions recueillies par la Station de biologie arctique, Office des recherches sur les pêcheries du Canada, Sainte-Anne-de-Bellevue (Québec) (qui fait maintenant partie du ministère des Pêches et des Océans), par les Musées nationaux du Canada et par les musées des États-Unis, identifiées par l'auteur. On y décrit la morphologie de la coquille d'individus et les populations de 64 espèces, ainsi que leurs aires de répartition. La zoogéographie des bivalves de l'Arctique canadien est analysée et illustrée en fonction de la glaciation du Wisconsin dans cette région et des caractéristiques actuelles des eaux marines arctiques et subarctiques.

Introduction

This Bulletin is a study of the fauna of marine bivalve molluscs in the shallow-water region of the Canadian central and eastern Arctic between Parr Inlet (82°31'N, 60°05'W) in the north, Cape Bathurst (70°32'N, 128°05'W) in the southwest, and the Strait of Belle Isle (51°30'N, 56°30'W) in the southeast.

As a list of bivalves of this region was never compiled, and areas of distribution of these molluscs almost unknown, the relation of bivalve fauna of this region to fauna of neighboring regions was never previously analyzed.

The region under study is between the Arctic and Atlantic oceans, and close to the Pacific Ocean. Although the Canadian Shield separates the deep regions of these oceans, their faunas are connected over the submerged northeastern part of the continent.

Recent bivalve fauna of this region is of Pleistocene origin. Its formation was determined by geological events of the Wisconsin period and by the presence of water masses both of Arctic and Atlantic origin.

The grounded Wisconsin ice destroyed the marine fauna of the region and caused intensive migrations at its periphery. The basic pattern of the recent distribution of marine bivalves is the result of several marine post-Wisconsin transgressions over the depressed areas freed by the retreating glacier, and followed by marine withdrawals caused by land rebound. Temporary climatic fluctuations, e.g. the hypsithermal, caused corresponding fluctuations in the distribution of marine bivalves. The zoogeography of recent bivalve fauna can be only understood against the background of events of the post-Wisconsin period.

In high latitudes, three marine zoogeographic zones were recognized — the Arctic, the Boreal, and an intermediate Low-Arctic (or Subarctic) Zone. Water temperature was regarded as the master factor in zoogeographic zonation, yet the temperature ranges as well as ecological peculiarities characteristic of these zones were never clearly stated; the boundaries of these zones remained vague.

Recognition of the importance of marine water masses in animal and plant distribution became the base for a new approach to marine zoogeography. At present, the chemical and physical properties of these masses are regarded as the basic parameters of marine environment, and determine the composition of fauna and flora, as well as the areas of distribution of both animal and plant species.

Ekman (1953, p. 138) was the first to stress that ". . . the North Atlantic testifies more closely than other parts of the ocean that marine zoogeography must primarily be the zoogeography of various waters, and only secondarily a zoogeography of various coastal regions." Dunbar (1968, p. 42) stated that in high latitudes there exists ". . . a broad zone in which the Arctic and the non-Arctic waters are found together in the upper layers (200–300 meters), either in closely associated streams or as mixed water." He identified the area of polar water as the marine Arctic Zone, the area of mixed waters as the Subarctic. He presented a map (fig. 10) of this zone in the Pacific and Atlantic sectors of the Arctic, and discussed the biological and zoogeographic implications (p. 43–49).

Only a few authors have studied distribution of benthic animals in relation to water masses (Blacker 1957, 1965; Galkin 1964; Kobiakova (1960); Nesis 1959, 1960, 1963a, b, 1965; Ockelmann 1958, 1965). Most malacologists still discuss distribution of molluscs in relation to temperature ranges (Ellis 1955; Fisher 1961; Hall 1964; Miloslavskaia 1958). Filatova (1957a, b) who produced the first zoogeographic scheme for this group of animals in the Eurasian Arctic seas, did not emphasize the relationship between the distribution of bivalves and the peculiarities of water masses of this region.

Dunbar (1968, p. 3) regarded development of life in the north as an ". . . adaptation of the whole ecosystem to the Arctic conditions" and stressed the importance of the time factor in the study of Arctic distributions.

In this Bulletin the existing pattern of distribution of bivalves is considered the result of a temporary balance between animals and their changing environment.

Wisconsin events and recent physiography of the Canadian Arctic marine region form the background for the discussion of bivalve distribution.

HISTORY OF FAUNISTIC EXPLORATION

Despite the remoteness of the Canadian Arctic from Europe, its exploration has been initiated by European countries searching for the northwest passage to the West Indies. Expeditions of the first, "classical," period were sponsored mainly by Great Britain and the Scandinavian countries. This period began with the journey of Baffin, 1616, and ended in 1859 with the search for the ill-fated expedition of Franklin. In attempting to pass through the Canadian Archipelago, expeditions of this period contributed to the knowledge of geography and oceanography, but only incidentally to biology, of this region.

The second period, 1860–1947, was characterized by a decline in participation of European countries, and by intensification of exploration by the Canadian Government.

The third, recent, period began in 1947 with the planned expeditions of the Arctic Biological Station, Ste. Anne de Bellevue, Que., the expeditions of the National Museums of Canada, and of other Canadian Government institutions. The work of the Pleistocene Group of the Geological Survey of Canada (GSC), of its Oceanography Branch, and the Bedford Institute of Oceanography greatly contributed to the knowledge of geology, oceanography, and marine biology of this region.

Shallow-water molluscs were the first to be collected. Early samples were mostly incidental, often inadequately labeled, and resulted in the publication of indiscriminate listings of bivalves collected by expeditions passing through several zoogeographic zones. Biological reports were seldom published simultaneously with the "Report of Progress" of the expeditions, and are widely scattered in both European and American publications. Despite all the drawbacks, the foundations of Canadian marine zoogeograhy were laid in this early period, and a considerable number of marine bivalve species were collected, many new to science.

Published Records

Published data on Canadian Arctic bivalves are summarized in Tables 1, 2, and 3. They record the first finding of each species in this region, and give names of species according to recent nomenclature. Species with type-locality in the Canadian Arctic are marked by asterisks(*). The original papers should be consulted for complete lists of species found by the expeditions.

The Canadian Archipelago (Table 1)

The earliest samples of Canadian bivalves came from the southeastern Canadian Archipelago and were collected by expeditions of Ross, 1818; Parry, 1819-20; and Belcher, 1852-54. Routes of these expeditions are mapped by A. Taylor (1955, fig. 3, 4, 11). Lists of bivalves published by Leach (1819), Gray (1824), and Reeve (1855) contain many common species, but also some rare ones, including several new to science (Table 1). The nomenclature used is partially outdated and some species have been obviously misidentified. The identity of *Nucula arctica* Gray, 1824 was discussed at length (Whiteaves 1901, p. 127), until its name was stabilized by the International

TABLE I. First records of bivalves in the Canadian central Arctic. (*Indicates species with type-locality in Canada)

First record	Species	
Leach 1819	*Hiatella arctica* (Linné 1767) **Pandora glacialis* Leach 1819 *Macoma calcarea* (Gmelin 1791) *Astarte borealis* (Schum. 1817)	**A. striata* (Leach 1819) **A. banksi* (Leach 1819) *Astarte* sp. (as *A. scotica)* *Musculus* sp. ?
Gray 1824	*Mya truncata* Linné 1758 **Portlandia arctica* (Gray 1824) *Nuculana minuta* (Fabr. 1776) *Cyrtodaria kurriana* Dunker 1862 **Astarte crenata* (Gray 1824) **A. arctica* (Gray 1824)	*Serripes groenlandicus* (Bruguière 1789) **Bathyarca glacialis* (Gray 1824) **Musculus niger* (Gray 1824) **M. discors* Linné var. *laevigatus* et var. *substriatus* (Gray 1824, Jensen 1912) **Pecten vitreus* (Gray 1824)
Sutherland 1852	*Montacuta substriata* (Montagu 1808)	
Reeve 1855	*Lima subauriculata* (Montagu 1808) *Portlandia arctica* (Gray 1824) var. *portlandica* (Hitchcock 1836) **P. siliqua* (Reeve 1855) **P. sulcifera* (Reeve 1855) *Nucula belloti* Adams 1856 *Yoldia hyperborea* (Loven) Torell *hyperborea* Ockelmann 1954	*Nuculana buccata* (Steenstrup 1842) *Musculus* sp. *Astarte borealis* (Schumacher 1817) **A. fabula* Reeve 1855 *A. globosa* Møller 1842 *Clinocardium ciliatum* (Fab. 1780) *Lyonsia arenosa* (Møller 1842)
Stimpson 1864	*Astarte elliptica* (Brown 1827)	*Crenella faba* (Müller 1776)
Smith 1877	*Nuculana pernula* (Müller 1779)	*Thyasira gouldi* (Philippi 1845)
Jeffreys 1877	*Cuspidaria subtorta* (G. O. Sars 1878)	
Grieg 1909	*Nuculana pernula costigera* (Leche 1883) *Macoma torelli* (Steenstrup) Jensen 1904 *M. moesta* (Deshayes 1854)	*M. loveni* (Steenstrup) Jensen 1904 *Thracia septentrionalis* Jeffreys 1872 *Thracia* sp.
Dall 1919	*Astarte warhami* Hancock 1846 *Liocyma fluctuosa* (Gould 1841) *Mya pseudoarenaria* Schlesch 1931 (as *M. intermedia* Dall 1898)	*Delectopecten greenlandicus* (Sowerby 1842) *Mytilus edulis* Linné 1758 *Musculus corrugatus* (Stimpson 1851)
Dall 1924	*Bathyarca frielei* (Friele 1877) (as *B. pectunculoides* (Scacchi 1833)) **Pseudamusium ringnesia* Dall 1924	*Yoldiella obesa* (Stimpson 1877)
Thorson 1951	*Periploma abyssorum* Verrill et Bush 1893	
Ellis 1960	*Nucula delphinodonta* Mighels et Adams 1842 *Thracia myopsis* (Beck) Møller 1842	*Axinopsida orbiculata* (G. O. Sars 1878) *Dacridium vitreum* (Møller 1842)
Wagner 1962	*Yoldiella frigida* (Torell 1859)	*Yoldiella tamara* (Gorbunov 1946)
I. Lubinsky 1976	*Thyasira dunbari* Lubinsky 1976	
Wagner 1977	*Yoldiella fraterna* Verrill and Bush 1898 *Y. lenticula* (Møller 1842)	*Thracia devexa* G. O. Sars 1878

Commission on the Zoological Nomenclature, 1966. *Yoldia hyperborea* (Loven) Torell was erroneously identified by Reeve as *Y. sapotilla* Gould (fide Ockelmann 1958), and *Cyrtodaria kurriana* Dunker as *Glycymeris siliqua* Lam. *Nucula expansa* Reeve and *N. inflata* Hancock are regarded now as conspecific with *N. belloti* Adams, 1856 (Schenck 1939). Of the 25 species of bivalves described as new by Leach, Gray, and Reeve, only 16 were actually new. Even so, they comprise almost one-third of all bivalve species collected by the early expeditions. Ellis (1960) recorded the following species new for the southeastern Canadian Archipelago: *Nucula delphinodonta* Migh. et Adams, *Dacridium vitreum* Møller, *Thracia myopsis* (Beck) Møller, and *Axinopsida orbiculata* (G. O. Sars). Ellis found *Mytilus edulis* Linné with fresh soft parts on the shores of Pond Inlet, North Baffin Island.

The eastern Canadian Archipelago was explored mostly by expeditions trying to reach the North Pole (Taylor 1955, fig. 15, 17, 28). Species added to the fauna of the Canadian Archipelago are listed in Table 1 under Smith (1877) and Jeffreys (1877) of the expedition of Nares, 1875–76; Stimpson (1864), expedition of Hayes; and Baker (1919), MacMillan's Crocker Land Expedition, 1913–17.

Bivalves of the western Canadian Archipelago were collected by the expeditions of Sverdrup, 1898–1902, and Stefansson, 1913–19 (Canadian Arctic Expedition). The routes are shown in Taylor (1955, fig. 24, 34). The molluscs collected were identified by Grieg (1909) who listed five species new to the region, and by Dall (1919, 1924) who added six species he believed to be new to science. According to N. MacGinitie (1959), however, *Liocyma beckii* and *L. viridis*, and *Mya intermedia* of Dall, are synonyms of *L. fluctuosa* Gould and of *Mya pseudoarenaria* Schlesch, respectively. Two species new to the region were added by Wagner (1962). *Thyasira dunbari* I. Lubinsky, 1976, was collected in the northern Canadian Archipelago by the MacDonald expeditions, 1952-57, and the Arctic Biological Station, 1962.

Thus, among 61 species found in the Canadian Arctic Archipelago, 15 were new to science.

The Canadian Eastern Arctic (Table 2)

Foxe Basin

Prior to the expeditions of the Arctic Biological Station, Foxe Basin was one of the least explored regions of the Canadian eastern Arctic. Parry navigated this basin in 1821–23 and reached Fury and Hecla Strait. The same route was taken by Bartlett (Norcross Expedition) in 1933. The biological results were not published. A few samples of bivalves of the Bartlett Expedition, identified by the author at the Smithsonian Institution, contain *Astarte striata* (Leach) and *Musculus laevigatus* (Gray) (USNM 406132, 464316, 464318, 464333, 464334, 464341, 4643453) (Table 2).

The Fifth Thule Expedition in 1921–24, collected five common species of bivalves (Laursen 1946).

The Arctic Biological Station Expedition in 1956 was the first to investigate in detail the bottom fauna of Foxe Basin. Eighteen species of bivalves were collected (Ellis 1960). Though no new records were added to the fauna of the Canadian Arctic, materials collected proved to be zoogeographically important.

Hudson Bay, Hudson Strait, and Ungava Bay

The first data on the bivalves of this region were by Stimpson (1861) who listed several common species from Ungava Bay, and recorded *Macoma balthica* Linné for the first time in this region.

Dall (1886) listed nine species from Ungava Bay, among them *Mya arenaria* Linné, (probably *M. pseudoarenaria*) though he did not state whether live specimens were found. Whiteaves (1881, 1885) examined the bivalves collected by Capt R. Bell in Hudson Bay and Hudson Strait. His

TABLE 2. First records of bivalves from the Canadian eastern Arctic. (*Indicates species with type-locality in Canada)

First record	Species	
Hancock 1846, Cumberland Sound	*Chlamys islandica* (Müller 1776) *Pecten greenlandicus* (Sowerby 1842) *Nucula belloti* Adams 1856 *Nuculana buccata* (Steenstrup 1842) *N. minuta* (Fabricius 1776) *Musculus niger* (Gray 1824) *M. discors* Linné var. *laevigatus* (Gray 1824, Jensen 1912)	*Macoma calcarea* (Gmelin 1791) *Astarte borealis* (Schumacher 1817) **A. warhami* Hancock 1846 *Serripes groenlandicus* (Bruguière 1789) *Cardium ciliatum* Fabr. 1780 *Mya truncata* var. *uddevalensis* Forbes 1846 *Hiatella arctica* (Linné 1767) *Lyonsia arenosa* (Møller 1842)
Stimpson 1861, Ungava Bay	*Nucula belloti* Adams 1856	*Mytilus edulis* Linné 1758
Whiteaves 1881, Hudson Bay	*Macoma balthica* (Linné 1758) *Astarte banksi* (Leach 1819)	*Mya* sp.? (as *Mya arenaria* L.)
Whiteaves 1885, Hudson Strait	*Nuculana pernula* (Müller 1779) *Yoldia myalis* (Couthouy 1838) *Chlamys islandica* (Müller 1776)	*Musculus niger* (Gray 1824) *Astarte elliptica* (Brown 1827) *Cyclocardia borealis* (Conrad 1831)
Dall 1886, Ungava Bay	*Crenella faba* (Müller 1776)	*Mya* sp.? (as *Mya arenaria* L.)
Whiteaves 1901, Hudson Bay	*Portlandia arctica* (Gray 1824)	*Astarte crenata* (Gray 1824)
Dall 1924, Burwell	*Yoldia hyperborea* (Loven) Torell 1859 (as *Y. sapotilla* Gould) *Musculus corrugatus* (Stimpson 1851)	*Macoma moesta* (Deshayes 1854) *Pandora glacialis* Leach 1819 *Lyonsia arenosa* (Møller 1842) as *L. hyalina* (Conrad)
Wacasey et al. 1976, James Bay	*Mya pseudoarenaria* Schlesch 1931	

papers (including that of 1901), provided the basic material on bivalves of this region. Whiteaves listed 26 species of molluscs, among them "*Mya arenaria* Linné" from Richmond Gulf and King George's Sound. The specimens from Richmond Gulf were examined (by the author) and found to be subfossil shells of *Mya pseudoarenaria*. There was no opportunity to study Whiteaves' specimens of *Mya* from Hudson Bay. It is doubtful, however, that this species ever lived in this bay. Whiteaves also found, for the first time in the Canadian Arctic, the zoogeographically important *Chlamys islandica* Müller, *Cyclocardia borealis* Conrad, *Yoldia myalis* Couthouy, and *Astarte elliptica* Brown.

Halkett (1898), who studied collections of Capt Wakeham from eastern Hudson Bay, and S. Brooks (1935), who worked on material from the same region, listed species already known from this area.

Dall (1924) identified bivalves collected north of Hudson Bay by the Neptune Expedition and added six species new to the Canadian eastern Arctic. Ockelmann (1958), however, pointed out that Dall's *Yoldia sapotilla* is *Y. hyperborea* (Loven) Torell *hyperborea* Ockelmann, and that *Lyonsia hyalina* is a misidentification. Laursen (1946) added *Astarte crenata* (Gray) from Roe's Welcome Strait as a species new to the eastern region. Richards (1936, 1941, 1962) listed common recent and Pleistocene bivalves from James Bay and western Hudson Bay. Wagner (1968) published a list of bivalves from central Hudson Bay, among them *Bathyarca glacialis* (Gray). This species was first collected by Clarke in 1963 in the southeastern trench of the Bay.

Western Shores of Baffin Bay

The first paper on molluscs from this region was of Hancock (1846). His *Nucula inflata* is regarded at present as a synonym of *N. belloti* Adams, and *Lyonsia gibbosa* Hancock as a synonym of *L. arenosa* Müller. New to the Canadian Arctic were *Crenella decussata* (Mont.), *Turtonia minuta* (Mont.), and *Cyrtodaria kurriana* Dunker. Lists of bivalves by Dall (1879, 1886) did not add new species to the fauna of the Canadian Arctic.

Table 3. First records of bivalves of the southern shores of Labrador (51-55°N). (*Indicates species not found north of the Strait of Belle Isle)

First record	Species	
Packard 1867	**Anomia aculeata* Gm. 1792	*Thyasira gouldi* (Philippi 1845)
	**A. ephippium* Linné 1758	*Venericardia borealis* (Conrad 1831)
	Astarte banksi (Leach 1819)	**Cardium pinnulatum* Conrad 1831
	A. elliptica (Brown 1827)	*Serripes groenlandicus* (Bruguière 1789)
	A. striata (Leach 1819)	**Gemma gemma* Totten 1834
	Cardium ciliatum Fabricius 1780	**Liocyma fluctuosa* (Gould 1841)
	C. hayesi Stimpson 1862	**Spisula solidissima* (Dillwyn 1817)
	**Placopecten grandis* (Solander 1786)	**S. polynyma* (Stimps. 1860)
	Chlamys islandica (Müller 1776)	**Mesodesma arctatum* (Conrad 1831)
	Lima subauriculata (Montagu 1808)	*Macoma calcarea* (Gmelin 1791)
	Nucula tenuis (Montagu 1808)	*M. balthica* (Linné 1758)
	N. belloti Adams 1856	**Ensis directus* (Conrad 1842)
	**Yoldia sapotilla* Gould 1841	**Thracia conradi* Couthouy 1839
	Nuculana buccata (Steenstrup 1842)	*T. myopsis* (Beck) Møller 1842
	N. minuta (Fabricius 1776)	**Periploma papyratia* (Say 1822)
	**Crenella glandula* (Totten 1834)	**Pandora trilineata* Gould 1841
	Musculus corrugatus (Stimpson 1851)	*Lyonsia arenosa* (Møller 1842)
	M. laevigatus (Gray 1824)	**Cyrtodaria siliqua* (Spengler 1793)
	Crenella faba (Müller 1776)	*Mya truncata* Linné 1758
	Musculus niger (Gray 1824)	*M. arenaria* Linné 1758
	**Modiolus modiolus* (Linné 1758)	*Hiatella arctica* (Linné 1767)
	Mytilus edulis Linné 1758	
Bush 1883	*Crenella decussata* (Montagu 1808)	*Pandora (Kennerlia) glacialis* Leach 1819
	Astarte borealis (Schumacher 1817)	*Axinopsida orbiculata* (G. O. Sars 1878)
	Cryptodon obesus Verrill & Bush 1873	*Astarte arctica* (Gray 1824)

Labrador Coast, 51°–55°N (Table 3)

Packard collected his material in 1860 at Caribou Island, and later extended his collecting area northward to Hopedale (Packard 1867). Bush (1883) published Packard's study of the molluscs of the 1882 Stearns Expedition to Labrador. Packard's studies showed that, besides many northern species, the fauna of Labrador contains several boreal species restricted mostly to the southern shores of Labrador (though some penetrate north of the Strait of Belle Isle). In Table 3 these species are marked with asterisks.

Molluscs Identified by Author

The basic sources of the material for this study were extensive collections from the central and eastern Arctic by the Arctic Biological Station (ABS), Ste Anne de Bellevue, Que., the Freshwater Institute (FWI), Winnipeg, Man. (both of the Department of Fisheries and Oceans), and by the National Museums of Canada (NMC), Ottawa.

Collections of bivalves from the Canadian Arctic were studied in the following museums of Canada and the United States: The National Museums of Canada (NMC), Ottawa; Redpath Museum, McGill University (RMM) Montreal, Que.; Bedford Institute of Oceanography (BIO), Dartmouth, N.S.; American Museum of Natural History (AMNH), New York, N.Y.; United States National Museum (USNM), Washington, D.C.; Museum of Comparative Zoology (MCZ), Harvard University, Cambridge, Mass.

Specimens of bivalves for the comparative studies were obtained from the Academy of Natural Sciences, Philadelphia, Pa.; Stanford University, Stanford, Calif. and Helsingør Biological Station, Denmark.

Bivalves collected by the following expeditions to the Canadian Arctic were identified by the author:

CANADIAN ARCHIPELAGO

NMC — McDonald Expedition 1952–54 to the northern inlets of Ellesmere Island collected 18 species of bivalves, 4 new to the region and 1 new to science. *Portlandia sulcifera* Reeve, 1855 was found here for the first time since its original description.

ABS — Expeditions of 1958–65 to the southeastern and central Canadian Archipelago: 46 species in 140 samples collected.

FWI — Expeditions of 1974–76 to Strathcona Sound, northern Baffin Island: 34 species in 82 samples collected.

CANADIAN EASTERN ARCTIC

NMC — Johannsen Expedition 1920 to Hudson and James bays collected 18 species in 20 samples.

The Clarke Expedition 1963 — In southeastern Hudson Bay collected 40 samples with numerous bivalves, 4 new to the region.

ABS — The Dunbar and Grainger Expeditions 1947–62: numerous bivalves in 418 samples collected.

LABRADOR

RMM — Steele Expedition 1957 to southern Labrador provided data on the distribution of southern bivalves on its shelf.

Thus, this work is based on identification and study of bivalves in about 1000 samples from the Canadian Arctic, in which 64 species, 5 new to the region have been identified, and 1 new to science described.

A list of specimens identified by the author with data on stations and number of specimens is in appendix 1 to the author's Ph.D. Thesis "Marine bivalve molluscs of the Canadian central and eastern Arctic," McGill 1972.

Marine Shallow-Water Region

The marine shallow-water region of the Canadian Arctic extends over the submerged northeastern part of the Canadian Shield and shelf. In the north, the region is bordered by the Arctic Ocean and Beaufort Sea, in the east by the narrows of Kennedy Strait, Kane Basin, and Smith Sound, followed southward by Baffin Bay, Davis Strait, and Labrador Sea.

This marine region is subdivided into the central (Archipelago) and the eastern Arctic, the latter formed by Foxe Basin, Hudson Bay, Hudson Strait, and the shelf waters of Labrador. Its southern boundary is in the region of the Strait of Belle Isle, Labrador, and the northern shelf of Newfoundland.

The shelf of the Canadian Archipelago is submerged below normal depth, estimated by Jennes (1953) as 300 m, and by Pelletier (1964), as 400–500 m. The physiography of this shelf is described, and the submarine topography presented by Pelletier (fig. 3–13).

The channels of the Canadian Archipelago are irregular; shallow at the mainland and increasing oceanward to 300–400 m deep with troughs of 500–800 m (Can. Hydrogr. Serv. 1966–67, chart 896-7).

Marine water bodies of the Canadian eastern Arctic are broad and shallow. The greater part of the bottom of Foxe Basin, Hudson Bay, and Ungava Bay lies at and above the isobate of 200 m. In Foxe Channel, northern Hudson Bay, and Hudson Strait depths increase from 400 m in the west to 800 m or more toward the Labrador Sea (Dunbar 1951, 1958; Prest 1969).

Labrador shelf at normal depth is narrow and dissected, but widens southward.

Marine waters of the Canadian central and eastern Arctic are in close contact with the Arctic Ocean in the north and the Atlantic in the southeast. Water of polar type with a temperature below 0°C and salinity below 33–34‰ is dominant (Dunbar 1951, fig. 3–12). However, in some areas changes in temperature and salinity are caused by either seasonal changes in insolation, addition of melt water, local mixing, etc., or by admixture of Atlantic water.

Waters of the Canadian Arctic region were discussed by many authors, e.g. Bailey (1957), Barber (1967, 1968), Barber and Glennie (1964), Barber and Huyer (1971), Campbell (1958), Campbell and Collin (1956), Campbell et al. (1964), Collin (1960, 1962), Collin and Dunbar (1964), Dunbar (1951, 1958), Ellis (1956, 1960), Grainger (1960), Hachey et al. (1954), Jennes (1953), Tully (1952), Wacasey et al. (1976). The data show that in the polar water of this region two layers originate, the surface and the subsurface, characterized mainly by the ranges in fluctuation of temperature and salinity. The surface layer is 50–70 m thick, with low temperature and salinity that fluctuate seasonally. In summer the temperature may rise to 5°C and salinity lower to 19‰ and even to 4‰ (Ellis 1960; Grainger 1959, 1960; Wacasey et al. 1976). Temperature and salinity of the subsurface layer are more stable. Temperature is below 0°C with an occasional minimum of -1.97°C, and salinity 33–34‰. These two layers are present in the entire region and are important in the distribution of marine benthic organisms.

In the proximity to the Atlantic Ocean another type of water originates that is characterized by a different degree of admixture of warmer and more saline waters of Atlantic origin. Usually this water is below 250 m and enters the Canadian Arctic region through deeper channels. Dunbar (1951, fig. 3, 4) described the water masses in the Canadian eastern Arctic. In 1968 (fig. 10) he illustrated the area of mixed waters (the subarctic marine region) in Baffin Bay and the adjacent Canadian Arctic. Traces of mixed waters were found in the southeastern Canadian Archipelago and northern inlets of Baffin Island (Bailey 1957, fig. 29; Barber and Huyer 1971; Collin 1960, 1962, fig. 2, 3) and in Hudson Strait (Campbell 1958; Grainger 1959; Dunbar 1958). Further penetration of Atlantic waters northward is prevented by the submarine topography of the Canadian Shield. Strong tides in the eastern Arctic contribute to the mixing of waters to a considerable depth, while temperature/salinity stratification is observed in areas of low-water exchange. In Hudson Bay, the thermocline is at a depth of 25 m in the shallows and at 50 m in deeper areas.

Thus, marine climate of the Canadian Arctic in proximity to the Baffin Bay–Davis Strait region is ameliorated by the mixed waters deflected from the West Greenland Current, and influenced by the proximity to Labrador Sea. The "North Water" in northern Baffin Bay probably contributes also to the amelioration of the Canadian eastern Arctic (Bailey 1957; Moira Dunbar 1969).

Waters in the Canadian Arctic are derived from the Arctic Ocean, and enter the Shield from the north. The depth threshold of the shelf and Canadian Archipelago permits entrance of only the upper layers of water, to about 300 m deep in the north, and less in the south. Therefore, only the polar water and some cold-water layers can enter the submerged region (Coachman and Aagard 1974, fig. 4). To those waters are added melt and drainage waters until the flow reaches the area of Atlantic influence.

There is a constant but unstable circulation over the submerged Canadian Arctic region caused by pressure of polar waters moving southward and a pressure of mixed waters moving northward. Depth changes, land dissection, and tides create an intricate pattern of water exchange and sediment deposition, more complicated than in any other part of the marine Arctic (Dunbar 1951, fig. 13; Elizarov and Zotov 1960;

Forgeron 1959; Pelletier 1968).

Outflow of polar waters from the Canadian Archipelago into Baffin Bay forms the Canadian polar current that moves close to Ellesmere and Baffin islands. In the eastern Arctic, the outflow passes through Fury and Hecla Strait, Foxe Basin and Channel into Hudson Strait. A branch enters northwestern Hudson Bay and, after circulating anticlockwise, joins the outflow through Hudson Strait into the Labrador current. Collin (1962) described the cross section of waters moving through the channels of the Canadian Archipelago as a waterway 120 km wide and 340 m deep. The flow varies greatly and depends on the difference in the water level between the Canadian Basin and Baffin Bay (Coachman and Aagard 1974, p. 50–54, fig. 4).

Dunbar (1962) regards Canadian Archipelago waters as a direct extension of the Arctic Ocean, and Foxe Basin and Hudson Bay as regions associated with this ocean. According to this concept, the southern boundary of the Canadian Arctic is in Davis Strait. A slight admixture of polar waters was found as far south as Massachusetts Bay.

The marine region south of Newfoundland differs greatly from the Canadian Arctic both in water masses and in pattern of circulation. Changes originate from the influx of waters from the Gulf of St. Lawrence and from close contact with the Atlantic Ocean (Bigelow 1927; Chamberlin and Stearns 1963; Ekman 1953; Hachey et al. 1954; Pyle 1962; Schroeder 1963). New water types originate here and marine environment changes.

SYSTEMATIC DESCRIPTION OF THE FAUNA OF BIVALVE MOLLUSCS

Class Bivalvia

Subclass Palaeotaxodonta (= Protobranchia)

ORDER NUCULOIDA

Superfamily NUCULACEA

Family NUCULIDAE

Genus *Nucula* Lamarck, 1799

Subgenus *Ennucula* Iredale, 1931

Nucula (Ennucula) belloti Adams, 1856 (Pl. I.1–5, p. 95)

Nucula belloti Adams, 1856: 51; Hanley 1860: pl. 229, fig. 128; Schenck 1939: pl. 6, fig. 19–21; pl. 8, fig. 10, 11, 13, 16–20

Distribution in the Canadian Arctic

Map 1, p. 74

Published records[1]

Nucula inflata, Hancock (1846), Cumberland Sound; Smith (1877), NW Baffin Bay; Whiteaves (1885), Hudson Strait; Baker (1919), NW Baffin Bay

Nucula expansa, Reeve (1855), Canadian Archipelago; Stimpson (1861), Hudson Bay; Packard (1891), Labrador; Richards (1936), James Bay

Nucula tenuis, Bush (1883), Labrador; Packard (1891), Labrador; Rodger (1893–95), Eglinton Harbour, Baffin Island; Whiteaves (1901), Hudson Bay; Grieg (1909), Canadian Archipelago; Dall (1919, 1924), Canadian Archipelago; Johnson (1926), Labrador; Thorson (1951), NW Baffin Bay; Ellis (1960), Pond Inlet, Foxe Basin

Nucula belloti, Wagner (1968), Hudson Bay

[1]Listed here and throughout under the binomen used in the records. Systematic arrangement conforms to Keen and Coan (1974).

New records

Canadian Archipelago, Foxe Basin, Hudson Strait, Hudson Bay, Ungava Bay, Frobisher Bay, Cumberland Sound (ABS and NMC).

Remarks

Since the first Arctic explorations, all northern specimens of *Nucula* have been identified as *N. tenuis* (Montagu 1808), whose type locality is Dunbar, Scotland (Montagu 1805–08: suppl., p. 56). However, three other related forms of *Nucula* have been described from the Canadian Arctic — *N. inflata* Hancock, 1846; *N. expansa* Reeve, 1855; and *N. belloti* Adams, 1856. They were regarded either as synonymous with or varieties of *N. tenuis* (Whiteaves 1901; Soot-Ryen 1932; Filatova 1948; Thorson 1951; MacGinitie 1959; Ockelmann 1958; Bernard 1979a; Hanley 1860; Gould 1870).

Schenck (1939), revised the nomenclature of nuculids and showed that northern forms, known as *N. inflata* Hancock and *N. expansa* Reeve, are conspecific with *N. belloti* Adams 1856. As the first two names are homonyms for *N. inflata* and *N. expansa* of Wissman 1841, the sole available name for the northern specimens in question is *N. belloti* of Adams.

Nucula belloti is abundant and common in the Canadian Arctic (Map 1). Populations differ in size and shape of their shells.

Canadian Archipelago: Dimensions of specimens[2] from Mould Bay, Ellef Ringnes Island were:

l	h	w	h:l	w:l
15.2	13.0	7.5	0.85	0.50
13.0	11.0	7.5	0.81	0.55

These specimens are almost round in outline. The peculiar features, pointed out by Schenck (1939), are well expressed in Pl. 1.1–3.

Foxe Basin: Abundant at all depths, and attains a length of 17 mm. Large shells are dark green, swollen, and short (Pl. 1.4, 5); smaller shells are elongated, narrow, and lighter colored.

Dimensions and h:l and w:l ratios of shells of *N. belloti* from Sta. 723 ABS were:

l	h	w	h:l	w:l
17.0	13.0	9.1	0.76	0.56
17.0	13.1	10.0	0.76	0.59
15.0	11.0	8.0	0.73	0.53

[2]All measurements of specimens are in millimetres (mm) and height = h, length = l, width = w.

Hudson Bay: Abundant and common. Shells are lighter colored and smaller than specimens from Foxe Basin; size decreases gradually toward James Bay, where only a few attain a length of 6 mm and are thin and brittle. Shells of dead animals are numerous, live specimens rare. This species dies out in the bay.

Dimensions of shells from central Hudson Bay (Sta. 59-68 ABS) were:

l	h	w	h:l	w:l
12.0	9.5	7.0	0.78	0.58
11.0	7.5	5.0	0.75	0.50
10.0	8.0	6.0	0.80	0.60

Baffin Bay-Labrador Sea: Specimens collected are large with dark green, strong, swollen shells. The largest specimens, up to 17 mm long, were taken off Button Islands, Hudson Strait, and in Hebron Fiord, Labrador.

N. belloti Adams from the Canadian Arctic, differs widely from *N. tenuis* Montagu. Canadian Arctic specimens of *N. belloti* are arcuate in outline, high, and swollen (Pl. I.1–5). Pouting anterior upper part gives the shell a "winged" appearance. It is separated from the rest of the shell by a broad radial ridge, with corresponding groove on interior side of the shell. Lunula and escutcheon are well defined; lunula cordiform, separated by a ridge from the rest of the shell. Hinge plate is less arcuate than the upper margin of the shell. There are 15–18 long, slender, anterior teeth, bent outward, and 8–10 strong, crowded, posterior teeth. Resilifer is narrow, long, slightly pressed up to the anterior row of teeth. A fine radial striation spreads over all the inner surface of the shell.

Both the very broad, short forms and the narrow, elongated forms occur together throughout the Canadian Arctic.

Variability of the shell is considerable. The h:l and w:l ratios of 180 specimens from different parts of the Canadian Arctic were:

	No. of specimens	l	h:l	w:l
Foxe Basin	40	8–17	0.73–0.85	0.49–0.65
Hudson Bay	80	6–12	0.70–0.90	0.49–0.67
Pond Inlet	10	7–14	0.77–0.82	0.47–0.67
Wellington Channel and Frobisher Bay	14	10–16	0.78–0.86	0.49–0.64
Labrador	16	10–16	0.79–0.90	0.54–0.64

Distribution of w:l and h:l ratios of 80 specimens from Hudson Bay and 80 from other water bodies in the Canadian Arctic shows that these ratios of populations from Hudson Bay and from other regions are more or less normally distributed. The mode and mean values of the ratios (h:l 0.82; w:l 0.56) in both groups are similar. The inflated specimens (*N. inflata* of Hancock) and the elongated narrow ones (*N. expansa* of Reeve) are only extreme variants of a unimodal population of *N. belloti*. There are no indications of the presence in the Canadian Arctic of separate populations of the two forms of this species. In other parts of its circumpolar area, one of the two forms of *N. belloti* may prevail.

Ockelmann (1958) identified the East Greenlandic specimens of *N. belloti* as *N. expansa* Reeve. The size and h:l ratios of specimens are similar to those from Foxe Basin, but the w:l ratio (0.58–0.55) is as low as that of the narrowest shells from the Canadian Arctic.

Filatova (1948) identified the Eurasian Arctic nucula as *N. tenuis* but her illustrations (pl. CV, fig. 1, 2) represent *N. belloti*. According to Filatova, "the *inflata-expansa* complex" occupies the coldest area of the Eurasian region and shells with a h:l ratio of 0.75 and w:l of 0.48 are common. But in the east Siberian Sea large specimens with very high ratios (0.80–0.90 h:l, and 0.60 w:l) prevail. Soot-Ryen (1932) stated that the difference between wide and narrow specimens of nucula in the above region was so striking that it was difficult to regard them as conspecific: expanded specimens can be 20–30% higher, and 20–25% wider, than narrow ones. In the Canadian Arctic such wide specimens were found, though rarely, in Foxe Basin and eastern Hudson Strait.

Specimens of *Nucula* from the western Arctic (Point Barrow) examined by the author in the collection of N. MacGinitie, Smithsonian Institution, and labeled as *N. tenuis*, *N. expansa*, and *N. inflata*, are those of *N. belloti* Adams.

General distribution

Greenland, Iceland, and all Eurasian seas.

N. belloti is a circumpolar panarctic species. In the Boreal and partially in the Subarctic Zone it is replaced by the closely related *N. tenuis* Mont.

Nucula (Ennucula) delphinodonta
Mighels and Adams, 1842
(Pl. I.6, 9, p. 95)

Nucula delphinodonta Mighels and Adams, 1842: 40, pl. 4, fig. 5

Distribution in the Canadian Arctic

Map 2, p. 74

Published records

Nucula delphinodonta, Johnson (1926), Labrador

Nucula delphinodonta, Ellis (1960), Eclipse Sound, N Baffin Island

New records

Hudson Strait, Dr Oughton coll. 1939, valves; Hudson Bay, Clarke coll. 1963, valves.

Remarks

Nucula delphinodonta was found in the southern part of the Canadian eastern Arctic and in Pond Inlet, North Baffin Island — regions influenced by Atlantic waters. The southern boundary of this species in the Northwest Atlantic is off the coast of New England.

General distribution

West Greenland: From 65 to 75°N.

East Greenland and Iceland: Absent.

Eurasian Arctic seas: Coasts of Norway, Murman, and southern shores of Barents Sea.

N. delphinodonta is a boreal Atlantic species, penetrating into the Arctic with the warmer currents.

Family NUCULANIDAE

Genus *Nuculana* Link, 1807

Nuculana pernula (Müller, 1779)
(Pl. I.7, 8, 10, 12, p. 95; Pl. II.1–3, p. 96)

Leda pernula Müller, 1779: 55; G. O. Sars 1878: pl.5, fig. 1a–d

Leda pernula Müller *costigera* Leche, 1883: 447, pl. 33, fig. 23, 24, 25

Leda buccata Steenstrup, 1842: pl. 228, fig. 63, 64

Leda jacksoni Gould, 1870: 163, fig. 469

Distribution in the Canadian Arctic

Map 3, p. 74

Published records

Leda pernula, Packard (1867), Labrador; Smith (1877), NW Baffin Bay; Whiteaves (1885), Hudson Strait; Whiteaves (1901), Hudson Bay; Baker (1919), NW Baffin Bay; Dall (1919), Canadian Archipelago; Johnson (1926), Labrador;

Richards (1936), Hudson Bay; Thorson (1951), NW Baffin Bay; Ellis (1960), N Baffin Island

Leda rostrata, Hancock (1846), Cumberland Sound

Leda buccata, Hancock (1846), Cumberland Sound; Reeve (1855), Canadian Archipelago; Packard (1891), Labrador; Richards (1941), James Bay

Leda jacksoni, Gould (1870), Labrador; Bush (1883), Labrador; Packard (1891), Labrador; Dall (1924), Canadian Archipelago

Nuculana pernula, Wagner (1968), Hudson Bay

New records

Canadian Archipelago and Canadian eastern Arctic (ABS and NMC).

Remarks

Nuculana pernula is widely distributed and abundant in the Canadian Arctic. Two subspecies, *N. pernula costigera* Leche and *N. p. buccata* Steenstrup, and many local races of this variable species have been found here.

Canadian Archipelago: The sole subspecies found here is *N. p. costigera* (Pl. I.7, 8, 10). It is characterized by an elongated narrow shape and a slender, upturned rostrum about twice as long as the anterior part of the shell. The periostracum is thin, ribbing irregular. Supporting rib on the inner side of the shell is long, curved downward. There are 14–16 anterior and 16–19 long and slender posterior teeth. Resilifer long, tightly pressed to posterior hinge plate. Angle between anterior and posterior parts of hinge plate is obtuse (Pl. I.8).

Dimensions of specimen from Prince Patrick Island (Sta. 10-55 NMC) were:

l	h	w	h:l	w:l
29.0	13.0	6.5	0.44	0.21
29.0	14.5	7.4	0.50	0.25
25.2	11.0	6.5	0.40	0.25

Both subspecies occur in Foxe Channel, Foxe Basin, northern Hudson Bay, and Hudson Strait. Here, *N. p. costigera* is abundant, and shells are large and well formed. *N. p. buccata* is a high and expanded form and is rare. Its sculpture consists of strong, coarse, regular ribs. The dark radial stripe of fine ribbing on the anterior part of the shell is well developed. Crossing of this ribbing with the basic sculpture produces a fine, meshlike design (Pl. I.12). Teeth are strong, short, crowded. Hinge plate robust, posterior and anterior parts meeting at a narrow angle.

Dimensions of *N. p. buccata* from the Foxe Basin (Sta. 901 ABS) were:

l	h	w	h:l	w:l
20.0	10.0	5.5	0.45	0.25
17.0	9.0	4.2	0.45	0.25
15.0	8.0	4.2	0.50	0.27

Labrador: The single form occurring here is *N. p. buccata* with well-developed features peculiar to this subspecies (Pl. I.11). Shells are extremely robust, periostracum rough, teeth are strong and crowded.

Dimensions of specimens of *N. p. buccata* found in Labrador (USNM 455394, Bryant; USNM 45592, Bartlett) were:

l	h	w	h:l	w:l
30.3	16.7	10.0	0.51	0.36
29.0	16.0	10.5	0.55	0.36
24.0	13.3	8.7	0.55	0.36

A population of peculiarly small (up to 20 mm long) but very high and wide *N. buccata* var. *brevis* Müller, (USNM 455390, 95821; MCZ 5470), (Pl. II.1–3) was found in Labrador.

It is short, broad, and almost triangular with a strongly arcuate lower margin, short rostrum, and a wide escutcheon defined by strong ridges. Teeth are short and crowded, hinge plates meet at 90°. The h:l (0.60) and w:l (0.40) ratios of 20 specimens are the highest for this species in the Canadian Arctic.

In the Canadian Arctic there is a latitudinal succession of subspecies of *N. pernula* (Fig. 1). *N. p. costigera* occupies the most northern region and is replaced by *N. p. buccata* to the south. Further southward *N. p. buccata* is replaced by *N. pernula* Müller, s. str., a boreal form that occurs in the western North Atlantic from Nova Scotia to Massachusetts. Its shells are small, light green, thin, and brittle (MCZ 451297, 451410, 451352, 462660; U.S. Fish Commission 73022, 73073, 15977; and others).

Dimensions of some specimens in these samples were:

l	h	w	h:l	w:l
19.0	9.0	3.8	0.47	0.21
10.0	4.0	2.2	0.48	0.22
15.0	7.0	3.6	0.40	0.24

The largest of the specimens examined was 23 mm long.

Region	Form of *N. pernula*	No. of spec.	Length (*mm*)
Canadian Archipelago	*N. p. costigera*	15	17–23
Foxe Basin–Hudson Bay	*N. p. buccata*	40	21–30
N Labrador	*N. p. buccata*	30	18–28
S Labrador	*N. p. buccata*	20	10–20
Gulf of Maine	*N. p. pernula*	45	10–22

Region	Form of *N. pernula*	No. of spec.	Length (*mm*)
Canadian Archipelago	*N. p. costigera*	15	17–23
Foxe Basin–Hudson Bay	*N. p. buccata*	40	21–30
N Labrador	*N. p. buccata*	30	18–28
S Labrador	*N. p. buccata*	20	10–20
Gulf of Maine	*N. p. pernula*	45	10–22

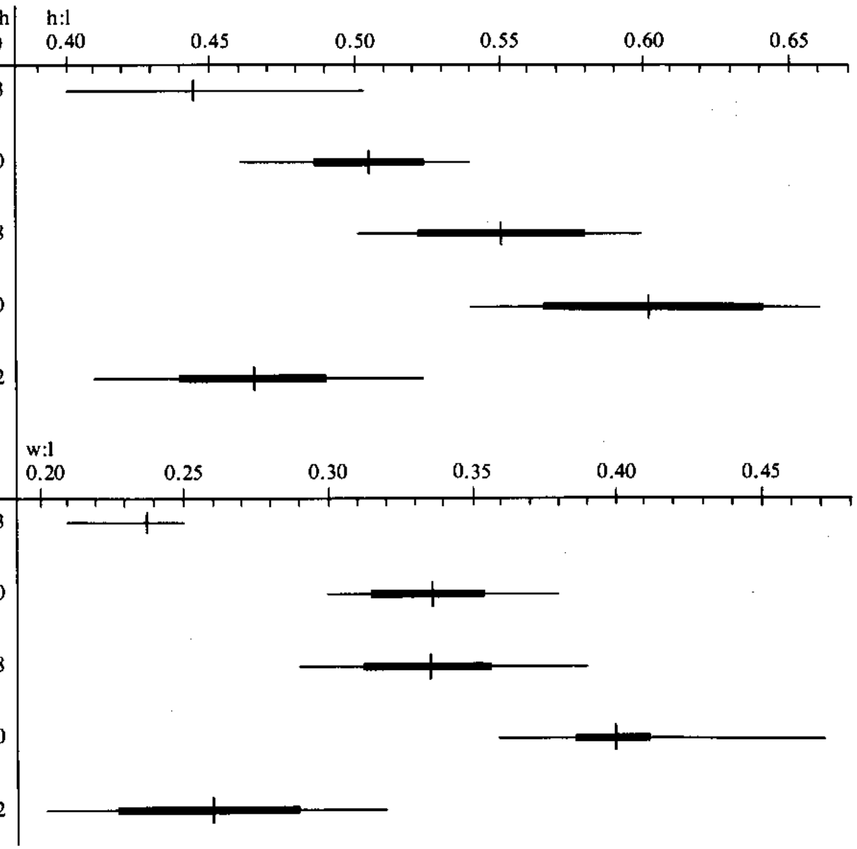


FIG. 1. Indices h:l and w:l of *Nuculana pernula* (Müller) in the Canadian Arctic and Northwest Atlantic. Thin line — observed limits of variation; transverse line — mean; thick bar — ± SD.

Figure 1 illustrates the w:l and h:l ratios of *N. p. costigera* and *N. p. buccata* from the Canadian Arctic, and of *N. pernula* from Massachussets, and their latitudinal trends. The similarity of indices of *N. p. costigera* and of the southern population of *N. pernula* does not indicate, however, that these forms are identical. They differ in many features of their shells and occur in different zones. *N. p. costigera* occurs in the coldest regions of the Arctic — the Canadian Archipelago, East Greenland, and Siberian seas, thus, in areas of polar waters. *N. p. buccata* occurs in mixed waters of the Subarctic Zone — in eastern Canadian Arctic and off western Greenland. It is probably endemic in the Northwest Atlantic; specimens that occur in the Barents and White seas differ from Canadian specimens and are regarded by Filatova (1948) as *N. pernula* f. *typica*.

General distribution

N. pernula s. lato is a panarctic species with boreal outposts. It has produced several subspecies in its large circumpolar area.

Nuculana minuta (Fabricius, 1776)
(Pl. II.4, p. 96)

Arca minuta Fabricius, 1776: 414
Leda minuta, Ockelmann 1958: pl. 1, fig. 10

Distribution in the Canadian Arctic

Map 4, p. 75

Published records

Arca minuta, Gray (1824), eastern Canadian Archipelago

Leda minuta, Hancock (1846), Cumberland Sound; Smith (1877), NW Baffin Bay; Packard (1867, 1891), Labrador; Halkett (1898), Hudson Bay; Whiteaves (1885), Hudson Strait; Whiteaves (1901), Hudson Bay; Packard (1891), Labrador; Bush (1883), Labrador; Rodger (1893–95), Hudson Strait; Grieg (1909), SW Canadian Archipelago; Baker (1919), NW Baffin Bay; Dall (1924), eastern Canadian Arctic; Johnson (1926), Labrador; Thorson (1951), NW Baffin Bay; Ellis (1960), N Baffin Island

Nuculana minuta, Wagner (1968), Hudson Bay

New records

Canadian Archipelago and Canadian eastern Arctic (ABS); southeastern Hudson Bay (NMC), Strathcona Sound (FWI).

Remarks

Nuculana minuta occurs throughout the Canadian Arctic, but is rare in the central part of the Canadian Archipelago. Its southern boundary is in northwest Massachusetts. Two forms of this species have been recognized, a tumid and a flattened one; both occur in the Canadian Arctic but their distribution is not well known. The largest specimen from Canadian waters measured 16.5 x 8.5 x 5.7 mm.

General distribution

Greenland: Entire shore of West Greenland, southern East Greenland.

Iceland: Off shores.

Eurasian Arctic seas: Southern shores of Barents Sea, rare in Kara Sea, absent eastward; reappears in the Chukchi and Bering seas.

N. minuta is a boreal, subarctic species, rare in the high-Arctic regions.

Genus *Yoldia* Møller, 1842

Yoldia hyperborea (Loven) Torell, 1859
(Pl. II.5–6, p. 96)

Yoldia hyperborea (Loven MS) Torell, 1859: 142, pl. 2, fig. 6a, b
Yoldia hyperborea (Loven) Torell *hyperborea* Ockelmann, 1954: 8–11, pl. 1, fig. 1; pl. 2, fig. 3
Yoldia hyperborea, Bernard 1979a: 20, fig. 25

Distribution in the Canadian Arctic

Map 5, p. 76

Published records

Nucula sapotilla, Reeve (1855), Wellington Channel

Yoldia hyperborea, Grieg (1909), Canadian Archipelago

Yoldia limatula, Dall (1919), Canadian Archipelago

Yoldia limatula, Dall (1924), Canadian Archipelago

Yoldia hyperborea, Ellis (1960), Foxe Basin

Yoldia limatula, Wagner (1968), Hudson Bay

New records

Canadian Archipelago, Foxe Basin, Hudson Bay, Ungava Bay (ABS).

Remarks

In the Canadian Arctic *Yoldia hyperborea* has been recorded as *Y. sapotilla* by Reeve, 1855, and as *Y. limatula* by Dall, 1924 (Ockelmann 1954). However, neither of the last two species was found north of the Strait of Belle Isle.

All specimens of *Y. hyperborea* from the Canadian Arctic belong to subspecies *hyperborea* Ockelmann, 1954. They are elongate-ovate and high; broad anterior and posterior parts end in a shallow sinuation of the lower margins. The posterior margin meets the upper margin almost at a right angle.

Dimensions of a few specimens of this subspecies from the Canadian Arctic were:

	l	h	h:l	f:b
Foxe Basin, Sta. 715 ABS	25.0	15.0	0.60	1.38
	24.2	15.5	0.64	-
	20.8	14.0	0.67	-
Hudson Bay, Sta. 613 ABS	32.0	17.0	0.52	1.38
	27.0	14.0	0.50	1.36
Ungava Bay, Sta. 334 ABS	42.0	22.0	0.52	1.28
	17.0	9.0	0.47	1.30

The largest specimens from Ungava Bay were 42 mm long, the greatest number of teeth was 32/25 and usually 15/11 to 29/21. The ratio of the number of teeth in front and behind the umbo (index f:b) varied from 1.28 to 1.38.

Y. h. hyperborea was found in the south-eastern and western parts of the Canadian Archipelago and throughout the Canadian eastern Arctic.

General distribution

Greenland: Middle and southern shores of West Greenland; southern East Greenland.

Iceland: Western shores.

Eurasian Arctic seas: In all seas. Subspecies not indicated.

Y. hyperborea s. lato is an Arctic species of circumpolar distribution.

Yoldia myalis (Couthouy, 1838)

Nucula myalis Couthouy, 1838: pl. 3, fig. 7
Yoldia myalis, Ockelmann 1954: pl. 2, fig. 5
Yoldia myalis, Bernard 1979a: 21, fig. 27

Distribution in the Canadian Arctic

Map 6, p. 76

Published records

Yoldia myalis, Whiteaves (1901), Hudson Strait

New records

None.

General distribution

The area of *Yoldia myalis* in the high-Arctic region of North America is disrupted. It occurs in the Pacific Arctic from Point Barrow to Puget Sound, and in the Northwest Atlantic from Newfoundland to Massachusetts Bay.

Y. myalis is a boreal-subarctic species, probably absent in the Canadian Arctic. The record by Whiteaves (1901) needs confirmation.

Genus *Yoldiella* Verrill and Bush, 1897

Yoldiella fraterna Verrill and Bush, 1898
(Pl. II.10-12, p. 96; Pl. III.1-3, p. 97)

Yoldiella fraterna Verrill and Bush, 1898: pl. 80, fig. 5; pl. 82, fig. 8; Filatova 1948; pl. CVI, fig. 7
Portlandia fraterna, Ockelmann 1958: pl. I, fig. 15

Distribution in the Canadian Arctic

Map 2, p. 74

Published records

None

New records

Starvation Cove, Victoria Island, Canadian Archipelago (ABS); Strathcona Sound, N Baffin Island (FWI).

Numerous specimens were collected at a depth of 100–200 m on sediments of mud and rocks. There were scattered as well as dense populations.

General distribution

Greenland: Western and eastern shores.

Iceland: No records.

Eurasion Arctic seas: In all seas.

The area of distribution of this species is not well known because of the confusion with other species of this genus (Ockelmann 1958, p. 37–39).

Yoldiella fraterna is known at present as a circumpolar, panarctic, and abyssal species.

Yoldiella frigida (Torell, 1859)
(Pl. II.8, p. 96)

Yoldia frigida Torell, 1859: 178, pl. 1, fig. 3
Portlandia frigida, Ockelmann 1958: pl. 1, fig. 14
Portlandia (Yoldiella) frigida, Bernard 1979a: 18, fig. 20

Distribution in the Canadian Arctic
Map 7, p. 77

Published records
Portlandia frigida, Wagner (1964), western polar shelf

New records
Canadian Archipelago: Mould Bay, Prince Patrick Island (ABS); Strathcona Sound (FWI).

General distribution
Greenland: Off northern shores of West Greenland; East Greenland in Scoresby Sound, and Franz Josef Fjord. Main populations at a depth of 30–150 m.

Iceland: Off northern and eastern shores.

Eurasian Arctic seas: In all seas.

In the north Canadian basin at depths of 300–1200 m (Clarke 1963); 27–2560 m (Bernard 1979a, p. 18)

Yoldiella frigida is a high-Arctic species of circumpolar distribution.

Yoldiella intermedia (M. Sars, 1865)
(Pl. II.7, p. 96)

Portlandia intermedia M. Sars, 1865: pl. 38, fig. 22–26; G. O. Sars 1878: pl. 4, fig. 9a, b; Ockelmann 1958: pl. 1, fig. 12; Bernard 1979a: 18, fig. 22

Distribution in the Canadian Arctic
Map 8, p. 77

Published records
Portlandia intermedia, Thorson (1951), off Lancaster Sound

P. intermedia, Wagner 1964, Ellef Ringnes Island

New records
Canadian Archipelago (ABS) and southern Hudson Bay (Clarke, NMC).

Specimens of this species have been found off the Mackenzie River delta, in Dolphin and Union Strait, and one in the eastern trench of Hudson Bay.

General distribution
Greenland: Northern fjords of West Greenland.

East Greenland: At all depths on northern shores, submerges southward.

Iceland: In greater depth off northern shores.

Eurasian Arctic seas: In all seas.

Yoldiella intermedia is a high-Arctic species with a broad depth range.

Yoldiella lenticula (Møller, 1842)
(Pl. I.9, p. 96)

Portlandia lenticula Møller, 1842: 17; G. O. Sars 1878: pl. 7, fig. 10a, b
Portlandia (Yoldiella) lenticula, Bernard 1979a: 18, fig. 23

Distribution in the Canadian Arctic
Map 7, p. 77

Published records
Portlandia lenticula, Wagner (1964), shelf off Ellef Ringnes Island, Canadian Archipelago

New records
Canadian Archipelago (NMC, ABS, FWI); Hudson Bay, James Bay, Richmond Gulf (ABS).

Yoldiella lenticula was found in the Canadian Archipelago and in Hudson Bay, at 10–130 m, and deeper in the northwestern Atlantic.

General distribution
Greenland: Off shores of West and East Greenland.

Eurasian Arctic seas: Coast of Barents Sea eastward to Laptev Sea. Mainly in deep waters north of 75°N and in the trenches of Kara Sea (Filatova 1948).

Y. lenticula is a panarctic species probably of circumpolar distribution.

Yoldiella tamara (Gorbunov, 1946)

Ledella tamara Gorbunov, 1946: 3, pl. 3, fig. 4; Clarke 1963: 100, pl. 2, fig. 9, 10

Distribution in the Canadian Arctic
Map 8, p. 77

Published records
Ledella tamara, Wagner (1964), shelf of NW Canadian Archipelago

New records
None.

General distribution
This small species (l = 3.3 mm, h = 2.4 mm) was collected from a depth of 2000 and 3700 m (Gorbunov 1946; Clarke 1963; Wagner 1967) in the Beaufort Sea. On the western shelf of the Canadian Archipelago it was found at a depth of 400 m.

Yoldiella tamara is a high-Arctic, deepwater species, possibly endemic in the Pacific Arctic.

Genus Portlandia Mørch, 1857

Portlandia arctica (Gray, 1824)
(Pl. III.4-9, p. 97)

Nucula arctica Gray, 1824: suppl. to app., p. 240
Nucula siliqua Reeve, 1855: pl. III, fig. 3a, b
Nucula portlandica Reeve, 1855: pl. XXXIII, fig. 44a, b
Portlandia arctica, G. O. Sars 1878: pl. 4, fig. 7a, b
Yoldia arctica, Mossewitsch 1928: pl. 1, fig. 1-5

Distribution in the Canadian Arctic
Map 9, 10, p. 78

Published records
Nucula arctica Gray, 1824, Canadian Archipelago
Nucula portlandica Reeve, 1855, Canadian Archipelago
Nucula siliqua Reeve, 1855, Canadian Archipelago
Yoldia arctica, Sutherland (1852), Barrow Strait
Portlandia glacialis, Whiteaves (1901), Richmond Gulf
Yoldia arctica, Grieg (1909), Canadian Archipelago
Portlandia arctica, Ockelmann (1958), N Baffin Bay
Portlandia arctica, Ellis (1960), Foxe Basin
Portlandia arctica, Wagner (1968), Hudson Bay

New records
Canadian Archipelago (ABS, NMC); Foxe Basin, Hudson Bay (ABS); Labrador (USNM).

Remarks
Portlandia arctica occurs throughout the Canadian Arctic. It is abundant at 10–400 m, and submerges in the Hudson Strait, Labrador Sea, and Gulf of St. Lawrence.

Three forms of this species occur in the Canadian Arctic: *Portlandia arctica* (Gray, 1824) (Pl. III.4, 5), *P. a.* var. *portlandica* (Hitchcock) (Pl. III.6), and *P. a. siliqua* (Reeve, 1855) (Pl. III.7-9, and the h:l and w:l ratios in Fig. 2).

Canadian Archipelago: Two forms found here were *P. a. portlandica* that occurred in shallow water at river mouths and off glaciers, and *P. a. siliqua* found in deeper waters of the eastern channels and in Baffin Bay.

P. a. portlandica is a low, narrow form with light green, soft periostracum and long tip. It seldom exceeds a length of 15 mm. The ratios are low: h:l varies from 0.52 to 0.62 (mean = 0.57); w:l from 0.31 to 0.40 (mean = 0.35) (Fig. 2).

P. a. siliqua is a large, tumid form with a stout, short tip. Its periostracum is brown or dark green, rough, with distinct radial striations formed by rows of small dots.

The dimensions and the h:l and w:l ratios of shells from Wellington Channel (USNM 199561) were:

l	h	w	h:l	w:l
21.7	13.0	10.0	0.60	0.46
20.4	14.5	9.6	0.60	0.40
20.0	13.5	9.5	0.68	0.48

The h:l ratio of 12 specimens from the same location varied from 0.60 to 0.64 and the w:l ratios from 0.40 to 0.47 (Fig. 2). Specimens of *P. a. siliqua* from the Canadian Archipelago have been identified as *Nucula arctica* (USNM 219683), *Yoldia glacialis* (USNM 12299), and *Leda arctica lutescens* (USNM 199563).

Foxe Basin: The single and abundant form is *P. a. siliqua* (Pl. III.7-9), taken from depths of 20–150 m. The shells are short, wide, and robust; hinge short with crowded strong teeth; muscle and liver scars distinct.

Dimensions of specimens from this basin (Sta. 723 ABS) and of type specimens of *P. a.* var.

Region	Form of *P. arctica*	No. of spec.	Length (*mm*)
Canadian Archipelago	*P. a. portlandica*	60	10–14
Foxe Basin	*P. a. siliqua*	45	15–20
Hudson Bay	*P. a. arctica*	25	10–20
James Bay	*P. a. portlandica*	25	10–15
Richmond Gulf	*P. a. portlandica*	20	10–15
Wellington Channel	*P. a. siliqua*	12	17–21
Labrador, Hebron Fiord	*P. a. siliqua*	10	20–25

Region	Form of *P. arctica*	No. of spec.	Length (*mm*)
Canadian Archipelago	*P. a. portlandica*	60	10–14
Foxe Basin	*P. a. siliqua*	45	15–20
Hudson Bay	*P. a. arctica*	25	10–20
James Bay	*P. a. portlandica*	25	10–15
Richmond Gulf	*P. a. portlandica*	20	10–15
Wellington Channel	*P. a. siliqua*	12	17–21
Labrador, Hebron Fiord	*P. a. siliqua*	10	20–25

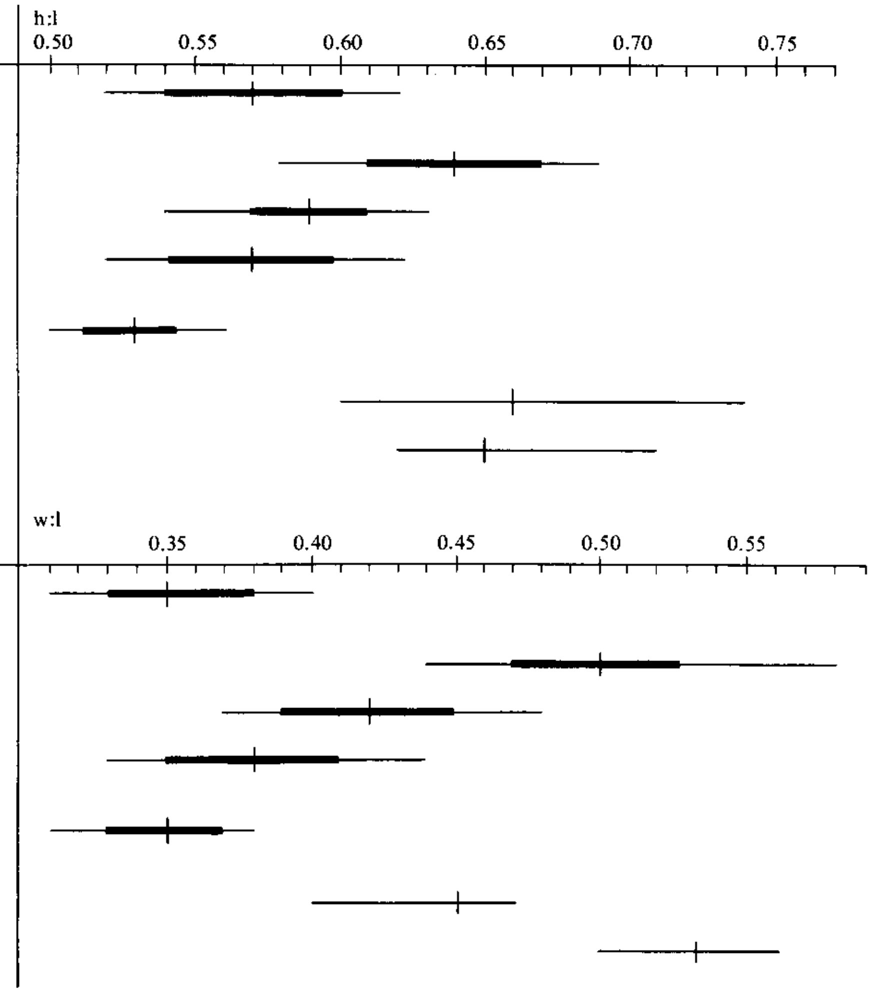


FIG. 2. Indices h:l and w:l of *Portlandia arctica* (Gray) in the Canadian Arctic. Thin line — observed limits of variation; transverse line — mean; thick bar — ± SD.

inflata of Leche, 1883, from the Laptev Sea were almost identical:

	l	h	w	h:l	w:l
Foxe Basin	19.0	13.0	10.0	0.68	0.57
	19.0	12.0	10.0	0.65	0.53
Laptev Sea	19.9	12.0	10.0	0.63	0.53
	16.0	11.0	9.0	0.69	0.56

The h:l ratios of 25 shells from Foxe Basin varied from 0.58 to 0.69 (mean = 0.64) and w:l ratios from 0.44 to 0.58 (mean = 0.50).

Hudson Bay: *P. a. arctica, P. a. portlandica*, as well as intermediate forms occur here. *P. a. arctica* lives in the deeper and colder waters of this bay; *P. a. portlandica* in shallower and more brackish regions.

The shells of *P. a. portlandica* are small, not over 15 mm long, light green, thin, and brittle (Pl. III.6). The h:l and w:l ratios are low.

Richmond Gulf: *P. a. portlandica* prevails here. Shells are extremely low and narrow (Fig. 2), periostracum lightly colored, valves brittle. They are the most elongated and lowest shells of this species in the Canadian Arctic.

Labrador: *P. a. siliqua* prevails on the shelf. The shape and size differ in almost every location. In the Hebron Fiord it is a large, angular, darkly colored form, resembling specimens from the eastern Canadian Archipelago.

Dimensions of the shells from Hebron Fiord (depth of 100 m, USNM 600864) were:

l	h	w	h:l	w:l
25.0	15.5	12.8	0.62	0.50
22.5	15.0	12.0	0.67	0.54
21.6	15.5	11.3	0.71	0.52

The h:l ratios of 10 specimens varied from 0.62 to 0.71 and w:l ratios from 0.50 to 0.56.

In Melville Sound (USNM 604898, 598, 581, 598602) a population of dwarfed specimens of *P. siliqua* was found that differed widely from the above forms.

Dimensions of the larger adults of this dwarfed form were:

l	h	w	h:l	w:l
8.0	4.8	3.2	0.60	0.40
7.8	5.0	4.0	0.64	0.51
7.8	5.0	3.8	0.64	0.59

Dwarfism in this population is environmentally induced; molluscs taken at the entrance to the sound are similar to those from the head of the sound, but of normal size.

Systematic discussion

The relationship between the lower taxa of *P. arctica* were discussed by Mossewitsch (1928). He considered *P. a. arctica* living on the shelf of the larger and saltier Arctic seas as the typical form of this species. In shallow, less saline epicontinental waters *P. a. portlandica* Hitchcock, 1846 (*Nucula portlandica* Reeve, 1885) occurs. These two forms are connected by populations of intermediate specimens that produce a cline from the open shelf toward the shallower and brackish regions of inland waters. Clinal changes involve lowering and elongation of the shell and lowering of the ratios.

The second form of *P. arctica* discussed by Mossewitsch is *P. a. siliqua* Reeve, 1885, which differs greatly from the above forms and occurs in separate populations.

Comparison of *P. arctica* specimens illustrated by Mossewitsch (1928, pl. 1), with those collected in the Canadian Arctic (Pl. III.4), shows that *P. a. arctica* in its typical form was taken only from the deeper stations of the northern Labrador shelf. Changes in h:l and w:l indices (Fig. 2) indicate that the inland populations of *P. a. arctica* in Hudson Bay have already developed clinal changes toward *P. a. portlandica*. The changes become pronounced in populations from the northern Hudson Bay and increase toward James Bay and Richmond Gulf (Fig. 2).

P. a. siliqua in the Canadian Arctic stands apart from the above forms of *P. arctica*. It occurs in separate populations and areas at the shores of Baffin Bay, on the shelf of Labrador, and in Foxe Basin. It is a large form with high h:l and w:l indices almost constant within the populations (Fig. 2).

Mossewitsch (1928) data on *P. a. siliqua* and those based on Canadian populations indicate that this form is probably a separate species and should be designated as *Portlandia siliqua* (Reeve 1855).

General distribution

Greenland: Northern shores of West Greenland. Abundant in East Greenland, where *P. a. portlandica* is dominant.

Eurasian Arctic seas: In all seas except Chukchi Sea.

P. arctica s. lato is a high-Arctic circumpolar species with southern outposts into colder, deeper waters of the subarctic region.

Portlandia sulcifera (Reeve 1855)
(Pl. III.10–12, p. 97)

Nucula sulcifera Reeve, 1855: vol. 2, p. 397, pl. 33, fig. a, b, c

Distribution in the Canadian Arctic
Map 6, p. 76

Published records

Nucula sulcifera Reeve, 1855, Wellington Channel, Canadian Archipelago

New records
Canadian Archipelago (ABS, 1962; NMC, 1952).

Systematic remarks
Portlandia sulcifera was described from Canadian Archipelago specimens. Since the first description in 1855, the only other mention was by Thorson (1951) in a discussion on the distribution of *Yoldiella intermedia* (M. Sars); *P. sulcifera* was usually regarded as species dubius.

Examination of specimens of *Portlandia* in new materials from the Canadian Archipelago showed that *P. sulcifera* is a valid species.

Specimens of *P. sulcifera* do not exceed 17 mm in length. The periostracum is light green, soft, of a structure peculiar to the genus *Portlandia*.

Dimensions of larger specimens were:

l	h	w	h:l	w:l
16.5	10.0	5.8	0.60	0.38
15.9	10.0	5.0	0.63	0.36
12.3	7.6	4.0	0.62	0.32

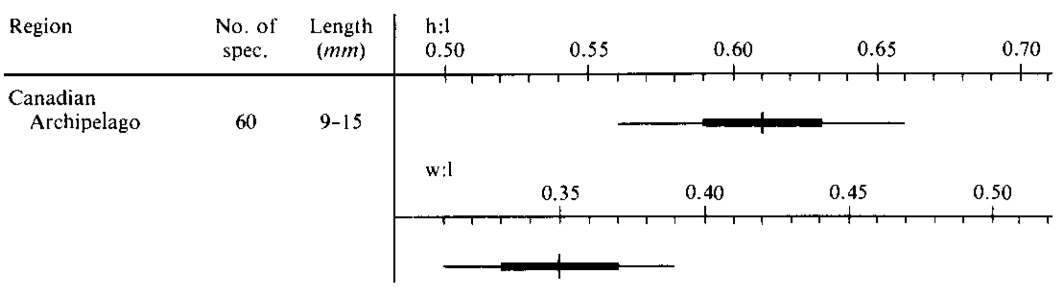


FIG. 3. Indices h:l and w:l of *Portlandica sulcifera* (Reeve) in the Canadian Arctic. Thin line — observed limits of variation; transverse line — mean; thick bar — ± SD.

Shells of *P. sulcifera* are high, short, and extremely narrow. Indices of 60 specimens are presented in Fig. 3. The shells are broadly rounded and more symmetrical in side view than those of *P. arctica*. Central portions of valves are flattened; beaks small, well defined, situated immediately anteriad to the middle of shell. Anterior and posterior parts of the shell are almost equal in length, and equally rounded. Anterior and posterior upper margins are straight and equally slanted. Lower margin is straight, tip short, well defined, tapering, shell under the tip broadly rounded; hinge delicate and small, its anterior and posterior parts slanting equally. Hinge plates are narrow and join the resilifer at the same level. Therefore, the resilifer is symmetrical and its straight lower margin does not extend beyond adjacent ends of the hinge plates. Each plate has about 13 small, slender, straight teeth. The pallial line is far above the lower margin of the shell. Posteriorly it produces a broad curvature parallel to that of the lower posterior margin of the shell. Pallial sinus extends slightly beyond the anterior margin of the posterior muscle scar. Labial palps and proboscides are slanted posteroventrally (Fig. 4).

P. sulcifera differs in many respects from *P. arctica*. The main features of specimens of equal length, by which these species can be separated are:

P. arctica Pl. III.4–9	*P. sulcifera* Pl. III.10–12
Shell elongate, swollen; w:l = 0.42 (0.37–0.43)	Shell short, narrow; w:l = 0.35 (0.31–0.39)
Anterior part high, broadly rounded, posterior narrowed, elongated, and tapering	Anterior and posterior parts of shell equally high, posterior part broadly rounded
1/3–1/2 of posterior part of shell tapers	Only 1/4–1/5 of posterior part of shell tapers
Tip large, straight, or upturned, situated at middle of height of shell	Tip small, well defined, straight, or turned down, situated above middle of height of shell
Posterior upper ridge straight or upturned	Posterior ridge straight or turned down
Surface smooth; periostracum rough	Surface sulcate; periostracum soft
Hinge strong; teeth long	Hinge weak; teeth short, thin
Anterior hinge plate joins resilifer at level beneath the posterior	Anterior and posterior hinge plates join resilifer on same level
Resilifer large, strong; lower rounded margin extends below proximal end of anterior hinge plate	Resilifer elongate, weak; straight lower margin at level with proximal end of anterior hinge plate
Pallial line close to lower margin of shell, only slightly curved posteriorly	Pallial line distant from lower margin of shell, forms broad curvature in truncated postero-ventral part of shell
Sinus short, not extending beyond anterior margin of posterior muscle scar	Sinus long, extends to, and beyond anterior margin of posterior muscle scar

P. sulcifera and *P. arctica* differ in the structure of the body (Fig. 4). In *P. sulcifera* labial palps are short, fanlike, without impression of the liver margin. The palps and proboscides are slanted posteroventrally toward the truncated lower end of shell. In *P. arctica* the labial palps are narrow, elongated, parallel to the longitudinal axis of the shell, pointing toward the tip.

Figures 2 and 3 show that the h:l indices of *P. sulcifera* are close to those of *P. a. siliqua* and the highest shells of *P. a. arctica*. The w:l indices are close to those of the narrowest shells of *P. a. portlandica*. The high, short, and extremely flattened shells of *P. sulcifera* differentiate this species from all forms of *P. arctica*.

P. sulcifera is a high-Arctic species probably endemic in the Canadian Archipelago.

Subclass Pteriomorphia

ORDER ARCOIDA (= EUTAXODONTA)

Family ARCIDAE

Genus *Bathyarca* Kobelt, 1891

Bathyarca glacialis (Gray, 1824)
(Pl. IV.1, p. 98)

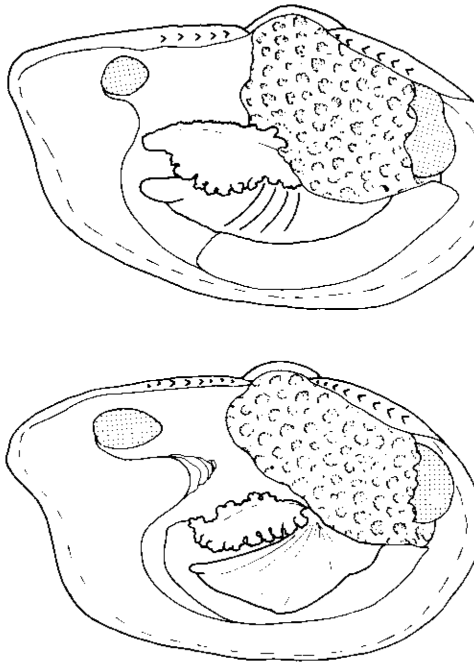
Arca glacialis Gray, 1824: suppl. to app., p. 240; G. O. Sars 1878: pl. 4, fig. 1a, b, c
Bathyarca glacialis, Bernard 1979a: 22, fig. 30

Distribution in the Canadian Arctic
Map 11, p. 79

Published records
Arca glacialis, Dall (1919, 1924), Wellington Channel; Canadian Archipelago
Bathyarca glacialis, Wagner (1968) Hudson Bay

New records
Canadian Archipelago (NMC, ABS), Hudson Bay (Clarke 1963).

Bathyarca glacialis is abundant in the Canadian Archipelago and in deep waters of Hudson Bay. Larger specimen measure 11.3 x 7.7 x 5.6 mm. It is a deepwater species emerging into the Canadian Arctic shallow waters, where it is quite abundant.



A

B

FIG. 4. Some features of gross anatomy: (A), *Portlandia arctica* (Gray); (B), *P. sulcifera* (Reeve). (Note the form and position of labial palps, proboscides, muscle scars, and pallial sinuses.)

General distribution

Greenland: Off Umanak-Upernavik and Yulianehaab in West Greenland, off entire coast of East Greenland. In the north it occurs at depths of 6–10 m, but submerges to below 300 m off the southern shores. The largest specimen from Greenland was 32 mm long.

Iceland: Off northern shores at 80 m and deeper.

Eurasian Arctic seas: In deeper waters from Barents Sea eastward to Vrangel Island and in bathial of polar ocean. Emerges in East Siberian Sea.

B. glacialis is an Atlantic species emerging on the shelf in the coldest regions of the Arctic — the Canadian Archipelago, east Siberian seas, and Northeast Greenland. Considering the high-Arctic distribution of this species, it is advisable to check the southern boundaries of its distribution, believed to be in the Mediterranean Sea.

Bathyarca frielei Jeffreys MS (Friele, 1877)

Arca frielei Friele, 1877; Ockelmann 1958: pl. 1, fig. 17
Bathyarca frielei, Clarke 1963: pl. 2, fig. 12–14

Distribution in the Canadian Arctic
Map 11, p. 79

Published records
B. frielei, Wagner (1964), shelf off Ellef Ringnes Island, Canadian Archipelago

New records:
None.

Remarks

Bathyarca frielei was found on the western polar shelf in a few localities at depths of 200–600 m.

Outside the Canadian Arctic it occurs in East Greenland and the Barents and Kara seas.

Ockelmann (1958, p. 43) and Clarke (1963, p. 101) pointed out high variability and similarity of *B. frielei* to *B. pectunculoides* Scacchi. Revision of the taxonomy and distribution of these species is needed. The author did not examine the Canadian Arctic specimens.

B. frielei is a high-Arctic, deepwater species.

ORDER MYTILOIDA (= DISODONTA)

Superfamily MYTILACEA

Family MYTILIDAE

Genus *Mytilus* Linné, 1758

Mytilus edulis Linné, 1758
(Pl. IV.2,3, p. 98)

Mytilus edulis Linné, 1758: 705
Mytilus pellucidus Pennant, 1777: 59

Distribution in the Canadian Arctic
Map 12, p. 79

Published records
Mytilus edulis, Stimpson (1861), Hudson Bay; Whiteaves (1885), Hudson Strait; Packard (1867), Labrador; Bush (1883), Labrador; Whiteaves (1881), Hudson Bay; Dall (1886), Ungava Bay; Halkett (1898), Hudson Bay; Packard

(1891), Labrador; Whiteaves (1901), Hudson Bay, Richmond Gulf; Dall (1919), western Canadian Archipelago; Richards (1936), James Bay; Laursen (1946), Pond Inlet; Brooks (1935), Southampton Island; Richards (1941), western Hudson Bay; Ellis (1955), Padloping Island, Baffin Island; Ellis (1960), Pond Inlet; I. Lubinsky (1958, 1967), Canadian eastern Arctic

New records

Hudson Bay (ABS, NMC); Bathurst Inlet, Coronation Gulf (W. Blake, GSC). Parlaiyut Bay (FWI).

Remarks

Mytilus edulis occurs in the Canadian eastern Arctic southward from Foxe Channel and from the Padloping Island (southern Baffin Island). It was collected in Pond Inlet by Laursen (1946) and Ellis (1960). In the western Canadian Arctic, *Mytilus* was found in Dolphin and Union Strait (Dall 1919), Bathurst Inlet (Blake 1973), and off the mouth of the Mackenzie River (ABS), Parlaiyut Bay (FWI). Living *M. edulis* were not found in the central Canadian Archipelago between Kent Peninsula in the west, Pond Inlet and Foxe Channel in the east.

The southern boundary of *M. edulis* in the Northwest Atlantic is Cape Hatteras.

In the Canadian Arctic, *M. edulis* are smaller than in the Atlantic, and vary greatly in size. The largest specimens, 80 mm long, were found in the Ungava Bay (Lubinsky 1958, 1967).

Hudson Bay: *M. edulis* is remarkably abundant off the Belcher Islands. Shells are dark brown or black (Pl. IV.2). Valves are thin and transparent in all young and in many adult specimens. The pattern of blue and whitish rays is distinct, ocher-red spots are often present, surface is finely striated.

The h:l and w:l ratios of specimens from Belcher Islands were:

	No. of specimens	l	h:l	w:l
Sta. 60-6 ABS	26	12–70	0.46–0.55	0.34–0.47
Sta. 60-8 ABS	17	22–50	0.47–0.58	0.38–0.46

The oldest specimens were 17 years old.

Richmond Gulf: *M. edulis* was collected at a depth of over 3 m on sandy bottom with some vegetation. Two- to 4-year-old specimens were not over 15 mm long. Older specimens were not found. The molluscs probably could not survive long on this type of bottom. Well-established colonies of dark, heavy, but battered *Mytilus* were found on the rocky shores of Richmond Gulf, the largest 35 mm long.

James Bay: (Pl. IV.3). All *Mytilus* in this Bay are small, with translucent, light-tan shells. Outlines are rounded, side ridges obsolete, beaks low, far from anterior end of shell. Growth lines are crowded but clearly visible. Shells are low and extremely narrow. The h:l ratio of 40 specimens was 0.49 (0.49–0.53), w:l 0.33 (0.29–0.43).

Baffin Bay, Cumberland Sound: A few adult specimens with heavy black shells and scalelike growth marks were collected by ABS. The largest measured 56.0 x 28.5 x 32.0 mm, and was 13 years old.

Pond Inlet: Specimens are strong with black shells and scalelike growth marks.

Dimensions and h:l and w:l ratios of shells of *M. edulis* were:

l	h	w	h:l	w:l	age
67.7	33.0	22.0	0.49	0.29	14
20.0	10.0	7.2	0.50	0.36	5
14.7	9.0	6.0	0.61	0.40	4
6.0	3.5	2.3	0.59	0.38	3

Populations of *M. edulis* in the Canadian Arctic contain many specimens with radial pattern peculiar to *M. pellucidus* Pennant, 1777 (Pl. IV.3.); Lubinsky (1958).

It is difficult to regard *M. pellucidus* as a subspecies of *M. edulis* (Dodge 1952, p. 214): the presence of radial pattern is easily observed in thinner translucent shells, but is concealed in thicker ones. Although specimens with transparent shells and clear radial pattern do occur in Atlantic populations of *M. edulis*, populations of southeastern Hudson Bay and James Bay consist almost entirely of such specimens. Changes in *M. edulis* from the normal Atlantic type toward the pellucid type in James Bay develop gradually and are clinal.

General distribution

Greenland: Abundant at southern shores of West and East Greenland. Isolated colonies occur up to Thule district, West Greenland.

Iceland: "Occurring in abundance all around the country" (Madsen 1949).

Eurasian Arctic seas: Southern shores of Barents Sea and in White Sea. Last small colonies at western shores of Kara Sea and at Yugorsky Shar, Chukchi Sea.

Shells were up to 83 mm long in East Greenland and in the Canadian Arctic, and up to

70 mm in Eurasian Arctic seas.

M. edulis is a boreal-subarctic species. It penetrates into the Arctic with the offshore currents of the Atlantic and Pacific subarctic waters. It occurs also in the littoral of polar waters, warmed up in summer.

Genus *Crenella* Brown 1827

Crenella decussata (Montagu, 1808)
(Pl. V.5, p. 99)

Mytilus decussatus Montagu, 1808: 69
Crenella decussata, G. O. Sars 1878: pl. 3, fig. 4; Bernard, 1979a: 25, fig. 33

Distribution in the Canadian Arctic
Map 13, p. 80

Published records
Crenella decussata, Bush (1883), Labrador; Rodger (1893-95), Hudson Bay; Johnson (1926), Labrador; Whiteaves (1901), Hudson Bay

New records
Ungava Bay (ABS); southeastern Hudson Bay (NMC).

Crenella decussata was seldom collected in the Canadian Arctic, possibly because of its small size (4.5 x 3.8 x 2.5 mm). It was found only in the southern part of the Canadian eastern Arctic. Southward it reaches Cape Hatteras.

General distribution
Greenland: Middle and southern shores of West Greenland, southern shores of East Greenland.

Iceland: Off entire coast

Eurasian Arctic seas: Only in White and Barents seas. Abundant in shallow water on sandy sediments.

C. decussata is a boreal Atlantic species entering the Subarctic zone with the Atlantic waters.

Crenella faba (Müller, 1776)
(Pl. V.4, p. 99)

Mytilus faba Müller, 1776: 250
Modiolaria faba, Jensen 1912: pl. 3, fig. 8a–c

Distribution in the Canadian Arctic
Map 14, p. 80

Published records
Modiolaria faba, Packard (1867), Labrador; Packard (1891), Labrador; Ellis (1960), Foxe Basin

Crenella faba, Bush (1883), Labrador; Pfeffer (1886), Cumberland Sound; Stimpson (1864), Smith Sound; Dall (1879), Cumberland Sound; Dall (1886), Ungava Bay; Whiteaves (1901), Hudson Strait; Grieg (1909), Baffin Bay; Baker (1919), N Baffin Bay; Dall (1924), Ungava Bay; Johnson (1926), Labrador; Laursen (1946), Hudson Bay, Pond Inlet

New records
Canadian eastern Arctic (ABS, NMC, and Dr Oughton); Strathcona Sound (FWI).

Remarks
Crenella faba is common in the Canadian eastern Arctic and rare in the southeastern Canadian Archipelago. It lives in shallow waters to a depth of about 50 m.

C. faba attains its largest size of 18 mm in the colder regions of the Canadian eastern Arctic — Foxe Basin, northern Hudson Bay, and Hudson Strait. *C. faba* is rare and not over 10 mm long in southern Hudson Bay, James Bay, and Ungava Bay.

Dimensions of larger specimens from the Canadian Arctic (ABS) were:

	l	h	w	h:l	w:l
Foxe Basin, Sta. 828	17.0	12.0	8.0	0.74	0.47
Foxe Basin, Sta. 901	16.0	12.0	8.0	0.75	0.50
Foxe Channel, USNM 406121	18.0	13.0	9.0	0.72	0.50
Burwell, Sta. 226	17.0	13.0	8.5	0.77	0.50
	11.0	8.0	7.0	0.72	0.64

H:l ratios of 25 specimens from Foxe Basin varied from 0.69 to 0.82, and w:l ratios from 0.44 to 0.56.

C. faba shows a peculiar correlation between the height of the shell and development of ribbing — the higher the shell, the less conspicuous the ribbing. A similar correlation was observed in *Musculus discors.*

However, smooth forms of *C. faba* similar to the *laevigata* form of *M. discors* have not been found.

In the south, the area of *C. faba* overlaps that of a related species, *C. pectinula* Gould. It is possible that *C. pectinula* is a southern subspecies of *C. faba*.

The thin, brittle, transparent "*C. pectinula*" from southern Hudson Bay, identified as such by Whiteaves (Johannson coll. 1920, NMC) may be a "Kummerform" of *C. faba*.

General distribution

Off West Greenland.

C. faba is a Northwest Atlantic subarctic species that enters the Canadian eastern Arctic with the currents of mixed waters.

Crenella glandula (Totten, 1834)

Modiola glandula Totten, 1834: 367, fig. 3
Crenella glandula, Gould 1870: 184, fig. 492

Distribution in the Canadian Arctic

Published records

Crenella glandula, Packard (1863), Labrador; Bush (1883), Labrador; Packard, (1891), Labrador

New records

None.

Crenella glandula is a boreal North Atlantic species, occurring from southern Labrador to Cape Hatteras.

Genus Dacridium Torell, 1859

Dacridium vitreum (Møller, 1842)
(Pl. V.3, p. 99)

Modiola vitrea Moller, 1842: 92
Dacridium vitreum, Ockelmann 1958: pl. 1, fig. 19

Distribution in the Canadian Arctic

Map 15, p. 81

Published records

Dacridium vitreum, Ellis (1960), Pond Inlet, N Baffin Island; Wagner (1964), western shelf, Canadian Archipelago

New records

Canadian Archipelago (ABS); Hudson Bay, James Bay (NMC); Strathcona Sound (FWI).

Remarks

The distribution of *Dacridium vitreum* in the Northwest Atlantic is little known because of its small size and similarity to the juvenile *M. edulis*. It occurs at depths of 10–1000 m in muddy sediments. It was found by Whiteaves (1872) in the Gulf of St. Lawrence at 200–600 m and by Verrill (1885) off Nova Scotia at 200 m. It occurs in the North Atlantic to a depth of 850 m (Clarke 1962).

General distribution

Greenland: Off middle shores of East and West Greenland.

Iceland: Off eastern and southern shores.

Eurasian Arctic seas: In deepest and coldest regions of the shelf and in Arctic Ocean north of 75°N.

Ockelmann (1958), showed that within the distribution area of this species in the North Atlantic, four different forms of *Dacridium* occur, which he regards as separate species. Ockelmann stated that *D. vitreum* s. str. is a panarctic species in the Atlantic sector of the Arctic. Bernard (1979a, p. 26); Wacasey et al. (1976, p. 27) recorded it from western Beaufort Sea.

Genus *Musculus* Röding 1798

Musculus corrugatus (Stimpson, 1851)
(Pl. IV.7-10, p. 98)

Mytilus corrugatus Stimpson, 1851: 12
Modiolaria corrugata, Jensen 1912: 62, pl. 2, fig. 7a–d

Distribution in the Canadian Arctic

Map 16, p. 81

Published records

Modiolaria corrugata, Packard (1863, 1883, 1891), Labrador; Dall (1919), Canadian Archipelago; Dall (1924), Burwell; Ellis (1960), Pond Inlet

New records

Canadian central and eastern Arctic (ABS, FWI); Canadian eastern Arctic (NMC).

Remarks

Musculus corrugatus is rare in the Canadian Arctic, and was not found in the central Canadian Archipelago. It reaches Cape Cod in the south. This species attains a size of 20 mm in Foxe Basin, where it is abundant.

The northern specimens are dark, external sculpture distinct (Pl. IV.7). It consists of strongly developed radial ribbing on the anterior and posterior parts of the shell, sharply separated from the middle portion, covered by a mesh of concentric weavy corrugations of periostracum. The last constant feature helps to separate this species from northern specimens of *Musculus discors* var. *substriatus*. This fine striation is visible in Pl. IV. 7 and in Bernard (1979a: 25, fig. 35). In Hudson Bay *M. corrugatus* is small, up to 15 mm long, light colored, with smoothed external features (Pl. IV.8, 9). In James Bay even the largest specimens are less than 8 mm long, and deformed (Pl. IV.10).

General distribution

Greenland: Rare off western shores; absent in East Greenland.

Iceland: Absent.

Eurasian Arctic seas: In all seas, but rare.

M. corrugatus is a low-arctic, boreal, circumpolar species, avoiding high-Arctic regions.

Musculus discors (Linné, 1767)
(Pl. IV.4–6, p. 98; Pl. V.1, 2, p. 99)

Mytilus discors Linné, 1767: 1159
Modiola laevigata et var. ß *substriata* Gray, 1824: suppl. to app., p. 244–245
Modiolaria discors var. *laevigata*, Jensen 1912; 57–62, pl. 3, fig. 4a–b
Modiolaria discors var. *substriata*, Jensen 1912: 58, pl. 3, fig. 5a–c

Distribution in the Canadian Arctic

Map 17, p. 82

Published records

"*Modiola laevigata* with var. ß *substriata*" Gray, 1824, Canadian Archipelago; Hancock (1846), Cumberland Sound

Modiolaria laevigata, Reeve (1855), Wellington Channel; Packard (1863), Labrador; Packard (1891), Labrador: Smith (1877), N Baffin Bay; Whiteaves (1885), Hudson Strait; Pfeffer (1886), Cumberland Sound; Dall (1886), Ungava Bay; Grieg (1909), N Baffin Bay; Laursen (1946), Pond Inlet, Hudson Bay; Ellis (1960), Foxe Basin

Modiola discors, Sutherland (1852), N Baffin Bay

Modiolaria discors, Bush (1883), Labrador; Packard (1891), Labrador; Whiteaves (1901), Hudson Bay; Brooks (1935), Hudson Bay

Modiolaria substriata, Baker (1919), N Baffin Bay; Dall (1924), Burwell

Modiolaria laevis, Dall (1924), Pond Inlet, Burwell

Musculus laevigatus, Dall (1919), Dolphin and Union Strait

Musculus substriatus, Johnson (1926), Labrador

New records

Canadian central and eastern Arctic (ABS, NMC).

Remarks

Musculus discors in both its forms, *laevigata* and *substriata*, is common and abundant in the Canadian Arctic, and extends south to Cape Cod. Occurs in waters up to 50 m deep. Specimens from Foxe Basin, Baffin Bay, and Hudson Bay are large, up to 38 mm long, but those from James Bay attain a length of only 12 mm (Pl. IV.5).

The small brittle specimens from James Bay, with smoothened outlines and ribbing resemble *Musculus discors* from the boreal regions (Pl. V.1, 2, from England).

Dimensions of some specimens from the Canadian Arctic were:

	l	h	w	h:l	w:l
Foxe Basin, Sta. 723 ABS	33.0	21.0	15.0	0.64	0.45
	29.0	19.0	16.0	0.65	0.55
Sta. 712 ABS	38.0	24.0	16.0	0.65	0.42
Frobisher Bay, Sta. 331 ABS	37.0	23.0	18.0	0.62	0.49
	35.0	22.0	15.0	0.63	0.43
James Bay, Sta. 59-11 ABS	11.0	7.0	5.0	0.64	0.45
	7.0	5.0	3.5	0.72	0.50
	6.5	5.0	3.0	0.77	0.46
Sta. 50-15	8.0	6.0	3.0	0.67	0.37
	8.0	5.0	3.0	0.63	0.37

H:l ratio of 25 specimens from Foxe Basin was 0.63 (0.59–0.67), shells of James Bay specimens 0.70 (0.60–0.78).

Systematic discussion

This species was described as "*Modiolaria laevigata* et var. ß *substriata*" by Gray (1824), on the basis of specimens from the Canadian Archipelago. Because of its similarity to *Mytilus discors* Linné, 1767, described from the Boreal zone, the relationship between these species has often been discussed. Jensen (1912, p. 57) pointed out that: "The true *Modiolaria discors* Linné does not occur at Greenland, Jan Mayen, or Iceland. The species is represented here by '*Modiolaria laevi-*

gata Gray' and '*Modiolaria substriata* Gray.' [Jensen regards them as] varieties of a species that also embraces '*Modiolaria discors* Linné'. The last name has the prior right by age and must consequently have the advantage in the designation of the species." It is obvious that under '*Modiolaria discors* Linné' Jensen means *Mytilus discors* Linné, 1767. Systematic relations of the last species to *Modiolaria laevigata* was discussed by Dodge (1952, p. 219-220).

Mytilus discors s. str. does not occur in the Canadian Arctic.

There are gradual latitudinal changes from the northern type (Pl. IV.4, 6), described by Gray (1824), toward the southern type of *M. discors* Linné illustrated on Pl. V.1, 2, from England (ANS 55164). The two types differ in development of ribbing — the lower the shell, the more conspicuous the ribbing.

Characters peculiar to each form (*M. d. laevigatus* and *M. d. substriatus*) develop with age. Young specimens are intermediate, but intermediate adults are rare. The two forms occur throughout the whole area of this species and can be found in the same "nest."

It seems that *M. discors* is a polymorphic species, and the nomenclature of Jensen (1912) is adequate.

General distribution

Greenland, Iceland.

Eurasian Arctic: Off entire coast.

M. discors is a circumpolar panarctic species with outposts in the Boreal zone.

Musculus niger (Gray, 1824)
(Pl. IV. 11, 12, p. 98)

Modiolaria nigra Gray, 1824: app., 244
Modiolaria nigra, Gould 1870: 191, fig. 488

Distribution in the Canadian Arctic

Map 18, p. 82

Published records

Modiolaria nigra, Gray (1824), Canadian Archipelago; Hancock (1846), Cumberland Sound; Reeve (1855), Canadian Archipelago; Whiteaves (1885), Hudson Strait; Bush (1883), Labrador; Packard (1891), Labrador; Whiteaves (1901), Hudson Bay; Grieg (1909), Canadian Archipelago; Dall (1919), Canadian Archipelago; Dall (1924), Hudson Strait; Johnson (1926), Labrador; Thorson (1951), N Baffin Bay; Ellis (1960), N Baffin Island

New records

Canadian Archipelago and Canadian eastern Arctic (ABS, NMC).

Remarks

Musculus niger is common but not abundant in the Canadian Arctic and occurs at a depth of 10-70 m. Its southern boundary is Cape Hatteras.

There is a considerable difference between specimens from the north and the south of the Canadian Arctic. Specimens from the Canadian Archipelago, Foxe Basin, and Pond Inlet are small, their periostracum dark and lustrous. They are angular, with well-developed beaks, and distinct sculpture (Pl. IV.11). Young specimens resemble, and were often confused with, *M. corrugatus* Stimpson, as that depicted by Oldroyd (1924, vol. 1, pl. 14, fig. 8, 9).

In Hudson Bay and southward, the shape of *M. niger* changes. It becomes larger, more elongated and flattened, with smoothened outlines and sculpture. The largest specimen of this type, 80 mm long, was collected in the Ungava Bay (Pl. IV.12).

General distribution

Greenland: Off entire eastern and northern coasts.

Iceland: Off coasts.

Eurasian Arctic seas: In all seas.

M. niger is a panarctic-boreal species of circumpolar distribution.

ORDER PTERIOIDA

Superfamily PECTINACEA

Family PECTINIDAE

Genus *Chlamys* Röding, 1798

Chlamys islandica (Müller, 1776)
(Pl. V.6, p. 99)

Ostrea islandica Müller, 1776: 248
Pecten islandicus, G. O. Sars 1878: pl. 2, fig. 2

Distribution in the Canadian Arctic

Map 19, p. 83

Published records

Pecten islandicus, Hancock (1846), Cumberland Sound; Stimpson (1851), Hudson Bay; Packard (1867), Labrador; Bush (1883), Labrador; Whiteaves (1881), Hudson Strait; Whiteaves (1885), Hudson Bay; Whiteaves (1901), Hudson Bay; Brooks (1935), Hudson Bay; Dall (1924), N Hudson Bay; Johnson (1926), Labrador; Richards (1936), W Hudson Bay; Richards (1941), James Bay; Thorson (1951), Labrador

New records

Hudson Bay and Cumberland Sound (ABS, NMC).

Remarks

C. islandica occurs in the Canadian eastern Arctic southward from Foxe Channel and Cumberland Peninsula. Living specimens are small and rare. Numerous large subfossil shells indicate, however, that the present scarce populations are remnants of past abundance. Specimens collected in Ungava Bay, up to 8.2 mm high, are the largest in the Canadian north. The southern boundary of this species is Cape Cod.

General distribution

Greenland: West Greenland from Thule southwards. East Greenland at head of Franz Josef Fjord only, possibly a relic. Recent young specimens are abundant in this fjord, adults rare. The largest measured 91.0 x 88.0 mm. Shells were found on the raised beaches at Cape Bismarck.

Iceland: Off all shores, in fjords as well as open sea. Largest specimen 90.0 mm high.

Eurasian Arctic seas: Southern shores of Barents Sea and White Sea; southwestern shores of Kara Sea; southern boundary Stavanger Fjord, Norway.

Chlamys islandica is a boreal-subarctic species occurring in the Subarctic zones of the North Atlantic and Pacific oceans.

Genus *Delectopecten* Stewart, 1930

Delectopecten greenlandicus (Sowerby, 1842)
(Pl. V.7, p. 99)

Pecten greenlandicus Sowerby, 1842: 57, pl. 3, fig. 40

Pecten groenlandicus, G. O. Sars 1878: pl. 2, fig. 4a–c.

Propeamussium (*Actinula*) *groenlandicum*, Ockelmann 1958: pl. 2, fig. 2

Distribution in the Canadian Arctic

Map 20, p. 83

Published records

Pecten greenlandicus, Hancock (1846), Cumberland Sound; Grieg (1909), Baffin Bay; Baker (1919), NW Baffin Bay; Whiteaves (1901), Richmond Gulf; Ellis (1960), Eclipse Sound, Baffin Bay; Thorson (1951), off Lancaster Sound; Exeter Sound, Baffin Island

Pecten andersoni, Dall (1919), Dolphin and Union Strait

Pseudamussium binominatus, Wagner (1968), Hudson Bay

New records

Canadian Archipelago, Foxe Basin, Hudson Bay (ABS, NMC, FWI).

Remarks

Numerous new records show that *Delectopecten greenlandicus* is widely distributed and abundant in the Canadian Arctic. It is found in the Canadian Archipelago at depths of 5–30 m, but usually below 50 m. In the Canadian eastern Arctic it is confined to deeper and colder waters and submerges in Baffin Bay, Labrador Sea, and Gulf of St. Lawrence. A few specimens were found in the North Atlantic at a depth of 2000 m (Clarke 1962). The southern boundary is the deep waters off Cape Cod.

The largest shells of *D. greenlandicus*, 30 mm high, were found in the Canadian Archipelago. Dimension of specimens from Sta. 10-55 NMC, Slidre Fiord, Ellesmere Island were:

h	l	w
30.0	32.0	7.0
28.0	29.0	7.0
27.0	31.0	6.6

D. greenlandicus decreases in size in Foxe Basin. In the central part of Hudson Bay it is not over 10 mm high, and still smaller in James Bay.

Populations of small specimens in the Atlantic Ocean, and large specimens in the Arctic region, were observed by the first explorers. The Atlantic specimens are described as *D. greenlandicus* f. *minor*.; large Arctic specimens are often described as f. *major*.

Ockelmann (1958, p. 72), stated that Atlantic and Arctic specimens represent species A and B that differ not only in the size of shell, but also in structure of the soft body. Species "A" occurs in the Arctic, species "B" in the Atlantic.

According to the identification by Ockelmann, the small specimens from Hudson Bay belong to the Arctic species "A."

The authors' study of the growth rates of *D.*

greenlandicus (sp. A) from the Canadian Arctic shows that the difference in the size of specimens in the Canadian Archipelago and in Hudson Bay is the result of lowered growth rates in the bay.

General distribution

Greenland: Northern coast of West Greenland; entire coast of East Greenland, where specimens are up to 32 mm high.

Iceland: Off southern and eastern shores. Largest specimens 12 mm high.

Eurasian Arctic seas: Abundant in deeper water from Barents Sea to approximately 165°E in East Siberian Sea. Attains a height of 32 mm in coldest regions.

D. greenlandicus (sp. A, sensu Ockelmann, 1958) is a high-Arctic species, known at present from the Atlantic sector of the Arctic.

Family LIMIDAE

Genus *Lima* Bruguière, 1797

Lima subauriculata (Montagu, 1808)

Pecten subauriculata Montagu, 1808: suppl., p. 63, pl. 29, fig. 2
Lima (Limatula) subauriculata, Smith 1951: pl. 10, fig. 4

Distribution in the Canadian Arctic

Map 13, p. 80

Published records

Lima subauriculata, Reeve (1855), Canadian Archipelago, Wellington Channel

New records

None.

Remarks

The record by Reeve extends the distribution of Limidae from the northwestern Atlantic into the Canadian Arctic.

In the revision of Limidae of the North Atlantic, Jensen (1912) and Ockelmann (1958) pointed out that *Lima subauriculata* was often confused with *L. similis* Jensen, a southern deep-water species. The author was unable to examine specimens of *L. subauriculata* from the Canadian Arctic.

General distribution

Greenland: Middle and southern shores of West Greenland; southern shores of East Greenland.

Iceland: Southeastern shores.

Eurasian Arctic seas: Faeroes, Norway, Murman.

ORDER VENEROIDA (= TELEODONTA)

SUBORDER DIOGENODONTINA

Family ASTARTIDAE

Introduction

The family Astartidae in the Canadian Arctic is represented by a large group of species of only the type genus *Astarte*. Ecologically it is a complex group, consisting of species with different requirements as to depth, bottom sediments, temperature, and salinity.

The distribution of many species extends over more than one zoogeographic zone, but there are species endemic in the high Arctic. Canadian boreal species are known only from southern Labrador.

Although *Astarte* is one of the oldest living bivalves, the northern fauna contains some species that probably originated as late as the Pleistocene period.

The Arctic species of *Astarte* are variable and at times closely resemble each other. Therefore, their taxonomy is involved, and synonomy abundant and complicated. Dall (1903, p. 837) was the first to compile a list of North American species of this genus. He subdivided it into three sections, of which two occur in the Canadian Arctic. In this Bulletin, the subgeneric taxon referred to by Dall as "Section," and as a subgenus by T. Abbott (1974) and Bernard (1979a) will not be used. The species will be arranged, however, in the order used by Dall (1903).

Family ASTARTIDAE

Genus *Astarte* Sowerby, 1816

Astarte arctica (Gray, 1824)

Crassina arctica Gray, 1824: app., 243
Astarte borealis, Jensen 1912: pl. 4, fig. 1a, b
Astarte arctica, Filatova 1948: pl. CX, fig. 4; 1957: 54

Distribution in the Canadian Arctic

Map 21, p. 84

Published records

Crassina arctica Gray, 1824, Canadian Archipelago

Astarte arctica, Sutherland (1852), Barrow Strait; Bush (1883), Labrador; Stimpson (1861), Ungava Bay; Packard (1891), Labrador; Baker (1919), N Baffin Bay

New records

Diana Bay in Ungava Bay (ABS).

Remarks

This rare species was found in the Canadian eastern Archipelago, Ungava Bay, and off Labrador.

The collection of the Blue Dolphin Expedition, 1952, contains many specimens of *Astarte arctica* from Canada (Baffin Bay, Frobisher Bay USNM 95729, Cumberland Gulf USNM 95730, and Labrador USNM 181921).

A. arctica was often regarded as a variety of *A. borealis* and listed under this name.

A. arctica differs from *A. borealis* by the chestnut-brown, lustrous, finely striated periostracum, firmly attached to the shell. A few thin, narrowly spaced ribs may, or may not be present on the apex. The periostracum of *A. borealis* is dull, chalky, thick, and peels off easily. The ribs are large and broadly spaced. In young specimens they cover the entire shell.

The shell of *A. arctica* is rounded or ovate, with high beaks. Both the lunula and escutcheon are well developed and defined. The shell expands under the beaks and gradually narrows toward the margins. In outline it strongly resembles the cyprinoid shell. The margins of valves are sharp, and the pallial line is at a distance from them. The inner marginal part of the shell is flat, well separated from the central concave portion.

Ten specimens from Greenland, 29–37 mm long, had a h:l ratio varying from 0.79 to 0.90, and w:l from 0.39 to 0.50.

General distribution

The distribution is not well known.

Greenland and Iceland: The statement by Dall (1903), that *A. arctica* occurs in Greenland has not been confirmed by Greenlandic explorers (Jensen 1912; Thorson 1951; Ockelmann 1958). Collections of the *Valorous* Expedition contain, however, specimens of *A. arctica* taken off West Greenland (USNM 169659, 169656, 169657). The specimen of *Astarte* from Iceland, depicted as *A. borealis* by Jensen (1912, pl. 4, fig. 1a, **b**) is that of *A. arctica* Gray.

Eurasian Arctic seas: *A. arctica* occurs in the Barents and White seas, off Spitzbergen, Murman, and Norway (Filatova 1948, 1957a, b).

A. arctica is an Atlantic subarctic species.

Astarte borealis (Schumacher, 1817)
(Pl. V.8, 9, p. 99)

Tridonta borealis Schumacher, 1817: 47, pl. 17, fig. 1
Crassina semisulcata Leach, 1819: 172
Tridonta borealis, G. O. Sars 1878: pl. 5, fig. 8
Astarte borealis, Jensen 1912: pl. 4, fig. 1a–f

Distribution in the Canadian Arctic

Map 22, p. 84

Published records

Crassina semisulcata, Gray (1824), Canadian Archipelago

Astarte richardsoni Reeve, 1855, Lancaster Sound

Astarte semisulcata, Hancock (1846), Cumberland Sound; Smith (1877), Smith Sound

Astarte lactea, Whiteaves (1881, 1885), Hudson Strait

Astarte borealis, Dall (1879), Cumberland Sound; Bush (1883), Labrador; Grieg (1909), Ellesmere Island; Baker (1919), N Baffin Bay; Dall (1919), western Canadian Archipelago; Dall (1924), Hudson Bay, Beechey Island, Melville Island; Brooks (1935), Hudson Bay; Johnson (1926), Labrador; Richards (1936), James Bay; Laursen (1946), Pond Inlet; Richards (1941), W Hudson Bay; Ellis (1960), Arctic Bay, N Baffin Island, Foxe Basin

New records

Canadian Archipelago (ABS, NMC, FWI); eastern Arctic (ABS, NMC).

Remarks

Astarte borealis is widely distributed in the Canadian Arctic and occurs from the northernmost shores of Canada and Greenland to Massachusetts.

It is a variable species with several forms and an involved synonymy. Two forms were found in the Canadian Arctic, *A. borealis* var. *placenta* Mørch and *A. b.* var. *withami* Wood.

The typical form, as well as var. *withami*, occurs mainly in the eastern Canadian Arctic and off Labrador.

A. b. placenta is the sole form in the Canadian Archipelago and Foxe Basin. It is elongated and extremely narrow (Pl. V.8, 9). For shells of this type see Jensen (1912, pl. 4, fig. 1f), MacGinitie (1959, pl. 22, fig. 5, 6), and Filatova (1948, pl. CX). The periostracum of *A. b. placenta* is dull, grayish-brown, thick, and peels off easily. Beaks are small, elevated, and taper forward. Ribs are small near the beaks, but become larger at the middle of the shell, and disappear toward the margins. In young specimens they cover the entire shell (see Bernard 1979a, fig. 70). Such forms were described as *A. rhomboidalis* by Leche (1883). Dall (1903) regarded *A. b. placenta* as a young specimen of *A. borealis*. There are many 5-year-old specimens of *A. b. placenta* in the ABS collections.

Dimensions of *A. b. placenta* from the Canadian Arctic were:

	No. of specimens	l	h:l	w:l
Canadian Archipelago	25	20–36	0.76 (0.70–0.84)	0.30 (0.24–0.36)
Foxe Basin	25	30–41	0.76 (0.68–0.83)	0.35 (0.30–0.40)
Pond Inlet	15	30–40	0.76 (0.69–0.80)	0.35 (0.30–0.39)

A. borealis placenta is a high-Arctic form abundant in shallow waters of lowered salinity. It is the sole form in East Greenland and a dominant one in all Eurasian seas.

Another form of *A. borealis, A. b.* var. *withami* Wood, is a rounded, expanded form with black-brown periostracum. It attains a length of 40 mm; h:l and w:l indices of Canadian specimens vary from 0.80 to 0.90 and 0.43 to 0.47, respectively.

A. borealis s. lato is a circumpolar panarctic species with boreal outposts.

Astarte crenata (Gray, 1824)
(Pl. V.10–12, p. 99; Pl. VI.1–3, p. 100)

Nicania crenata Gray, 1824: app., 242
Astarte crenata, Jensen 1912: pl. 4, fig. f, g; Ockelmann 1958: pl. 1, fig. 20, 21

Distribution in the Canadian Arctic
Map 23, p. 85

Published records
Nicania crenata Gray, 1824, Prince Regent Inlet, Canadian Archipelago

Astarte crenata, Johnson (1926), Labrador; Whiteaves (1901), Richmond Gulf, Hudson Bay; Laursen (1946), Hudson Bay; Thorson (1951), Jones Sound, Lancaster Sound, Canadian Archipelago

New records
Canadian Archipelago and Hudson Bay (ABS), Pond Inlet, North Baffin Island (Ellis 1960).

Remarks
The relationship of subspecific taxa of *Astarte crenata* (Gray) has not been sufficiently investigated. The following species by early authors were included as synonyms: *A. crebricostata* MacAndrews and Forbes 1847; *A. subaequilatera* Sowerby, 1855; *A. acuticostata* Jeffreys and Friele, 1877; *A. crenata* var. *inflata* Hagg, 1904.

Dall (1903), regarded these forms as valid species, Jensen (1912), as varieties of *A. crenata*, Filatova (1948) and Ockelmann (1958) as subspecies of *A. crenata*. These authors showed that off the shores of East Greenland and in the Eurasian Arctic seas each form occupies a separate area, but all are connected by intermediate specimens. *A. crenata crenata* (Gray) occurs off open shores in high-Arctic regions at depths of 30–300 m, whereas *A. c. acuticostata* Jeffreys and Friele is a high-Arctic, deepwater form which emerges toward the heads of fjords. *A. c. subaequilatera* Sowerby (= *A. crebricostata* MacAndrews) occurs in warmer regions of the Arctic and in the Atlantic. It seems justified, as suggested by Ockelmann (1958, p. 94) to regard all these forms as subspecies of *A. crenata* (Gray).

In the Canadian Arctic *A. c. crenata* (Gray) occurs in the Archipelago and the colder regions of the eastern Arctic at a depth of 20–700 m; *A. c. crebricostata* MacAndrews and Forbes was found in a cold-water trench of the southeastern Hudson Bay at a depth of 160 m, and also off Labrador; *A. c. acuticostata* Jeffreys and Friele occurred off Ellef Ringnes Island (NMC 14893, labeled as *A. globosa* Møller) (Pl. V.3).

Specimens of *A. c. crenata* are straw colored, glossy, with thin, regular ribs near the apex, disintegrating into striations toward the margins of the shell. Outlines of the shells are arcuate, the apex high, anterior hinge plate straight. The largest specimen measured 23.0 x 18.0 x 12.0 mm.

Specimens of *A. c. crenata* found in the southern Hudson Bay are peculiar. The shells are small, rounded, and greatly expanded (Pl. V.11, 12). Shells of adult specimens have about 50 ribs.

Dimensions of three specimens of *A. c. crenata* were:

	l	h	w	h:l	w:l
Sta. 59-15	22.8	18.5	13.8	0.81	0.60
B. 13	20.0	17.2	11.5	0.86	0.57
ABS	19.2	16.0	11.5	0.83	0.60

These ratios are the highest observed in this species in the Canadian Arctic.

An isolated population of *A. crenata crebricostata* was found in the deep region of Hudson Bay. The shells are elongated, with attenuated anterior part (Pl. VI.1, 2). The periostracum is rough, ribbing distinct; ribs (30–50) large, separated by wide interspaces, unequal, and covered with wrinkles. Periostracum is similar to that of *A. subaequilatera* discussed and illustrated by Ockelmann (1958, p. 96, pl. 1, fig. 7). The shells resemble those of *A. c. subaequilatera* var. *whiteavesi* Dall, 1903, from the Gulf of St. Lawrence, but are much more expanded, shortened, with heavier valves thickened toward the margins.

This isolated population is probably a relic from the period of broader communication of the Canadian Arctic waters with the Atlantic Ocean.

General distribution

Greenland: Coldest regions of West and East Greenland (Ockelmann 1958, fig. 5, p. 95).

Eurasian Arctic seas: From Barents Sea to Chukchi Sea.

A. c. crenata and *A. c. crebricostata* occur only in the western part of the Eurasian Arctic (Filatova 1957a, b).

A. crenata s. lato is a panarctic species, producing many subspecies in its large circumpolar area.

Astarte elliptica (Brown, 1827)

Crassina elliptica Brown, 1827: III, pl. 18, fig. 3

Astarte elliptica, Jensen 1912: pl. 4, fig. 4a–g; Filatova 1948: pl. CIX, fig. 10

Distribution in the Canadian Arctic

Map 24, p. 85

Published records

A. compressa, Whiteaves (1885), Hudson Strait

Astarte elliptica, Packard (1891), Labrador; Bush (1883), Labrador; Johnson (1926), Labrador

New records

Pond Inlet and Frobisher Bay (ABS).

Remarks

The synonymy of this species is confusing (Gould 1870, p. 124; Whiteaves 1901, p. 130; Dall 1903, p. 941; Thorson 1951, p. 75). Many records from the Canadian Arctic are erroneous. The study of museum materials from the Canadian region shows that *A. elliptica* occurs only off the eastern shores of the Canadian Arctic from the Canadian Archipelago to Labrador and southward to Massachusetts.

General distribution

Greenland: West and East Greenland.

Iceland: Off shores.

Eurasian Arctic seas: Barents and White seas, southern shores of Kara Sea.

A. elliptica is a low-Arctic-boreal species, occurring in the Atlantic sector of the Arctic.

Astarte soror Dall, 1903
(Pl. VI.4–6, p. 100)

Astarte soror Dall, 1903: 947, pl. LXII, fig. 11

Distribution in the Canadian Arctic

Map 24, p. 85

Published records

A. soror Dall, 1903, Wellington Channel; USNM, Feilden (1838), Pierce Bay

New records

None.

Remarks

Astarte soror was described by Dall (1903) from Disco Bay, West Greenland. This is a large species with rough periostracum and a heavy shell. Dall suggested its close relationship with the pleistocene **A. laurentiana* Lyell. Comparison of shells of this fossil species in collections of the Redpath Museum and in the USNM with those of *A. soror*, shows that the latter is more closely related to the *Tridonta* group of species than to the *Nicania* group, to which *A. laurentiana* belongs.

General distribution

A. soror was found in the Baffin Bay region. It is an Arctic species endemic in the Canadian-Greenlandic Region.

"*Astarte montagui* (Dillwyn, 1817)"

Systematic discussion

Leach (1819) placed into the genus *Nicania* a circumpolar group of small *Astarte*, known at present under the collective name of "*Astarte montagui* Dillwyn" (Jensen 1912; Filatova 1948, 1957a, b; Ockelmann 1958; MacGinitie 1959; Bernard 1979a). Jensen (1912) included in this group the following species: *Venus compressa* Montagu, 1808; *Nicania banksi* Leach, 1819; *N. striata* Leach, 1819; *Astarte fabula* Reeve, 1855; *A. globosa* Møller, 1842; *A. pulchella* Jonas, 1845; and *A. warhami* Hancock, 1846 (see also Dall 1903).

The extreme variability and similarity of the different northern populations of *Astarte* and lack of large series for comparative studies has resulted in the description of numerous species. In the last decade, almost all northern "*Nicania*" have been lumped under one name, *A. montagui* Dillwyn (see Jensen 1912). As a result, the synonymy became increasingly involved, identity of species was lost, and areas of distribution became indiscernible. The situation did not improve when Gray's paper (1839) interchanged the numbers of the figures representing *A. banksi* and *A. striata*.

Jensen (1912) attempted to organize the chaos within "*A. montagui*" on the basis of height to length relation of shells, and recognized three varieties within this "species." He retained for them the specific names of the original species included in the group. The elongated form became *A. montagui* var. *warhami*; the shortened, *A. montagui* var. *striata*; and the shortest, *A. montagui* var. *banksi*. These varieties, according to Jensen, have different areas of distribution within that of the "species." *A. montagui* var. *warhami* is the northernmost.

Ockelmann (1958, p. 84), confirmed Jensen's observation and pointed out that the h:l ratio of the shells increases toward higher latitudes, and that this gradation has the character of a cline. Filatova (1948, 1957a, b), and MacGinitie (1959, p. 67) and Bernard (1979a, p. 44) accepted Jensen's system.

The study of *Astarte* specimens from the Canadian Arctic included in "*A. montagui*" by Jensen (in the collections of ABS, NMC, USNM, and MCZ) and of specimens from Greenland (kindly sent to the author by Ockelmann, Helsingør Marine Laboratories), shows that *A. montagui* sensu Jensen embraces three distinct species described by early authors: *A. montagui* (Dillwyn) (= *A. banksi* Leach), *A. striata* Leach, and *A. warhami* Hancock. The w:l and h:l indices of these species overlap, and a shortened *A. warhami* may have indices of *A. striata* and even of *A. banksi*, and superficially resemble them. The h:l and w:l ratios, though helpful in the study of variability in populations of a single species, are not a reliable tool for separating the above species. However, they can be identified on the basis of the original descriptions and subsequent redescriptions (Smith 1877; Dall 1903; and others). The following features are useful in the identification of species included in a group of "*A. montagui.*"

A. warhami Hancock 1846: Ribs in adults do not reach the lower margin of the shell, but disintegrate gradually (or abruptly as in *A. fabula* Reeve) into striation. Young specimens 8–10 mm long have about 30 broad, rounded, and irregular ribs. At the apex of the shell, and near the anterior and posterior ends, the ribs divide and often coalesce with the neighboring ribs to form a pattern of a loosely woven net with unclear interspaces between them.

A young specimen of *A. warhami* with the characteristic pattern of this ribbing reminiscent of *A. esquimalti* Baird, 1863, is illustrated on Pl. VI.12 (see also Dall 1903, pl. LXIII, fig. 11, 12).

The periostracum of *A. warhami* is chestnut-brown with silky luster. A few radial rows of dot-like impressions run often from beaks to the outer margins of the shell, (Pl. VI.10).

The hinge plate under the anterior lateral tooth of the right valve is continuous with that of the cardinal teeth. The anterior lateral tooth is narrow, long, and low. Muscle scars are large, situated near the middle of the height of the shell. Their longer axes, about one third the height of the shell, are almost vertical.

A. striata Leach 1819: Ribs in adults extend to the lower margin of the shell, run parallel to each other, and never coalesce (Pl. VI.7–9). They are sharp, and the interspaces narrow and deep. Young specimens, 8–10 mm long, have about 50 ribs. Periostracum is light or dark brown, chalky, never lustrous. Anterior lateral tooth of the right valve is triangular, short and high, its hinge plate separated from that of the cardinal teeth. Muscle scars are small, less than one-third the height of the shell, the greater part situated above the level of the shell's center. The longer axes are slightly tilted toward the shell's apices.

A. fabula Reeve, 1855: Specimens labeled as *A. fabula* in the collections of the ABS, NMC, USNM, and MCZ, are *A. warhami.* The sudden change in the sculpture of the shell, believed to be a specific character of *A. fabula*, is the result of suddenly interrupted growth. Young *A. warhami* are completely covered with ribs, which gradually disappear in the process of subsequent growth and are replaced by striation. If the growth is suddenly interrupted, a heavy check mark appears. Resumption of growth results in the formation of the striated portion of the shell that is peculiar to the older shells. Young specimens of *A. fabula* have never been found.

The observations of Jensen (1912), and Ockelmann (1958) concerning the elongation of the shells of "*A. montagui*" toward higher latitudes, are basically correct. Indeed, *A. warhami*, a northern species, is more elongated than the rounded southern *A. striata*. Yet these changes are not clinal, but involve three distinct species, gradually replacing each other in latitudinal direction, with their areas overlapping.

Without examining extensive material on these three artificially united species, it is difficult to single out each and to determine the areas of distribution. However, on the basis of the material from the Canadian Arctic in the collections of museums of Canada and of the United States, it was possible to differentiate the following species and to trace the areas of their distribution in the Canadian Arctic.

Astarte globosa Møller, 1842

Astarte globosa Møller, 1842: 76

Distribution in the Canadian Arctic

Published records

Astarte globosa, Reeve (1855), Wellington Channel

New records

Prince Patrick Island (NMC); Ungava Bay (ABS).

Remarks

Astarte globosa is probably not a separate species, but an aberrant form in populations of some smaller *Astarte*. It is rare in the Canadian Arctic, as well as in Greenland and the Eurasian seas, and never forms populations of its own.

Astarte montagui (Dillwyn, 1817)

Venus montagui Dillwyn, 1817: 167
Nicania banksi Leach, 1819: 62
Astarte banksi, Gray 1839: app., pl. 44, fig. 9

Distribution in the Canadian Arctic

Map 21, p. 84

Published records

Astarte banksi, Whiteaves (1885), Burwell, Resolution Islands; Dall (1924), Burwell; Packard (1867, 1891), Labrador; Bush (1883), Labrador; Richards (1941), Hudson Bay

New records

Ungava Bay (ABS).

Remarks

The area of distribution of this species in the Arctic is not well known because of the taxonomic difficulties discussed above. It was recorded off Greenland, Iceland, and from the Barents and White seas.

Astarte montagui (= *A. banksi*) seems to be a boreal species with outposts in the Subarctic zone.

**Astarte laurentiana* Lyell, 1845, Pleistocene

Astarte laurentiana Lyell, 1845: 126 fig. 15a–c; Dawson 1872: 379; pl. 4, fig. 8; pl. 7, fig. 2

Remarks

Astarte laurentiana was found in Pleistocene deposits of eastern Canada and of New England. It is not known whether this species has any descendants. Dall (1903, p. 943) regarded it as *A. laurentiana* Lyell, 1845 (var.?) *soror*.

Comparison of specimens of *A. laurentiana* Lyell with those of *A. soror* Dall (USNM) and of *A. striata* Leach showed that *A. laurentiana* is much closer to the last species of this genus (see also Dawson 1872). There is a great resemblance in many characters, e.g. size, shape, ribbing, structure of the hinge, and shape of the muscle scars.

Iceland: Off shores.

Eurasian Arctic seas: No published information.

A. striata is a subarctic species with outposts into the high-Arctic zone.

Astarte striata (Leach, 1819)
(Pl. VI.7–9, p. 100)

Nicania striata Leach, 1819: app. 2, 62
Astarte montagui var. *striata*, Jensen 1912: pl. 14, fig. 2b; Filatova 1948: pl. CX, fig. 7

Distribution in the Canadian Arctic

Map 25, p. 86

Published records

Nicania striata Leach, 1819, NW Baffin Bay; Gray (1824), NW Baffin Bay, Canadian Archipelago

Astarte striata, Smith (1878), Pierce Bay, Baffin Bay; Stimpson (1861), Hudson Bay; Packard (1891), Labrador; Johnson (1926), Labrador; Richards (1936), Hudson Bay

New records

Foxe Basin (USNM); Hudson Bay, Ungava Bay (ABS).

Remarks

Astarte striata was found in the southeastern Canadian Archipelago, southern Foxe Basin, in Hudson and Ungava bays, off Labrador, Newfoundland, and in the Gulf of St. Lawrence. Its southern boundary is not well known because it has often been identified as "*A. montagui.*"

Dimensions of specimens of *A. striata* collected off the southeastern end of Melville Peninsula, USNM 434676, were as follows:

l	h	w	h:l	w:l
13.7	10.5	6.0	0.77	0.44
11.9	9.0	4.8	0.80	0.44
10.2	8.5	5.0	0.83	0.50

The h:l and w:l ratios of 25 specimens 10–15.5 mm long were 0.80 (0.75–0.88) and 0.46 (0.40–0.52), respectively.

General distribution

Greenland: Entire western shore, and southern half of eastern shore.

Astarte warhami Hancock, 1846
(Pl. VI.10–12, p. 100)

Astarte warhami Hancock, 1846: 336, pl. 5, fig. 15, 16
Astarte fabula Reeve, 1855: vol. 2, pl. 33, fig. 5a, b
Astarte montagui var. *warhami*, Jensen 1912: pl. 4, fig. 2c
Astarte pulchella Jonas, 1845 (fide Dall 1903: 942)

Distribution in the Canadian Arctic

Map 26, p. 86

Published records

Astarte warhami Hancock, 1846, Cumberland Sound; Smith (1877), N Baffin Bay; Gray (1824), NW Baffin Bay

Astarte fabula Reeve, 1855, Wellington Channel; Smith (1877), N Baffin Bay; Baker (1919), Smith Sound; Dall (1924), Melville Island; Johnson (1926), Labrador

New records

Canadian Archipelago (ABS, FWI); Foxe Basin and Pond Inlet (ABS); Hudson Bay, Ungava (ABS, NMC); Labrador (Steele coll.).

Remarks

Astarte warhami occurs throughout the Canadian Arctic and is the sole and abundant representative of the *Nicania* group in the Canadian Archipelago. Here and in Foxe Basin *A. warhami* attains its largest size and is most characteristic in form. It decreases in size and becomes less abundant in southern Hudson Bay and Ungava Bay, where its shape is variable.

Dimensions of specimens from the Canadian Archipelago (Ellef Ringnes Island, Sta. 15-52 NMC) were:

l	h	w	h:l	w:l
28.0	21.5	12.3	0.76	0.44
19.8	15.5	7.5	0.77	0.38

Average h:l and w:l indices of 80 specimens were:

	No. of speci-mens	l	h:l	w:l
Prince Patrick Island, Sta. 15-52 NMC	30	12–28	0.79 (0.73–0.86)	0.42 (0.37–0.50)
Ellesmere Island, Sta. 10-55 NMC	15	16–20	0.80 (0.76–0.84)	0.40 (0.36–0.45)
Foxe Basin, Sta. 723 ABS	26	16–23	0.78 (0.70–0.85)	0.42 (0.37–0.53)
Coburg Island, USNM 466686	9	12–17	0.83 (0.80–0.87)	0.40 (0.38–0.46)

A. warhami occurs at a depth of 5–200 m in the Canadian Arctic and submerges deeper in Baffin Bay and Labrador Sea. Its southern boundary is Newfoundland.

General distribution

A. warhami has often been referred to as *A. montagui* and, therefore, its distribution will be known only after reexamination of the original material.

Greenland: Off the northern shores of West Greenland. In East Greenland it is ". . . by far the commonest form" (Ockelmann 1958, p. 87). "East Greenlandic specimens are lower and more elongate than those of similar size from the Canadian Arctic but almost of equal length" (Ockelmann 1958, p. 86).

Eurasian Arctic seas: Both *A. warhami* and *A. fabula* are recorded from Kara Sea (Filatova 1957a, p. 54).

A. warhami is the sole representative of the *Nicania* group in the collection of N. MacGinitie from Point Barrow, examined by the present author.

A. warhami is a high-Arctic circumpolar species, that occurs in waters of polar origin.

Family CARDITIDAE

Genus *Cyclocardia* Conrad, 1867

Cyclocardia borealis (Conrad, 1831) (Pl. VII.1-3, p. 101)

Cardita borealis Conrad, 1831: 39, pl. 8, fig. 1; Gould 1870: 146, fig. 455

Cyclocardia borealis, Tucker Abbott, 1974: 478, fig. 5493

Distribution in the Canadian Arctic

Map 27, p. 87

Published records

Cardita borealis, Whiteaves (1885), Hudson Strait; Packard (1867), Labrador

Venericardia borealis, Bush (1883), Labrador; Whiteaves (1901), Ashe Inlet, Hudson Strait; Packard (1891), Labrador; Dall (1924), Burwell, Hudson Strait; Johnson (1926), Labrador

New records

Off Digges Islands, North Hudson Bay (ABS).

Remarks

Cyclocardia borealis is endemic to the Northwest Atlantic. Its area extends from the mouth of Hudson Bay to Cape Hatteras. In the Canadian Arctic it usually occurs at depths of over 25 m. Off the coast of Nova Scotia its area overlaps with that of *C. novangliae* Morse (M. Smith 1951, pl. 73, fig. 10), which is often regarded as a southern form of *C. borealis.*

C. borealis is the single representative of its genus in the Canadian Arctic, though other species occur in the Pacific and Eurasian sectors of the Arctic. Their relationship with *C. borealis* was discussed by Filatova (1948) and Nesis (1963a).

C. borealis is a boreal species penetrating into the Subarctic zone of the Canadian Arctic.

Family MONTACUTIDAE

Genus *Montacuta* Turton, 1822

Montacuta substriata (Montagu, 1808)

Venus substriata Montagu, 1808: suppl., 48, pl. 29, fig. 6

Distribution in the Canadian Arctic

Map 28, p. 87

Published records

Montacuta substriata, Sutherland (1852), Assistance Bay, Barrow Strait

New records

None.

Montacuta substriata was known previously only from the eastern Atlantic (Madsen 1949; Ockelmann 1958). The author has not seen specimens taken from the Canadian Arctic.

Superfamily CYAMIACEA

Family Turtonidae

Genus *Turtonia* Alder, 1848

Turtonia minuta (Fabricius, 1780)

Venus minuta Fabricius, 1780: 412
Cyamium minutum, G. O. Sars 1878: pl. 19, fig. 14a–c.
Turtonia minuta, Filatova 1948: pl. CX, fig. 18a–d

Distribution in the Canadian Arctic
Map 27, p. 87

Published records
Turtonia minuta, Dall (1924), Canadian eastern Arctic

New records
None.

In the Canadian Arctic, *Turtonia minuta* was found only once (Cumberland Sound). In the Northwest Atlantic it occurs from Newfoundland to Cape Cod.

General distribution
West Greenland: Disco Bay.
Iceland, Faeroes, and Norway.
Eurasian Arctic seas: Barents Sea, White Sea, and Bering Sea.
T. minuta is a boreal species. Its distribution in the Canadian Arctic is not known.

Superfamily LUCINACEA

Family THYASIRIDAE

Genus *Axinopsida* Keen and Chavan, 1951

Axinopsida orbiculata (G. O. Sars, 1878) (Pl. VII.4, 5, p. 101)

Axinopsis orbiculata G. O. Sars, 1878: 63, pl. 12, fig. 11a–d

Distribution in the Canadian Arctic
Map 28, p. 87

Published records
Axinopsis orbiculata, Bush (1883), Labrador; Packard (1891), Labrador; Ellis (1960), N Baffin Island

New records
Canadian Archipelago, Creswell; Foxe Basin, Hudson Bay, Hudson Strait, Frobisher Bay (ABS); Strathcona Sound (FWI).

Remarks
Axinopsida orbiculata occurs usually with *T. gouldi* Phil., and is often mistaken for it. It has been taken in the southeastern Canadian Archipelago and in the Canadian eastern Arctic at a depth of 3–110 m. The southern boundary is off Cape Cod. Adult specimens from Canada attain a size of 4.6 x 4.4 x 2.8 mm.

General distribution
Greenland and Iceland.
Eurasian Arctic seas: All Arctic seas including Bering Sea.
A. orbiculata is a panarctic and possibly circumpolar species.

Genus *Thyasira* Lamarck, 1818

Thyasira dunbari Lubinsky, 1976 (Pl. VII.6, 9, p. 101)

Thyasira dunbari Lubinsky, 1976: 1667–1670, pl. 1, fig. 1–6

Distribution in the Canadian Arctic
Map 29, p. 88

Published records
Thyasira dunbari, Lubinsky (1976), northern Canadian Archipelago

New records
None.

Remarks
Thyasira dunbari occurs in the muddy bottom of bays and fjords of the northernmost islands of the Canadian Archipelago at a depth of 2–50 m, often at the outwash fan of rivers.

T. dunbari is distinguished by the elongated pyriform shape, high hinge portion of the shell that is about half the total shell height, and slightly undulating disk that extends down and forward. Prodissoconch is small, about 0.16 mm. The posterior hinge plate is long, strongly bent forward, meeting the anterior plate at a right angle. Under the beaks there is a well-formed callus. Hinge is similar in both valves; no teeth vestiges.

Dimensions of specimens from Isachsen Bay, Ellef Ringnes Island were:

l	h	w	h:l	w:l
6.5	8.6	5.t	1.29	0.77
6.4	8.1	5.0	1.26	0.78
6.1	8.0	4.8	1.24	0.78

The h:l ratio of 15 specimens was 1.23 (1.16–1.29) and w:l 0.75 (0.70–0.84). The h:l ratio is age dependent and higher in older specimens; the young are more rounded and symmetrical (Lubinsky 1976, pl. 1, fig. 6).

T. dunbari differs from other northern species of *Thyasira* of similar size by its high, forward curved shell, high hinge part, small prodissoconch, callus, and the absence of teeth vestiges.

General distribution

According to Ockelmann (personal communication), *Thyasira dunbari* also occurs off East Greenland. He considers it a northern counterpart of the boreal *T. equalis* Verrill and Bush, 1898.

T. dunbari is a shallow-water, high-Arctic species endemic in the Canadian-Greenlandic Arctic.

Thyasira gouldi (Philippi, 1845)
(Pl. VII.7, 8, 10–12, p. 101)

Lucina gouldii Philippi, 1845: 74
Cryptodon gouldii, Gould 1870: 100, fig. 406
Axinus gouldii, G. O. Sars 1878: pl. 19, fig. 6a, b
Thyasira gouldi, Ockelmann 1958: pl. 2, fig. 4, 5; Bernard 1979a: 37, fig. 52

Distribution in the Canadian Arctic

Map 29, p. 88

Published records

Cryptodon gouldi, Packard (1867), Labrador; Bush (1883), Labrador; Whiteaves (1901), Labrador

Axinus gouldi, Smith (1877), NW Baffin Bay; Baker (1919), NW Baffin Bay

Thyasira flexuosa, Dall (1919), Dolphin and Union Strait

Thyasira gouldi, Ellis (1960), N Baffin Island

New records

Canadian Archipelago, Cresswell; Foxe Basin, Ungava Bay, Hudson Bay (ABS, NMC); Strathcona Sound (FWI).

Remarks

Thyasira gouldi is common and abundant in the Canadian Arctic except the central part of the Canadian Archipelago. A large specimen measured 9.0 x 9.6 x 6.3 mm. It occurs mostly at depths of 2–50 m. Southward this species probably reaches Massachusetts.

General distribution

Greenland, Iceland: Off all coasts

Eurasian Arctic seas: In all seas.

T. gouldi is a panarctic and probably a circumpolar species.

Superfamily CARDIACEA
(= Cyclodonta)

Family CARDIIDAE

Genus *Clinocardium* Keen, 1936

Clinocardium ciliatum (Fabricius, 1780)
(Pl. VIII.1, p. 102)

Cardium ciliatum Fabricius, 1780: 410; G. O. Sars 1878: pl. 5, fig. 4a, b

Distribution in the Canadian Arctic

Map 30, p. 88

Published records

Cardium islandicum, Hancock (1846), Cumberland Sound; Packard (1867), Labrador; Whiteaves (1881), Hudson Strait; Whiteaves (1885), Hudson Bay; Whiteaves (1901), Hudson Bay; Halkett (1898), Hudson Strait; Johnson (1926), Labrador

Cardium ciliatum, Reeve (1855), Wellington Channel; Packard (1891), Labrador; Dall (1886), Ungava Bay; Dall (1919), Canadian Archipelago; Dall (1924), Ungava Bay; Baker (1919), NW

Baffin Bay; Richards (1936), Hudson Bay; Richards (1941), James Bay; Ellis (1960), N Baffin Island, Foxe Basin

New records

Canadian Archipelago and eastern Arctic (NMC and ABS).

Remarks

Clinocardium ciliatum occurs throughout the Canadian Arctic at depths of 10–200 m on muddy sediment with gravel. It is rare in the Canadian Archipelago, and abundant in the eastern Arctic. Its southern boundary is Cape Cod.

The largest specimen from the Canadian Archipelago measured 50.0 x 44.3 x 29.5 mm. In Hudson and Ungava bays this species is abundant, but less than 40.0 mm long. Living specimens occur among masses of empty shells on the so-called "Cardium bottom," which extends from shallow water down to 200 m.

Dimensions of large specimens collected off Labrador (USNM) by Nutt in 1952 were:

	l	h	w
Emily Harbor USNM 604929	65.0	68.0	42.0
	56.0	65.5	42.0
	57.0	61.0	42.0
Cape Harrigan USNM 598569	45.0	48.0	32.0
	43.0	45.0	26.0
	40.0	42.0	28.0

The largest specimen of *C. ciliatum* from Iceland was 81 mm long; from East Greenland and the Eurasian seas, 60 mm.

General distribution

Greenland, Iceland, and all Eurasian Arctic seas.

C. ciliatum is an Arctic species with boreal outposts, probably with interrupted circumpolar distribution.

Genus *Serripes* Beck, 1841

Serripes groenlandicus (Bruguière, 1789)
(Pl. VIII.2, p. 102)

Cardium groenlandicum Bruguière, 1789: 222

Aphrodite groenlandica, G. O. Sars 1878: pl. 5, fig. 3a, b

Distribution in the Canadian Arctic

Map 31, p. 89

Published records

Cardium groenlandicum, Hancock (1846), Cumberland Sound; Sutherland (1852), Canadian Archipelago; Grieg (1909), Canadian Archipelago

Serripes groenlandicus, Reeve (1855), Canadian Archipelago; Packard (1867), Labrador; Whiteaves (1885), Hudson Bay; Packard (1891), Labrador; Halkett (1898), Hudson Strait; Whiteaves (1901), Hudson Bay; Dall (1919), Canadian Archipelago; Dall (1924), Burwell; Richards (1936), James Bay; Rodger (1895), N Baffin Bay; Ellis (1960), N Baffin Island

New records

Canadian Archipelago and eastern Arctic (NMC, ABS).

Remarks

S. groenlandicus occurs throughout the Canadian Arctic and south to Cape Cod.

It is not abundant in the Canadian Archipelago and specimens do not exceed 52 mm in length. It is abundant in the eastern Arctic and attains a larger size, but the specimens become smaller toward James Bay. The largest specimens were taken off Labrador (Dr Nutt Expedition, 1959) were:

	l	h	w
Emily Harbor USNM 604849	92.0	49.0	56.0
	66.0	58.0	36.0
Domino Harbor USNM 598538	91.0	79.0	54.0
	88.0	76.0	50.0
Hamilton Inlet USNM 509579	89.0	72.0	47.0
	75.0	61.0	37.0

Specimens from Greenland were up to 94 mm long; those from the Eurasian seas, to 100 mm.

General distribution

Entire shores of Greenland, Iceland, and all Eurasian Arctic seas.

S. groenlandicus is a circumpolar and panarctic species.

Superfamily VENERACEA

Family VENERIDAE

Genus *Liocyma* Dall, 1870

Liocyma fluctuosa (Gould, 1841)
(Pl. VIII.3, p. 102)

Venus fluctuosa Gould, 1841: 87, fig. 50
Gomphina fluctuasa, Ockelmann 1958: pl. 2, fig. 9
Liocyma fluctuosa, MacGinitie 1959: pl. 2, fig. 1-8; Bernard 1979a: 51, fig. 85

Distribution in the Canadian Arctic
Map 27, p. 87

Published records

Liocyma fluctuosa, Bush (1883), Labrador

Liocyma beckii, Dall (1919), Dolphin and Union Strait

Liocyma viridis, Dall (1919), Dolphin and Union Strait

New records

Prince of Wales Strait, Canadian Archipelago (ABS).

Remarks

Liocyma fluctuosa occurs in the Canadian Arctic in two widely separated areas — the southwestern Canadian Archipelago and off the southern shores of Labrador. Southward it reaches Massachusetts.

MacGinitie (1959) revised the genus *Liocyma* in the Pacific sector of the Arctic, and stated that the difference between *L. fluctuosa* Gould, and the northern species, *L. viridis* and *L. beckii* Dall (1902), is not sufficient to regard these forms as separate species; thus, the last two names become synonyms of *L. fluctuosa* Gould. The records of *L. beckii* and *L. viridis* Dall, 1919 from Dolphin and Union Strait are used here as those of *L. fluctuosa* Gould. Bernard (1979a, p. 52) reports *L. fluctuosa* from the western Beaufort Sea.

General distribution

Greenland: Abundant in East Greenland and rare in West Greenland.

Eurasian Arctic seas: In all seas including Chukchi.

L. fluctuosa is a panarctic species with possibly circumpolar distribution disrupted in the Canadian Arctic.

Family TELLINIDAE

Subfamily MACOMINAE

Genus *Macoma* Leach, 1819

Macoma balthica (Linné, 1758)
(Pl. VIII.4-7, p. 102)

Tellina balthica Linné, 1758: 677
Tellina (Macoma) balthica, Jensen 1905: pl. 1, fig. 1a, b
Macoma fusca, Gould 1870: pl. 94, fig. 400

Distribution in the Canadian Arctic
Map 32, p. 89

Published records

Tellina fusca, Sutherland (1852), Baffin Bay; Packard (1867), Labrador

Macoma fragilis, Stimpson (1861), Ungava Bay; Whiteaves (1881), Hudson Strait; Bush (1883), Labrador; Packard (1891), Labrador; Richards (1941), James Bay

Macoma balthica, Whiteaves (1901), Labrador; Richards (1941), W Hudson Bay

New records

Canadian eastern Arctic (ABS, NMC).

Remarks

Macoma balthica occurs in Hudson Bay and Strait, Frobisher Bay, and off the shores of Labrador. It penetrates into the St. Lawrence River up to Quebec. In the Northwest Atlantic it reaches Massachusetts.

It is a shallow-water species occurring in the Canadian Arctic down to 20 m; and in James Bay to 60 m.

In the Northwest Atlantic the size of *M. balthica* decreases northward. Near its southern boundary, Massachussets Bay, it attains a length of 40 mm (MCZ); in the Bay of Fundy and Nova Scotia, 20 mm; and off Labrador and Pangnirtung of only 16 mm. In the Hudson Bay it becomes dwarfed and decreases in size toward James Bay, where it is only up to 10 mm long.

Specimens from James Bay were identified by Whiteaves as *M. inconspicua* Sowerby (collection of NMC and F. Johannsen, 1921). However, the study of a large series of this *Macoma* from Hudson and James bays shows that they are dwarfed *M. balthica*. A similar phenomenon, dwarfing of this species in brackish waters, was observed by Meyer and Moebius (1872) in Kiel Bay of the Baltic Sea.

The area of *M. balthica* is disrupted in the North Atlantic and the molluscs in the European and North American populations differ: the European specimens are large, with heavy shells and periostracum with light purple stripes on white background. They are elongated, posterior ends attenuated, lower margins arcuate. A specimen of this type is illustrated by Meyer and Moebius (1872) and by Segestrale (1960, fig. 23).

M. balthica from the American shores of the North Atlantic is whitish gray, chalky, thin, and brittle, its periostracum easily peels off. Anterior and posterior parts of the shell are almost symmetrical, the posterior part slightly shortened and broadened. Shells of this type are depicted by Gould (1870, fig. 400) and T. Abbott (1974, fig. 5713).

Shells of this species from the Pacific and Atlantic areas differ, and this was sufficient to regard the Pacific populations at first as a subspecies of *M. balthica*, and later as a separate species described as *M. inconspicua* by Broderip and Sowerby (1829). The opinion that *M. inconspicua* is a separate species, closely related to *M. balthica*, is shared at present by Dodge (1952), Dunnill and Ellis (1969), and Abbott (1974).

General distribution

West Greenland: Disco Bay.

Iceland: Off shores.

Eurasian Arctic seas: Shallow water of Barents Sea, isolated populations in Baidaratsky Bay, Kara Sea.

M. balthica is a boreal, shallow-water species with outposts into the Subarctic zone. It is a relic in the Laptev Sea.

Macoma calcarea (Gmelin, 1791)
(Pl. IX.1, 4, 7, 10, p. 103; Pl. X.1, 4, 7, 10, p. 104)

Tellina calcarea Gmelin, 1791: 3236
Macoma calcarea, Jensen 1905: fig. 2a, b; Dunnill and Coan 1968: fig. 9, 10
M. calcarea f. *obliqua*, Soot-Ryen 1932: 16, 17, pl. 2, fig. 4–6

Distribution in the Canadian Arctic

Map 33, p. 90

Published records

Tellina calcarea, Hancock (1846), Cumberland Sound; Sutherland (1852), NW Baffin Bay

Tellina proxima, Reeve (1855), eastern Canadian Archipelago

Macoma subulosa, Packard (1867, 1891), Labrador; Bush (1883), Labrador; Stimpson (1861), Ungava Bay

Macoma tenera, Dall (1886), Ungava Bay

Macoma calcarea, Whiteaves (1881), eastern Hudson Bay; Whiteaves (1885), Hudson Strait; Whiteaves (1901), Hudson Bay, Hudson Strait, Richmond Gulf; Baker (1919), NW Baffin Bay; Dall (1919), Dolphin and Union Strait; Dall (1924), Ungava Bay; Richards (1936), James Bay; Richards (1941), Hudson Bay; Thorson (1951), NW Baffin Bay; Ellis (1960), N Baffin Island

New records

Canadian central and eastern Arctic (ABS, NMC). Southward it reaches Massachussets.

Macoma calcarea, widespread and abundant in the Arctic, seems to be rare in the central part of the Canadian Archipelago. The largest specimens, up to 45 mm long, were found in the eastern Arctic.

General distribution

Greenland and Iceland: In shallow water off all coasts.

Eurasian Arctic seas: In all seas.

Soot-Ryen (1932), mentioned two forms of this species from the East Siberian Sea. One, *M. calcarea* f. *obliqua*, was found also in Foxe Basin (808 ABS) (Pl. X.1, 4, 7, 10) and in Liverpool Bay (61-1017 ABS).

M. calcarea is a panarctic-boreal species with circumpolar distribution.

Macoma inconspicua (Broderip and Sowerby, 1829)
(Pl. VIII.8, 9, 12, p. 102)

Tellina inconspicua Brod. and Sow., 1829: 363
Macoma inconspicua, Dunnill and Ellis 1969: fig. 3a–d, 6, 9L

Distribution in the Canadian Arctic

Map 32, p. 89

Published records

None

New records

Bathurst Inlet, Canadian Archipelago (Blake Jr. GSC).

Remarks

Macoma inconspicua from the Bathurst Inlet is less than 10 mm long, with high, thin, chalky shell, and gray periostracum that peels off easily. It resembles dwarfed *M. balthica* from southern Hudson Bay and James Bay, which was identified by Whiteaves (1901) as *M. inconspicua* (NMC).

M. balthica and *M. inconspicua* differ mainly in the outlines of the shells and the shape of sinuses (Pl. VIII.4,5,6,9,12).

The identity of populations of *M. balthica* and of *M. inconspicua* in the Atlantic and the Pacific sectors of the Arctic has been repeatedly discussed. In agreement with Dodge (1952, p. 51, 52) and Dunnill and Ellis (1969), the name of *M. inconspicua* Brod. and Sow., is used in this Bulletin to designate a species closely related to *M. balthica* L. from the western North American Arctic.

General distribution

According to Dunnill and Ellis (1969), *Macoma inconspicua* occurs in the "Arctic Ocean to San Diego, California." Bathurst Inlet is the most eastern known record.

Macoma loveni (Steenstrup) Jensen, 1904
(Pl. IX.2, 5, 8, 11, p. 103)

Tellina (Macoma) loveni, Jensen 1904: 111, pl. 1, fig. 5a–h
Macoma loveni, Ockelmann 1958: pl. 2, fig. 11

Distribution in the Canadian Arctic

Map 35, p. 91

Published records

Macoma loveni, Grieg (1909), Jones Sound, Canadian Archipelago

New records

Foxe Channel, Southampton Island, Cotter Island, Hudson Bay (ABS); Strathcona Sound (FWI).

Remarks

In the Canadian Arctic this species is rare and confined to shallow inland waters. Not recorded south from Hudson Strait. Specimens from Foxe Basin were identified as "*M. inflata* Stimpson = *M. loveni* Steenstrup" (USNM 108787).

A closely related species, *Macoma inflata* Stimpson MS occurs in the Northwest Atlantic (Dawson 1872, pl. 5, fig. 6; Verrill and Bush 1898, pl. 88, fig. 6), which has often been regarded as identical with *M. loveni. M. inflata*, however, is large, elongated, and less expanded than the high and short *M. loveni*. In the first species the apex is low and wide, in the second, small and tapering. Collections of USNM contain samples of *M. inflata* from Hopedale, Labrador (341376), Hebron (438925), Gulf of St. Lawrence (95638), and Gaspe (108790). The southern samples are from Massachusetts Bay.

General distribution

Greenland: Disco Bay, West Greenland; entire shore of East Greenland.

Iceland: Absent.

Eurasian Arctic seas: All seas except the White Sea.

M. loveni is a high-Arctic species occurring in the Atlantic sector of the Arctic. *M. inflata* is a subarctic-boreal species, probably endemic in the Northwest Atlantic.

Macoma moesta (Deshayes, 1854)
(Pl. IX.3, 6, 9, 12, p. 103)

Tellina moesta Deshayes, 1854: 361
Tellina (Macoma) moesta, Jensen 1905, pl. 1, fig. 4a–c
Macoma oneilli Dall, 1919: 20, pl. 2, fig. 1
Macoma moesta, Ockelmann 1958: pl. 2, fig. 13

Distribution in the Canadian Arctic

Map 34, p. 90

Published records

Macoma moesta, Grieg (1909), NW Baffin Bay; Ellis (1960), Pond Inlet, Baffin Island; Foxe Basin

Macoma oneilli Dall, 1919, Canadian Archipelago; Dall (1924), Ungava Bay

New records

Canadian Archipelago, Canadian eastern Arctic (ABS, NMC).

Remarks

Macoma moesta is common in the Canadian Arctic. It has been taken from depths of 5–70 m in the Canadian Archipelago and Foxe Basin, but in Hudson and Ungava bays it is confined to deeper, colder zones. It is probable that Ungava Bay is the southern boundary of this species. *M. moesta* is abundant in the Canadian Archipelago and Foxe Basin and rare in the southern part of the Arctic. It is confined to polar waters.

M. oneilli described by Dall (1919) from Dolphin and Union Strait is regarded as a synonym of *M. moesta* (MacGinitie 1959; Ockelmann 1958).

General distribution

Greenland: Off Godthaab, West Greenland, where it is probably a relic from a colder period. It is common off the northern shores of East Greenland and more abundant than *M. calcarea*.

Iceland: Absent.

Eurasian Arctic seas: Abundant in colder regions north of 75°N.

M. moesta is a high-Arctic, circumpolar species.

Macoma planiuscula Grant and Gale, 1931
(Pl. X.2, 5, 8, 11, p. 104)

Macoma planiuscula Grant and Gale, 1931: 372, pl. 14, fig. 11a, b; pl. 20, fig. 8a, b

Distribution in the Canadian Arctic

Map 32, p. 89

Published records

None

New records

Amundsen Gulf, Canadian Archipelago (NMC).

Remarks

This species differs from other northern *Macoma* by its off-white, smooth, lustrous periostracum, tightly adherent to the shell. Its valves are thin, porcellaneous, strong. The posterior part of the shell is attenuated, with a strong posterior flexure. A large ligament extends to the middle of the posterior upper margin of the shell and is surrounded by two distinct wrinkled ridges, terminating slightly behind the umbones. Sinuses similar to those of *M. calcarea*, one in the left valve more rounded (Plate X.8); they are in contact with the pallial line along almost their entire length. Distance between the tip of the sinus and the anterior muscle scar of the right valve is twice that of the left valve.

Hinge: Anterior cardinal tooth of the right valve is broadened and attached by a thin footing to the adjacent thickening of the hinge plate. There is a thin supporting lamella beneath and in front of it. The posterior cardinal tooth is triangular, two-lobed, with fragile footing. Anterior cardinal tooth of left valve is robust, bipartite, with thin footing. Posterior cardinal is widened with a thin lamella behind it. Tooth and lamella are attached to the thickened end of the posterior hinge plate.

Abbott (1974, p. 506), regards *M. planiuscula* as a synonym of *M. lama* Bartsch, 1929, described from the western coast of Kamchatka. E. Coan (personal communication) expressed a similar opinion.

M. lama (Bartsch 1929, pl. 2, fig. 8–14) is, however, larger, higher, more expanded and twisted than *M. planiuscula* from the Canadian Arctic (Plate X.2, 5, 8,11) and from Bristol Bay, Bering Sea (specimens kindly made available by courtesy of M. Keen, Stanford University).

Dimensions of specimens of *M. planiuscula* from the Canadian Arctic, Bristol Bay in Alaska, and of *Macoma lama*, Kamchatka, given by Bartsch (1929), were:

	l	h	w	w:l	h:l
M. planiuscula:					
Amundsen Gulf, NMC 48421	22.5	15.2	7.5	0.69	0.30
	20.7	14.5	5.3	0.70	0.26
	21.0	15.5	7.0	0.70	0.33
Bristol Bay, Bering Sea, Staff. G. Mus. 48421	23.0	17.0	8.0	0.73	0.34
M. lama:					
Kamchatka, USNM	29.5	23.2	10.0	0.78	0.35

Although the similarity of specimens is considerable and the differences may be induced by the zonal environment, it is advisable, at present, to retain the name *M. planiuscula* for the populations of this *Macoma* in the Canadian Arctic and off the coast of Alaska, until its relationship with *M. lama* can be studied.

General distribution

M. planiuscula is a Pacific subarctic species with the easternmost populations in the Gulf of Amundsen. Its southern boundary in the Pacific is Pudget Sound.

Macoma torelli (Steenstrup) Jensen, 1904
(Pl. VIII.10, 11, p. 102)

Tellina (Macoma) torelli (Steenstrup) Jensen

1904: pl. 1, fig. 3a–i
Macoma torelli, Ockelmann 1958: pl. 2, fig. 12

Distribution in the Canadian Arctic
Map 35, p. 91

Published records
Macoma torelli, Grieg (1909), Jones Sound, Canadian Archipelago

New records
Pond Inlet, Baffin Island; Canadian Archipelago and Canadian eastern Arctic (ABS). Distribution of this rare species is little known. In the Canadian Arctic it has been taken at depths of 20–200 m.

General distribution
Greenland: Northern West Greenland; entire coast of East Greenland, but rare in the south.
Iceland: Absent.
Eurasian Arctic seas: In colder regions of Kara and Barents seas and in deeper water in East Siberian and Chukchi seas.
Macoma torelli is a high-Arctic species probably with a disrupted circumpolar distribution.

ORDER MYOIDA
(= ASTHENODONTA)

Superfamily MYACEA

Family MYIDAE

Genus *Mya* Linné, 1758

The synonymy and distribution of the northern species of *Mya* were discussed by Schlesch (1931), MacGinitie (1959), MacNeil (1965), and Strauch (1972). The study of this genus in high latitudes is complicated by the postpleistocene changes in the areas of distribution of the species, and by the similarity of young specimens of different species. Young *M. truncata* and dwarfed adults in James Bay resemble young *M. pseudoarenia* Schlesch, 1931 (= *M. truncata* f. *ovata* Jensen, 1900), a species often confused with both *M. arenaria* and *M. truncata*.

Mya arenaria Linné, 1758

Mya arenaria Linné, 1758: 610; Foster 1946: 32–35, pl. 20, 21

Distribution in the Canadian Arctic
Map 36, p. 91

Published records
Mya arenaria, Packard (1867), Labrador; Bush (1883), Labrador

New records
Southern Labrador, Nain and Hopedale (coll. Steele 1952).

Remarks
There are dubious records of *Mya arenaria* from Georges Strait (western Hudson Strait) by Halkett (1898). Dall (1886), stated that this species occurs in the Ungava Bay "generally." Whiteaves (1901) recorded it from Richmond Gulf. However, Whiteaves specimens seen by the author in the collections of the NMC, are the subfossil shells of *M. pseudoarenaria*.
Despite the intensive investigations of Hudson and James bays by the Arctic Biological Station and the National Museums of Canada, neither live *M. arenaria* nor its fossil shells were found in the Canadian Arctic.
M. arenaria occurs from southern Labrador in the Northwest Atlantic to Florida.

General distribution
Eurasian Arctic seas: Abundant at Finmarken, Murman and White seas. Eastern boundary in Barents Sea off Cape Kanin Nos.
M. arenaria is a boreal species, penetrating into the Arctic with the Atlantic waters.

Mya truncata Linné, 1758
(Pl. X.3, 6, 9, 12, p. 104)

Mya truncata Linné, 1758: 670; Foster 1946: 2, 20, 17, 18; fig. 1–4.

Distribution in the Canadian Arctic
Map 36, p. 91

Published records
Mya truncata and *M. truncata uddevalensis*, Gray (1824), Canadian Archipelago; Reeve (1855), Canadian Archipelago; Sutherland (1852), NW Baffin Bay; Smith (1877), NW Baffin Bay; Stimpson (1861), Ungava Bay; Pfeffer, (1886),

Cumberland Sound; Whiteaves (1885), Hudson Strait; Whiteaves (1881), Hudson Bay; Dall (1879), Cumberland Sound; Bush (1883), Labrador; Packard (1863, 1867), Labrador; Dall (1886), Ungava Bay; Whiteaves (1901), Hudson Bay; Grieg (1909), NW Baffin Bay; Dall (1919), Pond Inlet; Baker (1919), NW Baffin Bay; Brooks (1935), N Hudson Bay; Dall (1924), W Canadian Archipelago; Richards (1936), James Bay; Richards (1941), W Hudson Bay; Ellis (1960), N Baffin Island

Mya uddevalensis Hancock, 1846, Cumberland Sound

New records

Canadian central and eastern Arctic (ABS and NMC).

Remarks

Mya truncata is a common bivalve in the Canadian Arctic. Its southern boundary is Massachusetts Bay. It occurs in the intertidal and upper sublittoral zone, but juveniles have been taken at greater depth.

The typical, elongated form of *M. truncata* is seldom found in the Canadian Arctic. Most specimens are *Mya t. uddevalensis* Forbes, 1846, a shortened form with slanted posterior end of shell. The degree of slanting of the posterior end increases with age. In the Canadian eastern Arctic *M. truncata* attains a length of 80 mm. Only dwarfed specimens occur in southern Hudson and James bays.

General distribution

Greenland and Iceland: Off shores.

Eurasian Arctic seas: In all seas.

M. truncata is a boreal-panarctic species of circumpolar distribution.

Mya pseudoarenaria Schlesch, 1931

Mya pseudoarenaria Schlesch, 1931: 136, pl. 13, fig. 10-12; MacNeil 1965: pl. 7, fig. 9-14; Strauch 1972: 131-139, 171-173, pl. 10, fig. 10; Bernard 1979a: 53, fig. 87; Bernard 1979b: 188-189, fig. 7-9

Distribution in the Canadian Arctic

Map 36, p. 91

Published records

Mya intermedia Dall, 1919, Dolphin and Union Strait

Mya pseudoarenaria, MacNeil (1965), Dolphin and Union Strait

Mya pseudoarenaria, Wacasey et al. (1976), James Bay

New records

James Bay (Johannsen 1920, NMC); southeastern Hudson Bay (ABS, 1958-59); Belcher Island and James Bay (Clarke 1963, NMC).

Remarks

Mya pseudoarenaria was recently recognized (Schlesch 1931) as a species and separated from the group of forms of *Mya truncata,* where it was placed by Jensen (1900). Relations of *M. pseudoarenaria* to *M. japonica, M. arenaria,* and *M. truncata* were discussed by MacGinitie (1959, p. 186-189), Laursen (1966, p. 390-418), Bernard (1979a, p. 53). As more data accumulate on the morphology of shells of this species and its area of distribution, it becomes more evident that *M. pseudoarenaria* cannot be regarded as a form of *M. truncata* (MacNeil 1965; Strauch 1972; Bernard 1979b; and this Bulletin).

Large shells of this species, up to 8 cm long, were collected by Clarke (1963) on the shores and in the shallow water of southeastern Hudson Bay and James Bay. Only dwarfed live specimens of *M. pseudoarenaria* were collected in James Bay, most not over 2 cm long.

There is no doubt that this species is close to extinction in its present relict area in the Canadian eastern Arctic. Schlesch (1931), MacNeil (1965), and Strauch (1972) showed that *M. pseudoarenaria* has retreated from the entire northwest Atlantic area.

Superfamily HIATELLACEA

Family HIATELLIDAE

Genus *Cyrtodaria* Daudin MS, Reuss, 1801

Cyrtodaria kurriana Dunker, 1862

(Pl. XI.1, 4, p. 105)

Cyrtodaria kurriana Dunker, 1862: 38; Ockelmann 1958: pl. 2, fig. 14; Bernard 1979a, fig. 92, 94

Distribution in the Canadian Arctic

Map 37, p. 92

Published records

Glycimeris kurriana, Dall (1879), Cumberland Sound; Dall (1919), Herschel Island, Cape Bathurst, Dolphin and Union Strait

Glycimeris siliqua, Gray 1824, Canadian Archipelago

New records

Canadian Archipelago and southern shores of Baffin Island (ABS).

Remarks

Cyrtodaria kurriana was found in two areas — Dolphin and Union Strait, western Canadian Archipelago, and off the southern shores of Baffin Island. Its boring habits complicate distribution studies. Its shells are up to 4 cm long.

At the southern shores of Labrador it is replaced by a related boreal species, *C. siliqua*, with which it has often been confused.

General distribution

Greenland: Godthaab and Disco Bay in West Greenland. Entire shore of East Greenland, rare in the south.

Iceland: Absent.

Eurasian Arctic seas: Kara Sea to Bering Sea.

C. kurriana is a high-Arctic species of a disrupted circumpolar distribution.

Genus *Hiatella* Daudin, in Bosc, 1801

Hiatella arctica (Linné, 1767)
(Pl. XI.7, p. 105)

Mya arctica Linné, 1767: 113

Saxicava arctica, G. O. Sars 1878: 95, pl. 20, fig. 8a–c

Saxicava pholadis G. O. Sars, 1878: pl. 20, fig. 7a–c

Distribution in the Canadian Arctic

Map 38, p. 92

Published records

Saxicava arctica, Gray (1824), Canadian Archipelago; Smith (1877), NW Baffin Bay; Dall (1886), Ungava Bay; Grieg (1909), NW Baffin Bay; Baker (1919), NW Baffin Bay; Brooks (1935), N Hudson Bay; Richards (1936), James Bay; Richards (1941, 1962), N Hudson Bay; Johnson (1926), Labrador, N Baffin Bay, N Hudson Bay; Laursen (1946) and Ellis (1960), N Baffin Bay

Saxicava pholadis, Hancock (1846), Cumberland Sound; Dall (1924), Canadian Archipellago

Saxicava rugosa, Sutherland (1852), NW Baffin Bay; Reeve (1855), Wellington Channel; Packard (1863), Labrador; Packard (1867), Labrador; Whiteaves (1885), Hudson Strait; Whiteaves (1901), Hudson Bay

New records

Canadian eastern Arctic (ABS).

General distribution

Hiatella arctica is one of the commonest circumpolar species and is considered a cosmopolitan. However, larvae from the northern and southern parts of its area differ morphologically (Thorson 1936, 1951; Ockelmann 1958). It is possible, therefore, that more than one species of *Hiatella*, indistinguishible in the adult stage, occur within its large area.

Subclass Anomalodesmata

ORDER PHOLADOMYOIDA
(= EUDESMODONTIDA)

Family PANDORIDAE

Genus *Pandora* Hwass, 1795

Pandora glacialis Leach, 1819
(Pl. XI.3, 6, p. 105)

Pandora glacialis Leach, 1819: app. 2, 61–62; G. O. Sars 1878: pl. 1, fig. 1a–b

Distribution in the Canadian Arctic

Map 39, p. 92

Published records

Pandora glacialis, Sutherland (1852), Barrow Strait; Johnson (1926), Labrador; Grieg (1909), Canadian Archipelago

Kennerlia glacialis, Packard (1891), Labrador; Bush (1883), Labrador; Richards (1936), James Bay; Dall (1924), Burwell

New records

Canadian Archipelago, Foxe Basin, Hudson Bay, northern Labrador (ABS, NMC).

Pandora glacialis is rare in the Canadian Arctic. It is a shallow-water species occurring at depths to 50 m. Southward it reaches St. Lawrence Bay.

General distribution

Greenland: Absent in West Greenland. Isolated populations in Scoresby Sound and in Franz Josef Fjord.

Iceland: Not recorded.

Eurasian Arctic seas: Cold regions of Barents Sea and in all Arctic seas.

P. glacialis is a high-Arctic and circumpolar species.

Family LYONSIIDAE

Genus *Lyonsia* Turton, 1822

Lyonsia arenosa (Møller, 1842)
(Pl. XI.5, p. 105)

Pandorina arenosa Møller, 1842: 20
Lyonsia arenosa, G. O. Sars 1878: pl. 34, fig. 2a, b

Distribution in the Canadian Arctic

Map 39, p. 93

Published records

Pandorina arenosa, Reeve (1855), Canadian Archipelago

Lyonsia gibbosa, Hancock (1846), Cumberland Sound

Lyonsia arenosa, Whiteaves (1885), Ungava, Burwell; Bush (1883), Labrador; Packard (1891), Labrador; Grieg (1909), Canadian Archipelago; Baker (1919), NW Baffin Bay; Johnson (1926), Labrador; Dall (1919), Dolphin and Union Strait

New records

Alert, Ellesmere Island, and eastern Canadian Arctic (NMC); Pond Inlet, Baffin Bay (Ellis 1955, 1960)

Remarks

Lyonsia arenosa occurs throughout the Canadian Arctic, and extends southward to Nova Scotia. It has often been confused with *L. hyalina* Conrad (T. Abbott 1974, p. 554), which occurs from Labrador to Massachusetts. *L. arenosa* was recorded by Dall (1924) from Burwell, North Labrador.

General distribution

Greenland: Entire shores of West and East Greenland.

Iceland: Off eastern and northern shores.

Eurasian Arctic seas: All seas.

L. arenosa is a high-Arctic, circumpolar, shallow-water species.

Family PERIPLOMATIDAE

Genus *Periploma* Schumacher, 1817

Periploma abyssorum Verrill (MS), Bush, 1893
(Pl. XI.2, p. 105)

Periploma abyssorum Bush, 1893: 227, pl. 2, fig. 12, 13
Periploma fragilis, Gorbunov 1946: 317, pl. 4, fig. 4a–d

Distribution in the Canadian Arctic

Map 40, p. 93

Published records

Periploma abyssorum, Thorson (1951), off Lancaster Sound; Ellis (1960), Arctic Bay, N Baffin Island

New records

Franklin–Darnley Bay, Amundsen Gulf (ABC); Hudson Bay (ABS); Strathcona Sound, Canadian Archipelago (FWI).

Remarks

Periploma abyssorum was regarded as a deepwater species. However, its occurrence at depths of 25–50 m in Franklin Bay, Strathcona Sound, Pond Inlet, and Hudson Bay as well as in the Eurasian Arctic indicates that *P. abyssorum* may be primarily a high-Arctic, shallow-water species.

General distribution

Greenland and Iceland: No records.

Eurasian Arctic seas: Shallow water off Vrangel Island, Chukchi Sea (Soot-Ryen 1932).

Gorbunov (1941, 1946) questioned the identity of *P. abyssorum* in Chukchi Sea and identified it as *P. fragilis* Totten, 1835, a Boreal Northwest Atlantic species (Abbott 1974, p. 560, fig. 630). This last name was accepted in the Russian literature and *P. abyssorum* regarded as a synomym of *P. fragilis*; it is recorded under this name from the Kara to the Bering Sea.

The difference in the shape of the left and right valves in adults of both species mentioned by

Gorbunov (1946) is a feature peculiar to all Periplomatidae and not sufficient to regard these two species as synonymous. The figure in Filatova (1948, plate 113) is that of *P. abyssorum* Verrill and Bush, not of *P. fragilis* Totten.

P. abyssorum is a panarctic species with a broad depth range.

Periploma fragilis (Totten, 1835)

Anatina fragilis Totten, 1835: 347
Periploma fragilis, Verrill 1873: 673; Abbott 1974: 560

Distribution in the Canadian Arctic
Map 40, p. 93

Published records
Periploma fragilis, Johnson (1926), Labrador

New records
None.

General distribution

Periploma fragilis occurs from Labrador to New Jersey, and is endemic to the western North Atlantic. Records of the species in the Eurasian Arctic seas are doubtful. The specimen of "*P. fragilis*" depicted by Filatova (1948, pl. CXIII, fig. 5), is *P. abyssorum* Verrill. *P. fragilis* should be regarded as a boreal species with outposts in the subarctic.

Family THRACIIDAE

Genus *Thracia* Blainville, 1824

Subgenus *Thracia* s. str. Soot-Ryen, 1941

Thracia devexa G. O. Sars, 1878
(Pl. XI.8, p. 105)

Thracia devexa G. O. Sars, 1878: pl. 6, fig. 11
Thracia (Thracia) devexa, Soot-Ryen 1941: pl. 2, fig. 5–10; pl. 6, fig. 4; Bernard 1979a: 61, fig. 105

Distribution in the Canadian Arctic
Map 40, p. 93

Published records
None

New records

Canadian Archipelago, Ellef Ringnes Island, Prince Patrick Island (NMC); Ellesmere Island, Banks Island, Franklin Bay (ABS); SE Hudson Bay (NMC).

These are the first records of this rare species in the Canadian Arctic. It has been found at depths of 10–250 m. Dimensions of an adult specimen are 30.5 x 22.0 x 13.8 mm.

General distribution

West Greenland: Absent.

East Greenland: Franz Josef Fjord, Scoresby Sound, and Lindenows Fjord.

Iceland: Absent.

East Atlantic: Norway, Spitzbergen, Novaya Zemlia.

Thracia devexa has often been confused with related species and, therefore, its area of distribution is not well known.

T. devexa is a high-Arctic Atlantic species.

Thracia (Thracia) myopsis (Beck) Møller, 1842
(Pl. XI.11, p. 105)

Thracia myopsis Møller, 1842: 94
Thracia (Thracia) myopsis, Soot-Ryen 1941: pl. 6, fig. 3

Distribution in the Canadian Arctic
Map 41, p. 94

Published records

Thracia myopsis Packard, 1867, Labrador; Bush (1883), Labrador; Ellis (1960), Eclipse Sound, N Baffin Island

New records

Canadian Archipelago: Strathcona Sound (FWI), Ellesmere Island (NMC); Frobisher Bay, S Hudson Bay (ABS).

Thracia myopsis has been recorded from Labrador to Massachusetts. New records extend its area of distribution into the Canadian Arctic where it occurs at depths to 50 m.

General distribution

Greenland: Western shores from Umanak southward; Scoresby Sound and Angmagssalik in

East Greenland.

Eurasian Arctic seas: In all seas.

T. myopsis is a panarctic, shallow-water species, possibly circumpolar.

Subgenus *Crassithracia* Soot-Ryen, 1941

Thracia septentrionalis Jeffreys, 1872

Thracia septentrionalis Jeffreys, 1872: 238
Thracia (Crassithracia) septentrionalis, Soot-Ryen 1941: 19–22, pl. 1, fig. 9, 10

Distribution in the Canadian Arctic

Map 41, p. 94

Published records

Thracia septentrionalis, Grieg (1909), Canadian Archipelago; Ellis (1960), N Baffin Island

New records

Strathcona Sound, Canadian Archipelago (FWI); Hudson Bay (ABS).

Thracia septentrionalis is rare in the Canadian Arctic. It has been found in Smith Sound, Strathcona Sound, Pond Inlet, and at the mouth of Hudson Bay. It is a shallow-water species and occurs at depths to 100 m. Southward it reaches New England.

General distribution

Greenland and Iceland: Off shores.

Eurasian Arctic seas: Filatova (1957a), recorded *T. septentrionalis* from the Barents, White, and Kara seas. However, Ockelmann (1958) stated that this species does not occur in the Eurasian seas.

T. septentrionalis is a panarctic, probably West Atlantic, species with outposts in the Boreal zone. Its area of distribution is not well known.

ORDER SEPTIBRANCHIDA

Family CUSPIDARIIDAE

Genus *Cuspidaria* Nardo, 1840

Cuspidaria arctica (M. Sars, 1865)
(Pl. XI.10, p. 105)

Naera arctica M. Sars, 1865 in G. O. Sars 1878: pl. 6, fig. 5a–c
Cuspidaria arctica, Ockelmann 1958: pl. 3, fig. 7, 8

Distribution in the Canadian Arctic

Map 42, p. 94

Published records

None

New records

Canadian Archipelago, Ellesmere Island (ABS); Ellef Ringnes Island and Coronation Gulf (NMC).

A few specimens of this species were collected in the Canadian Archipelago at depths of 10–135 m. Dimensions of the largest specimen were 18.0 x 11.9 x 9.4 mm.

General distribution

Greenland: Rare off West and East Greenland; in shallow water and to a depth of 700 m.

Eurasian Arctic seas: From Barents Sea eastward to the East Siberian Sea.

Cuspidaria arctica is a high-Arctic, Atlantic species.

Cuspidaria glacialis (G. O. Sars, 1878)

Naera glacialis G. O. Sars, 1878: pl. 6, fig. 8a, b
Cuspidaria glacialis, Ockelmann 1958: pl. 3, fig. 10; Bernard 1979a: 62, fig. 107

Distribution in the Canadian Arctic

Map 42, p. 94

Published records

Cuspidaria glacialis, Thorson (1951) E Lancaster Sound, depth 680 m; reported as *C. obesa* (Loven) by Thorson (1951) (fide Ockelmann 1958)

New records

None.

This species was found in deep water off the eastern Canadian Archipelago.

General distribution

Greenland: Rare off West Greenland, common off East Greenland.

Iceland: In deep water.

Eurasian Arctic seas: From Barents Sea to West Siberian Sea. Bernard (1979a) reported this species in Beaufort Sea.

Cuspidaria glacialis is a deepwater, pan-arctic, possibly an Atlantic species.

Cuspidaria subtorta (G. O. Sars, 1878)
(Pl. XI.9, 12, p. 105)

Naera subtorta G. O. Sars, 1878: pl. 6, fig. 6a–c

Cuspidaria subtorta, Ockelmann 1958: pl. 3, fig. 9

Distribution in the Canadian Arctic

Map 42, p. 94

Published records

Naera subtorta, Jeffreys (1877), Hall Basin, 82°N

New records

Canadian Archipelago (NMC 1952, 1954); Hudson Bay (ABS); Strathcona Sound (FWI).

Remarks

Cuspidaria subtorta was found in the Canadian Arctic at a depth of 10–150 m.

Dimensions of Canadian specimens from Prince Patrick Island were 8.0 x 5.3 x 3.8 mm and from Ellef Ringnes Island 10.0 x 6.5 x 5.5 mm.

In the southern Hudson Bay this high-Arctic species is probably a relict.

General distribution

Greenland: Probably extinct in West Greenland. Northern shores of East Greenland.

Iceland: Northern shores.

Eurasian Arctic seas: From Barents Sea to Laptev Sea. Bernard (1979a) reported this species in Beaufort Sea.

C. subtorta is a high-Arctic species probably of the Atlantic sector of the Arctic. Absent in the Pacific.

ZOOGEOGRAPHY OF MARINE BIVALVE FAUNA IN THE CENTRAL AND EASTERN CANADIAN ARCTIC

Patterns and Origins of Distribution

The composition of the Canadian Arctic fauna is determined by the position of the region in high latitudes, by the proximity to the Arctic, Atlantic, and Pacific oceans and contacts with their faunas. Distribution of faunistic elements was greatly influenced by the last phases of the Wisconsin glaciation and by the recent physiography of the shield and of the marine shallow-water region. The relic and recent physiography and distributions are tightly interwoven and are difficult to analyze separately.

Data on recent distribution of the 64 species of bivalves known to occur in the Canadian Arctic (Maps 1–42) are compiled in Fig. 5, which lists marine regions in geographic succession from the Arctic Ocean to the Atlantic. In this direction, the marine waters form a continuous system of channels, embayments, etc., with a constant flow of water from the Arctic Ocean to the Labrador Sea. Hudson Bay, though semi-isolated, is bound in its circulation to the general flow over the continent and is placed in the list between Foxe Channel and Hudson Strait.

Species are listed in order of geographic position of their areas in the Canadian region, starting from the western Canadian Archipelago. Areas are indicated by a line crossing the column, or part of it, showing the western (left), central, or eastern (right) part of the water body belonging to the area. Maps referred to in the first column are located at the back of the book. Maps for species occuring only at the southernmost part of the Labrador shelf are not included.

Boundaries of Canadian species in the Northwest Atlantic are indicated as far as Cape Cod, the southern limit for most northern bivalves. Southern ranges of some Acadian and Virginian species extending north to the Labrador Shelf are indicated also as far as Cape Cod.

The following species are not listed in the Table: *Pseudamusium ringnesia* Dall, described on a basis of a single valve from the western Canadian Archipelago and not found since; *Thyasira equalis* Verrill and Bush, sensu Ockelmann (1958), found in the southeastern Canadian Archipelago and in Strathcona Sound and now under investigation by Ockelmann. According to his personal communication, the northern populations of this mollusc may belong to a different species. A record of *Montacuta substriata*, a Norwegian species in the Canadian waters, requires verification.

Figure 5 shows the presence of two groups of species, Arctic bivalves with the main areas in the north; and subarctic bivalves with more southerly distribution.

The Arctic bivalves occur over the entire region, though some may be confined to deeper waters in the south. Their southern ranges differ; some were found only north of Hudson Strait, others occur also on the Labrador Shelf, and some extend their outposts to Cape Cod.

The subarctic bivalves occur mainly in the Canadian eastern Arctic and on the Labrador Shelf. Their southern ranges extend mainly to Cape Cod, but northern ranges vary. Most species occur south of Hudson Strait (Maps 12, 19, 32, 37), but a few also occur in small isolated areas in the southeast and southwest of the Canadian Archipelago, probably as relicts (Maps 2, 12, 19, 23, 24, 37, and 41).

The general pattern of the fauna is that of gradual latitudinal changes, resulting in a maximum difference between faunas of the central and the eastern Canadian Arctic, and between those northward and southward from the Labrador Shelf.

Other peculiarities of the fauna are the low participation of deepwater elements, presence of relict areas of the Arctic and subarctic species, and the presence of Canadian, Canadian-Greenlandic, Pacific, and Atlantic endemics. There is also a noticeable difference in the biological features of fauna in the north and south of this region, depending mainly on the participation of species with different modes of feeding and dispersion.

Distribution of Bivalves and Late-Wisconsin Events

The last glaciation in the Canadian Arctic was a period of catastrophic changes in the bivalve fauna caused by the advances and retreats of the Laurentian glacier. The faunistic shifts were extensive. Evidence of former migrations of bivalves can be found in the recent patterns of distribution of faunistic elements. These migrations can be divided into retreats before the advancing glacier and subsequent returns in the course of later marine transgressions, the centrifugal and the centripetal glacial migrations, to use Bartenev's (1933a, b) terms.

The glacial events in the Canadian Arctic were discussed in papers by Andrews (1969–1978), and Blake (1970–1975), also Andrews and Ives (1972), Andrews and Pelletier (1976), Bloom (1971), Bryson et al. (1969), Craig (1965, 1968), Falconer et al. (1965), Hughes et al. (1977), Løken (1962), Pelletier (1964), Wagner (1970), and many others. Boundaries of the glaciation and the patterns of ice retreat are schematically presented by Prest (1969, 1970), Prest et al. (1974).

The marine fauna was greatly affected by fluctuations in the ice margins and the position of the periglacial marine zone of waters of low temperature and salinity. However, this created a favorable environment for the northern bivalves, as indicated by their growth rates and weight of their shells (Carey and Nasseruddin 1961; Jensen 1905; and others).

On the basis of the map of ice retreat, given by Prest (1970, fig. XII-15) the following provisional scheme of late-glacial bivalve migrations can be proposed.

During the last Wisconsin glaciation that occupied enormous surfaces of land and sea (Hughes et al. 1977), the marine fauna of the Canadian Arctic was either destroyed by the glacier, or moved away from it and survived in the periglacial marine zone. The Arctic populations were separated for a long time from those in the Northwest Atlantic, which were moved to the shores of Virginia and later replaced by the returning southern fauna (Clark 1906).

During the first stages of retreat the glacier disintegrated at the margins. Northern bivalves followed the glacier settling over the submerged continent and in the temporary water bodies, e.g. the Champlain Sea (Clark 1906; Elson 1969a, b; Gadd 1971; Wagner 1970). The periglacial marine zone with its bivalves moved into the Canadian Arctic about 14,000–12,000 B.P.

The finding of shells of marine bivalves at the end moraines and in the highest beaches indicates that the immigration took place at the earliest stages of transgressions. The following bivalves were already living at that time in the Canadian Arctic: *Portlandia arctica, Mya truncata, M.*

Map no.	Name of species	Canadian Arctic waters					NW Atlantic Ocean	
		Archi-pelago	Foxe Basin	Hudson Bay	Hudson Strait	Labra-dor	Nfld.-N.S.	Cape Cod, Mass.
11	*Bathyarca frielei* (Friele)							
32	*Macoma inconspicua* (Brod. and Sow.)							
32	*M. planiusculd* Grant and Gale							
8	*Yoldiella tamara* (Gorbunov)							
2	*Y. fraterna* Verrill and Bush							
7	*Y. frigida* (Torell)							
42	*Cuspidaria arctica* (M. Sars)							
42	*C. glacialis* (G. O. Sars)							
6	*Portlandia sulcifera* (Reeve)							
29	*Thyasira dunbari* Lubinsky							
21	*Astarte arctica* (Gray)							
24	*A. soror* Dall							
13	*Lima subauriculoto* (Montagu)							
28	*Montacuta substriata* (Montagu)							
36	*Mya pseudoarenaria* Schlesch							
42	*Cuspidaria subtorta* (G. O. Sars)							
8	*Yoldiella intermedia* (M. Sars)							
7	*Y. lenticula* (Møller)							
11	*Bathyarca glacialis* (Gray)							
23	*Astarte crenata* (Gray)							
40	*Thracia devexa* G. O. Sars							
15	*Dacridium vitreum* (Møller)							
10	*Portlandia arctica siliquo* (Reeve)							
3	*Nuculana pernula costigera* (Leche)							
34	*Macoma moesta* (Deshayes)							
35	*M. loveni* (Steenstrup)							
35	*M. torelli* (Steenstrup)							
37	*Cyrtodaria kurriana* Dunker							
1	*Nucula belloti* Adams							
9	*Portlandia arctica* (Gray) s. lato							
20	*Delectopecten greenlandicus* (Sowerby)							
26	*Astarte warhami* Hancock							
37	*Pandora glacialis* Leach							
3	*Nuculana pernula* (Müller) s. lato							
4	*N. minuta* (Fabricius)							
16	*Musculus corrugatus* (Stimpson)							
17	*M. discors* (Linné)							
18	*M. niger* (Gray)							
30	*Clinocardium ciliatum* (Fabricius)							
31	*Serripes groenlandicus* (Bruguière)							

FIG. 5. Distribution of marine bivalves in the Canadian central and eastern Arctic and in the Northwest Atlantic.

Map no.	Name of species	Canadian Arctic waters: Archi-pelago	Foxe Basin	Hudson Bay	Hudson Strait	Labra-dor	NW Atlantic Ocean: Nfld.-N.S.	Cape Cod, Mass.
22	*Astarte borealis* (Schumacher)							
33	*Macoma calcarea* (Gmelin)							
36	*Mya truncata* Linné							
38	*Hiatella arctica* (Linné)							
39	*Lyonsia arenosa* (Møller)							
28	*Axinopsida orbiculata* (G. O. Sars)							
29	*Thyasira gouldi* (Philippi)							
5	*Yoldia hyperborea* (Loven) Torell							
25	*Astarte striata* (Leach)							
14	*Crenella faba* (Müller)							
3	*Nuculana pernula buccata* (Steenstrup)							
12	*Mytilus edulis* Linné							
13	*Crenella decussata* (Montagu)							
23	*Astarte crebricostata* (McAndr. and Forbes)							
41	*Thracia septentrionalis* Jeffreys							
41	*T. myopsis* (Beck) Møller							
40	*Periploma abyssorum* Verrill							
19	*Chlamys islandica* (Müller)							
32	*Macoma balthica* (Linné)							
27	*Cyclocardia borealis* (Conrad)							
2	*Nucula delphinodonta* Mighels and Adams							
24	*Astarte elliptica* (Brown)							
21	*Astarte montagui* Dillwyn							
6	*Yoldia myalis* (Couthouy)							
27	*Turtonia minuta* (Fabricius)							
36	*Mya arenaria* Linné							
27	*Liocyma fluctuosa* (Gould)							
40	*Periploma fragilis* (Totten)							
	Crenella glandula (Totten)							
	Crenella pectinula (Gould)							
	Cyrtodaria siliqua (Spengl.)							
	Modiolus modiolus (Linné)							
	Placopecten magellanicus (Gmelin)							
	Yoldia sapotilla (Gould)							
	Cardium elegantulum (Beck) Møller							
	Anomia squamula Linné							
	Thracia conradi Couthouy							
	Ensis directus (Conrad)							

Horizontal lines indicate extension of areas over the western, middle, or eastern portion of the water bodies.

pseudoarenaria, Hiatella arctica, Macoma calcarea, M. moesta, Astarte borealis, A. warhami, A. striata, Serripes groenlandicus, Cardium ciliatum, and *Bathyarca glacialis*, all abundant and common in the recent fauna (Andrews 1970, 1972; Blake 1970, 1972, 1973; Craig 1960; Pelletier et al. 1968; Wagner 1967, 1968).

The period of the Cochrane readvance was followed by the rapid division and disintegration of the central block of ice with a portion remaining for a longer period over the District of Keewatin and Foxe Basin. The Innuitian glacier stayed a longer time over Ellesmere Island (Andrews and Ives 1972; Blake 1973; Falconer et al. 1965; Ives 1964).

During the maximum transgression at about 9500–8000 B.P., when the Tyrell Sea and Foxe Basin were formed and the Canadian Archipelago was free from ice, marine connections over the shield were broader and deeper, facilitating expansion of the fauna and the establishment of the primary postglacial patterns of distribution. The Tyrell Sea receded in the marine retreat at about 9000-7000 B.P., leaving behind its shallow remnant — Hudson Bay.

The marine retreat restricted the areas of distribution of the entire bivalve fauna, specially the deepwater elements. The deepwater regions were separated first by the ice block over Foxe Basin and later by the shallow plateau of this basin. Some marine connections were interrupted and the first relict areas formed. The southern species, *Mytilus edulis, Chlamys islandica*, and *Macoma balthica* extended their northern ranges during the Hypsithermal period but subsequently retreated, leaving behind their relict populations (Andrews 1974; Blake 1972, 1973; Richards 1962; Andrews and Drapier 1967; Dyck and Fyles 1963, 1964; Dyck et al. 1965; Dyck et al. 1966; Lowden and Blake 1968, 1970; Lowden et al. 1967). The slow retreat of marine waters still continues. The bivalves retreat from the increasingly shallow and stagnant marine water bodies is evidenced by the pauperization of the fauna of James Bay.

The migration periods of bivalves can be dated approximately by the chronologically better-known episodes of the glacial retreat and of marine transgressions, e.g. the first stages of marine transgressions at the outer ice margins over the Canadian Arctic, 13,000–12,000 B.P.; opening of the Canadian Archipelago, 10,000–9,000 B.P; formation of Cockburn moraines at 9000–8000 B.P. and the rapid ice disintegration afterwards; formation of the Tyrell Sea, 9000 B.P; Hudson Bay, 7000 B.P; and Foxe Basin 6000 B.P. and later.

It is assumed that the immigration of bivalve fauna proceeded from the borders of the monolith glacier, and after its breakup, through the passages allowed by the ice. At this period, many species rejoined their areas disrupted by the Laurentian glacier, but some areas remain disrupted. The relict areas of deepwater species and of the shallow-water Arctic and subarctic species were formed at a later period of retreat. Recent marine bivalve fauna of the Canadian Arctic can be regarded as a postglacial relict of a temporary geological existence.

Distribution of Bivalves and the Marine Waters of the Canadian Arctic

Marine waters of the Canadian central and eastern Arctic are of polar origin. However, there is an intrusion of mixed waters of the subarctic type in the southern part of the Canadian eastern Arctic and in isolated areas of the southwestern and southeastern Canadian Archipelago (Dunbar 1968, fig. 10). Though the admixture of Atlantic waters is low, it produces considerable changes in the distribution of different faunistic groups of bivalves. Figures 5 and 6 show that the areas of faunistic shifts correspond to changes in the types of marine waters.

The relations between the faunistic areas and of the Arctic and subarctic marine waters was complicated by the postglacial events, causing continuous shifts in the fauna. Besides other factors, the depth reduction resulted in a shift in the vertical zonation, e.g. the admixture of littoral elements to those of the sublittoral zone, and general changes in the areas of distribution.

It may be misleading to consider some recent distributions as indicative of species' affinities to marine waters. *Liocyma fluctuosa* occurs in the southernmost part of the Canadian eastern Arctic and western Canadian Archipelago, thus in the realm of subarctic waters (Dunbar 1968). Yet it occurs off the entire Eurasian shelf, even in the coldest regions. Therefore, in high latitudes the nature of a species can be identified only on the basis of its entire area of distribution.

Using the data on circumpolar distribution of Canadian Arctic bivalves (Filatova 1948, 1957a; Ockelmann 1958; MacGinitie 1959; G. O. Sars 1878; Bernard 1979a; and others) it is possible to subdivide the bivalves of the Canadian region into the following three groups of species:

1) Bivalves in waters of polar origin (map numbers in parentheses): *Nucula belloti* (1),

Nuculana pernula costigera (3 in part), *Portlandia arctica arctica* (9), *P. a. portlandica* (9 in part), *P. sulcifera* (6), *P. a. siliqua* (10), *Yoldiella fraterna* (2), *Y. frigida* (7), *Y. intermedia* (8), *Y. lenticula* (7), *Y. tamara* (8), *Dacridium vitreum* (15), *Bathyarca frielei* (11), *B. glacialis* (11), *Delectopecten greenlandicus* (20), *Thyasira gouldi* (29), *T. dunbari* (29), *Astarte arctica* (21), *A. crenata* (23), *A. warhami* (26), *Macoma loveni* (35), *M. moesta* (34), *M. torelli* (35), *Thracia devexa* (40), *Cyrtodaria kurriana* (37), *Cuspidaria arctica* (42), *C. glacialis* (42), *C. subtorta* (42), *Periploma abyssorum* (40).

2) Bivalves in polar and mixed waters: *Nucula tenuis* s. lato (1), *Nuculana pernula* s. lato (3), *N. minuta* (4), *Musculus discors* (17), *M. corrugatus* (16), *M. niger* (18), *Astarte borealis* (22), *Axinopsida orbiculata* (28), *Clinocardium ciliatum* (30), *Serripes groenlandicus* (31), *Macoma calcarea* (33), *Mya truncata* (36), *Hiatella arctica* (38), *Lyonsia arenosa* (39), *Pandora glacialis* (37).

3) Bivalves in mixed waters: *Nucula delphinodonta* (2), *Nuculana pernula buccata* (3 in part), *Yoldia hyperborea hyperborea* (5), *Yoldia myalis* (6), *Mytilus edulis* (12), *Crenella decussata* (13), *Crenalla faba* (14), *Chlamys islandica* (19), *Astarte elliptica* (27), *A. striata* (25), *Cyclocardia borealis* (27), *Montacuta substriata* (28), *Turtonia minuta* (27), *Macoma balthica* (32), *Thracia septentrionalis* (41), *T. myopsis* (41), *Lima subauriculata* (13).

Discussion

1) Arctic bivalve molluscs in polar waters — Distribution of this group is bound to the marine waters of lowest temperature and salinity, with low seasonal fluctuations (Bailey 1957; Coachman and Aagard 1974; Dunbar 1951, 1958, 1968; and others).

This is a well-defined and dominant group comprising 70% of 64 species in the Canadian fauna, most with abundant populations. They occur over the entire Canadian Arctic region. They dominate in the cold-water layers in Hudson, James, and Ungava bays (Dunbar 1958, sections I–XVII; Grainger 1960, fig. 3, 6–12; Wagner 1968).

Southward from Hudson Strait the surface waters become more affected by insolation; changes in temperature affect the vertical distribution, especially of stenothermal cold-water species that submerge to a depth of a more stable environment. The warmed-up zone becomes favorable for the invasion by some southern species.

2) Arctic–boreal bivalve molluscs in polar and mixed waters — The southern boundaries of most polar shallow-water species in the Canadian Arctic are in the northern epicontinental marine waters, but some species produce outposts within the southward extensions of polar currents and enter the Acadian region. These species, designated as arctic–boreal, have a broader tolerance to higher temperature and salinity, acquired probably in the course of their glacial migrations (Valentine 1973). Within their extensive areas, the arctic–boreal species often produce subspecies or develop clines from one marine zone to another. There are also pairs of closely related species, each of the pair bound to either the Arctic or the boreal waters. They may have originated quite recently from a common Pleistocene stock. *Nucula belloti* - *N. tenuis; Thyasira gouldi* - *T. flexuosa; Crenella faba* - *C. pectinula; Periploma abyssorum* - *P. fragilis*, and others are examples of such pairs.

3) Subarctic bivalve molluscs in mixed waters — Subarctic molluscs comprise about 30% of bivalve species in the Canadian Arctic region. The main area of this group is in the mixed waters of the Labrador and Newfoundland shelf (Bailey and Hachey 1949; Dunbar 1968, fig. 10). These molluscs are southern immigrants with varying northern ranges. They produce outposts in the warmed-up littoral of the polar water zone, e.g. in Hudson Bay, Hudson Strait, and Ungava Bay, and occur in the littoral and sublittoral of the entire area of mixed waters.

Northern ranges of these species in the Canadian Arctic are shown in the distribution maps at the back of this Bulletin. In Ungava Bay were found *Crenella decussata* (Map 13), and *Nuculana pernula buccata* (Map 3); in Hudson Strait, *Yoldia myalis* (Map 6) and *Cyclocardia borealis* (Map 27); in Hudson Bay, *Mytilus edulis* (Map 12), *Chlamys islandica* (Map 19), and *Macoma balthica* (Map 32); in Foxe Basin isolated populations of *Astarte striata* (Map 25), *Crenella faba* (Map 14), and *Yoldia hyperborea* (Map 5). Isolated populations of these species were also found where subarctic waters penetrate into the southeastern and the western Canadian Archipelago.

Mollusc Distribution and Marine Faunistic Zonation in the Canadian Arctic

Participation in the fauna of the Arctic and subarctic bivalves changes in latitudinal direction. The percentual relation of these groups in different water bodies of the Canadian Arctic is shown in Fig. 6. The Arctic-boreal group of species is omitted, because it remains almost unchanged throughout the entire region.

In the north the Arctic group dominates the subarctic (Fig. 6). In Hudson Strait some Arctic species submerge from shallow waters into greater and colder depths. The polar fauna, though pauperized, extends its southern outposts with the cold currents into the boreal region of Acadia.

The number of subarctic species increases gradually southward exceeding that of the Arctic species in the shallow waters of eastern Hudson Strait. The subarctic species attain their maximum number at southern Labrador, then decline rapidly toward the region of the boreal fauna. Thus, Hudson Strait is an important boundary between the zones of polar and mixed faunas, the regions without and with the vertical faunistic zonation.

There are two areas of major changes in the composition of the fauna, both bound to changes in the marine waters: the first in the region of increased Atlantic influence in eastern Hudson Strait, and the second at Belle Island where northern waters are affected by the influx of waters from the Gulf of St. Lawrence and from the Atlantic Ocean. The faunistic boundary is not sharp and the peculiarities of the faunistic regions

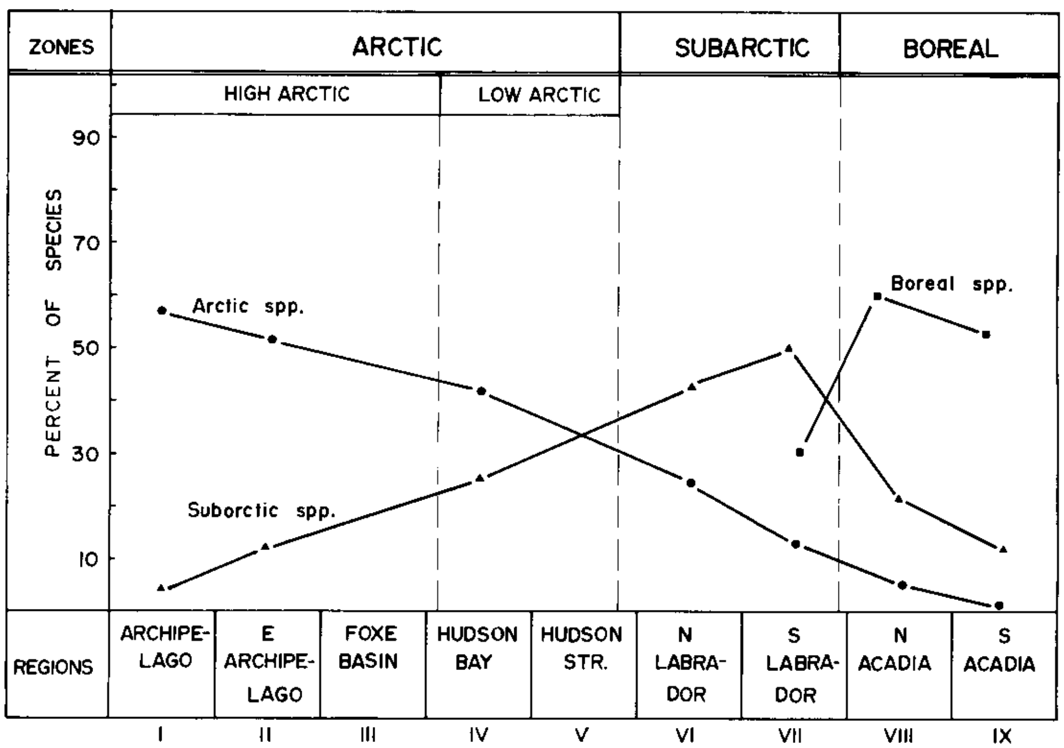


FIG. 6. Percentual relationship of the Arctic and subarctic groups of bivalve molluscs and position of marine zoogeographic zones in the Canadian Arctic and Northwest Atlantic.

become more expressed with increasing distance from the contact zone.

The increase in species diversity observed in the Canadian Arctic from the Arctic to Subarctic zone originates in the warmed-up littoral of the Arctic with the immigration of southern littoral species. The first signs of the vertical faunistic zonation appear. The main faunistic transition occurs in the sublittoral of the Subarctic zone.

Cumulative data on species distribution in the Canadian Arctic (Fig. 5, 6) indicate groups of species connected and not connected to the areas of recent extension of marine waters of different types. The complexes of species bound in distribution to the polar and subarctic waters form the faunistic Arctic and Subarctic zones. Other types of distribution are mostly relic.

Arctic Faunistic Zone

The Arctic fauna within the extension of the polar and the cold-water layers of the Arctic waters is divided into two subzones.

High-Arctic Faunistic Subzone

It is the distribution area of the Arctic species and the northern subspecies of the panarctic group. Regional Arctic endemics are present. There are scarce populations of subarctic species in the sublittoral in some areas open to the influence of subarctic waters of the neighboring oceans, e.g. southern Beaufort Sea and Baffin Bay; no vertical zonation in distribution of bivalves; domination of deposition feeders and mud engulfers with lecithotrophic larvae; low seasonal dependence in breeding.

Low-Arctic Faunistic Subzone

It is the area of polar waters with the littoral zone sufficiently warmed up seasonally to allow the survival of littoral subarctic species. The Arctic species dominate, but are restricted to the depths of more stable polar environment. The fauna is basically Arctic with some admixture of southern immigrants in suitable environment; growth rates of many panarctic species increase; many immigrants form clines; vertical zonation becomes gradually established; longer and more complicated food chains develop; differences in food habits and seasonal dependence in breeding increase.

Subarctic Faunistic Zone

This is an area of mixed waters with a mixed fauna. Arctic and subarctic species are in different proportions; the number of subarctic species increases; they appear both in the littoral and the sublittoral. Arctic species are restricted to cold-water areas. Subarctic subspecies and clines become important. Panarctic species increase in abundance and grow faster. Northern members of the pairs of species, subarctic and boreal, appear. Food habits and modes of dispersion become more diverse and complicated. This zone is not divided into subzones.

Northern boundaries of the Subarctic Faunistic Zone in the Canadian Arctic correspond in general to the area of marine subarctic waters indicated by Dunbar (1968, fig. 10). However, there are areas where subarctic species occur within the boundaries of polar waters (Fig. 7), e.g. in the southwestern and southeastern Canadian Archipelago and in Hudson Strait and Bay.

Presence of southern faunistic elements in the realm of polar fauna is in many instances a result of proximity of subarctic waters. There is an admixture of Baffin Bay waters in the Canadian eastern Archipelago and of Atlantic waters in the Canadian eastern Arctic (Bailey 1957; Barber and Huyer 1971; Collin 1960, 1962; Dunbar 1951, 1958). Amelioration of the littoral zone in the southern part of the Canadian eastern Arctic is caused by increased insolation.

Distributions Not Connected to Recent Extension of Marine Waters: Relict Areas

Patterns of distribution deviating from the usual relation between the faunas and types of marine waters are the relict distributions indicative of past environments. Some areas were disrupted by the entire glacier, some smaller areas became isolated later, during the retreat of marine waters from the shield.

Populations of bivalves in the Arctic and Atlantic regions were separated for a long time by the Wisconsin glacier. Many Arctic species rejoined their disrupted areas during the maximum marine transgression. Others remained in separated areas, and have evolved into closely related, but still differing, populations. The cause of this continuous isolation was not the marine environment, as can be seen from the difference in distribution of some Arctic species in the Nearctic and the Palearctic, e.g. *Liocyma fluctuosa* and *Yoldia myalis*. According to Nesis (1963a) these distant relict areas are the remnants of Pacific populations of previously widely distributed species, disrupted by glaciation.

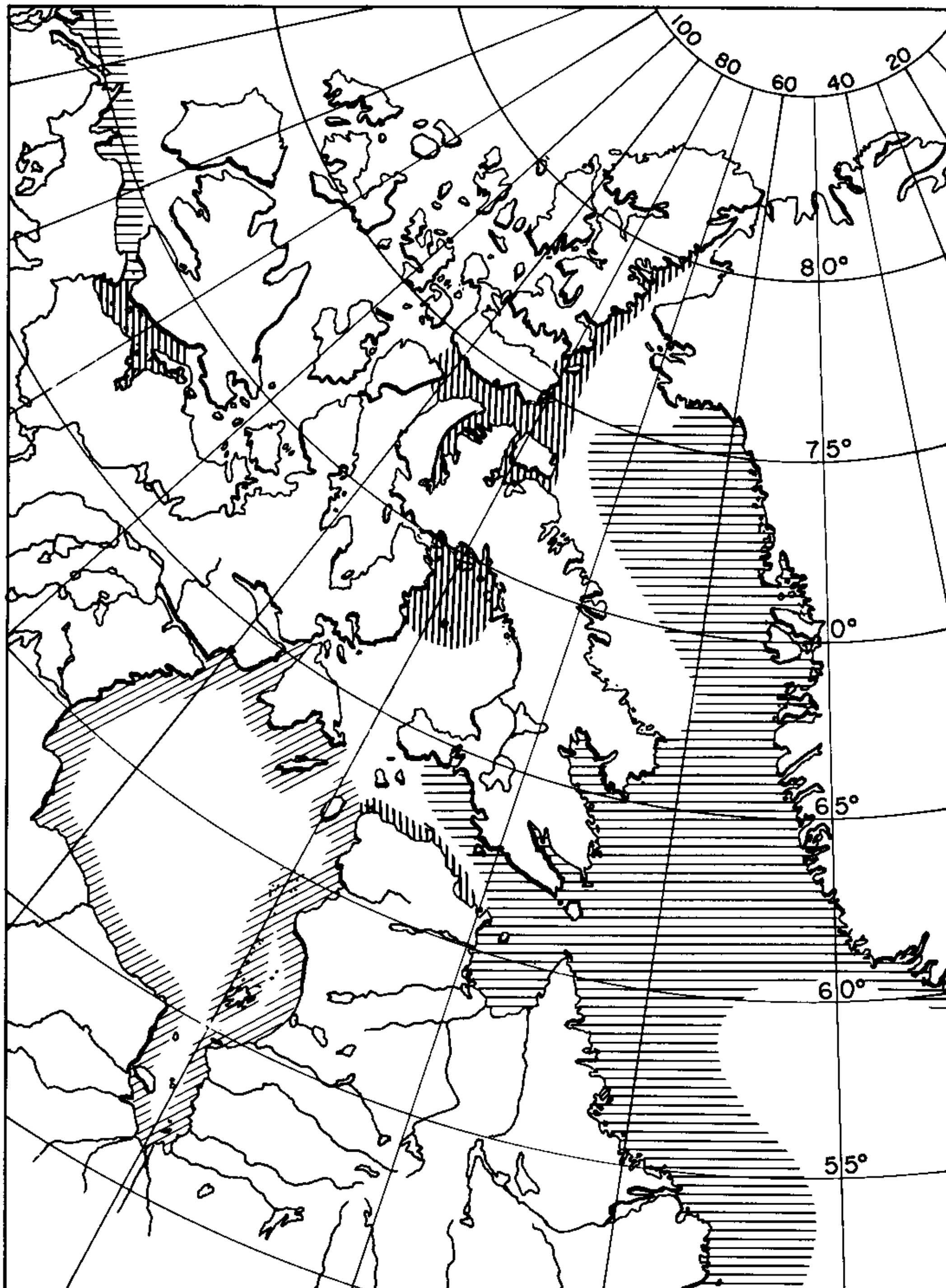


FIG. 7. Distribution of subarctic bivalves in the Canadian Arctic. [horizontal hatching] In subarctic waters; [diagonal hatching] in littoral of polar waters; [vertical hatching] in sublittoral of polar waters.

The epicontinental relict areas of the polar and subarctic species originated at different periods of the marine retreat, most recently probably after the Hypsithermal period. Hudson Bay itself is a relict of the Tyrell Sea. A relict area of pauperized deepwater fauna exists in the trench along the eastern shore of this bay. *Yoldiella intermedia, Periploma abyssorum, Cuspidaria subtorta*, and the oceanic *Crenella decussata, Astarte crebricostata*, and *Nucula delphinodonta* were found here. These species are absent in this bay outside the trench.

A relict area of subarctic species was found in the polar fauna of Foxe Basin. These populations probably became entrapped after the period of broad connections of the basin with southeastern waters.

Areas of Endemic Species

Canadian Endemics

The Canadian *Portlandia sulcifera* and the Canadian–Greenlandic *Thyasira dunbari* occur in a well-defined and isolated area of the Queen Elizabeth Islands. *Astarte soror* is probably a Baffin Bay endemic.

North Atlantic Endemics

Crenella faba, Nucula delphinodonta, Cyclocardia borealis, Cuspidaria arctica, and *C. glacialis* occur sporadically in the Canadian Arctic and are almost extinct here.

Pacific Endemics

Macoma inconspicua and *M. planiuscula* are confined to the western Canadian Archipelago.

Areas of the Arctic species were more stable than those of the subarctic. In the Hypsithermal period the planctotrophic subarctic species extended far north into Baffin Bay (Andrews 1972; Blake 1973, 1975). In 6000–3000 B.P. they occurred over Baffin Island shelf, but never entered Foxe Basin. Their planctonic larvae were probably prevented from entering the basin by the massive polar current moving through Foxe Channel.

Zoogeographic Subdivisions of Canadian Arctic Fauna

The main zoogeographic subdivision of the mollusc fauna of the area studied is in the Arctic and Subarctic faunistic zones, with boundaries almost coinciding with those of the corresponding marine waters.

The provinces within the zones of the fauna were determined on the basis of the presence or absence of species of different ecological affinities and endemism.

Figure 8 shows the zonal and provincial subdivisions of the Canadian Arctic bivalve fauna. Because of the extreme dissection of the marine

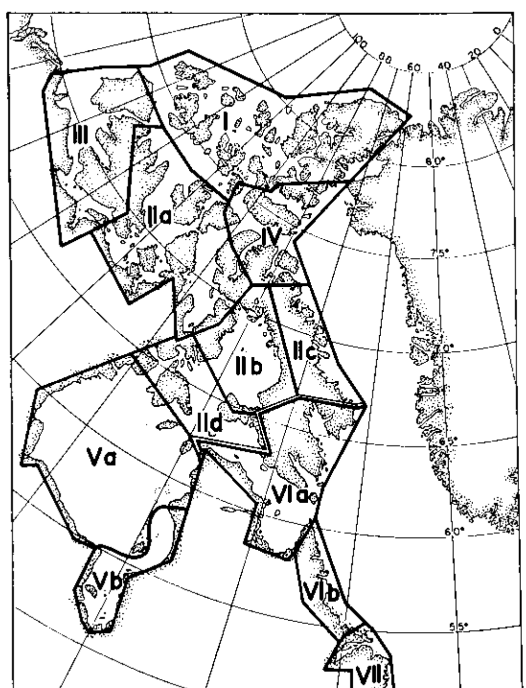


FIG. 8. Zoogeographic subdivisions of the bivalve fauna in the Canadian Arctic. ARCTIC FAUNISTIC ZONE (I–V) — *High-Arctic Subzone* (I–IV): Endemic Province of the Northern Canadian Archipelago (I), Central Shallow-Water Province (IIa, b), Subprovince of Foxe Basin (IIb), Province of Baffin Island Shelf (IIc), Southern Deepwater Province (IId), Province of Southwestern Canadian Archipelago (III), Province of Southeastern Canadian Archipelago (IV); *Low-Arctic Subzone* (V): Province of Hudson Bay (Va, b), Subprovince of James Bay (Vb). SUBARCTIC FAUNISTIC ZONE (VI, VII) — Northern Subarctic Province (VIa, b), Subprovince of Northern Labrador (VIb), Province of Southern Labrador (VII).

water system, boundaries between the subdivisions are indicated roughly by lines separating the marine areas and, by necessity, pass over the land units. Boundaries on the shelf are also indicated schematically.

The provinces form a mozaic reflecting the complexity of their origins.

The scheme of the faunistic subdivisions is shown in Fig. 8, I–VII.

Fauna of the Arctic Zone (Fig. 8, I–V)

Extension — Central and eastern Arctic, with boundaries in the shallow water at the southwestern shore of Hudson Strait, and at the middle section of its northern shore. In deep water, the Arctic fauna extends into Labrador Sea. The southern boundary of the Arctic zone in Baffin Bay is at Padloping Island off southern Baffin Island.

Basic features of the fauna — Arctic shallow-water species dominant and abundant. Panarctic species common. Emerging deepwater species rare, except *Pecten greenlandicus* and *Bathyarca glacialis*. A few subarctic species in restricted areas in the sublittoral. Canadian and Canadian-Greenlandic endemics abundant but not widespread.

The percentual and numerical relations of the Arctic species to other groups are shown in Fig. 7, 9, and 10.

Fauna of the High-Arctic Subzone (Fig. 8, I-IV)

Extension — Canadian Archipelago, Foxe Basin, Foxe Channel, and western Hudson Strait. Entire Arctic shelf from Cape Bathurst to Padloping Island.

The provinces of the High-Arctic Subzone are:

Endemic Province of Northern Canadian Archipelago (Fig. 8, I)

Extension — Littoral and sublittoral of the Queen Elizabeth Islands bordered in the south by M'Clure Strait–Lancaster Sound, and in the east by Ellesmere Island and Barrow Strait sill. Characteristic of the province are the abundant Canadian endemic *Portlandia sulcifera* and the Canadian–Greenlandic endemic *Thyasira dunbari*. The Arctic species and a few emerging deepwater ones dominate. Panarctic species are restricted in distribution.

Central Shallow-Water Province (Fig. 8, IIa, b)

Extension — Off the mainland from Kent Peninsula in the west to Foxe Channel in the south. Bordered in the north by M'Clure Strait–Lancaster Sound. An exclusively high-Arctic and shallow-water fauna. Abundant *Portlandia arctica portlandica, Nuculana pernula costigera*, and *Macoma moesta*. Emerging *Bathyarca glacialis* and *Delectopecten greenlandicus* compete in abundance with stenobathyal shallow-water species.

Subprovince of Foxe Basin (Fig. 8, IIb) — This subprovince is peculiar in many respects. It contains the least number of species; deepwater stenobathyal and emerging species are absent; the sole representative of *Portlandia* is *P. arctica siliqua*; in the north of the basin the subarctic *Crenella faba* and *Yoldia hyperborea* occur probably as relicts; species with planctotrophic larvae such as *Mytilus edulis, Macoma balthica*, and *Chlamys islandica* are absent; in the populations of *Macoma calcarea, M. calcarea* f. *obliqua* was found which occurs also in the northwestern Canadian Archipelago and off the east Siberian Islands. *Cyclocardia borealis* was found in Pleistocene deposits of the basin.

Province of Baffin Island Shelf (Fig. 8, IIc)

Extension — Baffin Island shelf from Pond Inlet in the north, to Padloping Island, southern Baffin Island. Waters of the Canadian Polar Current. Subarctic species, occurring both north and south of the province boundaries, are absent here.

Southern Deepwater Province (Fig. 8, IId)

Extension — Junction of Foxe Channel, western Hudson Strait, and northern Hudson Bay. This province is a barrier between the High-Arctic, Low-Arctic, and Subarctic zones. Basically a deepwater province with little-known fauna. Shores abrupt, strong polar currents pass from the north into the Labrador Sea. The province is remarkable for the poverty of shore fauna, destroyed by the ice. In the sublittoral were found *Nucula belloti, Nuculana pernula costigera, Yoldiella lenticula, Astarte warhami, Macoma loveni*, and single specimen of *Crenella faba* and of *Astarte striata*.

Province of Southwestern Canadian Archipelago (Fig. 8, III)

Extension — Amundsen and Coronation gulfs to Dease Strait at Kent Peninsula. Fauna high Arctic with admixture of some subarctic species in the sublittoral such as *Mytilus edulis*, the Pacific *Macoma inconspicua* and *M. planiuscula*, and rare specimens of *M. calcarea* f. *obliqua*. Peculiar for the province is the presence of populatlons of *Liocyma fluctuosa*, isolated from their Atlantic area.

Province of Southeastern Canadian Archipelago (Fig. 8, IV)

Extension — Southern shelf of Ellesmere Island from Smith Sound southward and including the inlets of northern Baffin Island. Extends into Lancaster Sound up to Barrow Strait sill. Fauna mixed; includes the deepwater *Periploma abyssorum, Cuspidaria arctica*, and *C. glacialis*. The oceanic *Astarte elliptica* and *A. arctica* occur in the sublittoral. The diversity of the fauna is increased by the presence of some subarctic species, e.g. *Nucula delphinodonta, Yoldia hyperborea, Crenella faba, Astarte striata, Thracia myopsis, T. septentrionalis*, and *Mytilus edulis* among abundant Arctic species. The panarctic *Nuculana minuta* and *Musculus corrugatus* are abundant. *Portlandia* is represented only by *P. arctica siliqua*. The fauna is similar to that of West Greenland.

Fauna of the Low-Arctic Subzone (Fig. 8, Va, b)

Extension — Hudson Bay to the islands at its entrance and James Bay. Marine waters of polar origin with slight influx of mixed waters from the east. The floor is shallow except for a trench running parallel to the eastern shore. Littoral zone is ameliorated by intensified insolation. Panarctic species abundant, growth rates high. Vertical zonation is established but often distorted by the land rebound.

Province of Hudson Bay (Fig. 8, Va)

Extension — Same as the Low-Arctic Subzone. Diversity of fauna increased. Infaunal and onfaunal Arctic and panarctic species abundant. Colonies of *Mytilus edulis, Musculus discors, Crenella faba, Macoma balthica*, and *Hiatella arctica* occur in the littoral. *Chlamys islandica* settles at a depth of 30–80 m.

Besides many lecithotrophic species and mud engulfers, there is a considerable group of suspension feeders with planctotrophic larvae.

Fauna of the trench at the eastern shore of the bay is peculiar in many respects. There are rare specimens of *Periploma abyssorum, Yoldiella intermedia*, the oceanic *Nucula delphinodonta, Crenella decussata*, and abundant *Astarte crenata crebricostata*, with admixture of *A. crenata crenata*. In shallow water were found many large shells of *Mya pseudoarenaria* and its live dwarfed adults and juveniles. The presence of different faunistic elements in the trench is correlated to different stages in the development of fauna of the Tyrell Sea into that of Hudson Bay. The main features of the fauna of this bay are the gradual extinction of deepwater and oceanic species and the expansion of shallow-water fauna.

Brackish Subprovince of James Bay (Fig. 8, Vb): *Extension* — James Bay with outpost into southeastern Hudson Bay. Polar water with great admixture of that from land drainage. Seasonally less saline and warmer than any other part of the Arctic. Water stability high with a thermocline in summer. Brackish waters moving northward affect the fauna of Hudson Bay at Belcher Islands and the eastern shores to Fort Harrison. The fauna of this subprovince does not differ much from that of Hudson Bay but is pauperized, the specimens dwarfed. Living *Cardium ciliatum, Chlamys islandica*, and *Serripes groenlandicus* occur amid masses of subfossil shells covered with heavy clay deposits. Vertical zones displaced. The bivalve fauna recuperates in the depth of the cold current moving anticlockwise in Hudson Bay close to the entrance to James Bay.

Fauna of Subarctic Zone (Fig. 8, VI, VII)

Extension — From Padloping Island at the southern shelf of Baffin Island southward to the shelf of Belle Island and Newfoundland. It extends into Hudson Strait and adjacent water bodies to the western end of the southern shore, and to Big Island at the middle of the northern shore.

Contact between polar and mixed waters, openness toward the Atlantic Ocean, and increased insolation influence the composition of the shallow-water fauna; the polar waters moving southward from the Arctic extend the outposts of the Arctic fauna into the Labrador region.

The boundary between the Arctic and the Subarctic zones is less well defined along the northern shores of Hudson Strait, where the strong polar current destroys the fauna of the offshore region. This boundary is more distinct at the southern shores of the strait, where subarctic species occur up to Nuvuk. *Nuculana pernula costigera* is replaced here by *N. p. buccata; Astarte elliptica, Nucula delphinodonta*, and *Liocyma fluctuosa* reappear.

NORTHERN SUBARCTIC PROVINCE (FIG. 8, VIa, b)

Extension — From Padloping Island southward and into eastern Hudson Strait. Along the Labrador Shelf to Lake Melville. The northern boundary of the province is marked by the last northern colonies of *Mytilus edulis*, and the last populations of *Yoldia myalis* and *Cyclocardia borealis* in Hudson Strait. The tidal mixing is intensive, vegetation rich. The subarctic species increase in numbers, the Arctic bivalves submerge into the waters of stable temperature and salinity.

Subprovince of Northern Labrador Shelf (Fig. 8, VIb): *Extension* — From the northernmost point of Labrador Shelf to Lake Melville. Fauna mixed. Arctic fauna dominates in the colder waters of the shelf and inlets; local races are often produced. Panarctic species prosper, individuals grow exceptionally large.

PROVINCE OF SOUTHERN LABRADOR (FIG. 8, VII)

Extension — From Lake Melville to the Newfoundland Shelf. Fauna basically subarctic with an admixture of boreal species in the south. Many high-Arctic species submerge, or occur in pockets of cold water. The participation of subarctic species declines southwards. Species new to this fauna appear: *Modiolus modiolus, Mya arenaria, Pecten magellanicus, Anomia squamula, Spisula polynyma*, and others. *Mytilus edulis* occurs off Newfoundland not only in offshore waters but also in the sublittoral, to a depth of 50 m (Nesis 1963a, 1965).

South of Newfoundland the polar waters mix with those of the Gulf of St. Lawrence and the Atlantic Ocean, and Arctic fauna declines.

The complicated zoogeographic mozaic of the bivalve fauna of the Canadian Arctic is the result of its intricate development since the early stages of the ice retreat 14,000–12,000 B.P. The patterns of this retreat, the separation of ice blocks, and the changes in land and sea levels created temporary passages and barriers for the dispersion of bivalves.

It can be assumed that the province of endemic species originated as a result of isolation by the waters of the M'Clure Strait–Lancaster Sound and by the barriers of Ellesmere Island and of the Innuitian glacier (Blake 1970, fig. 12, p. 569, 658). The rise of the land in the southwestern Canadian Archipelago and the tides and heavy ice in shallow Dease Strait created a barrier between provinces III and IIa. The area of subarctic species in the southeastern Canadian Archipelago, Province IV, can be regarded as a relict outpost of the Greenlandic fauna.

Foxe Basin was the last to be freed from ice, and its shallowness and the strong polar current formed a barrier both for the deepwater and for the subarctic fauna.

The Tyrell Sea supported periodically different faunas. Its deepwater fauna is now restricted to the eastern trench of Hudson Bay; the oceanic species entered this bay during its broader connections with the open sea. *Mytilus edulis*, though, inhabited Tyrell Sea since the first stages of inundation. The brackish Subprovince of James Bay originated probably during the last stages of marine retreat.

The complicated zoogeographic mozaic of the Canadian Arctic region contrasts with the relative simplicity of the zoogeography of the Eurasian Arctic as envisaged by Filatova (1957a, fig. 1b). The physiography of the Eurasian shelf results in a zonal distribution of its bivalve fauna extending parallel to the shore toward the abyssal Zone IV. The zoogeography of the western part of the Eurasian shelf is more complicated.

Relation of Canadian Arctic Fauna to that of the Northwest Atlantic

The general trend in the fauna of the Canadian Arctic is the southward replacement of the Arctic species by the subarctic with the Arctic-boreal group remaining more or less unchanged (Fig. 5).

Figures 9 and 10 show the number of species of different ecological affinities and their percentual relationships in the Canadian Arctic and

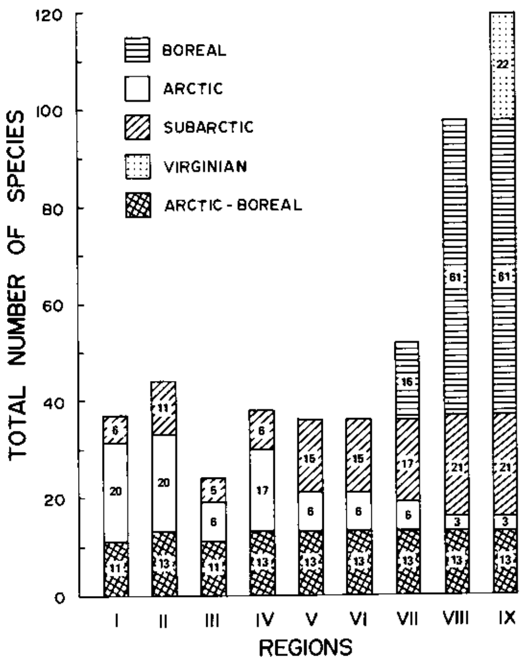


FIG. 9. Number of species in ecological groups of bivalve molluscs in the Canadian Arctic and Northwest Atlantic. CANADIAN ARCHIPELAGO REGION — I, Central and Western; II, Southeastern. CANADIAN EASTERN ARCTIC REGION — III, Foxe Basin; IV, Hudson Bay; V, Hudson Strait. LABRADOR COAST REGION — VI, Northern; VII, Southern. ACADIA REGION — VIII, Northern; IX, Southern.

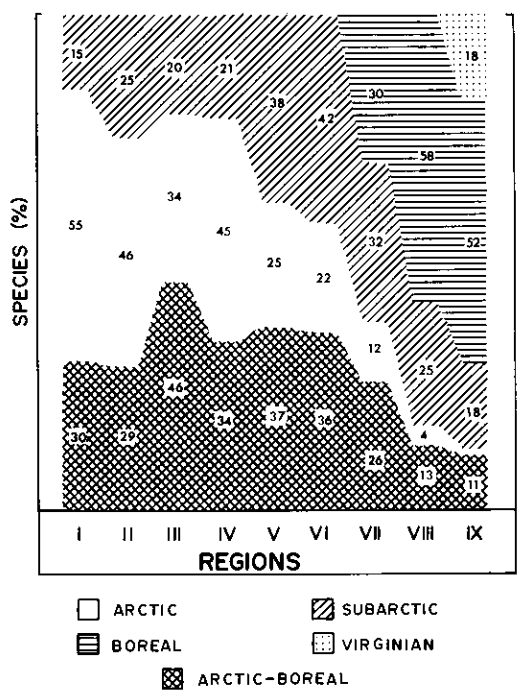


FIG. 10. Percentual relationship of ecological groups of bivalve molluscs in the Canadian Arctic and Northwest Atlantic. CANADIAN ARCHIPELAGO REGION — I, Central and Western; II, Southeastern; III, Foxe Basin; IV, Hudson Bay; V, Hudson Strait. LABRADOR COAST REGION — VI, Northern; VII, Southern. ACADIA REGION — VIII, Northern; IX, Southern.

in the Acadian fauna calculated for the Canadian Archipelago, eastern Arctic, Labrador coast, and Acadia.

Data for the Canadian Arctic region are by the author. Those for other regions are from Abbott (1974), Allen (1965), Detweiler (1915), Gould (1870), Ganong (1890), Johnson (1915, 1926, 1934), Kindle and Whittaker (1918), La Rocque (1953), Nesis (1963b), Packard (1863), Stafford (1912), Stimpson (1862), Verrill (1882, 1884, 1885), Verrill and Smith (1874), Whiteaves (1869, 1872, 1901).

The number of species (Fig. 9) changes only slightly from the central and western Canadian Archipelago (I) to northern Labrador (VI). This number is increased in the southeastern Canadian Archipelago (II) by the addition of a few subarctic species. The number of species is lowest in Foxe Basin (III). It increases from 39 species in the Canadian Archipelago to 120 in the Boreal Zone with the appearance of subarctic and boreal species and a few representatives of the Virginian fauna.

The number of Arctic species decreases from 20 in the central Canadian Archipelago (I) to 3 in Acadia (VII-IX), whereas the number of subarctic species increases from 6 in the southeastern Canadian Archipelago (II) to 21 off Newfoundland. The percentage of Arctic species (Fig. 10) decreases from 55 in the Canadian Archipelago (I-V) to 4 in the Acadian fauna (VIII, IX). The subarctic species increase from 15% in the eastern Canadian Archipelago to 42% at Newfoundland, but decrease toward the Acadian fauna. The northern species still comprise 29% of the boreal fauna.

The number of species of the Arctic-boreal group remains almost unchanged throughout the entire region, but increases to 40% in Foxe Basin, where the total number of species is low; Arctic, boreal species comprise 34-36% in the Canadian eastern Arctic, but decrease to 11% in the Acadian fauna.

It is difficult to determine the exact position of the southern boundary of the Canadian Arctic fauna. In its typical composition it extends to Belle Island region.

Acadian fauna contains representatives of both the Arctic and Virginian faunas (Bousfield 1967; Clark 1906; Ganong 1890; Gould 1870). This complicated composition is probably the result of glacial events, when the extensive periglacial marine zone was supporting the northern species in lower latitudes; some still survive there as relicts. With the withdrawal of polar waters, a favorable environment was created for the northward expansion of the southern fauna and its mixing with northern relicts.

The decline of the Arctic fauna takes place at the shores of Newfoundland and Nova Scotia, the region of complicated changes in the marine waters (Chamberlin and Stearns 1963; Ekman 1953; Lauzier and Hull 1962; Nesis 1965; Parr 1933; Pyle 1962; and Schroeder 1963).

In the offshore region of the Northwest Atlantic the cold current extends outposts of the northern fauna southward (Ekman 1953, p. 135-141). However, the ranges and seasonal fluctuations of the temperature and the high salinity are not beneficial to the northern species. Parr (1933) described four patterns of seasonal fluctuations in Massachussets Bay, all differing from those in the north, as described by Collin (1960), Dunbar (1958), and Grainger (1959, 1960). Massachussets Bay, with the well-established boreal fauna, cannot be regarded as an Arctic-boreal region, because of the presence of only pockets of northern fauna (Ekman 1953). The data show that among the 98 species of the northern and 120 of the southern Acadian fauna, only a few Arctic and 23 subarctic species remain. The presence of 52% of boreal species in northern Acadia and 70% of boreal plus Virginian species in southern Acadia leaves no doubt as to the boreal nature of the Acadian fauna. The patchy distribution of northern species indicates that the northern fauna is at its southern boundary here and almost extinct.

Woodward (1856) and Dunbar (1968) place the southern boundary of the Subarctic Zone at the southern shores of Newfoundland. The southern boundary of the northern bivalve fauna basically coincides with it.

Relations of Canadian Arctic Fauna to Neighboring Arctic Faunistic Regions

The Canadian Arctic marine region occupies a greater part of the Arctic shelf of North America between the Pacific and Atlantic oceans. The basic components of the fauna of this region are the Arctic shallow-water bivalves mostly with circumarctic distribution with only a few Atlantic and only two Pacific species.

Bivalve Fauna of the Canadian Arctic and Greenlandic Shallow-Water Regions

The shores of Greenland are exposed to both Arctic and Atlantic waters. The shelf is narrow and greatly dissected. The West Greenland current extends the area of mixed waters far northward. A branch of the cold East Greenland current and the warm Irminger current approach the coast of West Greenland in the south.

The East Greenlandic shelf is under the influence of the polar current. In the south, the underlaying Atlantic waters ameliorate the severe Arctic conditions.

The bivalve faunas of West and East Greenland differ considerably. The Atlantic subarctic species occur along the entire coast of West Greenland. The Arctic species occur mainly in the north and in some isolated southern embayments, possibly as relicts. In contrast, the fauna of East Greenland is high Arctic; subarctic species occur only off its southernmost part. The entire fauna of Greenland waters is Atlantic-Arctic with an admixture of Atlantic-subarctic and panarctic species.

The similarity of Greenlandic and Canadian fauna was expressed quantitatively by Ockelmann (1958, p. 192, fig. 27) as a percentage of species common to both regions. This is 65% for the fauna of West Greenland and 69% for East Greenland. My data indicate a 75 and 84% similarity between the fauna of Canada and Greenland. The similarity was increased by the recent finding in Canadian waters of *Yoldiella intermedia* G. O. Sars, *Y. fraterna* Verrill and Bush, *Y. lenticula* (Møller), *Y. frigida* (Torell), *Thyasira* *dunbari* Lubinsky, *Thracia devexa* (G. O. Sars), *T. septentrionalis* Jeffreys, *Bathyarca frielei* (Friele), *and Cuspidaria subtorta, C. arctica, C. glacialis*, all by G. O. Sars.

The presence of *Astarte soror* Dall, *Crenella faba* (Müller), *Macoma balthica* Linné, *Musculus corrugatus* (Stimpson), *Nucula delphinodonta* (Migh. et Adams), and *Turtonia minuta* (Fabr.) in the Canadian Arctic increases the similarity of its fauna to that of West Greenland. The presence of *Thracia devexa* G. O. Sars and *Pandora glacialis* (Leach) in the Canadian Arctic, and its absence in West Greenland, increase the similarity of the Canadian and East Greenlandic fauna.

Of the 21 families of bivalves represented in the Canadian Arctic fauna, 17 are also found in Greenland; of 32 Canadian genera 25 and 26, respectively, are represented off West and East Greenland. The Greenlandic fauna differs by the absence of Periplomatidae and Carditidae.

The Canadian Archipelago and East Greenland fauna have 90% of their species in common. The Canadian eastern Arctic and West Greenland fauna are only slightly less similar.

Bivalve Fauna of the Canadian Arctic and Eurasian Seas

The Eurasian shelf is over 1000 miles wide and slants gradually toward the Arctic Ocean. It is subdivided into a chain of open shallow seas and dissected by trenches in the west. Waters are polar, though the North Cape and Chukchi Sea currents introduce mixed waters into the eastern and western parts of this region. The Atlantic contributes to the waters of the Eurasian shelf much more than the Pacific (Timofeyev 1960; Coachman and Aagard 1974).

Filatova (1957a) lists 119 species of bivalves from the Eurasian region. Her data show that the temperate and polar species of Atlantic and Pacific origin decline toward the middle part of the shelf, and are at minimum at the East Siberian shallows. Here the areas of a number of "circumpolar" species become disrupted.

Filatova (1957b, p. 190) shows that Atlantic-Arctic species constitute 77% of the Arctic faunistic group; the remainder are of Pacific origin. The Atlantic boreal immigrants constitute 25% of the fauna and occur over an extensive area. The Pacific boreal immigrants constitute only 10% and occur only in a small area in the east of the Eurasian shelf. The dominance of the Atlantic fauna at the northern shelf was also stressed by Gur'ianova (1970, p. 30).

The southern immigrants extend their areas much further north in the western part of the Eurasian shelf than in Canadian waters. Subarctic species even enter the Kara Sea, whereas in Canada they reach only to southern Labrador. This difference in the northern ranges of southern species depends on the direction of currents. At the Canadian shores, the Canadian and Labrador currents extend the areas of northern species southward. At the shores of Europe, the northern branch of the Gulf Stream extends the areas of southern species far northward.

Sixty-eight Arctic species are common to Canadian and Eurasian Arctic fauna. However, a generalized comparison of the faunas would be misleading, because the number of species of Eurasian fauna decreases toward the center of the Eurasian region. Over 90% of the bivalves of the Arctic fauna (59 species) are common to the Canadian and Eurasian regions. The number of species in the Eurasian fauna decreases eastward from the Barents Sea. If the number of species in this sea is accepted as 100%, the decrease in diversity of the bivalve faunas in seas east of the Barents Sea, and the similarity of their faunas to Canadian fauna, may be expressed as follows:

	Decrease in diversity east of Barents Sea	Spp. common with Canadian Arctic
Kara	86%	76%
Laptev	70%	64%
East Siberian	66%	60%
Chukchi	54%	50%

Thus the number of species in common for the two regions decreases eastward because of the decrease in diversity in the Arctic fauna itself.

Fauna of Canadian and Western North American Arctic Regions

The bivalve faunas of these two regions have 16 panarctic circumpolar species in common. The fauna east of the Mackenzie River studied by Wagner (1977) is similar to that of the Canadian Archipelago, though there are a few species indicating Pacific influence. But the fauna of southern Beaufort Sea at the Alaskan shelf harbors a group of North Pacific endemics. According to Dall (1919), MacGinitie (1959), Filatova (1957a), and Bernard (1979a) the following Pacific species occur in the western North American Arctic: *Nuculana radiata* (Krause), *N. collinsoni* (Dall), *Bathyarca raridentata* (Wood), *Yoldia scissurata* (Dall), *Astarte alaskensis* (Dall), *A. polaris* (Dall), *A. esquimalti* (Baird), *Cardium californiense*

(Deshayes), *C. corbis* (Martin), *Cyclocardia crebricostata* (Krause), *Diplodonta aleutica* (Dall), *Axinulus careyi* Bernard, *Macoma planiuscula* Grant and Gale, *M. inconspicua* (Brod. Sow.), *Boreacola vadosa* Bernard, and *Thracia adamsi* N. MacGinitie. Even this partial list of species clearly shows that the fauna of the western American Arctic differs greatly from that of the Canadian Arctic.

West and east from the Mackenzie River the populations of many species of wide distribution differ slightly from those in the Canadian Atlantic region. They were described by Dall (1919) as separate species, e.g. *Liocyma beckii, L. viridis, Macoma oneilli, Pecten andersoni, Nucula quirica*. Schlesch (1931), Grau (1959), and MacGinitie (1959) studied these forms and pointed out that these populations are not sufficiently different from those of the closely related species to grant them species status. These populations indicate, however, the presence in this region of an independent evolutionary trend caused probably by the Wisconsin isolation.

The important zoogeographic features distinguishing the Canadian region from the western North American Arctic is the almost complete absence of Arctic species of recent Pacific distribution in Canada, and of the Atlantic Arctic species in the western North American region. The boundary between these two regions is in the vicinity of the Mackenzie River delta. The influx of fresh waters from this river and the western abrupt shelf of the Canadian Archipelago present a barrier for the faunistic exchange. The three species entering Canadian waters from the west are *Mytilus edulis, Macoma inconspicua*, and *M. planiuscula* — all tolerate well the brackishness of water in high latitudes.

The eastern boundary between the Atlantic and the Pacific species in the Eurasian Arctic fauna is at the New Siberian Islands. Gur'ianova (1970, p. 144) stresses the importance of this region as a zoogeographic boundary. She suggests that a land barrier, which recently disappeared, existed at the New Siberian Islands.

The areas of the Arctic and subarctic Atlantic and Pacific species conform to the usual zoogeographic subdivision of the Arctic shelf fauna into the Pacific and Atlantic sectors. The fauna of bivalves of the Canadian Arctic region belongs to the Atlantic sector as does the greater part of the Eurasian region.

The similarity of the bivalve faunas of Canadian and Greenlandic waters, and a great dissimilarity of these faunas with those westward from the Canadian Archipelago, is sufficient to separate the bivalve fauna of Arctic North America into two faunistic regions: the Canadian–Greenlandic and the western North American. The Canadian–Greenlandic region can be divided into two subregions, the Canadian and the Greenlandic, mainly on the basis of the difference in the distribution of Arctic and the subarctic species.

Acknowledgments

I wish to express my sincere thanks to the malacologists of the museums and research institutions of Canada and the United States who contributed to this research by placing at my disposal collections of bivalve molluscs from the Canadian marine Arctic, and by discussing the project.

My special thanks to Dr M. J. Dunbar, Marine Sciences Centre, McGill University, Montreal; Dr E. H. Grainger, Arctic Biological Station, Department of Fisheries and Oceans, St. Anne de Bellevue, Que; Dr A. H. Clarke, Department of Molluscs, National Museums of Canada, Ottawa (at present at the Smithsonian Institution, Museum of Natural History, Washington, D.C.); to staff members of the Department of Molluscs, National Museums of Canada, Ottawa; Freshwater Institute, Department of Fisheries and Oceans, Winnipeg, Man., Museum of Comparative Zoology, Harvard University; Museum of Natural History, Washington, and American Museum of Natural History, New York.

Samples for comparative studies were obtained through the courtesy of Dr Tucker Abbott, Academy of Natural Sciences, Philadelphia, PA.; Dr M. Keen, Stanford University, Stanford, CA, and Dr W. K. Ockelmann, Helsingør Biological Station, Helsingør, Denmark.

I am indebted to the staff of the Department of Zoology, University of Manitoba, and to the head of this Department, Dr H. E. Welch, for their interest and encouragement in this work.

My sincere thanks to Mr W. Heck, photographer of the Department of Zoology, University of Manitoba, for photographic work and the preparation of maps and diagrams.

This project was partially supported by the Northern Studies Committee Grant 345-1749-01, University of Manitoba, Winnipeg.

References

ABBOTT, R. T. 1974. American seashells, 2nd ed. Van Nostrand, New York. 663 p.

ADAMS, A. 1856. Description of 34 new species of bivalve molluscs (Leda, Nucula and Pythia) from the Cunningham collection. Zool. Soc. London, Proc. 24: 47-53.

ALLEN, J. A. 1965. Records of Mollusca from the Northwest Atlantic obtained by Canadian Fishery Research vessels, 1946-61. J. Fish. Res. Board Can. 22: 977-997.

ANDREWS, J. T. 1969. The pattern and interpretation of restrained postglacial and residual rebound in the area of Hudson Bay, p. 49-62. *In* P. J. Hood [ed.] Earth Sci. Symp. on Hudson Bay. Geol. Surv. Can. Pap. 68-53.

1970. A geomorphological study of postglacial uplift. Inst. Br. Geogr. Spec. Publ. 2: 156.

1972. Recent and fossil growth rates of marine bivalves, Canadian Arctic, and late-Quarternary Arctic marine environment. Palaeogeogr. Palaeoclimatol. Palaeoecol. 2: 157-176.

1974. Postglacial rebound with maximum postglacial marine limit. National Atlas of Canada, Map 35-36. Macmillan Co., Toronto.

ANDREWS, J. T., AND L. DRAPIER. 1967. Radiocarbon dates obtained through Geographical branch field observations 1955-56. Pt. 1. Geogr. Bull. 9(2): 115-162.

ANDREWS, J. T., AND J. D. IVES. 1972. Late and postglacial events (<10,000 BP) in the eastern Canadian Arctic with the particular reference to the Cockburn moraines and break-up of the Laurentide Ice Sheet, p. 149-174. *In* Y. Vasari et al. [ed.] Climate changes in Arctic areas during the last ten thousand years. Symp. Acta Univ. Ouluensis, Ser. A(3), Geol. 1: 149-174.

ANDREWS, J. T., AND B. R. PELLETIER. 1976. Collapse of the Hudson Bay ice centre. Geology 4(2): 73-95.

BAILEY, W. B. 1957. Oceanographic features of the Canadian Archipelago. J. Fish. Res. Board Can. 14: 731-769.

BAILEY, W. B., AND H. B. HACHEY. 1949. The vertical temperature structure of the Labrador Current. Can. Joint Comm. Oceanogr. N.S. Rep. 1: 10.

BAKER, F. 1919. Molluscs of the Crocker land Expedition. Am. Mus. Nat. Hist. Proc. 41: 479-577.

BARBER, F. G. 1967. A contribution to the oceanography of Hudson Bay. Dep. EMR Mar. Sci. MS Rep. Ser. 4: 69 p.

1968. The water and ice of Hudson Bay. The water, p. 287-318. *In* C. S. Beals [ed.] Science, history and Hudson Bay, Vol. 1. Dep. EMR.

BARBER, F. G., AND C. J. GLENNIE. 1964. On the oceanography of Hudson Bay, data 1961. Dep. Mines Tech. Surv. Mar. Sci. Dir. MS Rep. Ser. 1: 98 p.

BARBER, F. G., AND A. HUYER. 1971. On the waters of the Canadian Arctic Archipelago. Dep. EMR Mar. Sci. Dir. MS Rep. Ser. N21: 76 p.

BARTENEV, A. 1933. On some features of the history and formation of the Palearctic fauna. Zool. J. 12(1): 101-129; 12(3): 121-149. (In Russian)

BARTSCH, P. 1929. Report upon the collection of marine molluscs, made by professor K. Deriugin in the Gulf of Peter the Great (Obsor kollektsii morskikh molliuskov sobrannykh prof. K. Deriuginym v zalive Petra Velikogo. Gosud. gidrolog. Institut). Institute Hydrologique. Exploration des mers d'U.R.S.S., Fasc. 10: 131-140.

BERNARD, F. R. 1979a. Bivalve molluscs of the western Beaufort Sea. Nat. Hist. Mus. Los Angeles Cty. Contrib. Sci. 313: 1-80.

1979b. Identification of living *Mya* (Bivalvia: Myoida). *Venus*, Jpn. J. Malacol. 38(3): 185-204.

BIGELOW, H. B. 1927. Physical oceanography of the Gulf of Maine. Bull. Am. Bur. Fish. 11: 511-1027.

BLACKER, R. W. 1957. Benthic animals as indicators of hydrographic conditions and climatic changes in Svalbard waters. Great Britain, Ministry of Agriculture Fishing and Food. Fish. Invest. Ser. 2. 20(6): 49.

1965. Recent changes in the benthos of the West Spitsbergen fishing grounds. Int. Comm. Northwest Atl. Fish. Spec. Publ. 6: 791-794.

BLAKE, W. JR. 1970. Studies of glacial history in Arctic Canada. 1. Pumice, radiocarbon dates and differential postglacial uplift in the eastern Queen Elizabeth Islands. Can. J. Earth Sci. 7(2): 634-664.

1972. Climatic implications of radiocarbon — dated driftwood on the Queen Elizabeth Islands, p. 77-104. *In* Y. Vasari et al. [ed.] Climatic changes in Arctic areas during the last ten thousand years. Symp. Acta Univ. Ouluensis, A3, Geol. 1. Oulu.

1973. Former occurrence of *Mytilus edulis* L. on Coburg Island, Arctic Archipelago. Nat. Can. 100: 51-58.

1975. Radiocarbon age determinations and postglacial emergence at Cape Storm, southern Ellesmere Island, Arctic Canada. Geogr. Ann. 57 (Ser. A 1-2): 1-71. Reprint.

BLOOM, A. L. 1971. Glacial-Eustatic and Isostatic controls of sea level since the last glaciation, p. 355-379. *In* K. Turekian [ed.] The late Cenozoic glacial ages. Vol. 13. Yale Univ. Press, New Haven, NH.

BOUSFIELO, E. L. 1967. Postglacial dispersal patterns of littoral marine molluscs and crustaceans in eastern Canada. Am. Malacol. Union, Annu. Rep. 1: 42-44.

BRODERIP, W. J., AND G. B. SOWERBY. 1829. Observations on new and interesting Mollusca contained for the most part in the Museum of the Zoological Society. Zool. J. 4(15): 359-379. London.

BROOKS, S. 1935. The exploration of Southampton Island. Zoology. Mem. Carnegie Mus. 12 (Pt. 2, Sect. 5): 1-2.

BRDWN, T. 1827. Illustrations of the recent conchology of Great Britain and Ireland. 1st ed. London. xiii + 144 p.

Bruguière, J. G. 1789. Encyclopédie méthodique; histoire naturelle des vers, des mollusques, des coquillages et zoophytes. Vol. 1. Histoire naturelle des vers. Paris et Liège. 757 p.

Bryson, R. A., W. M. Wendsand, J. D. Ives, and J. T. Andrews. 1969. Radiocarbon isochrones on the disintegration of the Laurentian Ice Sheet. Arct. Alp. Res. 1: 1–14.

Bush, K. J. 1883. Catalogue of Mullusca and Echinodermata dredged on the coast of Labrador by the Expedition under the direction of Mr. W. A. Stearns in 1882. Proc. U.S. Natl. Mus. 6: 236–247, pl. 9.

1893. Report on the Mollusca dredged by "Blake" in 1880, including descriptions of several new species. Reports on the results of dredging. . . by the U.S. Coast Survey Steamer "Blake." Bull. Mus. Comp. Zool. 23(6): 197–244.

Campbell, N. J. 1958. The oceanography of Hudson Strait. Fish. Res. Board Can. MS Rep. Ser. (Oceanogr. Limnol.) 12: 60 p.

Campbell, N. J., and A. E. Collin. 1956. A preliminary report on some oceanographic features of Foxe Basin. Fish. Res. Board Can. MS Rep. (Biol.) 613: 42 p.

Campbell, N. J., J. R. N. Lazier, and R. H. Loucks. 1964. Preliminary assessment of the physical oceanography of the Labrador Sea during Norwestlant - 2, 1963. Bedford Inst. Oceanogr. Rep. 64(3): 33 p.

Canadian Hydrographic Service. 1966–67. Arctic bathymetry north of 72°N, 90°–180°W. Chart 896, 897, 1: 2000000. A centennial project of the Canadian Hydrographic Service. Dep. EMR Mar. Sci.

Carey, S. W., and Nasseruddin Ahmad. 1961. Glacial marine sediments, p. 865–894. *In* G. Raasch [ed.] Geology of the Arctic. 2. Univ. Toronto Press, Toronto. 1196 p.

Chamberlin, J. L., and F. Stearns. 1963. A geographic study of the clam, *Spisula polynyma* (Stimpson). *In* Serial Atlas of the Marine Environment. Folio 3: 11 p. Am. Geogr. Soc. New York.

Clark, W. B. 1906. The Pleistocene fauna. The interpretation of the paleontological criteria, p. 192–210. *In* Pliocene and Pleistocene. Systematic Paleontology. Class Pelecypoda. Maryland Geol. Surv. 3.

Clarke, A. H. 1962. Annotated list and bibliography of the abyssal marine molluscs of the world. Natl. Mus. Can. Bull. 181: 1–144.

1963. Arctic archibenthal and abyssal molluscs — II. Molluscs dredged from Drifting Station Charlie (Alpha II). Natl. Mus. Can. Bull. 185: 90–109.

Coachman, L. K., and K. Aagard. 1974. Physical oceanography of Arctic and Subarctic seas, p. 1–72. *In* Y. Herman [ed.] Marine geology and oceanography of the Arctic seas. Springer Verlag, New York.

Collin, A. E. 1960. Oceanographic observations in the Canadian Arctic and the adjacent Arctic Ocean. Arctic 13(3): 194–200.

1962. The waters of the Canadian Archipelago. Bedford Inst. Oceanogr. Rep. 62-2: 1–11.

Collin, A. E., ano M. J. Dunbar. 1964. Physical oceanography in Arctic Canada. Annu. Rev. Oceanogr. Mar. Biol. 2: 45–75.

Conrao, T. A. 1831. American conchology or description and figures of the shells of the Atlantic coast of North America. Philadelphia. 39 p.

Couthouy, J. P. 1838. Descriptions of new species of mollusca and shells, and remarks on several polypi found in Massachusetts Bay. Bost. J. Nat. Hist. 2(1): 53–111.

Craig, B. G. 1960. Surficial geology of north-central District of Mackenzie. Northwest Territories. Geol. Surv. Can. Pap. 60–18: 8 p.

1965. Notes on moraines and radiocarbon dates in northwest Baffin Island, Melville Peninsula, and northeast district of Keewatin. Geol. Surv. Can. Pap. 65–20: 1–7.

1968. Late glacial and post-glacial history of the Hudson Bay region, p. 63–77. *In* P. J. Hood [ed.] Earth Sci. Symp. on Hudson Bay. Geol. Surv. Can. Pap. 68–53.

Dall, W. H. 1879. Molluscs, p. 145–146. *In* L. Kumlien: Contributions to the natural history of Arctic America made in connection with Howgate Polar Expedition 1877–78. Bull. U.S. Natl. Mus. 15(2).

1886. Report on molluscs collected by L. M. Turner at Ungava Bay, North Labrador and from the adjacent Arctic Seas. Proc. U.S. Natl. Mus. 9: 202–208.

1902. Synopsis of the Family Veneridae and of the North American recent species. Proc. U.S. Natl. Mus. 26: 335–412.

1903. Synopsis of the Family Astartidae, with a review of the American species. Proc. U.S. Natl. Mus. 26: 933–951.

1919. The mollusca of the Arctic coast of America collected by the Canadian Arctic Expedition west from Bathurst Inlet. Rep. Can. Arct. Exped. 1913–18. 8 (Pt. A): 1–20. Acland, King's Printer, Ottawa.

1924. Supplement to the report of the Canadian Arctic Expedition 1913–18, 8 (Pt. A): 31–35. Acland, King's Printer, Ottawa.

Dawson, W. J. 1872. Sub kingdom Mollusca. Can. Nat. 6(4): 369–389.

1893. The Canadian Ice Age. 301 p. W. V. Dawson, Montreal.

Deshayes, M. J. P. 1854. Description of new species of shells from the collection of Hugh Cuming, Esq. Proc. Zool. Soc. London, 22: 317–371.

Detweiler, J. D. 1915. Preliminary notes on the Mollusca of St. Andrews and vicinity, New Brunswick. Contrib. Can. Biol. Sess. Pap. 39B: 43–46.

Dillwyn, L. W. 1817. A descriptive catalogue of recent shells arranged according to the Linnean method, with particular attention to the synonymy. 1: 580 p.; 2: 581–1902; Index. London.

Dodge, H. 1952. A historical review of the Molluscs of Linnaeus. Pt. 1. The classes Loricata and Pelecypoda. Am. Mus. Nat. Hist. Bull. 100(1): 263 p.

Dunbar, M. J. 1951. Eastern Arctic waters. Bull.

Fish. Res. Board Can. 88: 131 p.

1958. Physical oceanographic results of the "Calanus" Expeditions in Ungava Bay, Frobisher Bay, Cumberland Sound, Hudson Strait and northern Hudson Bay, 1949–1955. J. Fish. Res. Board Can. 15: 155–201.

1962. Second report on the Bering Strait dam. Dep. North. Affairs Natur. Resour., North. Coord Res. Cent. 62-6: 23 p.

1968. Ecological development in polar regions. A study in evolution. Prentice-Hall Inc., New Jersey. 119 p.

DUNBAR, MOIRA. 1969. The geographical position of the North Water. Arctic 22(4): 438–441.

DUNKER, W. B. 1862. Beschreibung neuer Mollusken. Malakozoolog. Blätter 8: 35–45.

DUNNILL, R. M., AND E. COAN. 1968. A new species of the Genus *Macoma* (Pelecypoda) from West American coastal waters, with comments on *Macoma calcarea* (Gmelin, 1791). Natl. Mus. Can. Nat. Hist. Pap. 43: 19.

DUNNILL, R. M., AND D. V. ELLIS. 1969. Recent species of the genus *Macoma* (Pelecypoda) in British Columbia. Natl. Mus. Can. Nat. Hist. Pap. 45: 34.

DYCK, W., AND J. G. FYLES. 1963. Geological survey of Canada: radiocarbon dates I and II. Geol. Surv. Can. Pap. 63-21: 1–31.

1964. Geological Survey of Canada: radiocarbon dates III. Geol. Surv. Can. Pap. 64-40: 1-15.

DYCK, W., J. G. FYLES, AND W. BLAKE, JR. 1965. Geological Survey of Canada: radiocarbon dates IV. Geol. Surv. Can. Pap. 65-4: 1–23.

DYCK, W., J. A. LOWDON, J. G. FYLES, AND W. BLAKE JR. 1966. Geological Survey of Canada: radiocarbon dates V. Geol. Surv. Can. Pap. 66-48: 1-32.

EKMAN, S. 1953. Zoogeography of the sea. Sedgwick and Jackson, London. 417 p.

ELIZAROV, A. A., AND L. A. ZOTOV. 1960. Water-temperature fluctuations of the Labrador current on the Grand Banks of Newfoundland. Vses. n. -issl. Institut morskogo rybnogo Khos. Sovetskii Rybokhoz. Issledovaniia: 97–100. (In Russian)

ELLIS, D. V. 1955. Some observations on the shore fauna of Baffin Island. Arctic 8(4): 224–236.

1956. Some temperature and salinity records from the Canadian Arctic during 1954 and 1955. J. Fish. Res. Board Can. 13: 591–598.

1960. Marine infaunal benthos in Arctic North America. Arctic Inst. North Am. Tech. Pap. 5: 1–53.

ELSON, J. A. 1969a. Late quaternary marine submergence of Quebec. Rev. Geogr. Montreal 23(3): 247–258.

1969b. Radiocarbon dates, *Mya arenaria* phase of the Champlain Sea. Can. J. Earth Sci. 6: 367-72.

FABRICIUS, O. 1776. Fauna Groenlandica, systematice sistens animalis Groenlandiae occidentalis hactenus indagata. . . . maximaque parte secundum proprias observationes O. Fabricii. xvi + 452. Copenhagen.

1780. Fauna Groenlandica, systematice sistens animalis Groenlandiae occidentalis hactenus indagata, quoad nomen specificum, triviale vernaculumque. xvi + 452. 2nd ed. Gottlob Rothe, Hafniae et Lipsiae.

FALCONER, G., J. D. IVES, O. H. LØKEN, AND J. T. ANDREWS. 1965. Major end moraines in eastern and central Arctic. Can. Geogr. Bull. 7(2): 137–153.

FEILDEN, H. W. 1838. Arctic molluscan fauna. Zoologist 3(1): 435–440.

FILATOVA, Z. A. 1948. Class of bivalve molluscs, p. 405–446. *In* N.S. Gajevskaia [ed.] Keys to the fauna and flora of the northern seas of the USSR Sovetskaia Nauka. (In Russian)

1957a. General review of the fauna of the bivalve molluscs of the northern seas of the USSR Proc. Inst. Oceanology. Akad. Nauk USSR 20: 2–59. (In Russian)

1957b. Geographic subdivision of the northern seas by the distribution of the bivalve molluscs. Proc. Inst. Oceanology. Akad. Nauk USSR 23: 195–215. (In Russian)

FISHER A. G. 1961. Latitudinal variations in organic diversity. Am. Sci. 49(1): 50–75.

FORBES E. 1846. Catalogue of species of marine animals, the remains of which are found fossil in beds of the glacial epoch living in Gulf of St. Lawrence. Mem. Geol. Surv. G. B. Mus. Econ. Geol. 1: 406–432.

FORGERON, F. D. 1959. A preliminary study of Foxe Basin bottom sediments. Fish. Res. Board Can. MS Rep. (Oceanogr. Limnol.) Ser. 45: 46 p.

FOSTER, R. W. 1946. The genus *Mya* in the western Atlantic. Johnsonia 2(20): 29–35.

FRIELE, H. 1877. Preliminary report on Mollusca from the Norwegian North Atlantic Expedition in 1876. Nyt. Mag. Naturvidenskab. 23(3): 1-10.

GADD, N. R. 1971. Pleistocene geology of the central St. Lawrence lowland. Geol. Surv. Can. Mem. 359: 82–98.

GALKIN, Yu. T. 1964. Long term changes in the distribution of bivalve molluscs in the southern part of the Barents Sea. Murm. Mar. Biol. Inst. Proc. 6(10): 22–70. (In Russian)

GANONG, W. F. 1890. Southern invertebrates on the shores of Acadia. Trans. R. Soc. Can. 8(7): 167–185.

GMELIN, W. F. 1791. Molluscs, Bivalvia: Conchae, p. 3218–3252. *In* C. Linnaeus Systema Naturae per regna triae naturae. . . Editio decima tertia, aucta, reformata. Vol. 1(6). E. B. Beer, G. Leipzig. (Revised and augmented by Gmelin)

GORBUNOV, G. P. 1941. Donnoe naselenie morei Sovetskoi Arktiki. Probl. Arktiki. 7-8: 89–96. (In Russian)

1946. New and interesting species of Mollusca and Brachiopoda from the Arctic Ocean: Proc. Dreif. Exp. Glav. Upr. Sev. Mor. Puti. on icebreaker Sedov., 1937-1940. 3: 308–322. (Transl. from Russian by Head Office of the North Seas Connection)

GOULD, A. A. 1841. A report on the invertebrata of Massachusetts. XIII + 373 p. Folsom, Wells and Thurston, Cambridge, MA.

1870. Report on the Invertebrata of Massachusetts. . .comprising the Mollusca. 2nd. ed., W. G. Binney, 524 p. Wright and Potter, Boston, MA.

GRAINGER, E. H. 1959. The annual oceanographic cycle at Igloolik in the Canadian Arctic, 1. The zooplankton and physical and chemical observations. J. Fish. Res. Board Can. 16: 453–501.

1960. Some physical oceanographic features of southeast Hudson Bay and James Bay. Fish. Res. Board Can. MS Rep. Ser. (Oceanogr. Limnol.) 71: 20 p.

GRANT, U. S., IV, AND H. R. GALE. 1931. Catalogue of the marine Pliocene and Pleistocene Mollusca of California and adjacent regions. San Diego Soc. Nat. Hist. Mem. 1: 1036 p.

GRAU, G. 1959. Pectinidae of the eastern Pacific. Allan Hancock Pacific Expeditions. Univ. South. Calif. Publ. 23: 1–308.

GRAY, J. E. 1824. Shells. *In* Supplement to the Appendix to Captain Parry's first voyage for the discovery of a North West Passage in the year 1819–20. Nat. Hist. no. 10, Zool. App. 10: 240–246. John Murray, London.

1839. Molluscous animals and their shells, p. 101–155. *In* F. W. Beechey, The zoology of Captain Beechey's voyage. H. G. Bohn, London.

GRIEG, J. A. 1909. Brachiopods and molluscs with a supplement to the echinoderms. Rep. Second Norwegian Arctic Expedition in the "Fram" 1898–1902. 3(20): 95. Brøgger, Kristiania.

GUR'IANOVA, E. F. 1970. Peculiarities of the fauna of the North Polar Ocean and their importance in understanding the history of its formation, p. 126–156. *In* A. I. Tolmachev [ed.] North Polar Ocean. [Osobennosti fauny severnogo Polarnogo Okeana i ikh znachenie v ponimanii istorii ego obrasovania.] Hydrometizdat Leningrad. (In Russian)

HACHEY, H. B., F. HERMAN, AND W. B. BAILEY. 1954. The waters of the I.C.N.A.F. convention area. ICNAF Ann. Proc. 4: 67–100.

HALKETT, A. 1898. List of zoological specimens collected by Dr. W. Wakeham and Mr Low . . . Hudson Bay and Strait. *In* W. Wakeham. Report on the expedition to Hudson Bay and Cumberland Gulf in the steamship "Diana." Mar. Fish. Can. Pap. 11B: 80–83. Dawson, Ottawa.

HALL, C. A. JR. 1964. Shallow-water marine climates and molluscan provinces. Ecology 45(2): 226–234.

HANCOCK, A. 1846. A list of shells dredged on the west coast of Davis Strait; with notes and descriptions of eight new species. Ann. Mag. Nat. Hist. Ser. 1, Vol. 18, Pap. 30: 323–338. London.

HANLEY, S. C. T. 1860. Monograph of the family Nuculidae, former the Lamarckian genus *Nucula*, p. 105–168. *In* G. B. Sowerby, The Thesaurus Conchyliorum, Vol. 3(20). Sowerby, London.

HUGHES, T., G. H. DENTON, AND M. G. GROSSWALD. 1977. Was there a late-Würm Arctic ice sheet? Nature 266: 596–602.

IVES, J. D. 1964. Deglaciation and land emergence in northeastern Foxe Basin, N.W.T. Geogr. Bull. 21: 54–65.

JEFFREYS, J. G. 1872. The mollusca of Europe compared with those of eastern North America. Ann. Mag. Nat. Hist. (Ser. 4) 10: 237–247.

1877. The Post-Tertiary fossils procured by the late Arctic Expedition, with notes on some of the recent or living mollusca. Ann. Mag. Nat. Hist. (Ser. 4) 20: 229–242.

JENNES, J. J. 1953. The physical geography of the waters of the western Canadian Arctic. Geogr. Bull. 4: 33–64.

JENSEN, AD. S. 1900. Studier over nordiske Mollusker, I. *Mya*. Vidensk. Medd. Dan. Naturhist. Foren. Bd. 62: 133–158. Kjøbenhavn.

1904. Studier over nordiske Mollusker, III: 21–51 *Tellina* (*Macoma*). Vidensk. Medd. Dan. Naturhist. Foren. Kjøbenhavn (1905). p. 21–51.

1905. On the Mollusca of East Greenland. I. Lamellibranchiata. Medd. om Grønland. 29(9): 289–362. Copenhagen.

1912. Lamellibranchiata I. The Danish Ingolf Expedition 2(5): 1–119. Bianko Luno, Copenhagen.

JOHNSON, C. W. 1915. Fauna of New England. List of the Mollusca. Occ. Pap. Bost. Soc. Nat. Hist. 7(13): 231 p.

1926. A list of the Molluscs collected by Mr. Owen Bryand along the coasts of Labrador, Newfoundland and Nova Scotia. Nautilus 40(19): 128–135.

1934. A list of marine Mollusca of the Atlantic coast from Labrador to Texas. Bost. Soc. Nat. Hist. Proc. 40(1): 204 p.

KEEN, M. A., AND E. COAN. 1974. Marine molluscan genera of western North America. An illustrated key. Stanford Univ. Press, Stanford, CA. 208 p.

KINDLE, E. M., AND H. G. WHITTAKER. 1918. Bathymetric check-list of marine invertebrates of eastern Canada. Contrib. Can. Biol. Sess. Pap. 38a (14): 229–294.

KOBIAKOVA, Z. I. 1960. Benthos of the Norway-Iceland region as an indicator of water conditions. Zool. Zh. 39(3): 321–327.

LAROCQUE, A. 1953. Catalogue of recent Mollusca of Canada. Natl. Mus. Can. Bull. 129: 406 p.

LAURSEN, D. 1946. Quaternary shells collected by the Fifth Thule Expedition 1921–24. *In* Report of the Fifth Thule expedition 1921–24. 1(7): 59 p. Nordisk Forlag, Copenhagen.

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

LAUZIER, L. M., AND J. H. HULL. 1962. Sea temperatures along the Canadian Atlantic Coast. Prog. Rep. Atl. Coast Stn. Fish. Res. Board Can. 73: 11–15.

LEACH, W. E. 1819. A list of invertebrate animals, discovered by H.M.S. *Isabella* in a voyage to the Arctic regions: corrected by W. E. Leach, p. 169–179. *In* Sir John A. Ross, A Voyage of Discovery . . . for the purpose of exploring Baffin

Bay. Vol. 2, App. 4. Murray, London.
LECHE, W. 1883. Öfversigt öfver de af Vega-Expeditionen insamlade arktiska hafsmollusker. I. Lamellibranchiata. Vega-Exped. Vetensk. Iakttagelser 3: 433-54. Stockholm.
LINNÉ, C. 1758. Systema naturae, per regna triae naturae . . . . Editio decima reformata. 1. Regnum animale. iii + 824 p. Stockholm.
1767. Systema naturae per regna triae naturae . . . . Editio duodecima reformata. I(2): 533-1327. Stockholm.
LØKEN, O. H. 1962. The late-glacial and postglacial emergence and deglaciation of northernmost Labrador. Geogr. Bull. 17: 23-56.
LOWDON, J. A., AND W. BLAKE JR. 1968. Geological survey of Canada: radiocarbon dates VII. Geol. Surv. Can. Pap. 68-2(B): 207-245.
1970. Geological Survey of Canada: radiocarbon dates IX. Geol. Surv. Can. Pap. 70-2(B): 86.
LOWDON, J. A., J. G. FYLES, AND W. BLAKE JR. 1967. Geological Survey of Canada radiocarbon dates VI. Geol. Surv. Can. Pap. 65-2B: 22-72.
LUBINSKY, I. 1958. Studies on *Mytilus edulis* L. of the "Calanus" Expeditions to Hudson Bay and Ungava Bay. Can. J. Zool. 36: 869-881.
1967. Distribution and growth rates of *Mytilus edulis* L. in the Canadian Arctic. Annu. Rep. Am. Malacol. Union 1967: 17 p.
1976. *Thyasira dunbari* n. sp. (Bivalvia, Thyasiridae) from the Canadian Arctic Archipelago. J. Fish. Res. Board Can. 33: 1667-1670.
LYELL, CH. 1845. Travels in North America with geological observations in the United States, Canada and Nova Scotia. 1: 316 p.; 2: 272 p. Wiley and Putnam, New York.
MACGINITIE, N. 1959. Marine mollusca of Point Barrow, Alaska. Proc. U.S. Natl. Mus. 109: 59-208.
MACNEIL, F. S. 1965. Evolution and distribution of the genus *Mya*, and Tertiary migrations of mollusca. U.S. Geol. Surv. Prof. Pap. 483-G: 51.
MADSEN, H. 1949. Marine bivalvia. Zoology of Iceland 4(63): 1-116. Ejnar Munksgaard, Copenhagen.
MEYER, H. A., AND MOEBIUS K. A. 1872. Fauna der Kieler Bucht. Bd. 1(2), Die Prosobranchiata und Lamellibranchiata. XXIV + 139 p. W. Engelmann, Leipzig.
MIGHELS, J. W., AND C. B. ADAMS. 1842. Description of 24 species of the shells of New England. Bost. J. Nat. Hist. 4(1): 37-54.
MILOSLAVSKAIA, N. M. 1958. Temperature as the factor in distribution of bivalve molluscs of the eastern Murman. Proc. Murman. Biol. Sta. IV: 140-147. (In Russian)
MØLLER, H. P. C. 1842. Index Molluscorum Groenlandiae. Danske Naturh. Tidskr. Ser. 1(4): 76-97. Kjøbenhaven.
MONTAGU, G. 1805-1808. Testacea Britannica or natural history of British shells. 2, Suppl: V + 184 p. S. Woolmer, Exeter
MØRCH, O. L. A. 1857. Fortegnelse over Gronlands Bloddyr. *In* H. T. Rink, Grønland. . . Natur historiske Bidrag. 2(4): 75-100. (Separate: Prodromus, Molluscorum Grønlandiae)
MOSSEWITSCH, N. A. 1928. Beiträge zur Systematik, Oekologie and Verbreitung der recenten und fossilen *Yoldia arctica* Gray. Materials of the commission on the study of the Yakutsk. Autonom. Social. Sov. Rep. Ak. Nauk SSSR. 19: 1-37. Yakutsk.
MÜLLER, O. F. 1776. Zoologiae Danicae Prodromus, seu Animalium Daniae et Norvegiae indigenarum, characteres, nomina et synomina. Imprimus popularum, XXXII + 282 p. Havniae.
1779. Von zwoen wenig bekannten Muscheln. Verh. Ges. Naturforsch. Freunde zu Berlin 4: 55 p.
NESIS, K. N. 1959. Distribution of the boreal bottom animals at the shores of western Spitzbergen. Akad. Nauk USSR. Doklady 127(3): 677-680. (In Russian)
1960. Changes in the bottom fauna of the Barents Sea due to fluctuation of the hydrological regime. Sov. Fish. Invest. North Eur. Seas. p. 129-138. Moscow. (In Russian)
1963a. Pacific elements in northwest Atlantic benthos, p. 82-99. *In* Yu. Yu. Marti [ed.] Soviet Fisheries Investigations in the Northwest Atlantic. Rybn. Khos. Moskwa. (Transl. from Russian by Israel Program for Sci. Transl. Jerusalem, No. 994, 1963)
1963b. Soviet investigations of the benthos of the Newfoundland-Labrador fishing area, p. 214-220. *In* Yu. Yu. Marti [ed.] Soviet Fisheries Investigations in the Northwest Atlantic. Rybn. Khos. Moskwa. (Transl. from Russian by Israel Program for Sci. Transl. Jerusalem, No. 994, 1963)
1965. Biocenoses and biomass of the benthos of the Newfoundland-Labrador region. Tr. Issled. Inst. Morsk. Rybn. Khos. 57: 453-489. (In Russian)
OCKELMANN, W. K. 1954. On the interrelationship and the zoogeography of northern species of *Yoldia* Møller, s. str. (Mollusca, Fam. Ledidae) with a new subspecies. Medd. om Grønland 107(7): 32.
1958. The zoology of East Greenland. Marine Lamellibranchiata. Medd. om Grønland 122(4): 1-256, pl. 1-3.
1965. Developmental types in marine bivalves and their distribution along the Atlantic coast of Europe. Proc. 1st. Eur. Malac. Congr. 1962: 25-35.
OLDROYD, I. S. 1924. The marine shells of the West Coast of North America. 1(1): 247 p., 57 pl. Stanford Univ. Publ. Stanford.
PACKARD, A. S. 1863. A list of animals dredged near Caribou Island, Southern Labrador, during July and August, 1860, Can. Nat. Geol. 8: 401-429.
1867. Observations on the glacial phenomena of Labrador and Maine, with a view of the recent invertebrate fauna of Labrador. Bost. Soc. Nat. Hist. Mem. 1(2): 210-303.

1883. Additional list of Mollusca from Labrador. In the paper by K. Bush, 1883.

1891. The Labrador coast. Journal of the two summer cruises to that region. . . . and natural history. 513 p. N.D.C. Hodges, New York.

PARR, A. E. 1933. A geographical–ecological analysis of the seasonal changes in temperature conditions in shallow water along the Atlantic coast of the United States. Bull. Bingham Oceanogr. Collect. 4(3): 1–90.

PELLETIER, B. R. 1964. Development of submarine physiography in the Canadian Arctic and its relation to crustal movements. Rep. B.I.O. 64-16: 45 p.

1968. Submarine physiography, bottom sediments and models of sediment transport, p. 105–135. *In* P. J. Hood [ed.] Earth science Symposium on Hudson Bay. Geol. Surv. Can. Pap. 68-53.

PELLETIER, B. R., F. J. E. WAGNER, AND A. C. GRANT. 1968. Marine geology, p. 557–613. C. S. Beals [ed.] Science, History and Hudson Bay. Vol. 2. Queen's Printer, Ottawa.

PENNANT, T. 1777. British Zoology. 4th. ed. 4: 327 p. London.

PHILIPPI, R. A. 1845. Bemerkungen über die Molluskenfauna von Massachusetts. Zeitschr. d. Malakozoologie 2: 68–79.

PFEFFER, G. 1886. Mollusken, Krebse und Echinodermen von Cumberland-Sund. Deutsche Nord Polar Exped. Jahrb. Hamb. Wiss. Anst. 3: 23–50.

PREST, V. K. 1969. Retreat of Wisconsin and recent ice in North America. Geol. Surv. Can. Map 1257 A.

1970. Quaternary geology of Canada, p. 676–764. *In* R. J. W. Duglas [ed.] Geology and economic minerals of Canada. Geol. Surv. Can., Econ. Geol. Rep. 1: 838. Queen's Printer, Ottawa.

PREST, V. K., D. R. GRANT, AND N. RAMPTON. 1974. Glacial geology with maximum marine overlap. National Atlas of Canada, Map 33–34. Macmillan Co., Toronto.

PYLE, R. L. 1962. Sea surface temperature regime in the west north Atlantic 1953–54. Am. Geogr. Soc. Serial Atlas Mar. Environ. Folio 1: 2 p.

REEVE, L. 1855. Account of the shells collected by Capt. Sir Edward Belcher, north of Beechey Island. *In* Belcher: The Last of the Arctic voyages. 2: 392–399.

RICHARDS, H. G. 1936. Recent and pleistocene marine shells of James Bay. Am. Midl. Nat. 17: 528–545.

1941. Post-Wisconsin fossils from the west coast of Hudson Bay. Not. Nat. Acad. Nat. Sci. Philadelphia 84: 10.

1962. Studies on the marine Pleistocene. Part I. The marine Pleistocene of the Americas and Europe. Part II. The Marine Pleistocene molluscs of eastern North America. Trans. Am. Philos. Soc. N.S. 53(3): 141 p.

RODGER, A. 1893–95. Preliminary account of natural history collections made on a voyage to the Gulf of St. Lawrence and Davis Straits. Proc. R. Dubl. Soc. 20: 154–163.

SARS, G. O. 1878. Bidrag til Kundskaben om Norges Arktiske Fauna. I. Mollusca regionis Arcticae Norvegiae. xvi: 466 p. W. W. Brøgger, Christiania.

SARS, M. 1865. Om de i Norge forekommende fossile Dyrelevninger era Quartaer perioden. 217 p. Kristiania.

SCHENCK, H. G. 1939. Revised nomenclature for some nuculid pelecypods. J. Paleontol. 13(1): 21–41.

SCHLESCH, H. 1931. Kleine Mitteilungen VII. Beitrag zur Kenntniss der marinen Mollusken-Fauna Islands. 1, 2. Arch. Molluskenkunde. 4(5): 133–155.

SCHROEDER, E. H. 1963. North Atlantic temperatures at a depth of 200 metres. Am. Geogr. Soc. Serial Atlas Mar. Environ. Folio 2: 2 p.

SCHUMACHER, H. C. F. 1817. Essai d'un nouveau système des habitations des vers testacés. iv + 287 p. Copenhagen.

SEGESTRALE, S. G. 1960. Investigations on Balthic populations of the bivalve *Macoma balthica* (L). Societas Scientiarum Fennica. Commentationes Biologicae. XXIII(2): 1–72. Ejnar Munskgaard, Kobenhavn.

SMITH, A. E. 1877. On the Mollusca collected during the Arctic Expeditions of 1875–76. Ann. Mag. Nat. Hist. Ser. 4(20): 131–146. London.

1878. Mollusca, p. 223–233. *In* G. S. Nares. Alert and Discovery. Narrative of a Voyage to the Polar Sea 1875. Vol. 2. Searle and Rivington, London.

SMITH, M. 1951. East coast marine shells. 4th ed. 314 p. Edwards Brothers. Ann Arbor, MI.

SOOT-RYEN, T. 1932. Pelecypoda, with a discussion of possible migrations of Arctic pelecypods in Tertiary times. The Norwegian North Polar Expedition with the "Maud" 1918–25, scientific results. 5(12): 1–35. Geofysisk Inst., Bergen.

1941. Northern pelecypods in the collection of Thromsø Museum. 1. Order Anomalodesmacea. Thromsø Mus. Arshefter. 61(1): 1–41.

SOWERBY, G. B. 1842. Thesaurus Conchyliorum or figures and descriptions of Recent shells. Part 2. Monographs of the genera *Pecten* and *Hinnites*. p. 45–80. Sowerby, London.

STAFFORD, J. 1912. On the fauna of the Atlantic coast of Canada. Contrib. Can. Biol. p. 33–78.

STEENSTRUP, J. J. S. 1842. *In* G. B. Sowerby. Thesaurus Conchyliorum. Vol. 3. Sowerby, London.

STEWART, R. B. 1930. Gabb's California cretaceous and tertiary type Lamellibranchs. Acad. Nat. Sci. Philadelphia Spec. Publ. 3: 309 p.

STIMPSON W. 1851. Shells of New England. A review of the synonymy of the testaceous molluscs of New England, with notes of their structure, and their geographical and bathymetrical distribution. 56 p. Boston, MA.

1861. On the marine shells brought by Mr. Drexler from Hudson Bay. Proc. Acad. Nat. Sci. Philadelphia 13: 97.

1862. Check list of the shells of N. America, East coast, Arctic seas to Georgia. Smithson. Misc.

Collect. 2, Art. 6(2): 1–6.

1864. Synopsis of the marine invertebrata collected by the late Arctic Expedition under I. I. Hayes. Proc. Acad. Nat. Sci. Philadelphia. p. 138–142.

STRAUCH, F. 1972. Phylogenese, Adaptation und Migration einiger nordischer mariner Molluskengenera. Abh. Senckenb. Naturforsch. Ges. 531: 210 p.

SUTHERLAND, P. C. 1852. Journal of a voyage in Baffin's Bay and Barrow Straits in the years 1850–1851 performed by H.M.S. "Lady Franklin" and "Sophia." App., Zool. 2: 133.

TAYLOR, A. 1955. Geographical discovery and exploration in the Queen Elizabeth Islands. Dep. Mines Tech. Surv. Geogr. Br. Mem. 3: 172.

THORSON, G. 1936. The larval development, growth, and metabolism of Arctic marine bottom invertebrates. Medd. om Grønl. 100(6): 155.

1951. The Godthaab Expedition 1928. Scaphopoda, Placophora, Solenogasters, Gastropoda Prosobranchiata, Lamellibranchiata. Medd. om Grønl. 81(2): 117.

TIMOFEYEV, V. T. 1960. Water masses of the Arctic Basin. Gidrometizdat. 191 p. Leningrad. (In Russian)

TORELL, O. M. 1859. Bidrag till Spitsbergens Molluskfauna. I. Akad. Afhandling. 154 p. Stockholm.

TOTTEN, J. G. 1834. Descriptions of some shells, belonging to the coast of New England. Am. J. Sci. 28(2): 347–353.

TULLY, J. 1952. Oceanographic data of the western Canadian Arctic Region. J. Fish. Res. Board Can. 8: 378–382.

VALENTINE, J. W. 1973. Evolutionary paleoecology of the marine biosphere. Prentice-Hall Inc., Englewood Cliffs. N.J. 511 p.

VERRILL, A. E. 1873. Report upon the invertebrate animals of Vineyard Sound and adjacent waters. Mollusca. Rep. U.S. Fish. Comm. 1871–72. p. 634–698.

1882. Catalogue of the marine Mollusca added to the fauna of the New England region during the past ten years. Trans. Conn. Acad. Arts Sci. 5(6): 447–587.

1884. Second catalogue of Mollusca recently added to the fauna of the New England coast and the adjacent parts of the Atlantic. Trans. Conn. Acad. 6: 139–294.

1885. Third catalogue of Mollusca recently added to the fauna of the New England coast and the adjacent parts of the Atlantic. Trans. Conn. Acad. 6: 396–452.

VERRILL, A. E., AND K. J. BUSH. 1897. Revision of the genera of Ledidae and Nuculidae of the Atlantic coast of the United States. Am. J. Sci. 4(3): 51–63.

1898. Revision of the deep-water Mollusca of the Atlantic coast of North America, with descriptions of new genera and species. Part I. Bivalvia. Proc. U.S. Natl. Mus. 20: 775–901.

VERRILL, A. E., AND J. T. SMITH. 1874. Report upon the invertebrate animals of Vineyard Sound. Rep. U.S. Fish. Comm. 1871–72 . Pt. 1: 295–778.

WACASEY, J. W., E. G. WATKINSON, L. KINLOUGH, 1976. Zoobenthos data from James Bay, 1959, 1974. Fish. Mar. Serv. Tech. Rep. 661: 62.

WAGNER, F. J. E. 1962. Faunal report, submarine geology program, Polar Continental Shelf Project, Isachsen, District of Franklin. Geol. Surv. Can. Pap. 61-27: 1-10.

1964. Faunal report II marine geology program, Polar Continental Shelf Project, Isachsen, District of Franklin. Geol. Surv. Can. Rep. Bedford Inst. Oceanogr. 64-1: 15 p.

1967. Additional radiocarbon dates, Tyrell Sea areas. Marit. Sediments 3(4): 100–104.

1968. Faunal study, Hudson Bay and Tyrell Sea, p. 7–48. *In* P. Hood [ed.] Earth Science Symposium on Hudson Bay. Geol. Surv. Can. Pap. 68-53.

1970. Faunas of the Pleistocene Champlain Sea. Geol. Surv. Can. Bull. 181: 72 p.

1977. Recent mollusc distribution patterns and palaeobathymetry, southeastern Beaufort Sea. Can. J. Earth Sci. 14(9): 2013–2028.

WHITEAVES, J. F. 1869. On the marine Mollusca of eastern Canada. Can. Nat. N.S. 4: 48–57.

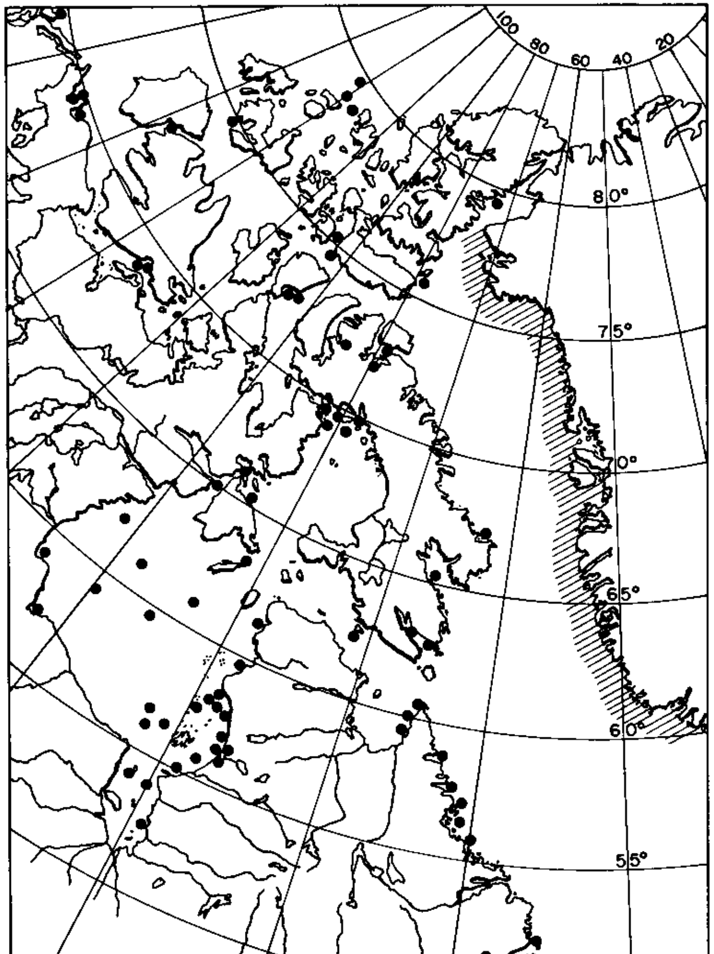
1872. Notes on a deep sea dredging expedition round the Island of Anticosti in the Gulf of St. Lawrence. Ann. Mag. Nat. Hist. Ser. 4(10): 341–354.

1881. Mollusca. *In* R. Bell: Report on Hudson's Bay Expedition. Report of progress, 1879, 1880. Geol. Surv. Can. Pt. C. App. 4: 75–76. Dawson Brothers, Montreal.

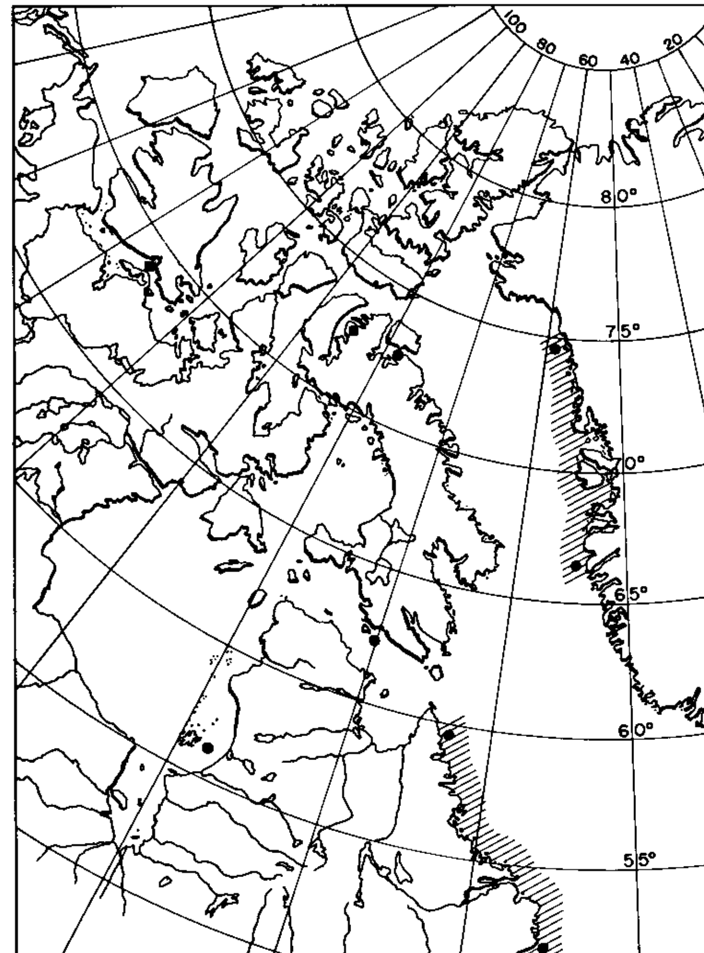
1885. List of marine invertebrates from Hudson's Strait. *In* R. Bell: Observations on the geology, mineralogy, zoology and botany, of the Labrador coast, Hudson's Strait and Bay. Geol. Surv. Can. Rep. Prog. 1882, 83, 84. App. Pt. DD: 58DD–60DD. Dawson Brothers, Montreal.

1901. Catalogue of the marine invertebrata of eastern Canada. Geol. Surv. Can. Publ. 772: 271 p.

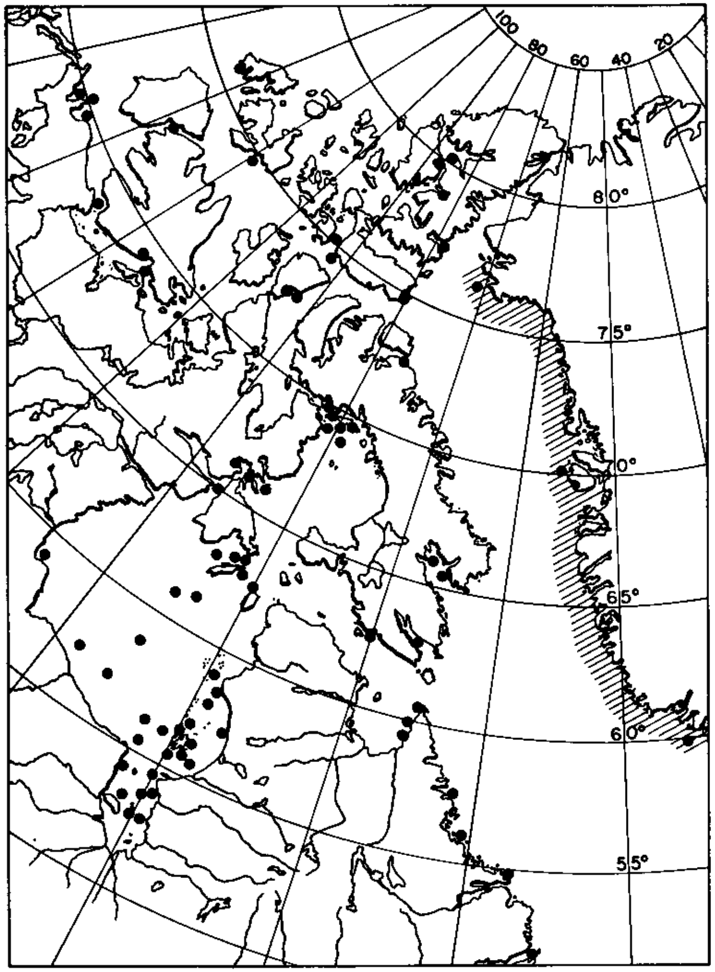
WOODWARD, S. P. 1856. A manual of the mollusca: a treatise of recent and fossil shells. 2nd ed. Virtue Brothers, London. xiv + 542 p.



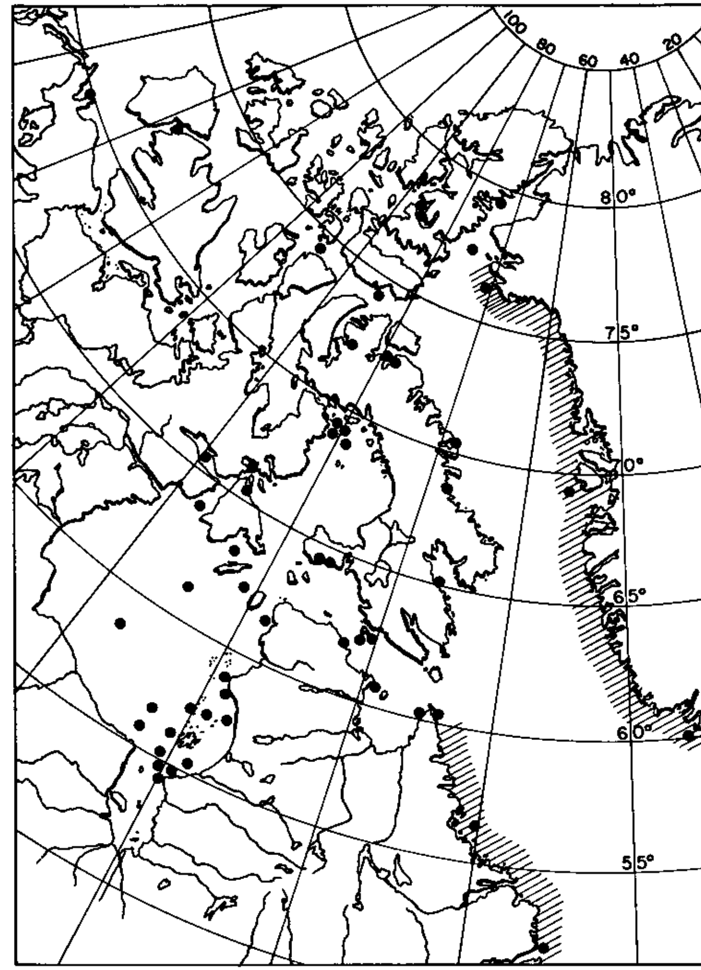
MAP 1. *Nucula belloti* Adams, p. 9



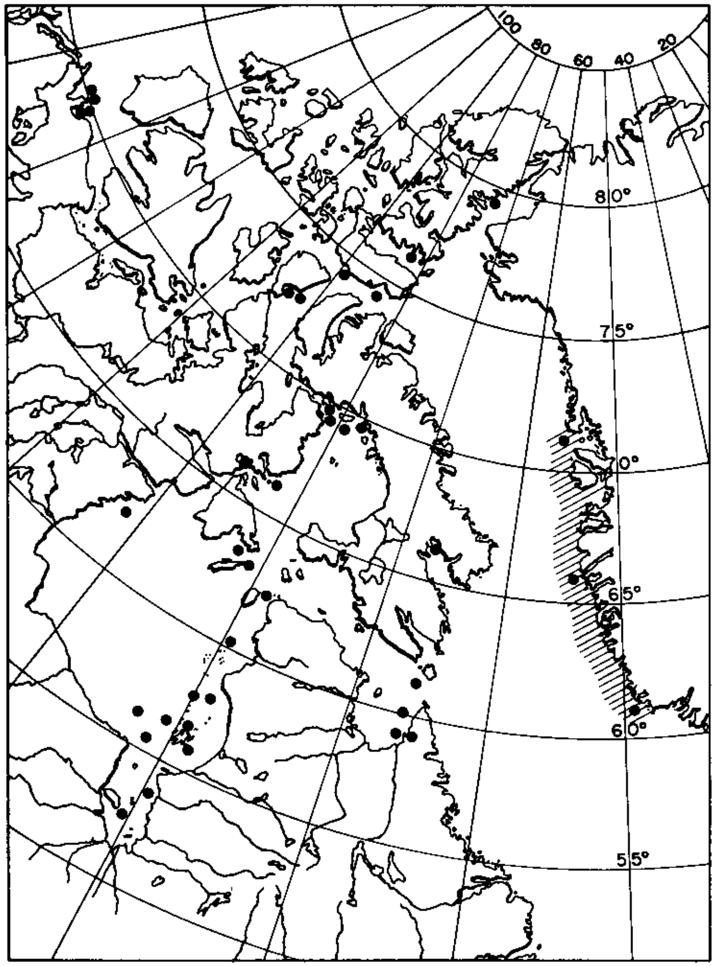
MAP 2. *Nucula delphinodonta* Migh. and Adams (●), p. 11; *Yoldiella fraterna* Verrill and Bush (■), p. 15



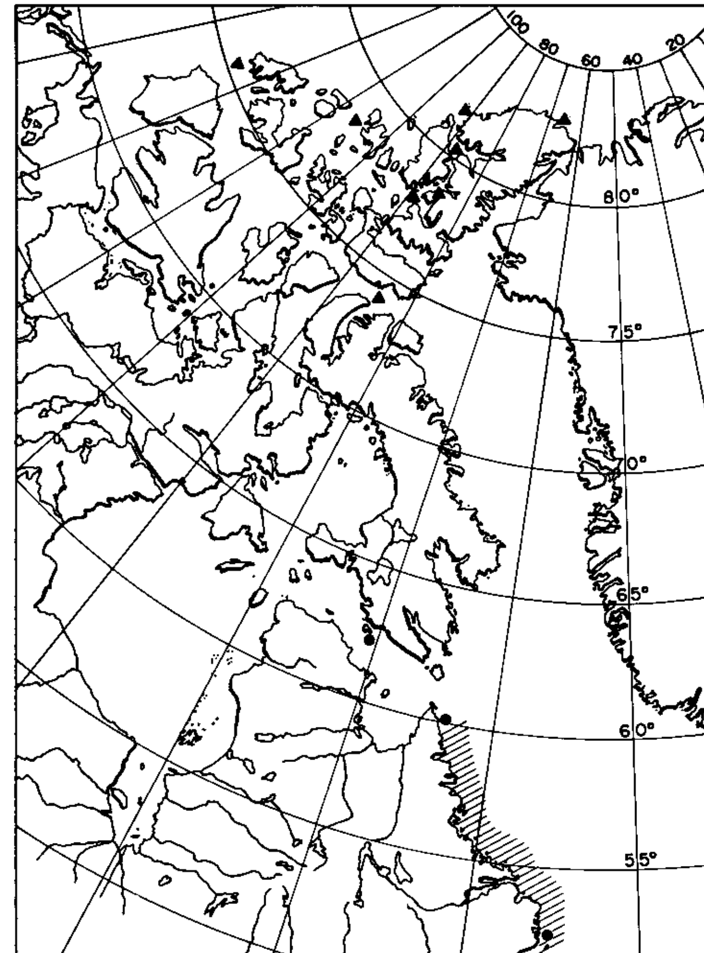
Map 3. *Nuculana pernula* (Müller), p. 11



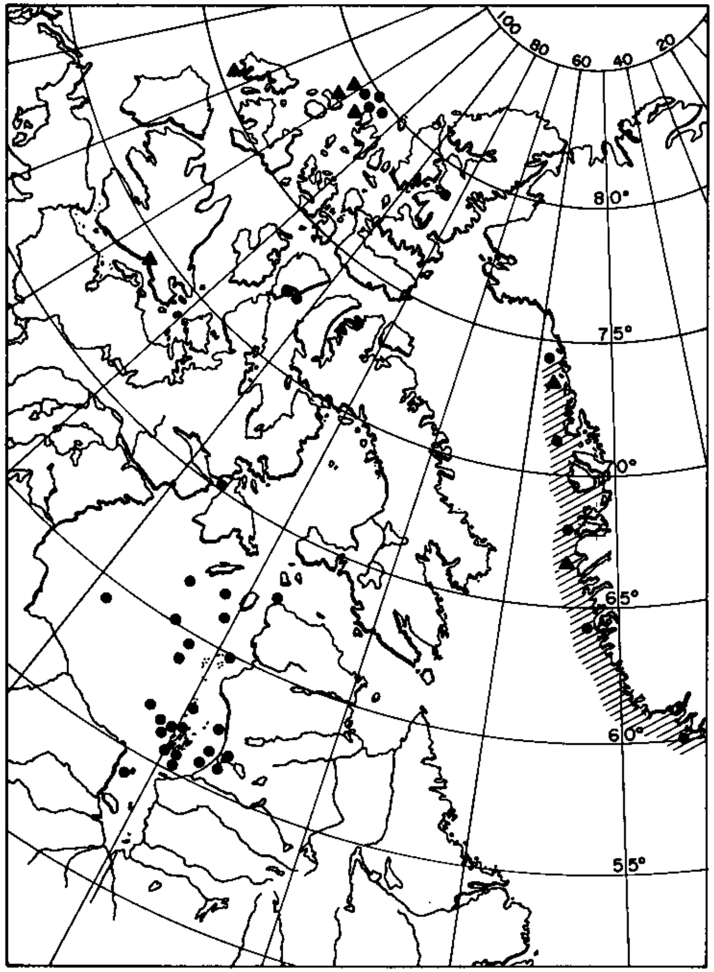
Map 4. *Nuculana minuta* (Fabricius), p. 14



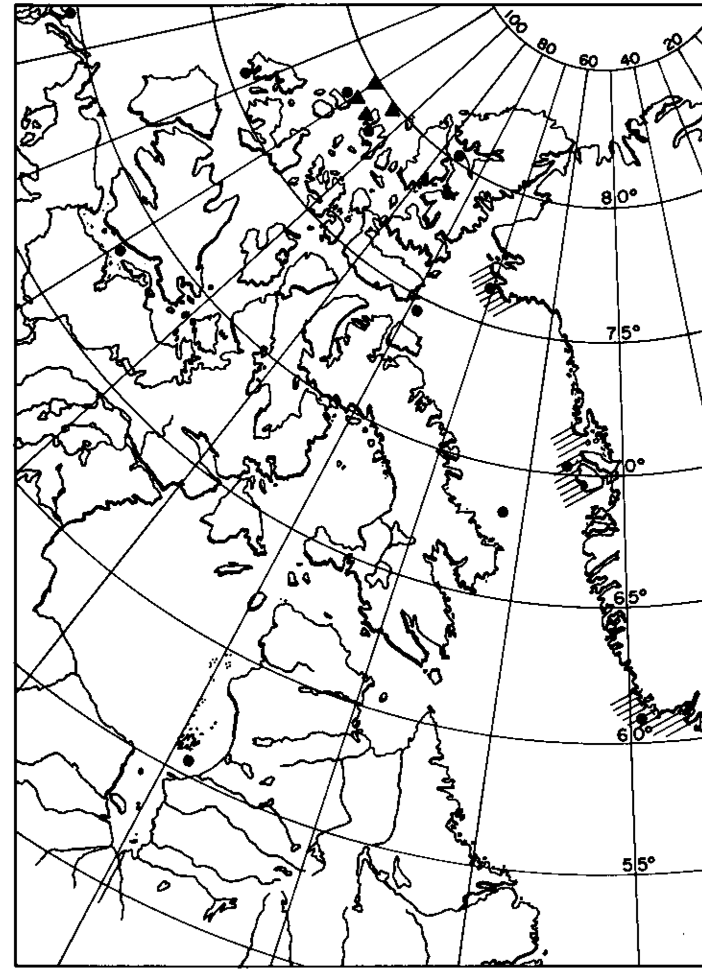
MAP 5. *Yoldia hyperborea* (Loven) Torell *hyperborea* Ockelmann, p. 14



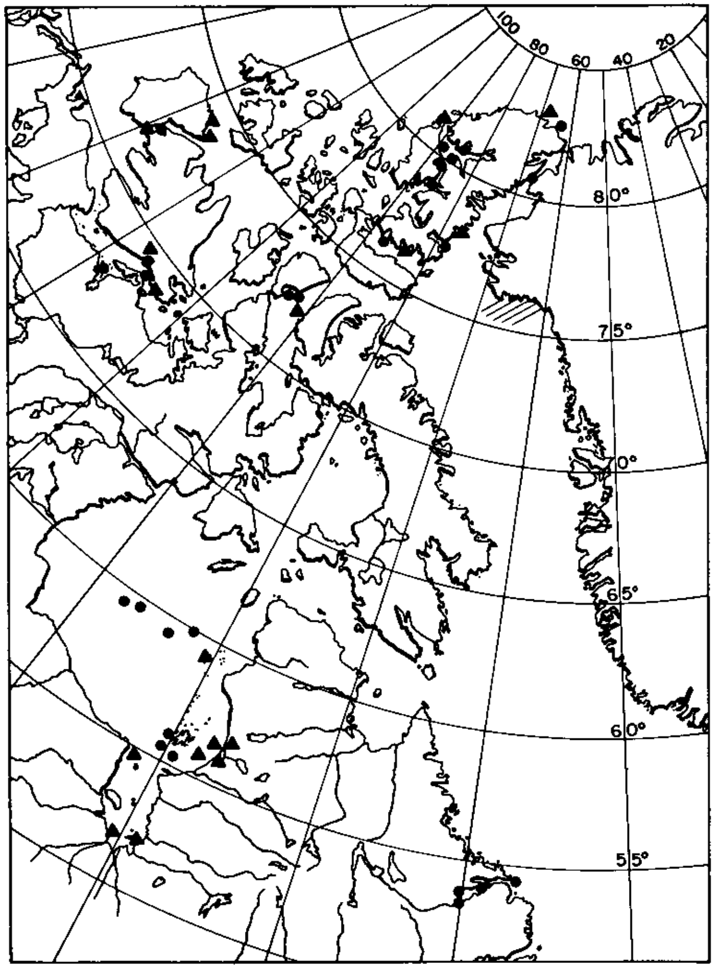
MAP 6. *Yoldia myalis* (Couthouy) (●), p. 15; *Portlandia sulcifera* (Reeve) (▲), p. 20



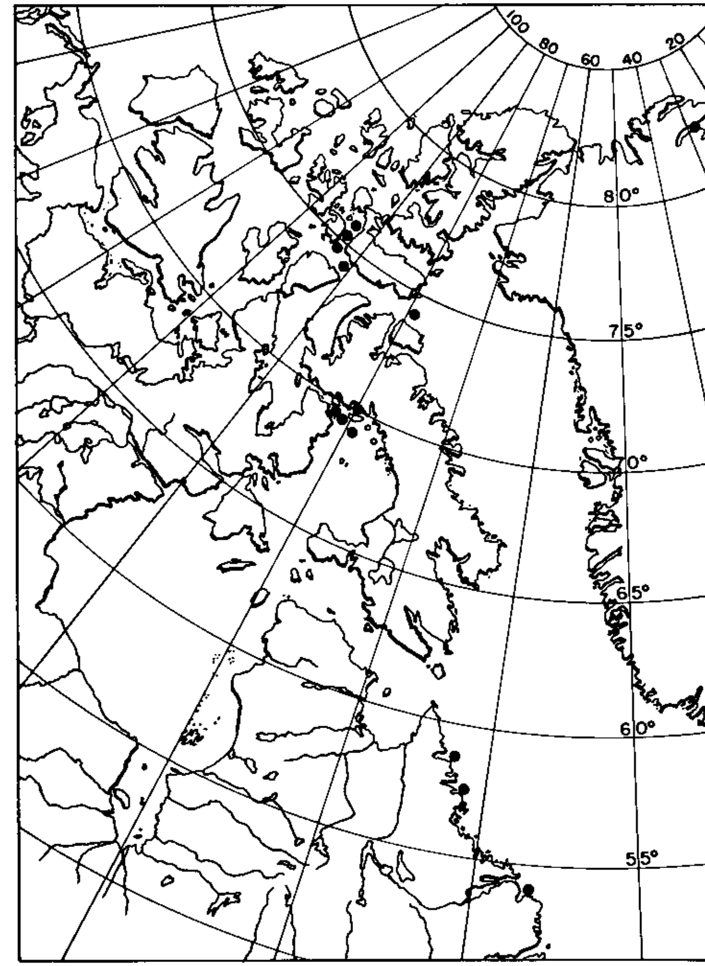
MAP 7. *Yoldiella lenticula* (Møller) (●), p. 16; *Y. frigida* (Torell) (▲), p. 16



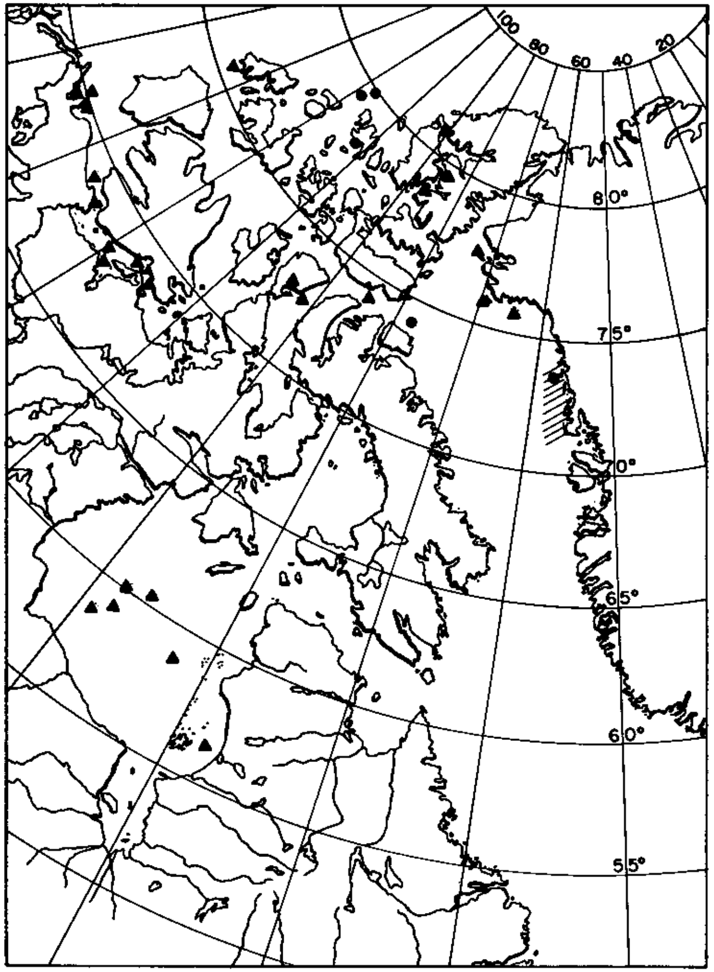
MAP 8. *Yoldiella intermedia* (M. Sars) (●), p. 16; *Y. tamara* (Gorbunov) (▲), p. 17



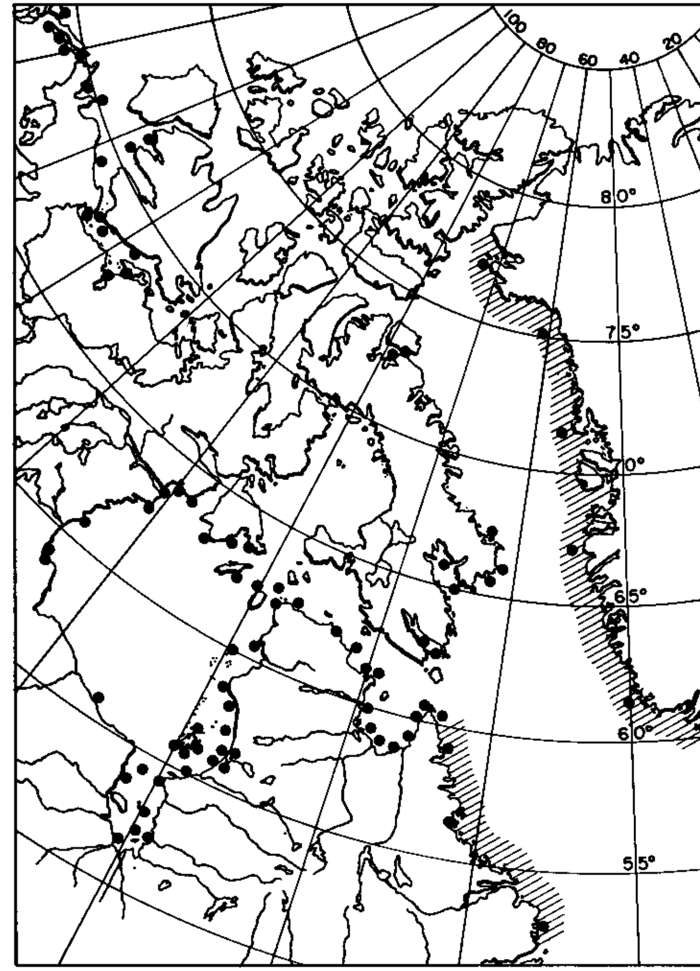
MAP 9. *Portlandia arctica arctica* (Gray) (●), p. 17; *P.a. portlandica* (Hitchcock) (▲), p. 17



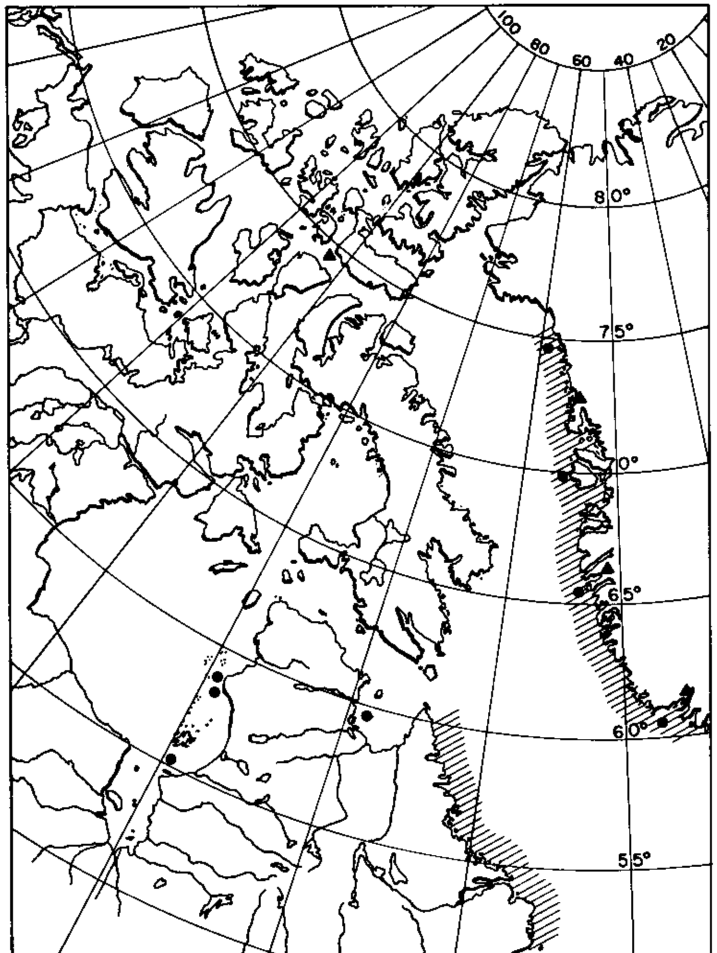
MAP 10. *Portlandia arctica siliqua* (Reeve), p. 17



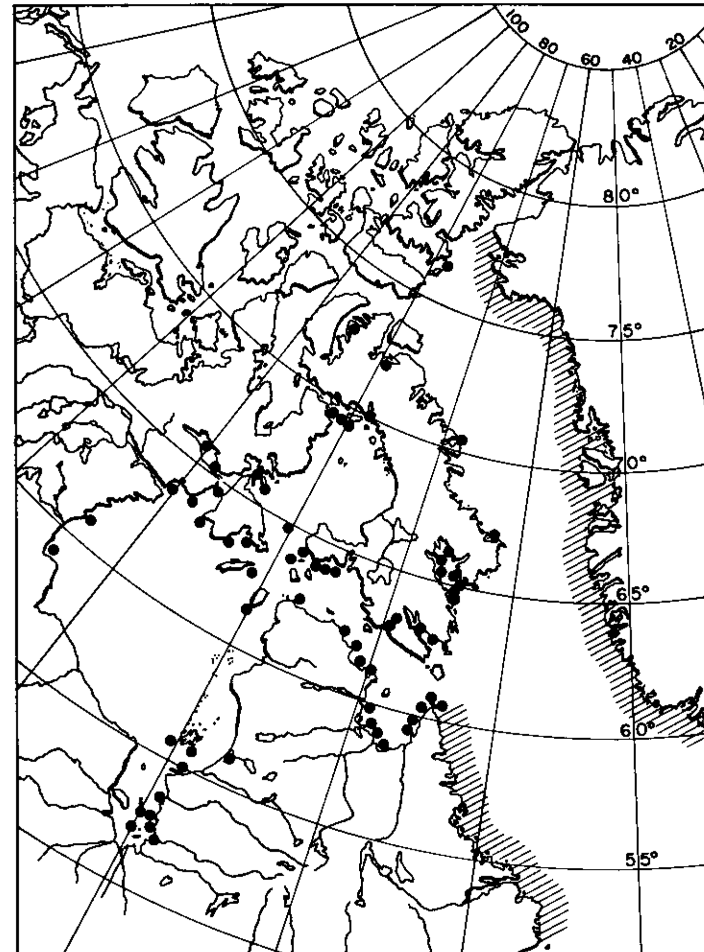
MAP 11. *Bathyarca glacialis* (Gray) (▲), p. 21; *B. frielei* (Friele) (●), p. 22



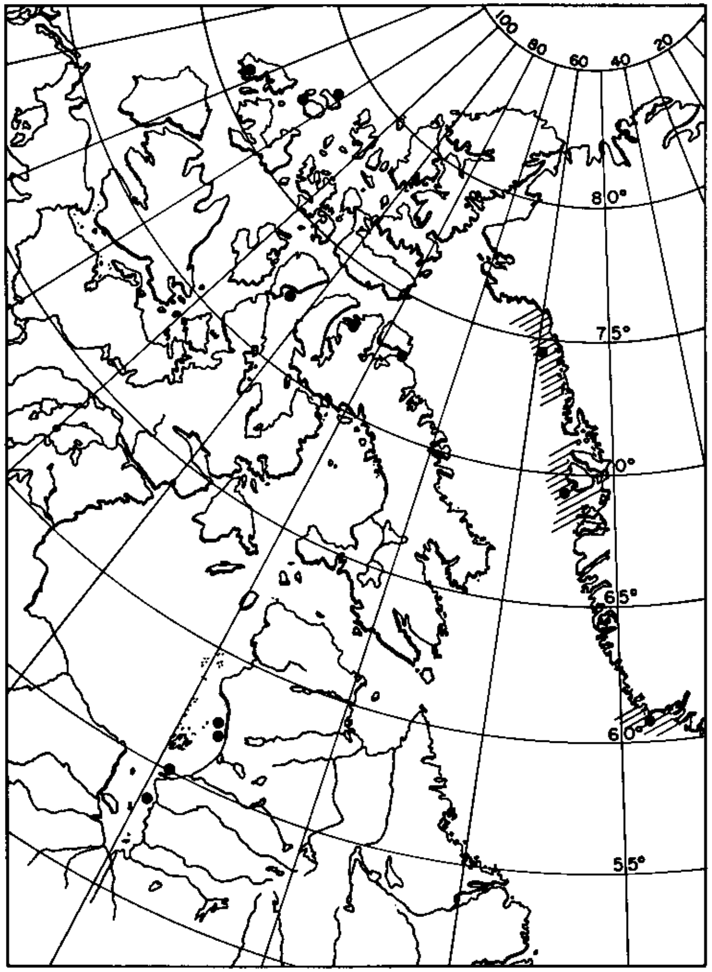
MAP 12. *Mytilus edulis* Linné, p. 22



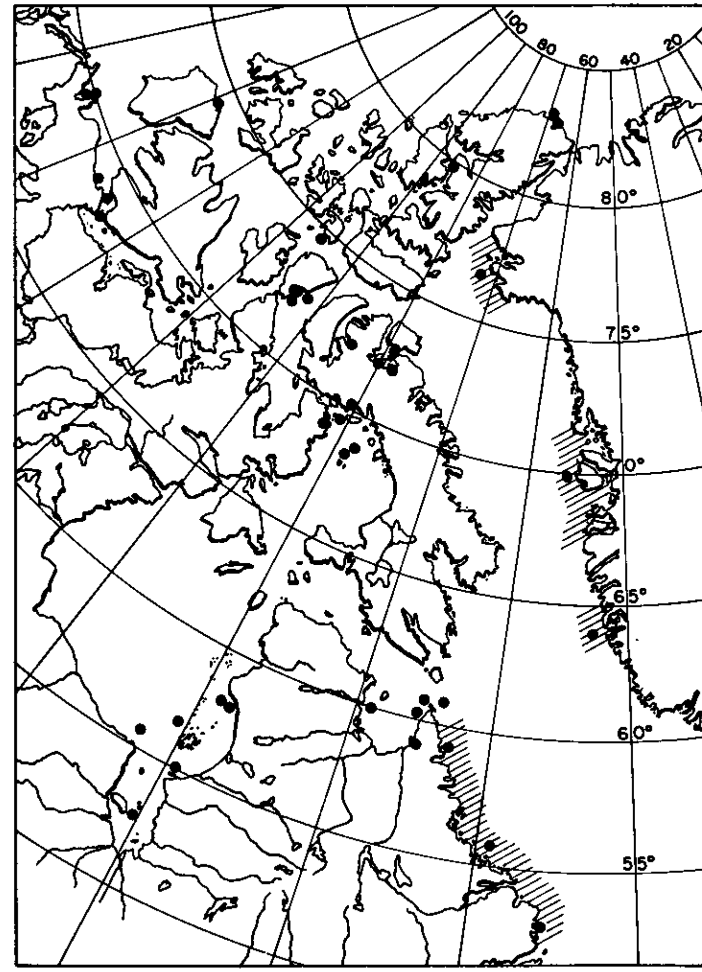
MAP 13. *Crenella decussata* (Montagu) (●), p. 24; *Lima subauriculata* (Montagu) (▲), p. 29



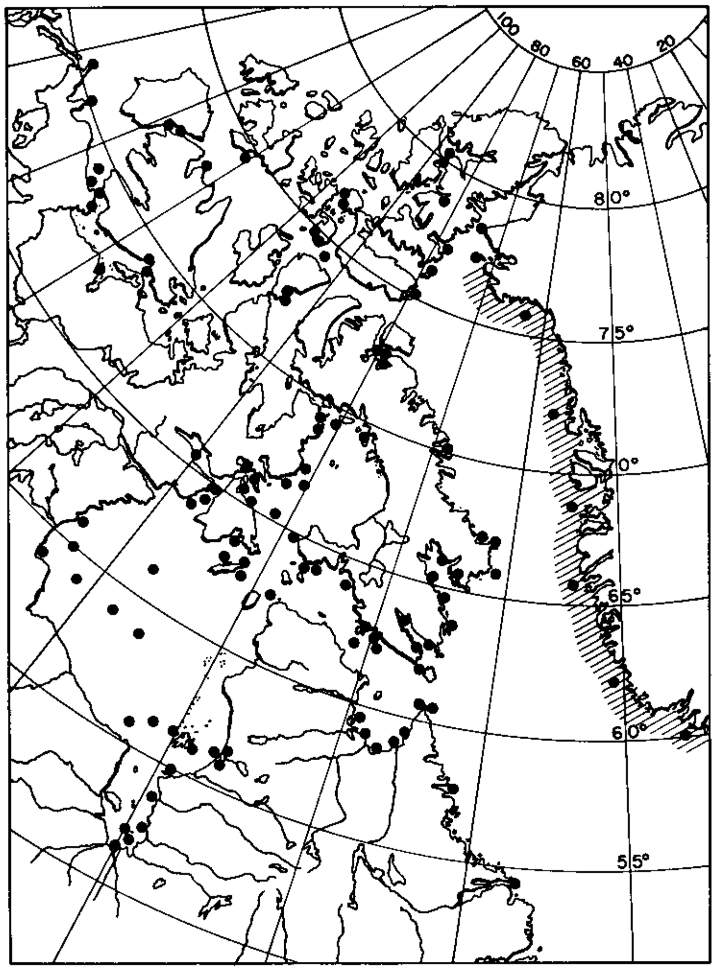
MAP 14. *Crenella faba* (Müller), p. 24



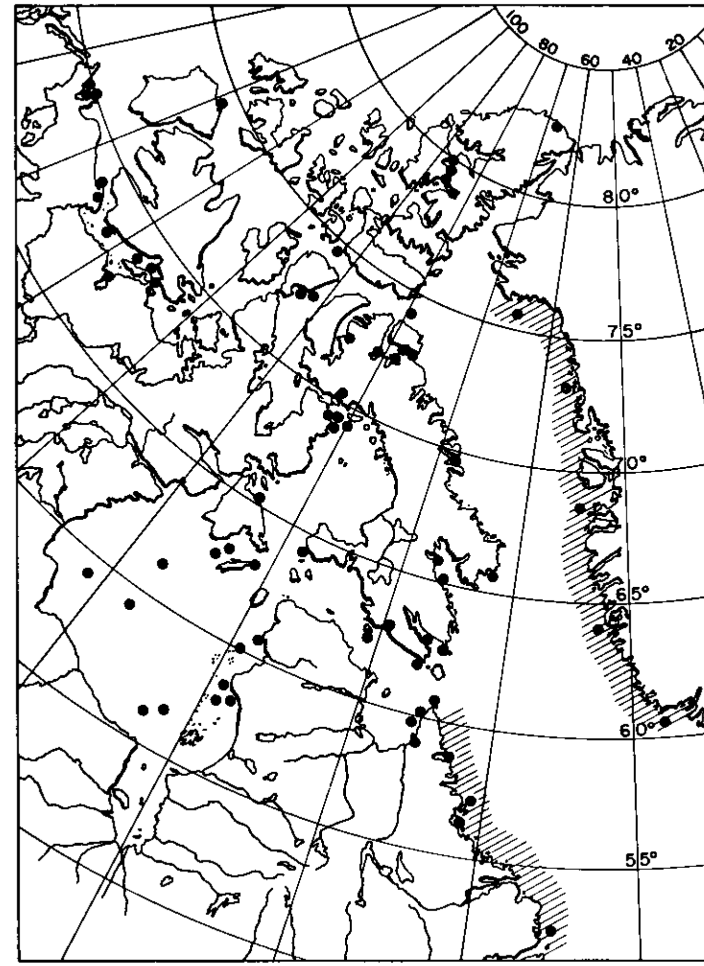
Map 15. *Dacridium vitreum* (Møller), p. 25



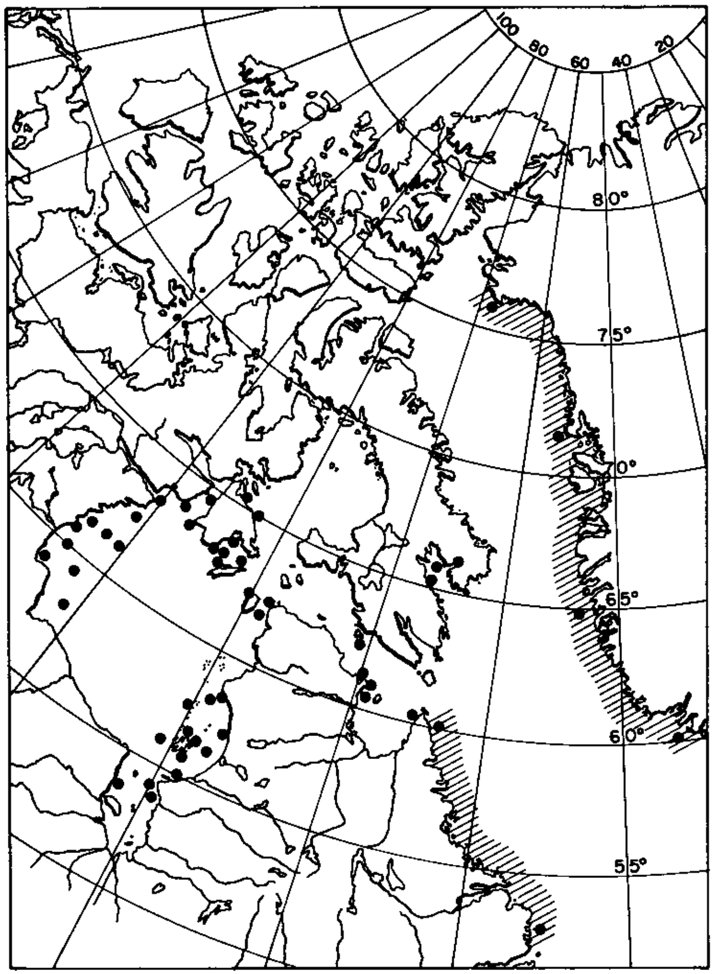
Map 16. *Musculus corrugatus* (Stimpson), p. 25



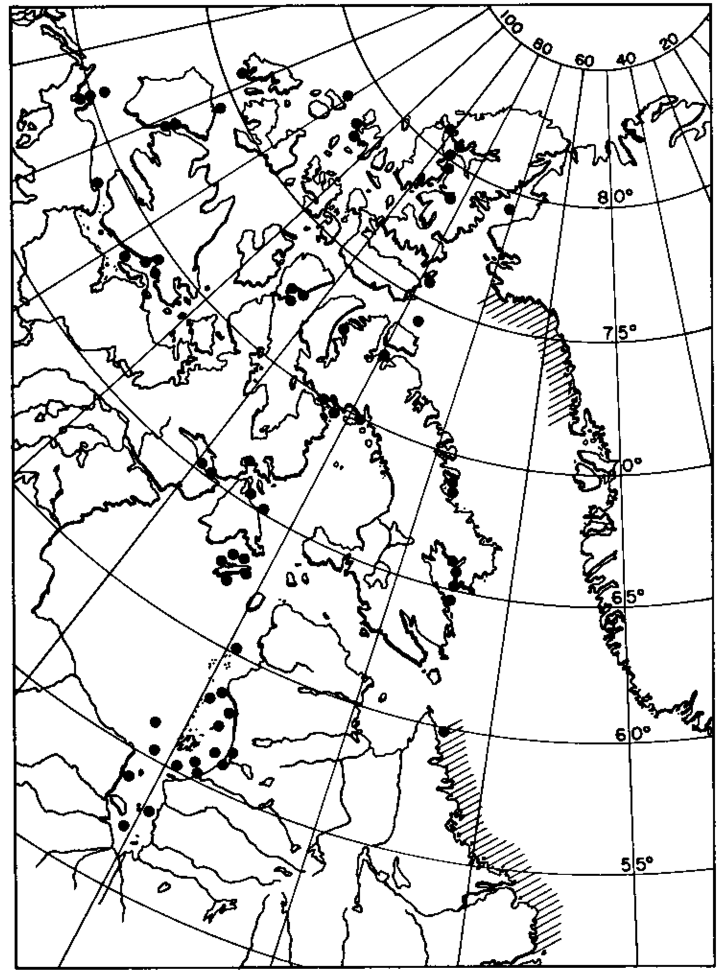
MAP 17. *Musculus discors* (Linné), p. 26



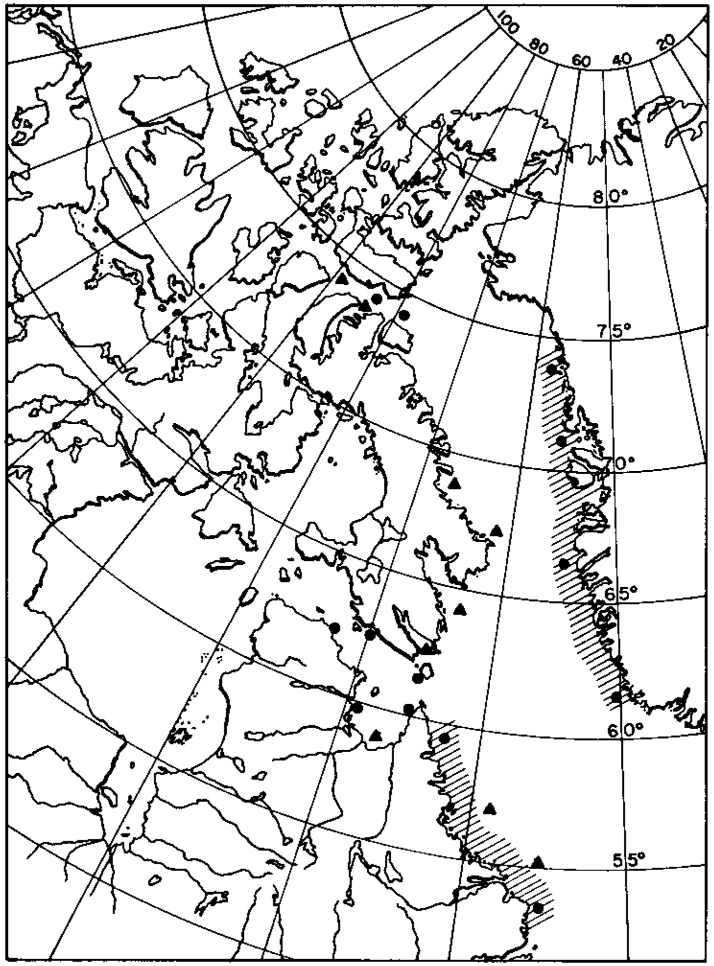
MAP 18. *Musculus niger* (Gray), p. 27



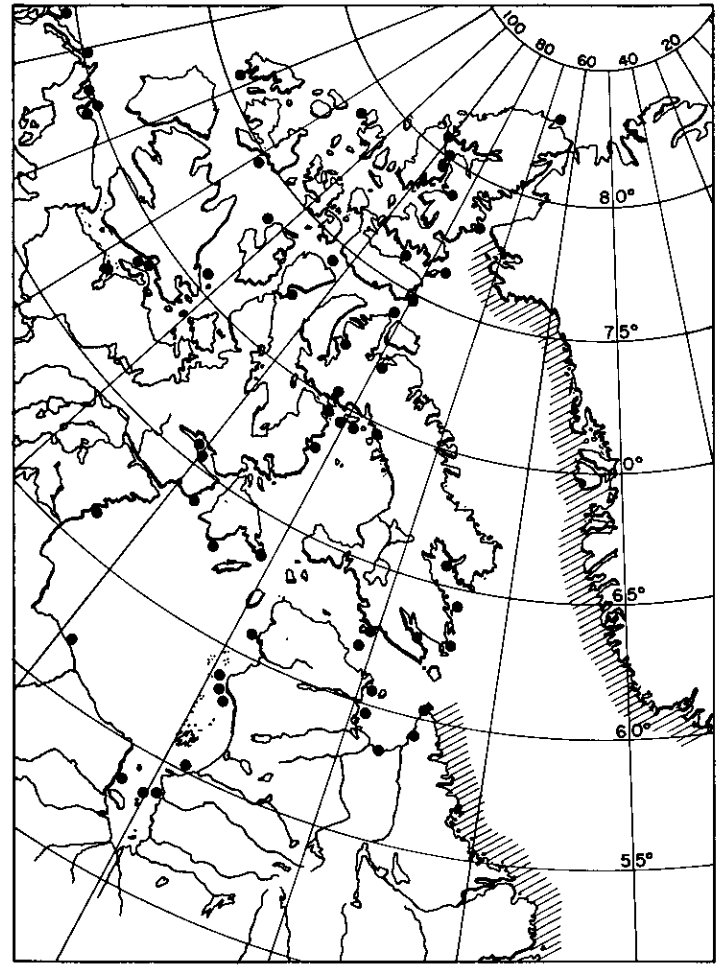
MAP 19. *Chlamys islandica* (Müller), p. 27



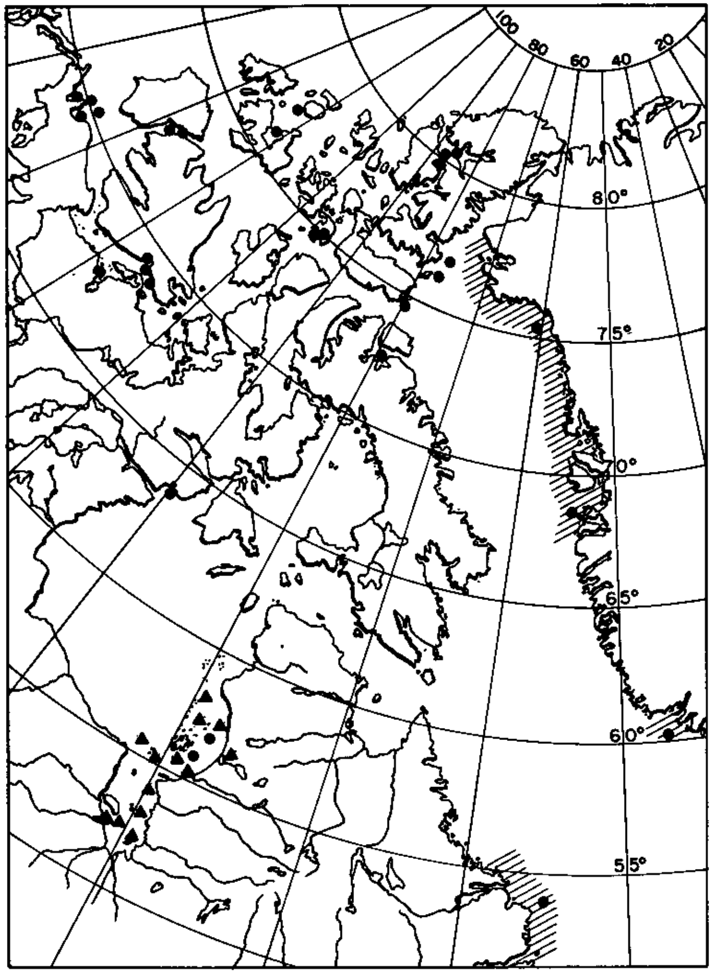
MAP 20. *Delectopecten greenlandicus* (Sowerby), p. 28



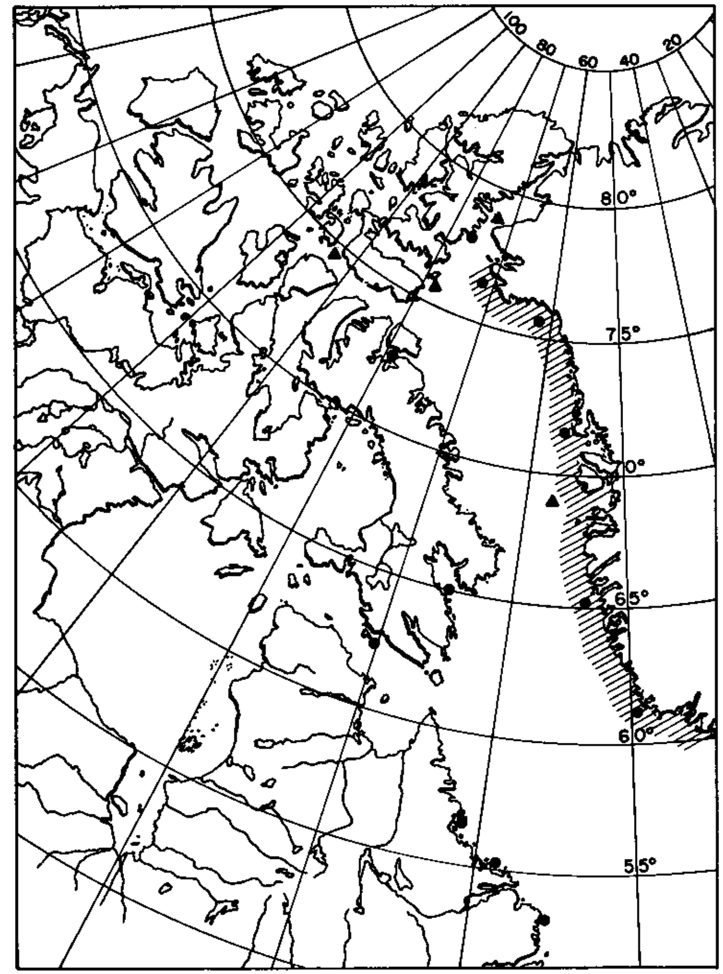
Map 21. *Astarte arctica* (Gray) (▲), p. 29; *A. montagui* Dillwyn (●), p. 34



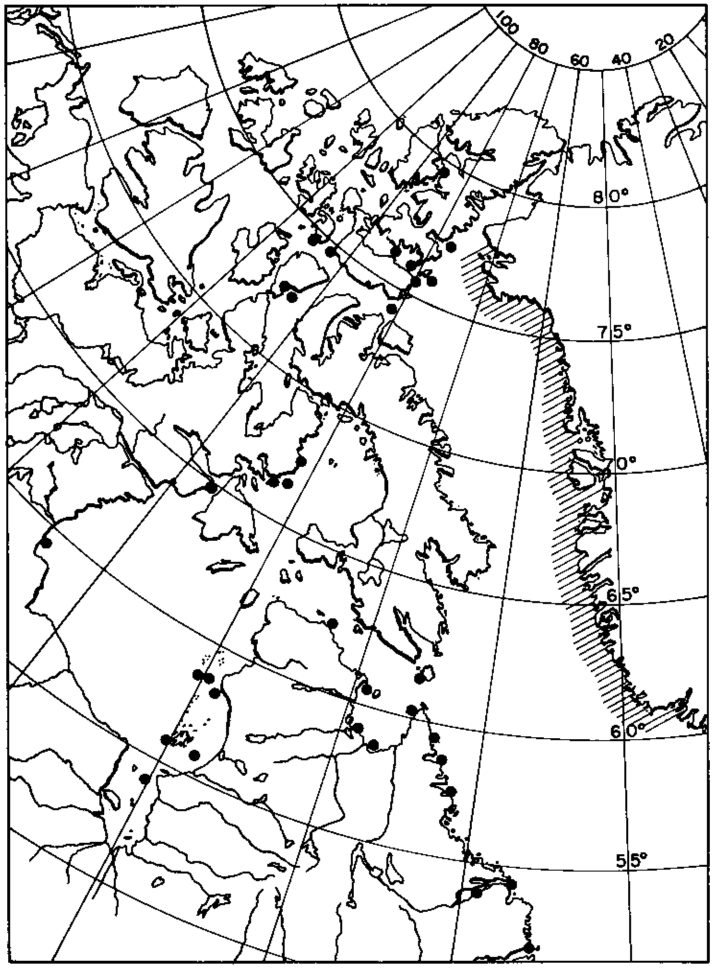
Map 22. *Astarte borealis* (Schumacher), p. 30



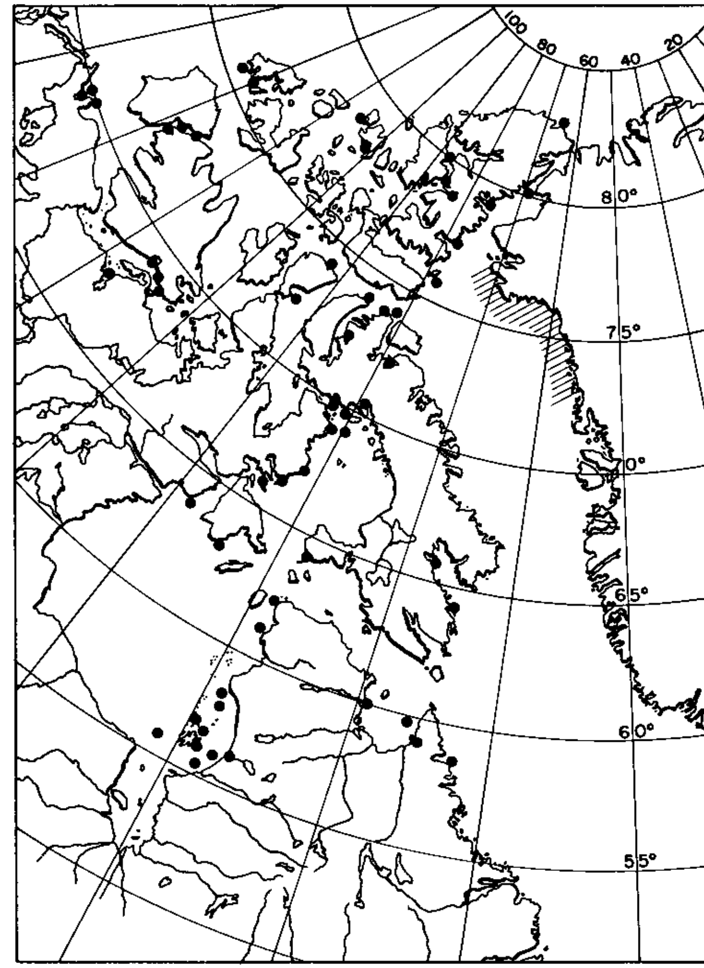
MAP 23. *Astarte crenata crenata* (Gray) (●), p. 31; *A.c. crebricostata* (McAndrews and Forbes) (▲), p. 32



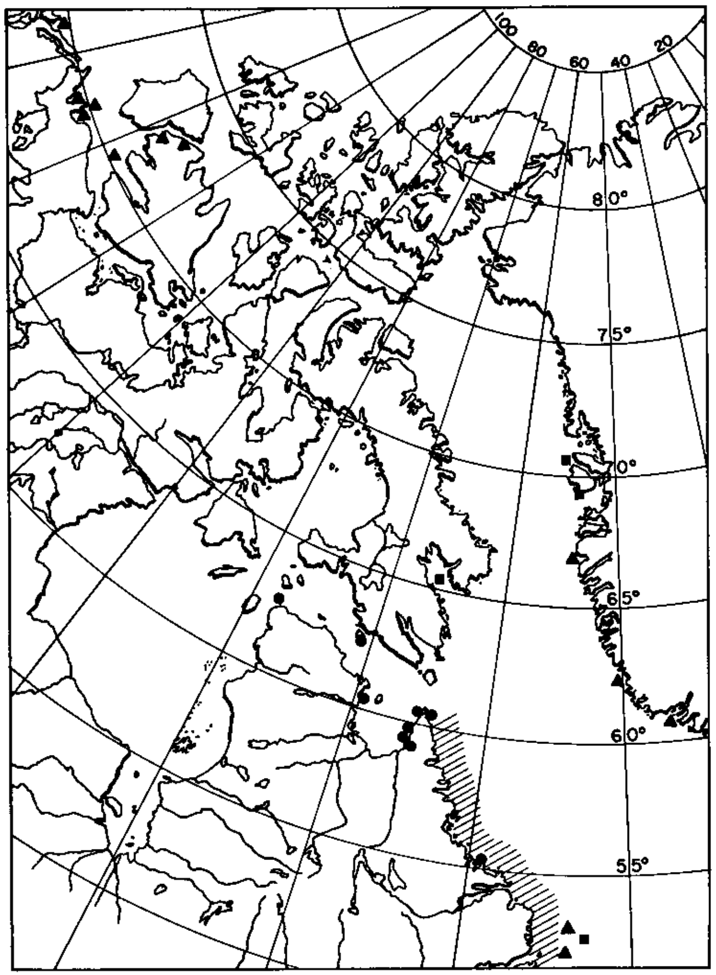
MAP 24. *Astarte elliptica* (Brown) (●), p. 32; *A. soror* Dall (▲), p. 32



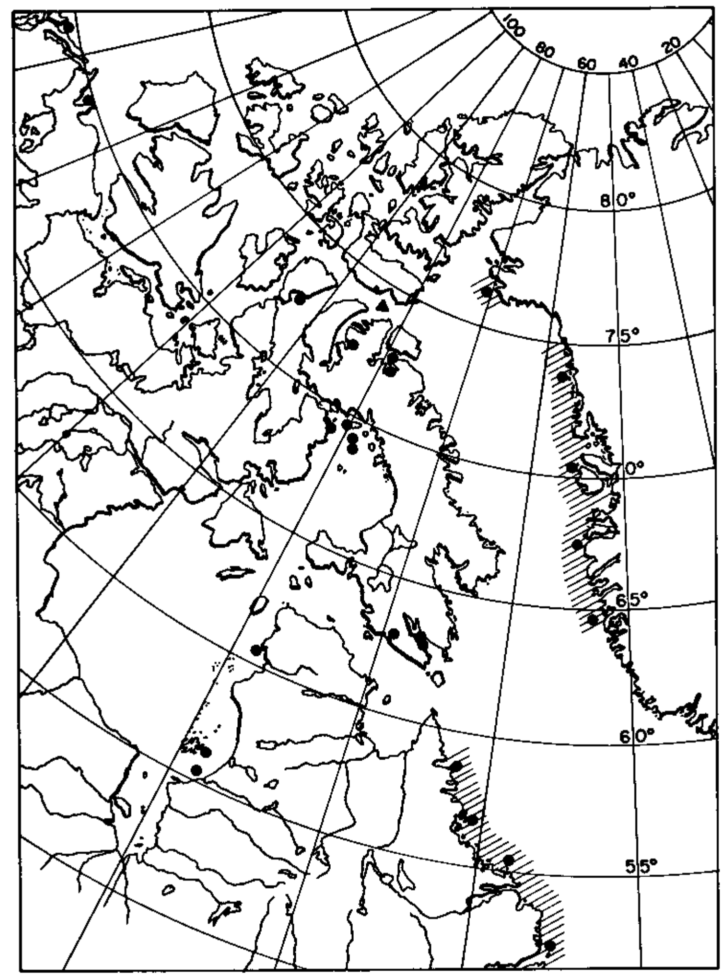
Map 25. *Astarte striata* (Leach), p. 35



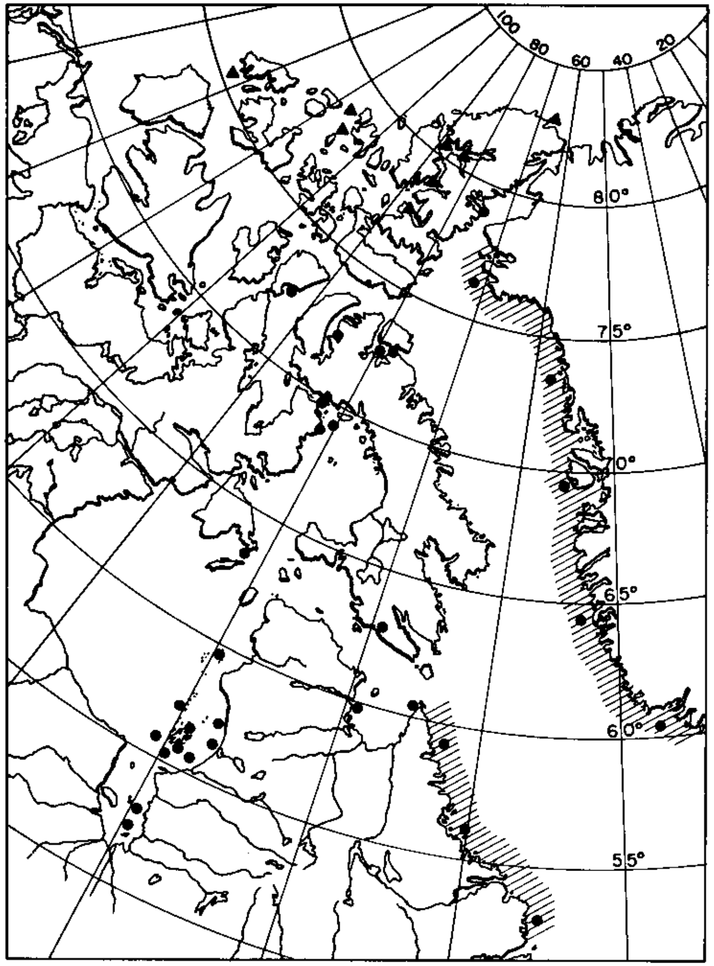
Map 26. *Astarte warhami* Hancock, p. 35



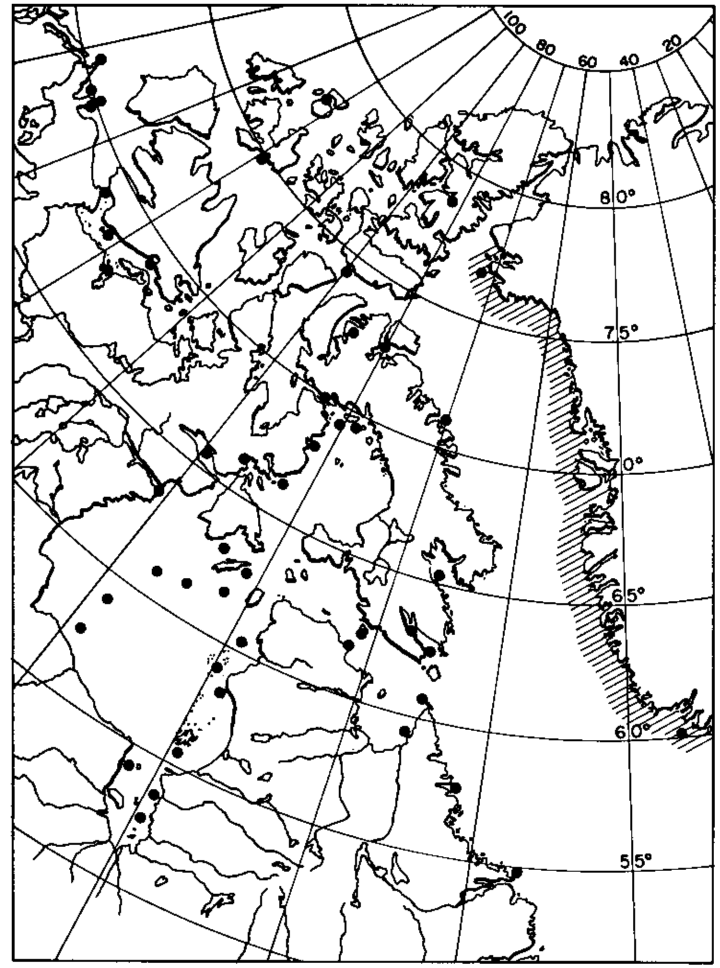
MAP 27. *Cyclocardia borealis* (Conrad) (●), p. 36; *Liocyma fluctuosa* (Gould) (▲), p. 40; *Turtonia minuta* (Fabricius) (■), p. 37



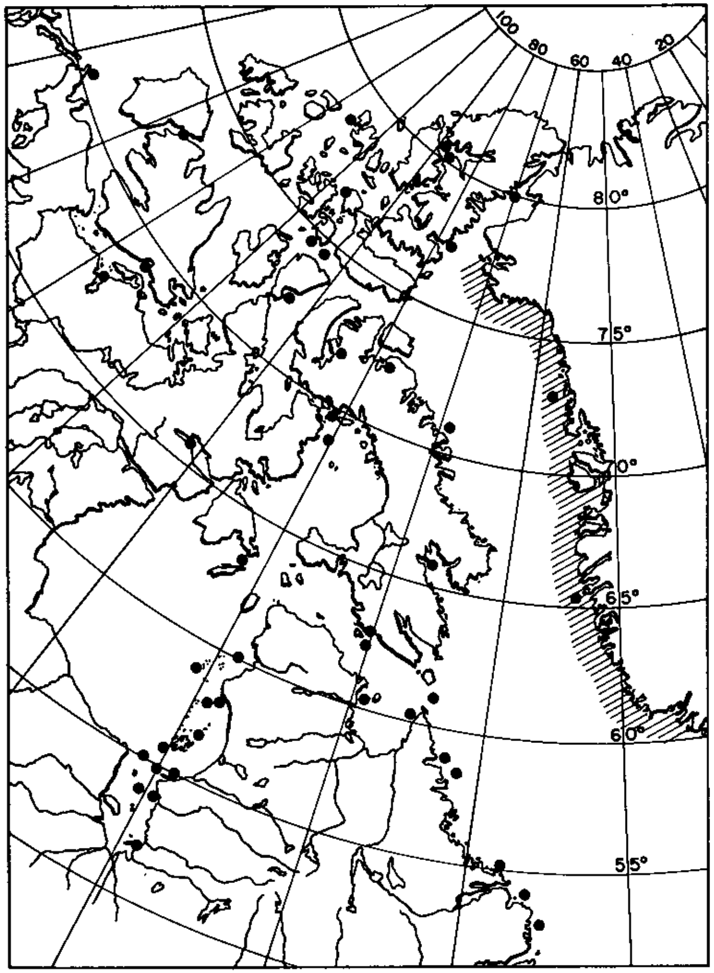
MAP 28. *Montacuta substriata* (Montagu) (▲), p. 36; *Axinopsida orbiculata* (G. O. Sars) (●), p. 37



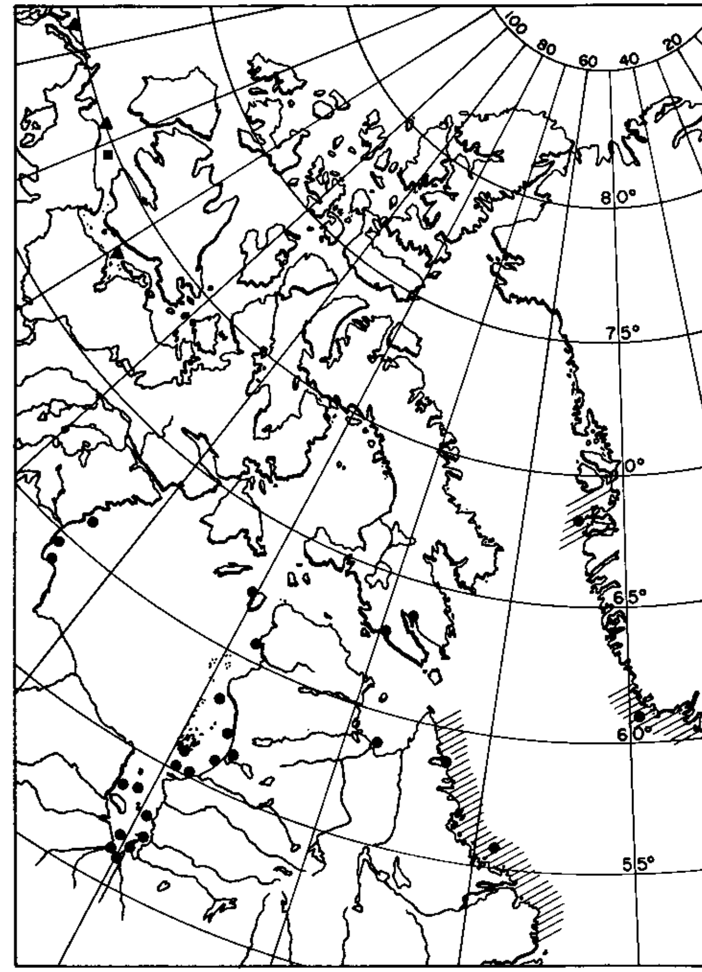
MAP 29. *Thyasira dunbari* Lubinsky (▲), p. 37; *T. gouldi* (Philippi) (●), p. 38



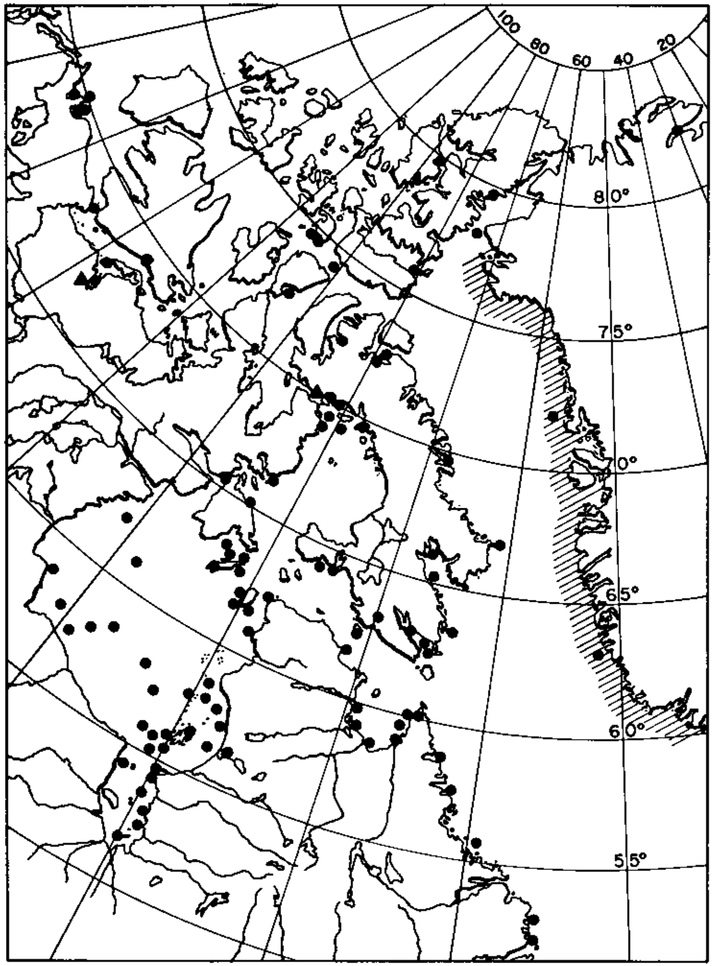
MAP 30. *Clinocardium ciliatum* (Fabricius), p. 38



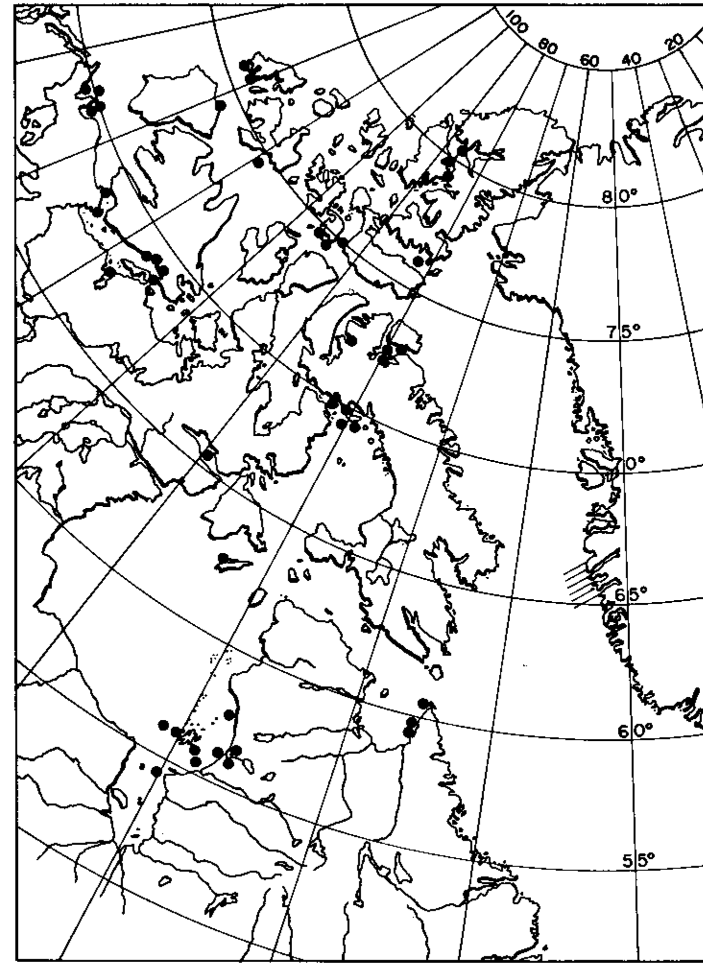
MAP 31. *Serripes groenlandicus* Bruguière, p. 39



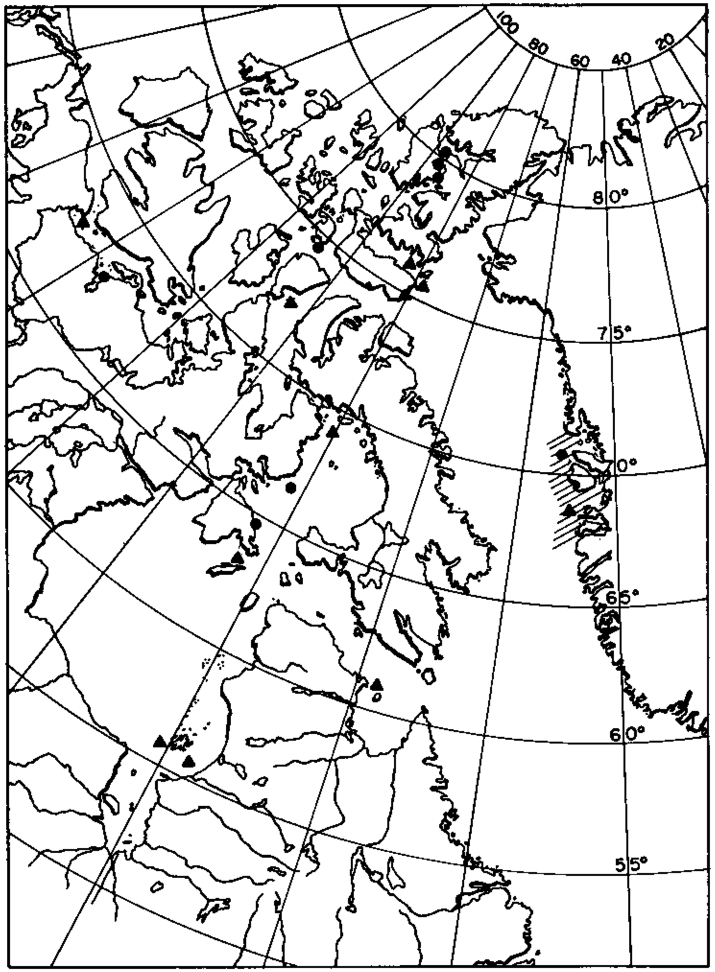
MAP 32. *Macoma balthica* (Linné) (●), p. 40; *M. inconspicua* (Broderip and Sowerby) (▲), p. 41; *M. planiuscula* Grant and Gale (■), p. 43



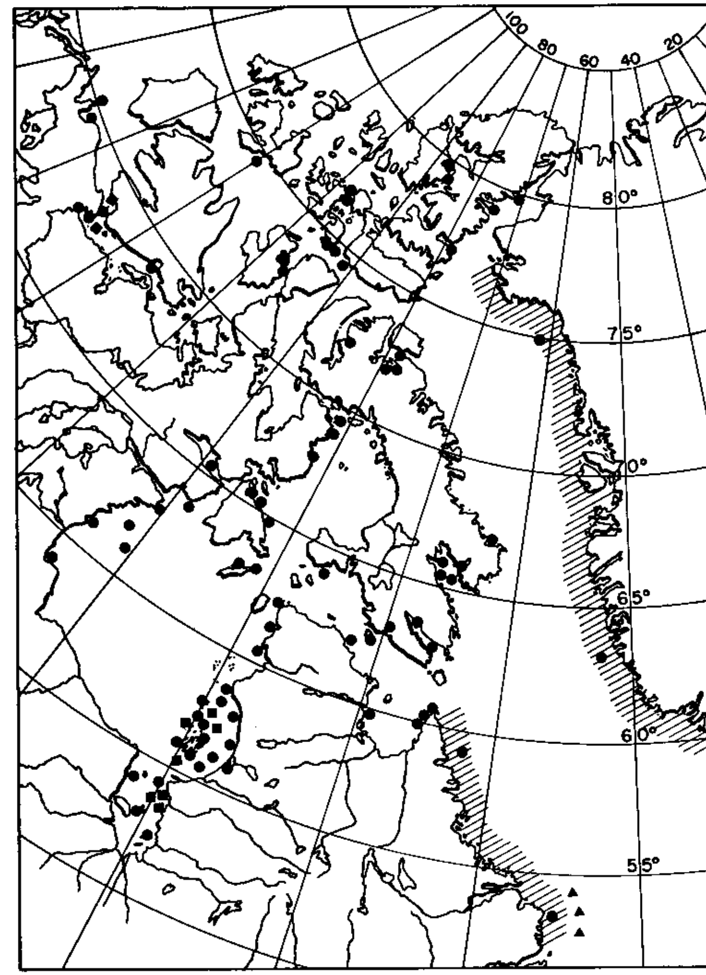
Map 33. *Macoma calcarea* (Gmelin) (●), p. 41; *M. calcarea* f. *obliqua* Soot-Ryen (▲), p. 41



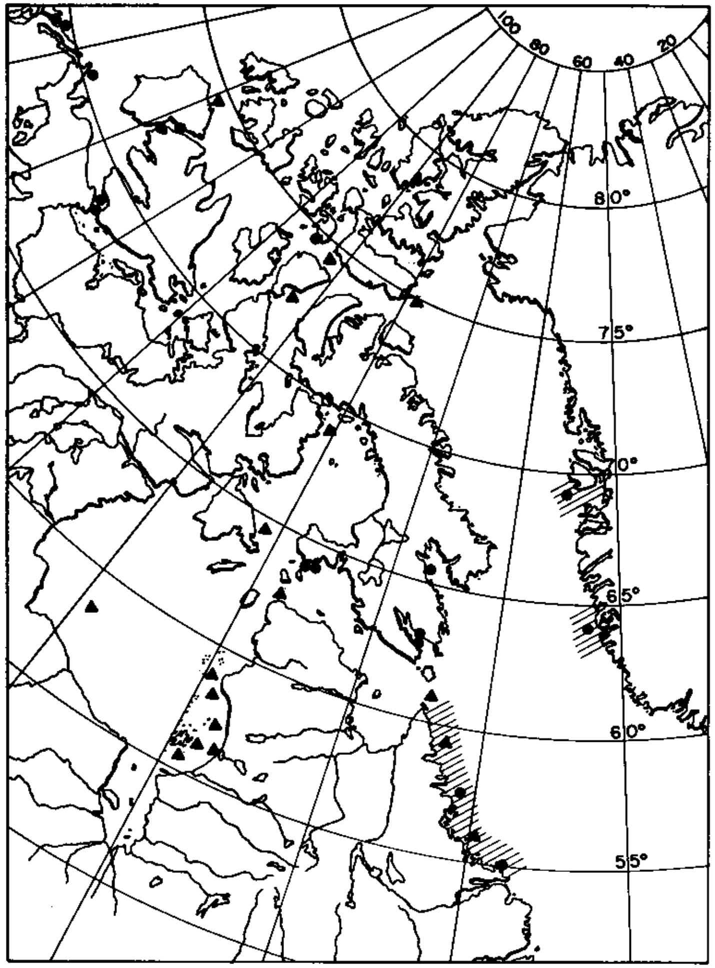
Map 34. *Macoma moesta* (Deshayes), p. 42



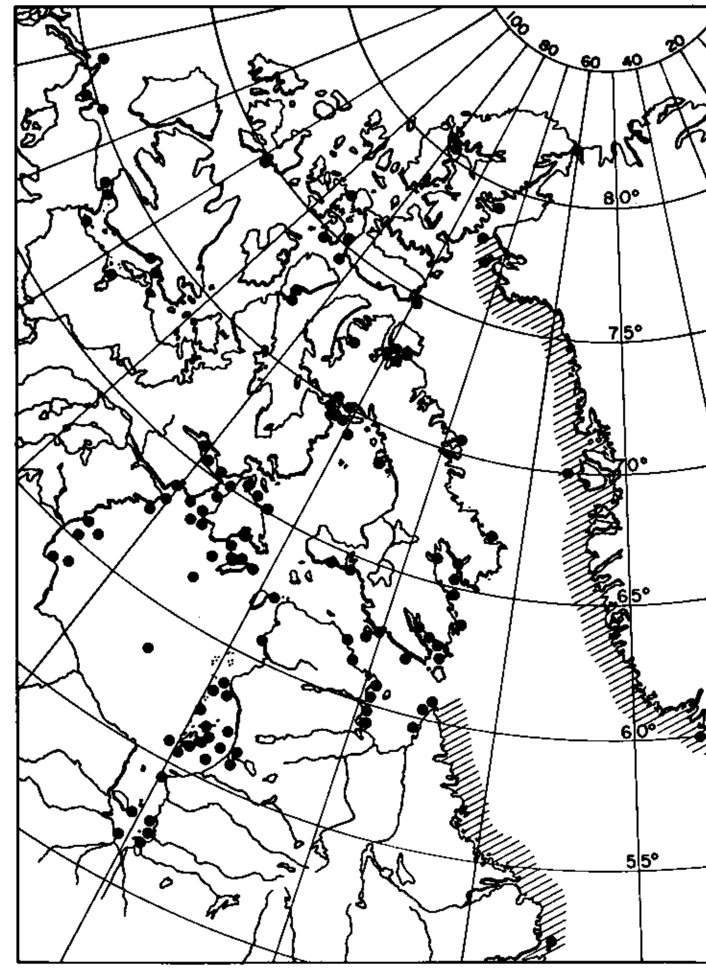
MAP 35. *Macoma loveni* (Steenstrup) Jensen (●), p. 42; *M. torelli* (Steenstrup) Jensen (▲), p. 43



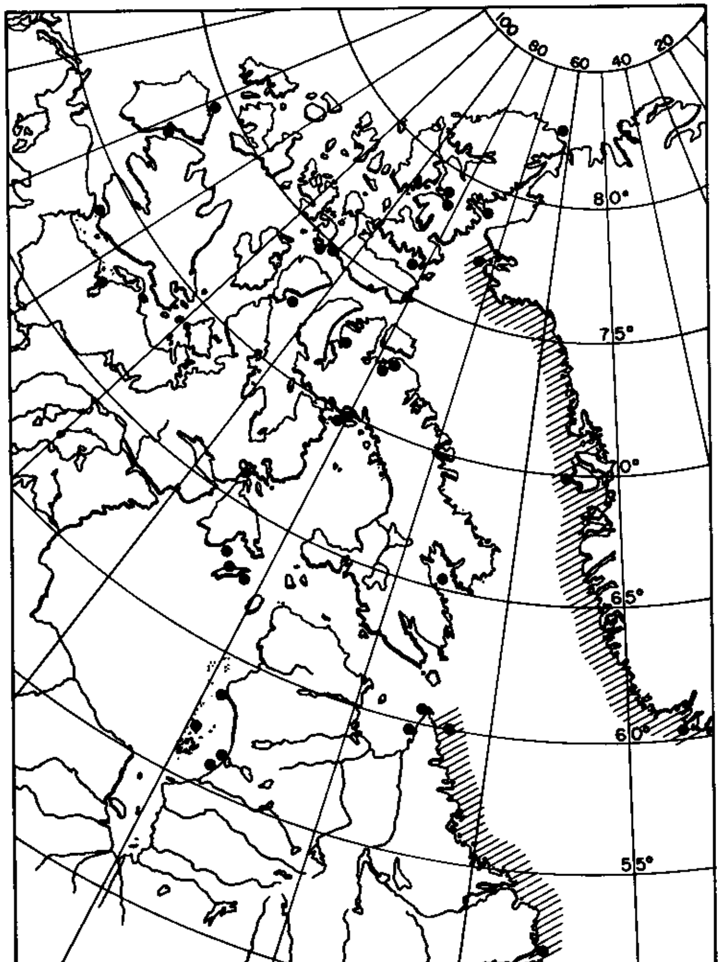
MAP 36. *Mya arenaria* Linné (▲), p. 44; *M. truncata* Linné (●), p. 44; *M. pseudoarenaria* Schlesch (■), p. 45



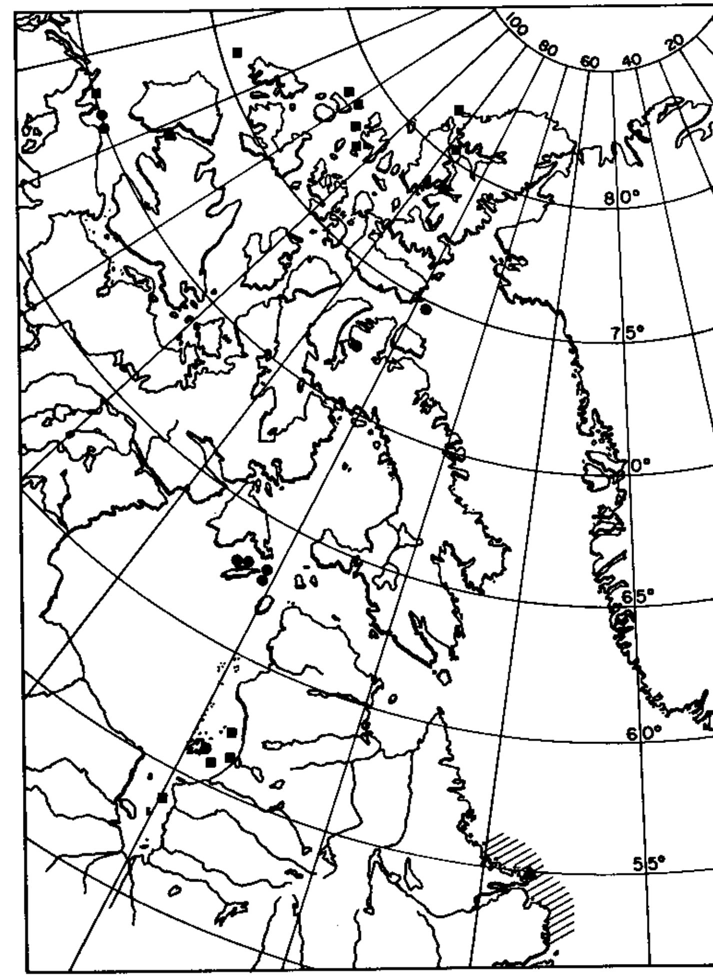
MAP 37. *Cyrtodaria kurriana* Dunker (●), p. 45; *Pandora glacialis* Leach (▲), p. 46



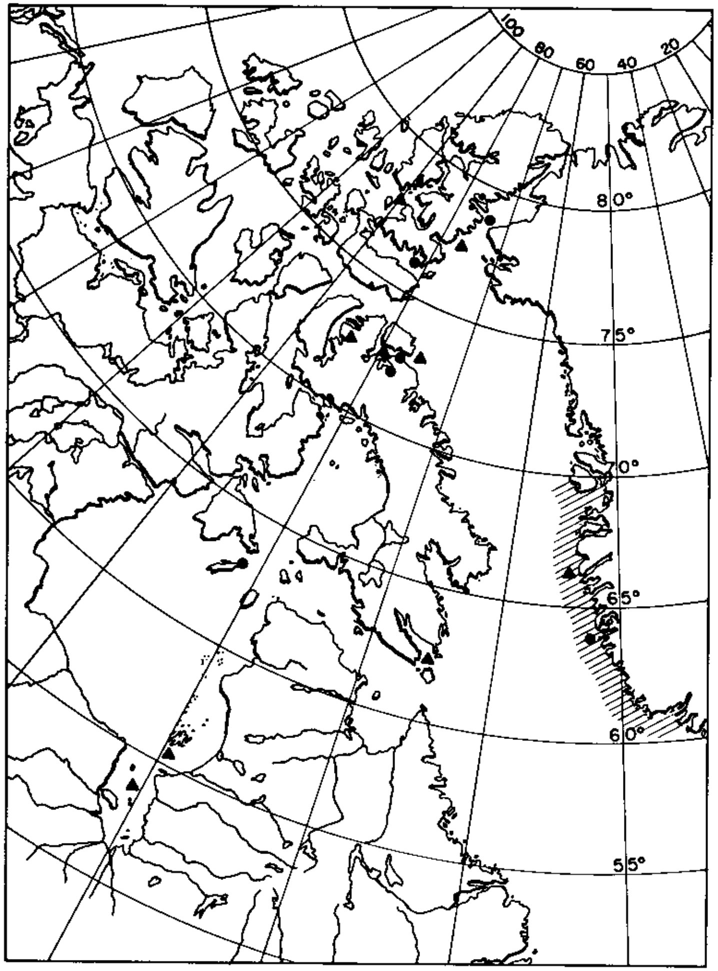
MAP 38. *Hiatella arctica* (Linné), p. 46



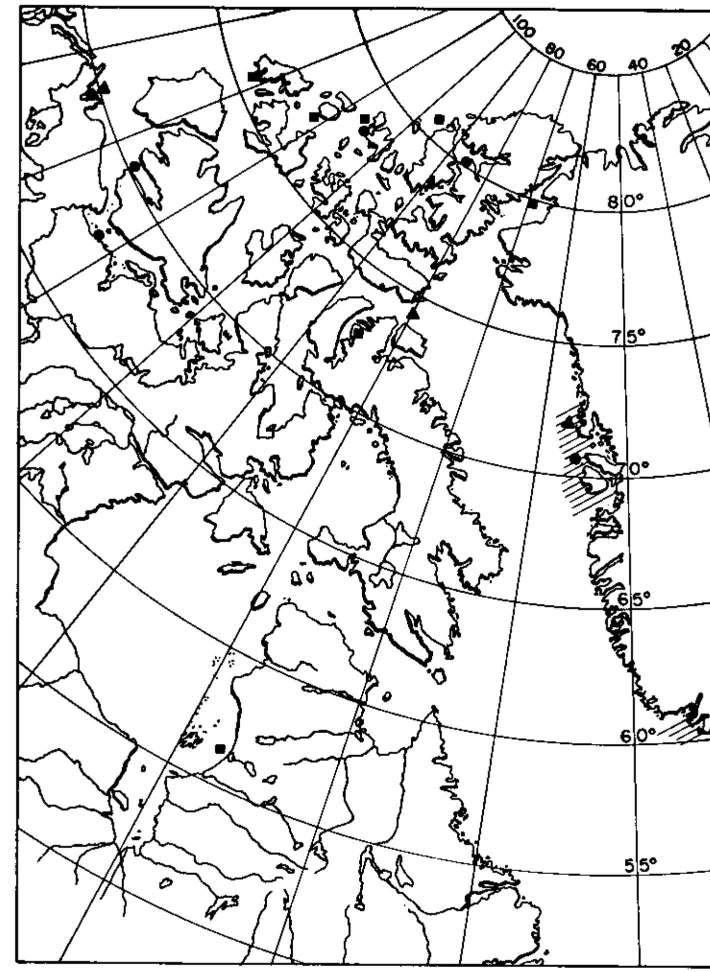
MAP 39. *Lyonsia arenosa* (Møller), p. 47



MAP 40. *Periploma abyssorum* Verrill (●), p. 47; *P. fragilis* (Totten) (▲), p. 48; *Thracia devexa* G. O. Sars (■), p. 48



MAP 41. *Thracia myopsis* (Beck) Møller (●), p. 48; *T. septentrionalis* Jeffreys (▲), p. 49



MAP 42. *Cuspidaria arctica* (M. Sars) (●), p. 49; *C. glacialis* (G. O. Sars) (▲), p. 49; *C. subtorta* (G. O. Sars) (■), p. 50

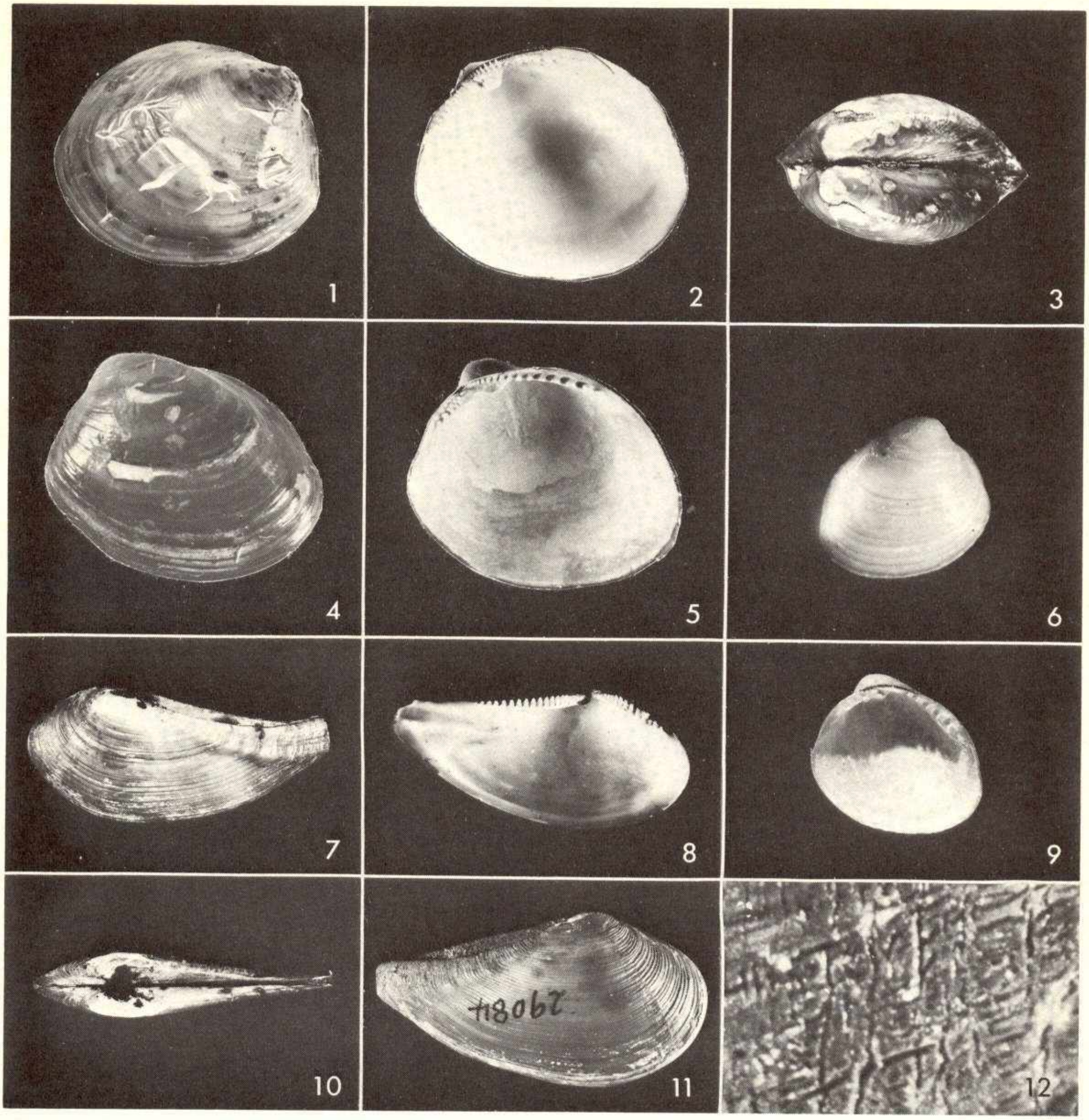


PLATE I. 1, 2, 3. *Nucula belloti* Adams, Prince Patrick Is., Canadian Archipelago, 15.2 x 13.0 x 8.2 mm (NMC 17-55); 4, 5. Same, Foxe Basin, 11.8 x 9.8 x 6.5 mm (ABS 57-719); 6, 9. *N. delphinodonta* Mighels and Adams, Pond Inlet, Baffin Is., 3.5 x 3.0 x 2.5 mm (NMC); 7, 8, 10. *Nuculana pernula costigera* (Leche), Slidre Fiord, Ellesmere Is., 29.0 x 13.0 x 6.5 mm (NMC 10-55); 11. *N. p. buccata* (Steenstrup), Labrador, 28.0 x 16.2 x 9.1 mm (MCZ 29084); 12. Same, periostracum on the anterior ray, (x 30).

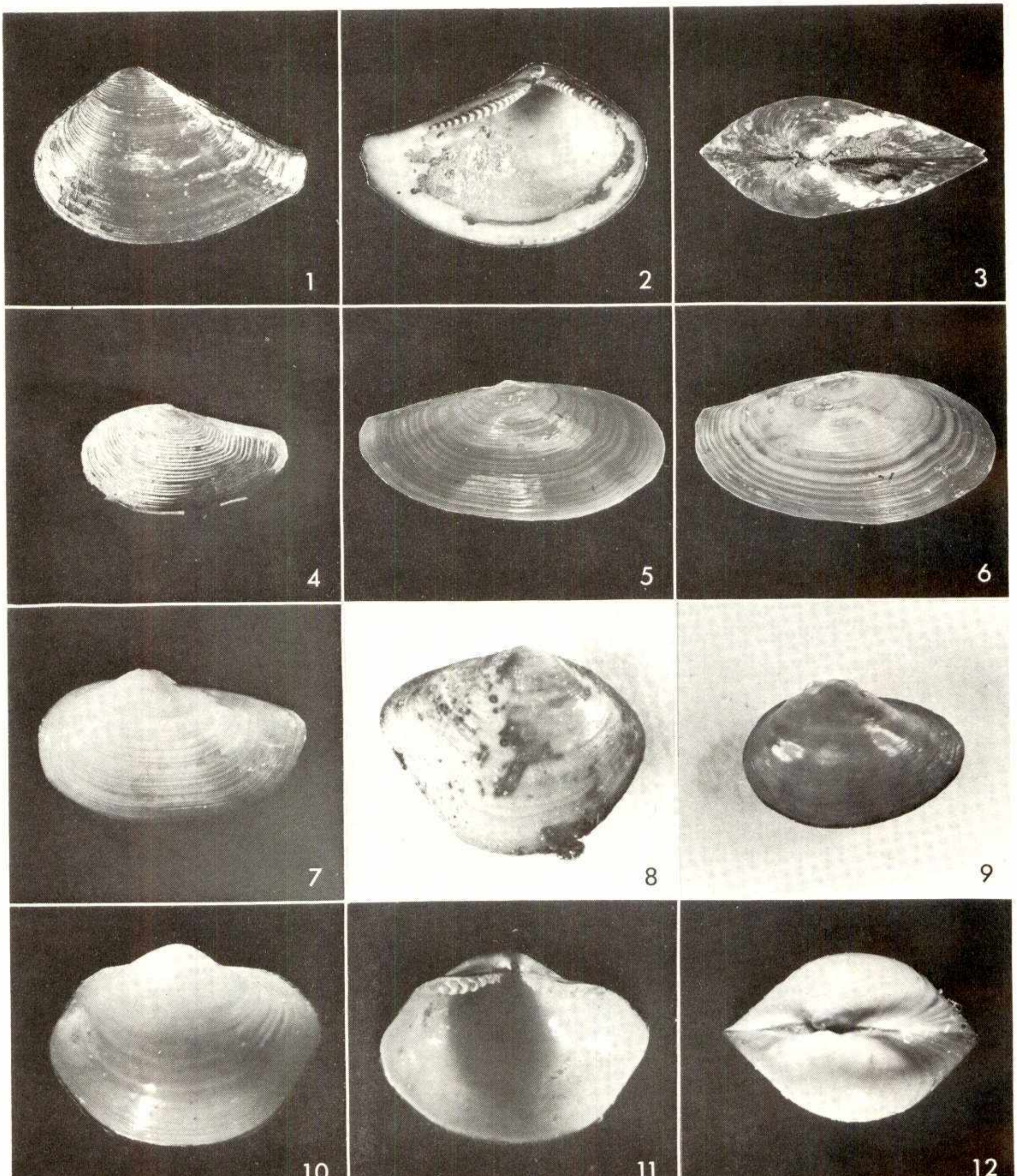


PLATE II. 1, 2, 3. *Nuculana pernula buccata* (Steenstrup) "var. *brevis* (Müller)," Labrador, 15.3 x 9.0 x 6.5 mm (MCZ 5470); 4. *N. minuta* (Fabricius), Banks Is., Canadian Archipelago, 13.2 x 7.2 x 4.2 mm (ABS 62-1103); 5. *Yoldia hyperborea* (Loven) Torell *hyperborea* Ockelmann, Ungava Bay, 29.0 x 13.5 x 7.0 mm (ABS 47-201); 6. Same, Foxe Basin, 30.5 x 17.0 x 9.5 mm (ABS 901); 7. *Yoldiella intermedia* (M. Sars), Slidre Fiord, Ellesmere Is., 13.0 x 7.5 x 5.7 mm (NMC 10-55); 8. *Y. frigida* (Torell), Prince Patrick Is., Canadian Archipelago, 4.0 x 3.1 x 1.6 mm (NMC 13-52); 9. *Y. lenticula* (Møller), Hudson Bay, 6.6 x 4.2 x 4.0 mm (ABS 59-72); 10, 11, 12. *Y. fraterna* Verrill and Bush, Victoria Is., Canadian Archipelago, 3.3 x 2.5 x 2.1 mm (ABS 1967).

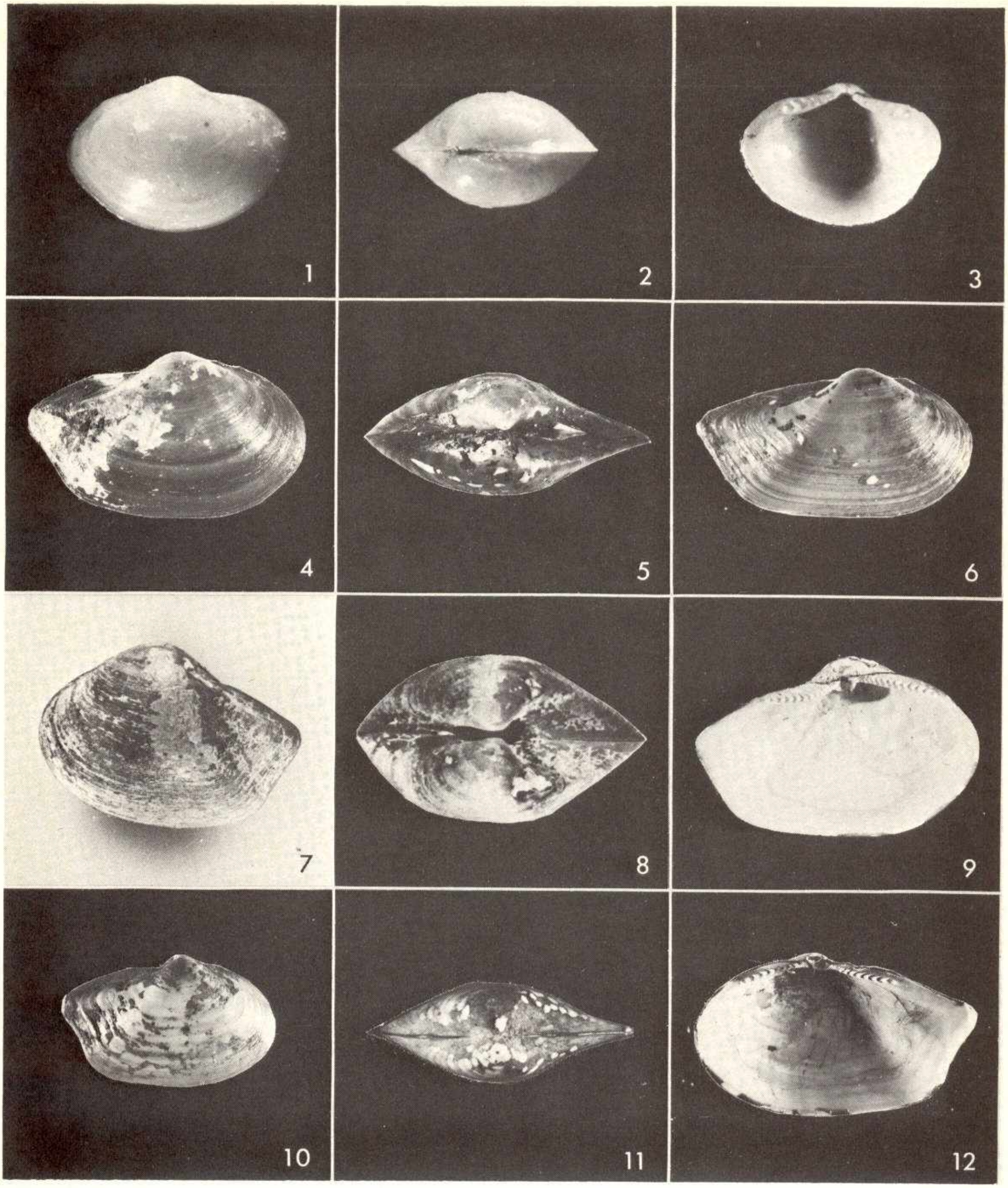


PLATE III. 1, 2, 3. *Yoldiella fraterna* Verrill and Bush, Strathcona Sd., Baffin Is., young specimen, 2.7 x 2.0 x 1.4 mm (FWI 14-2-74); 4, 5. *Portlandia arctica arctica* (Gray) Hudson Bay, 19.5 x 12.0 x 8.2 mm (ABS 59-72); 6. *P. a. portlandica* (Hitchcock), James Bay, 14.0 x 7.5 x 5.0 mm (ABS 59-11); 7, 8, 9. *P. a. siliqua* (Reeve) var. *inflata* (Leche), Foxe Basin, 19.2 x 13.5 x 11.8 mm (ABS 715); 10, 11, 12. *P. sulcifera* (Reeve), Ellef Ringnes Is., Canadian Archipelago, 14.5 x 9.2 x 5.0 mm (NMC 14-51).

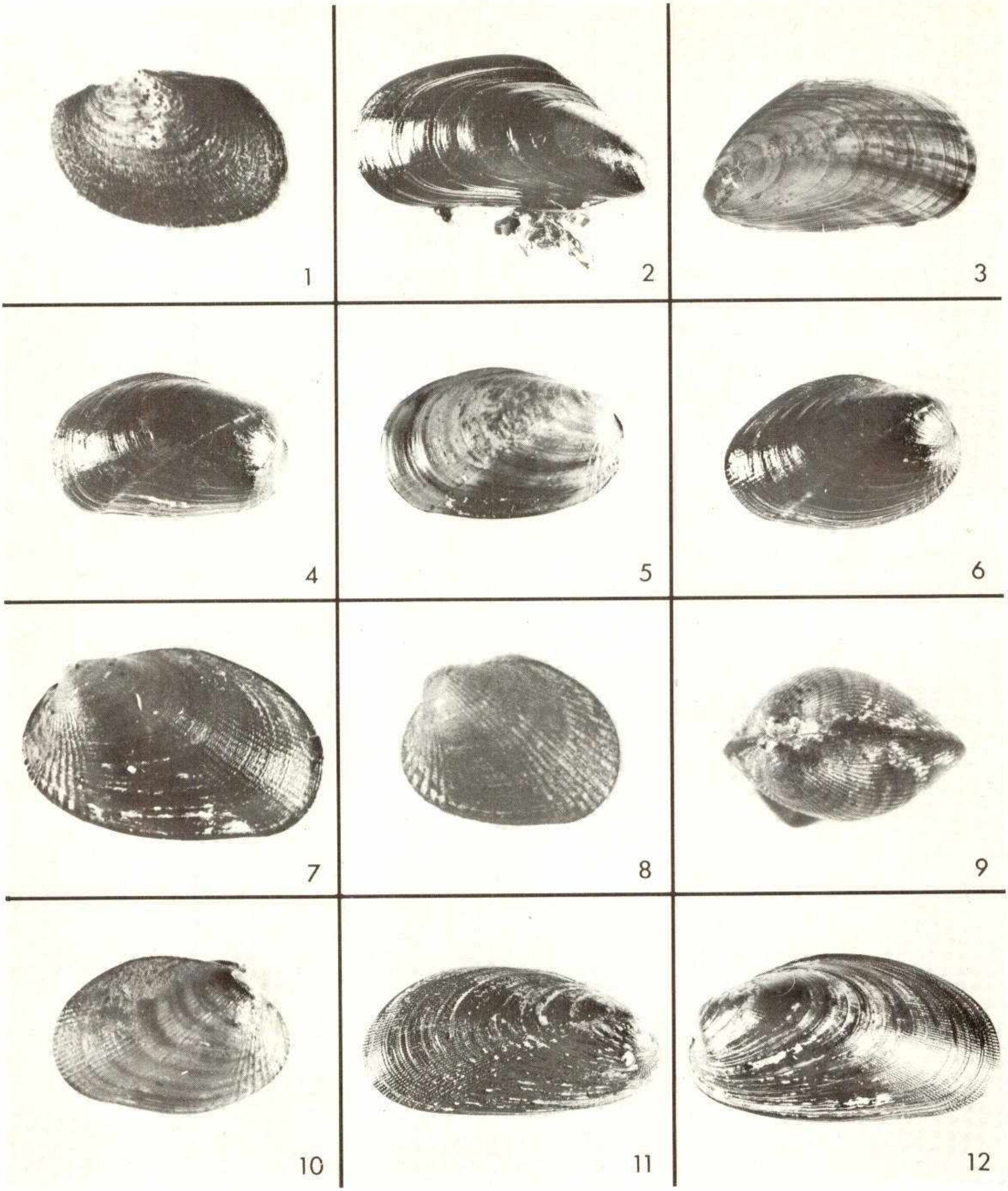


PLATE IV. 1. *Bathyarca glacialis* (Gray), Slidre Fiord, Ellesmere Is., L = 92 mm (ABS 62-3003); 2. *Mytilus edulis* Linné, Belcher Islands, Hudson Bay, 40.0 x 20.5 x 15.5 mm (ABS 60-5); 3. *M. edulis* Linné (= *M. pellucidus* Pennant), Paint Hills, James Bay, transmitted light, periostracum intact, L = 37 mm (NMC 1920); 4. *Musculus discors* (Linné) var. *laevigatus* (Gray), Frobisher Bay, L = 37 mm (ABS 319); 5. Same, James Bay, 8.0 x 5.0 x 3.2 mm (ABS 818); 6. *M. d.* (Linné) var. *substriatus* (Gray), Frobisher Bay, L = 32 mm (ABS 818); 7. *Musculus corrugatus* (Stimpson) Parr Inlet, Ellesmere Is., 12.9 x 8.1 x 5.5 mm (NMC 10-52); 8, 9. Same, Hudson Bay, 6.8 x 5.5 x 4.5 mm (ABS 59-72); 10. Same, James Bay, old specimen, pale, translucent, 7.7 x 5.7 x 3.8 mm (ABS 59-6); 11. *M. niger* (Gray), Ungava Bay, southern type, L = 80 mm (ABS 231); 12. Same, Parr Inlet, Ellesmere Is., 34.0 x 18.5 x 13.0 mm (NMC 10-54).

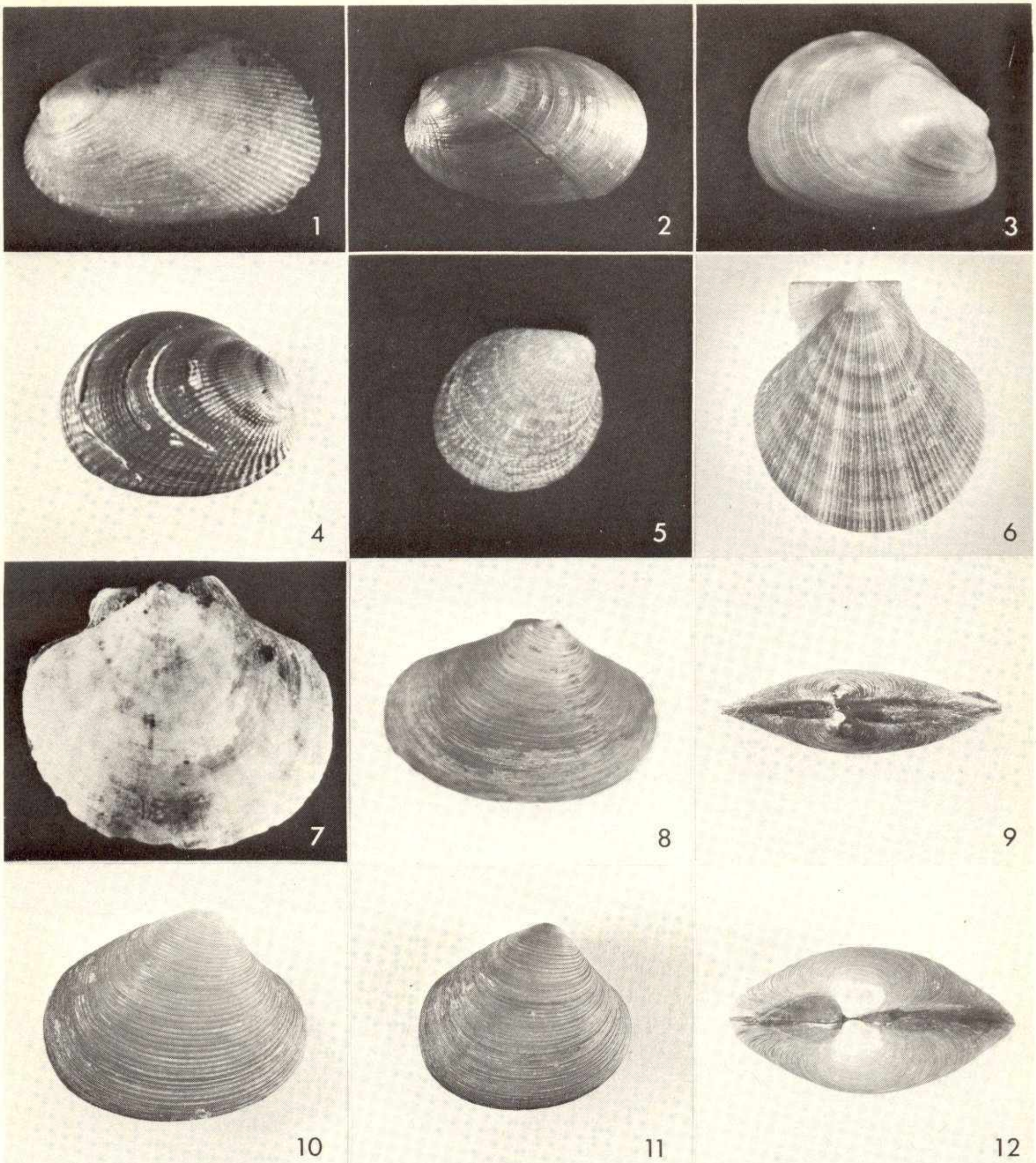


PLATE V. 1, 2. *Musculus discors* (Linné), Boreal type, England, pale, translucent. (Acad. Nat. Sci. Phila. 55164); 3. *Dacridium vitreum* (Møller), Frobisher Bay, 4.3 x 2.9 x 1.75 mm (ABS 67-5); 4. *Crenella faba* (Müller), Foxe Basin, 10.0 x 8.0 x 5.0 mm (ABS 828); 5. *C. decussata* (Montagu), Hopewell Sd., Hudson Bay, 4.0 x 3.0 x 2.8 mm (NMC 41170); 6. *Chlamys islandica* (Müller), Frozen Str., Hudson Bay, 42.0 x 46.0 x 12.0 mm (ABS 61-39); 7. *Delectopecten greenlandicus* (Sowerby), Prince Patrick Is., Canadian Archipelago, 32.0 x 29.0 x 7.0 mm (NMC 13-52); 8, 9. *Astarte borealis* (Schumacher) *placenta* (Mørch), Slidre Fiord, Ellesmere Is., 28.2 x 16.8 x 8.3 mm (NMC 10-55); 10. *A. crenata crenata* (Gray), Ellef Ringnes Is., Canadian Archipelago, 23.0 x 18.5 x 11.2 mm (ABS 103-60); 11, 12. Same, Hudson Bay, 19.0 x 17.0 x 10.0 mm (ABS 59-15).

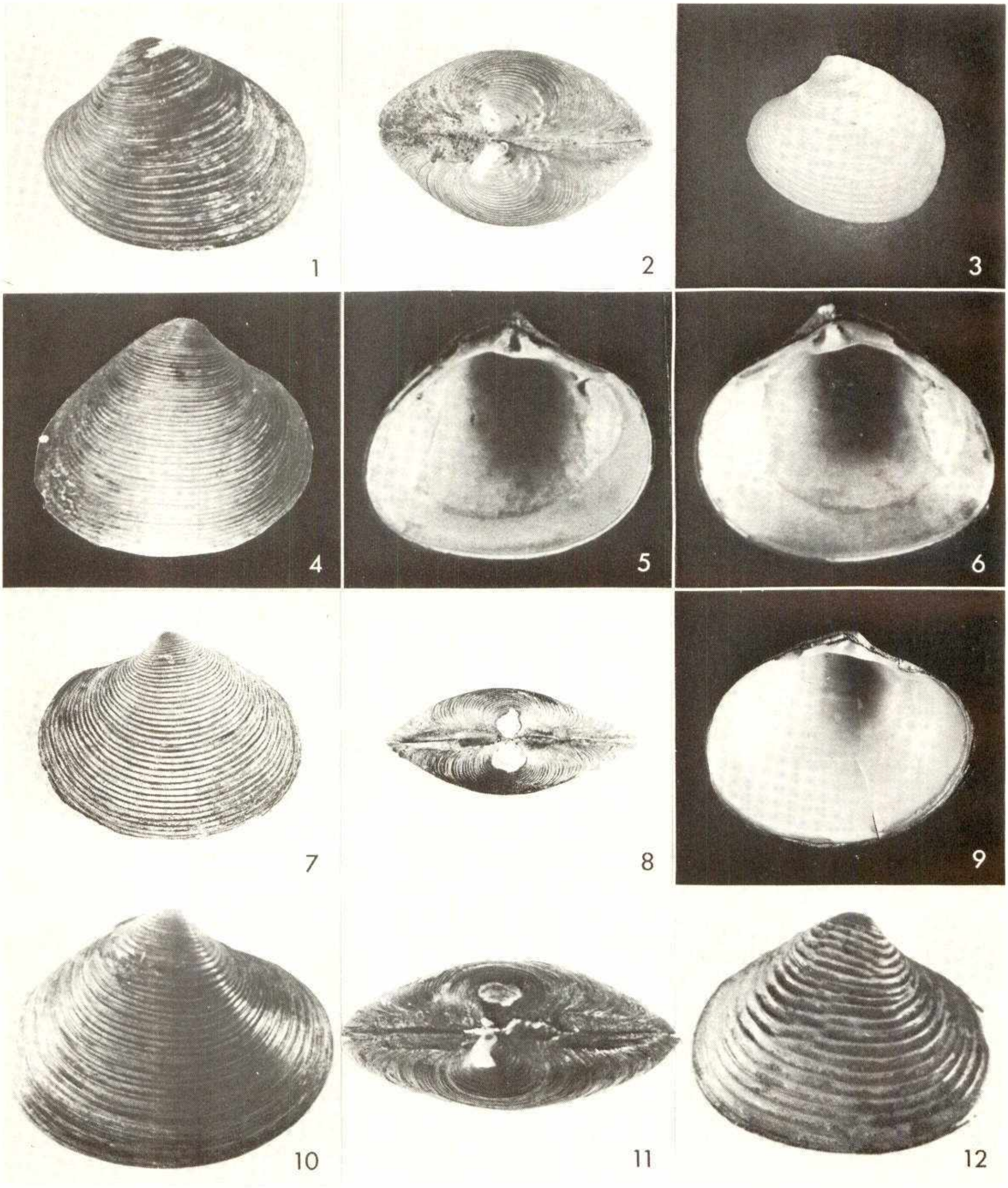


PLATE VI. 1, 2. *Astarte crenata crebricostata* MacAndrews and Forbes, Hudson Bay, 22.0 x 18.0 x 12.5 mm (ABS, 59-15); 3. *A. c. acuticostata* Jeffreys and Friele, Ellef Ringnes Is., Canadian Archipelago, 13.0 x 10.7 x 7.4 mm (NMC 14893); 4, 5, 6. *A. soror* Dall, Disco Bay, Greenland, 20.5 x 17.6 x 11.0 mm (USNM 109278); 7, 8. *A. striata* (Leach), Repulse Bay, Hudson Bay, 18.0 x 14.0 x 8.1 mm (ABS 711-55); 9, 10, 11. *A. warhami* Hancock, Prince Patrick Is., Canadian Archipelago, 19.0 x 14.5 x 6.8 mm (NMC 51-52); 12. Same, young specimen, distinct ribbing, L = 5.0 mm.

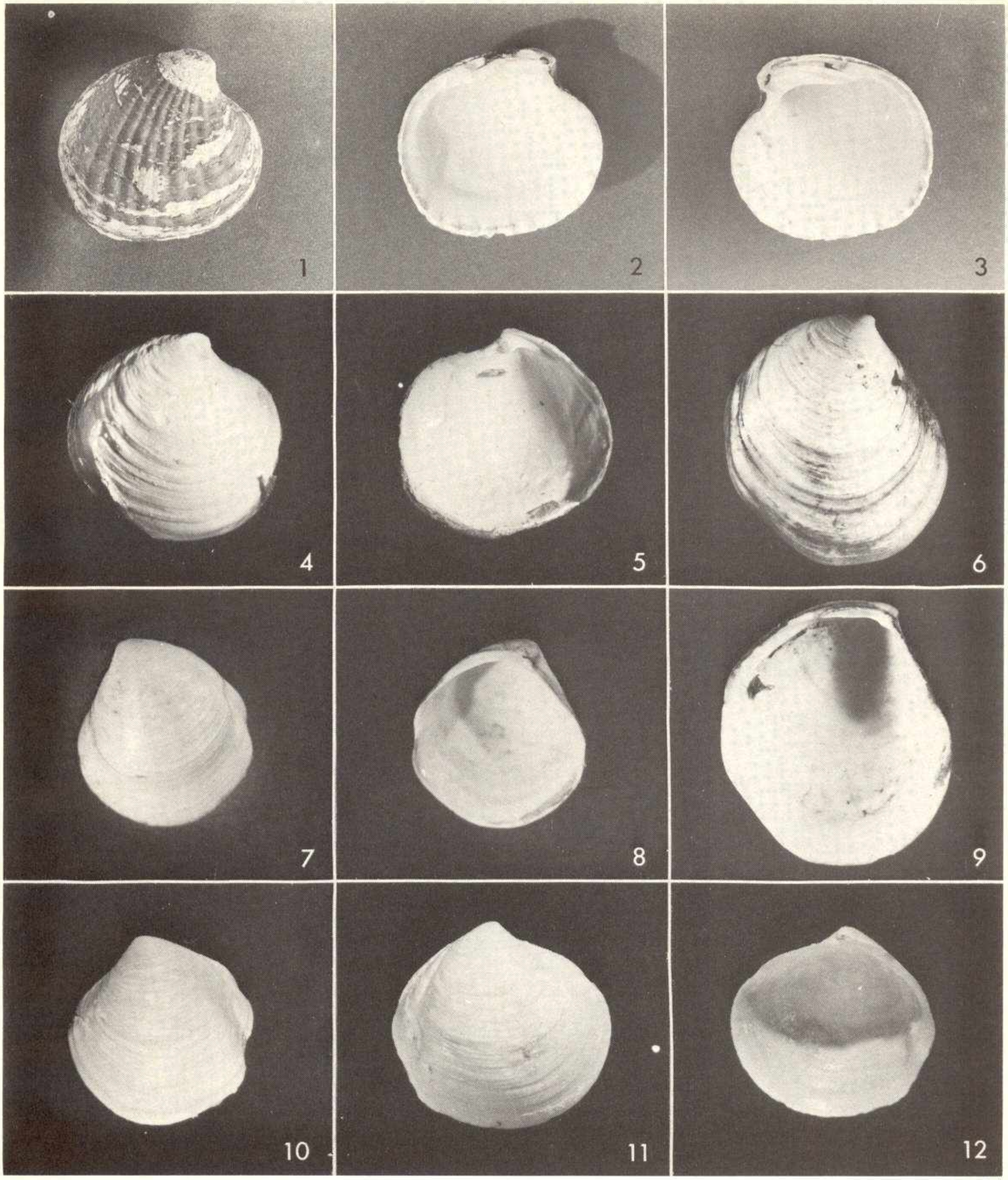


PLATE VII. 1, 2, 3. *Cyclocardia borealis* (Conrad), Ungava Bay, 22.4 x 22.0 x 13.0 mm (ABS 49-126); 4, 5. *Axinopsida orbiculata* (G. O. Sars), Frobisher Bay, 4.5 x 4.0 x 3.0 mm (NMC 42463); 6, 9. *Thyasira dunbari* Lubinsky, Ellef Ringnes Is., Canadian Archipelago, 6.2 x 7.8 x 4.8 mm (NMC 75803); 7, 8. *T. gouldi* (Philippi), Somerset Is., Canadian Archipelago, 4.0 x 4.2 x 2.8 mm (ABS 62-2005); 10. Same, Pond Inlet, Baffin Is., 6.0 x 6.0 mm (NMC); 11, 12. Same, Pond Inlet, 6.8 x 6.4 x 4.6 mm (NMC).

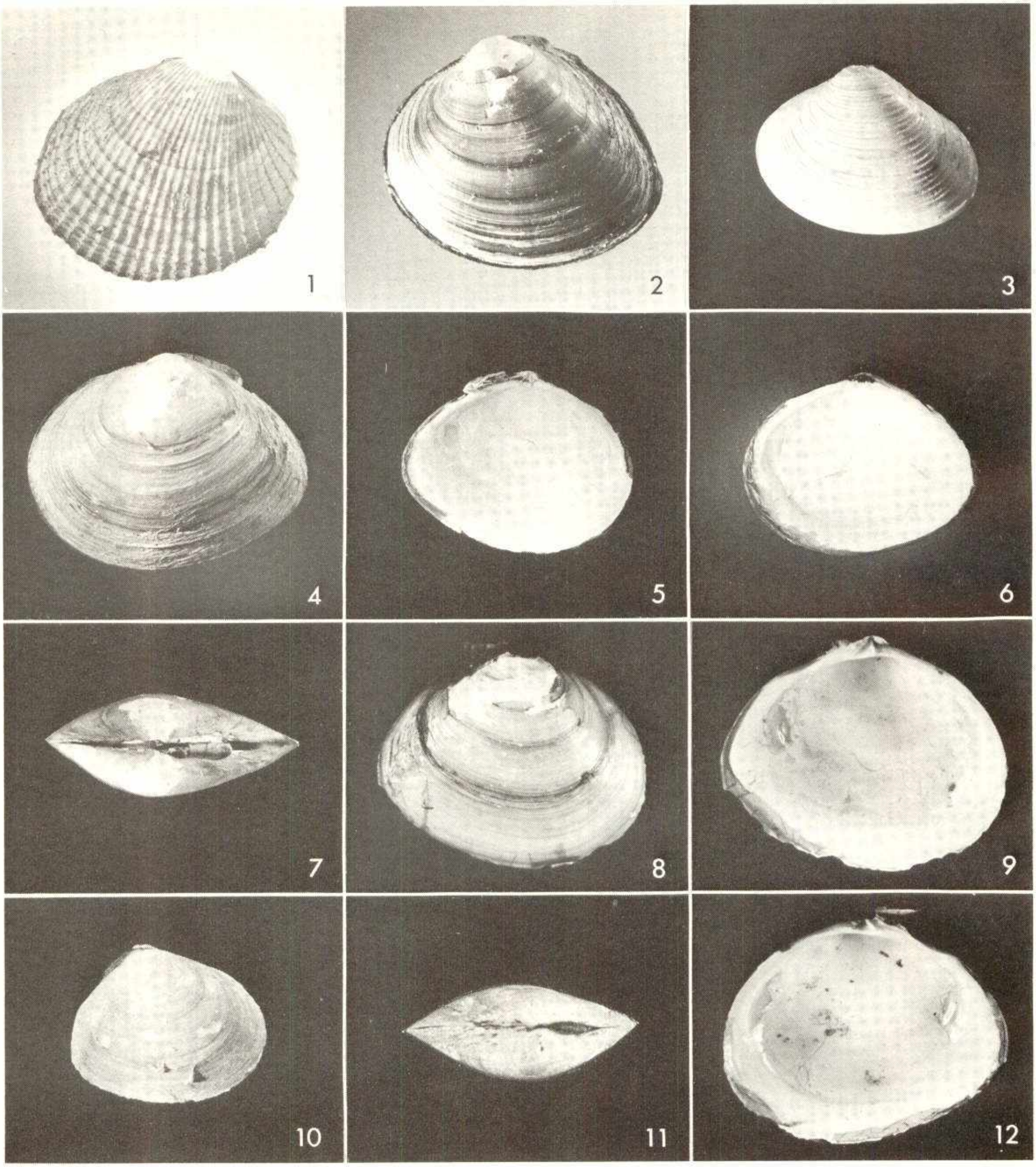


PLATE VIII. 1. *Clinocardium ciliatum* (Fabricius), Somerset Is., Canadian Archipelago, 41.0 x 35.7 x 23.3 mm (ABS 62-7300); 2. *Serripes groenlandicus* (Bruguière), Eureca Sd., Ellesmere Is., 50.0 x 42.2 x 25.3 mm (ABS 62-3001); 3. *Liocyma fluctuosa* Gould, Prince of Wales Str., Banks Is., Canadian Archipelago, 14.0 x 9.7 x 6.2 mm (ABS 62-1107); 4, 5, 6, 7. *Macoma balthica* (Linné), Ungava Bay, 18.2 x 14.3 x 7.8 mm (ABS 58-1031); 8, 9, 12. *M. inconspicua* (Broderip and Sowerby), Bathurst Inlet, Coronation Gulf, Canadian Archipelago, L = 10 mm, (GSC); 10, 11. *M. torelli* (Steenstrup) Jensen, Somerset Is., Canadian Archipelago, 8.3 x 7.0 x 3.7 mm (ABS 62-2002).

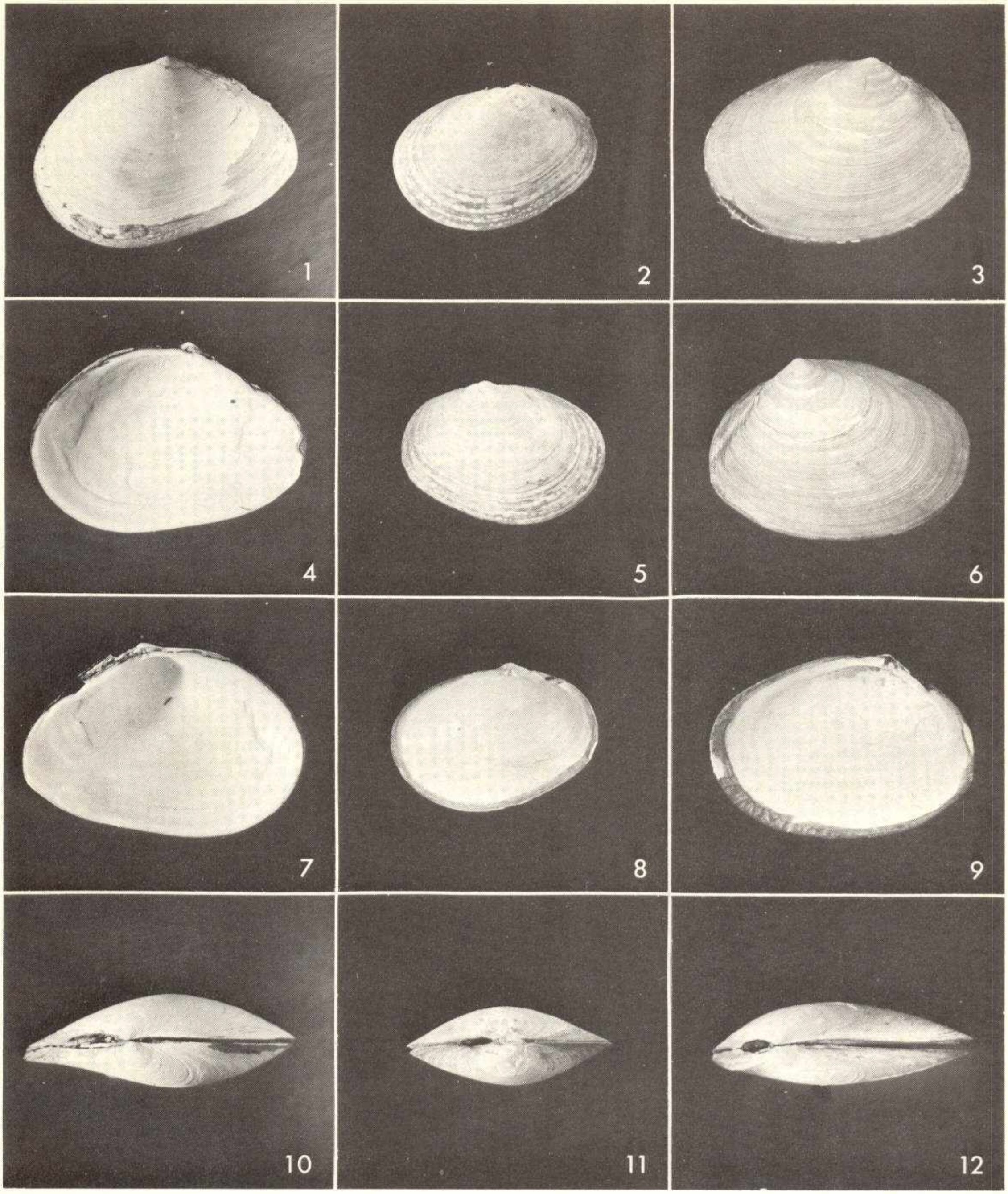


PLATE IX. 1, 4, 7, 10. *Macoma calcarea* (Gmelin), Cornwallis Is., Canadian Archipelago, 35.5 x 24.6 x 12.3 mm (ABS 62-4006); 2, 5, 8, 11. *M. loveni* (Steenstrup) Jensen, Slidre Fiord, Ellesmere Is., 9.1 x 6.8 x 3.5 mm (ABS 62-3003); 3, 6, 9, 12. *M. moesta* (Deshayes), Victoria Is., Canadian Archipelago, 21.5 x 16.5 x 6.4 mm (ABS 66-029).

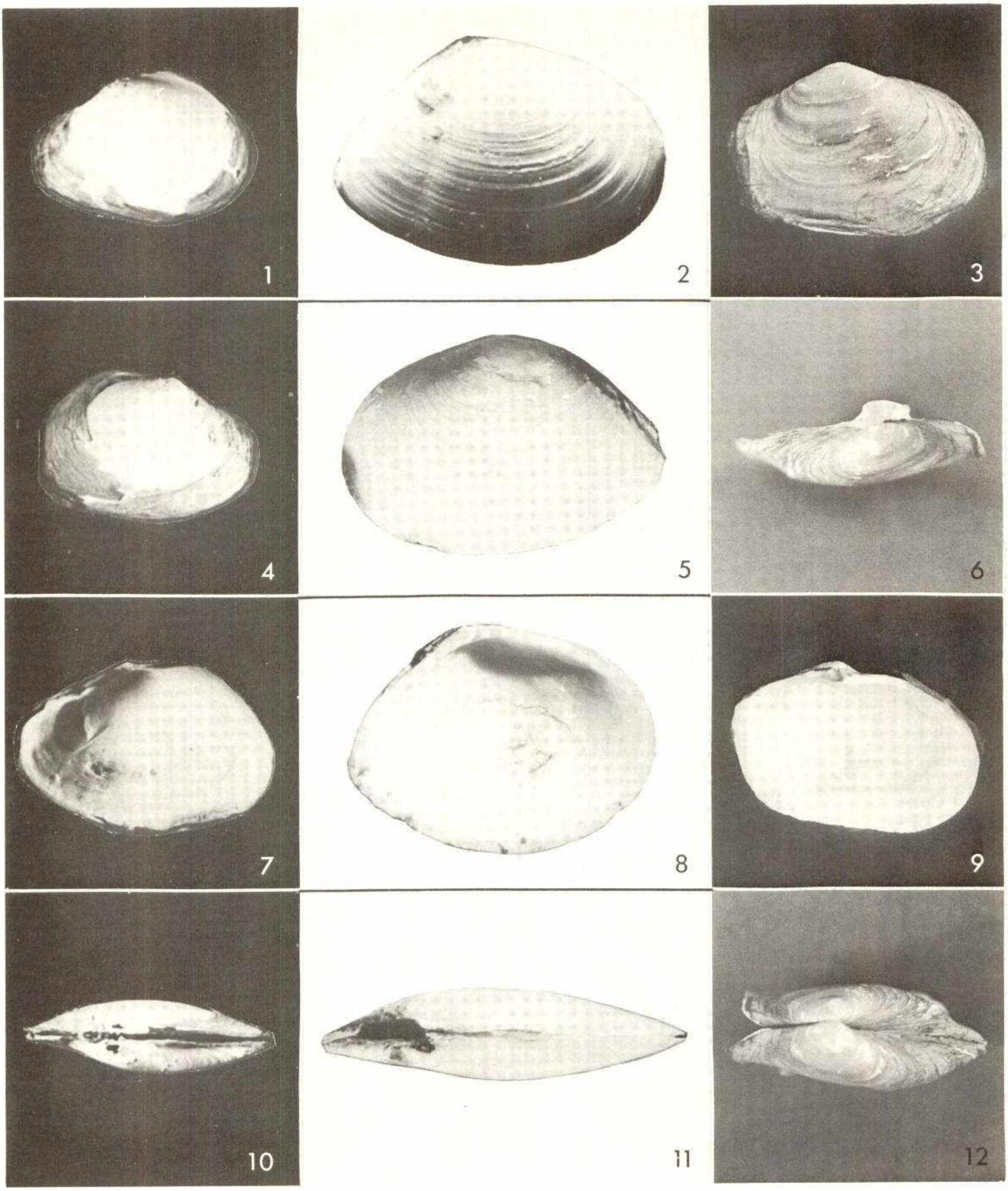


PLATE X. 1, 4, 7, 10. *Macoma calcarea* (Gmelin) f. *obliqua* Soot-Ryen, Foxe Basin, (ABS 808); 2, 5, 8, 11. *M. planiuscula* Grant and Gale, Coronation Gulf, Canadian Archipelago, 18.8 x 13.7 x 4.8 mm (NMC); 3, 6, 9, 12. *Mya truncata* Linné *uddevalensis* Forbes, Devon Is., Canadian Archipelago, 20.8 x 14.7 x 8.3 mm (ABS 62-4300).

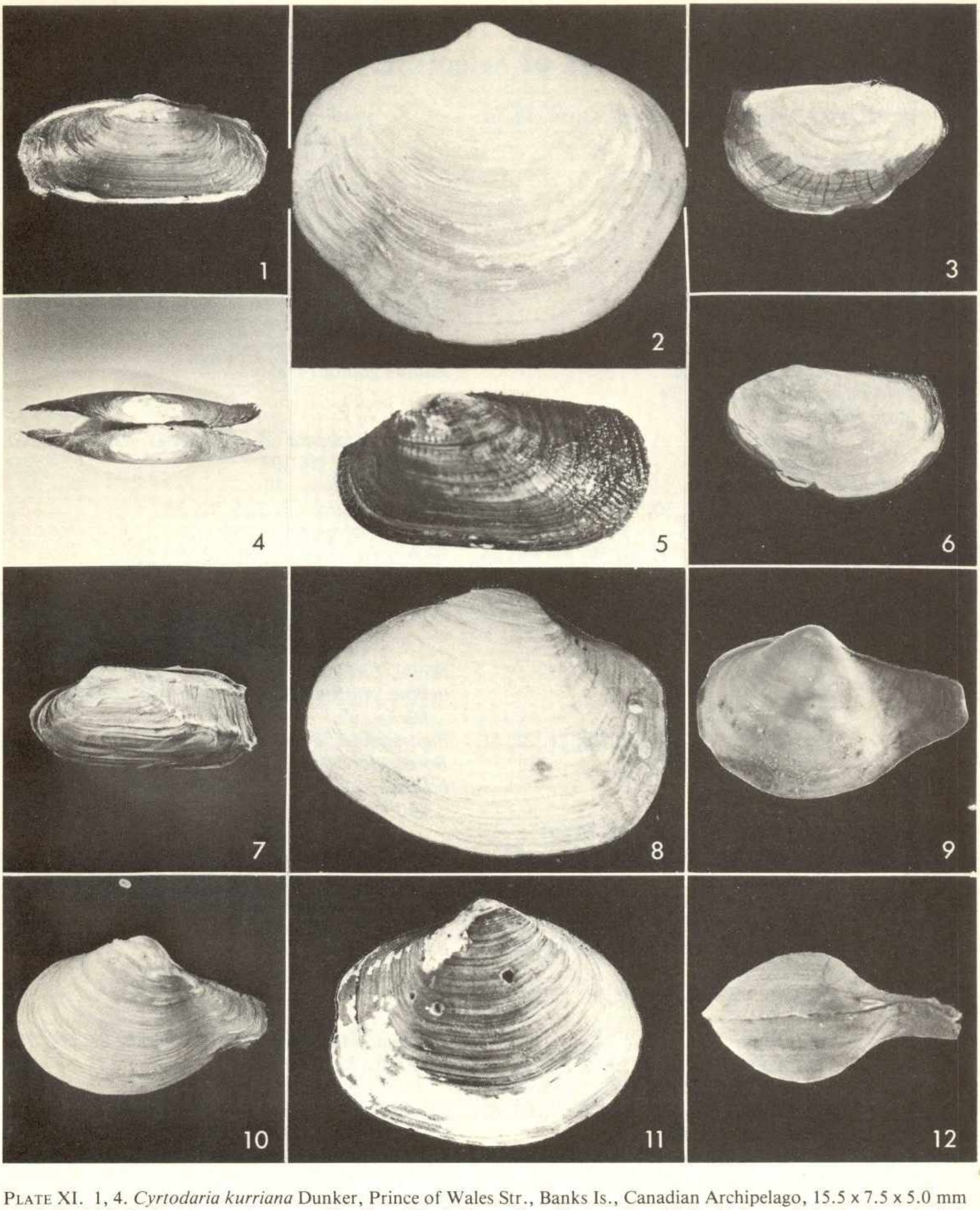


PLATE XI. 1, 4. *Cyrtodaria kurriana* Dunker, Prince of Wales Str., Banks Is., Canadian Archipelago, 15.5 x 7.5 x 5.0 mm (ABS 62-1106); 2. *Periploma abyssorum* Verrill and Bush, Evans Str., Hudson Bay, 23.0 x 20.8 mm; 3, 6. *Pandora glacialis* Leach, Somerset Is., Canadian Archipelago, 15.7 x 9.5 x 2.6 mm (ABS 62-203); 5. *Lyonsia arenosa* (Møller), Slidre Fiord, Ellesmere Is., 1.9 mm (NMC 10-55); 7. *Hiatella arctica* (Linné), Eureca Sd., Ellesmere Is., 15.7 x 7.0 x 5.6 mm (ABS 62-3002); 8. *Thracia devexa* G. O. Sars, Ellef Ringnes Is., Canadian Archipelago, 28.0 x 20.8 x 14.0 mm (NMC 25-54); 9, 12. *Cuspidaria subtorta* (G. O. Sars), Prince Patrick Is., Canadian Archipelago, 9.5 x 5.8 x 5.4 mm (NMC 13-55); 10. *C. arctica* (M. Sars), Ellef Ringnes Is., Canadian Archipelago, 17.8 x 11.6 x 9.5 mm (NMC 4526); 11. *T. myopsis* (Beck) Møller, Prince Patrick Is., Canadian Archipelago, 30.0 x 26.7 mm (NMC 10-52).

Index of Scientific Names

abyssorum, Periploma 3, **47**, 48, 53, 55, 59, 61, 93, 105
aculeata, Anomia 6
acuticostata, Astarte 31, 100
adamsi, Thracia 66
alaskensis, Astarte 65
aleutica, Diplodonta 66
Anatina fragilis 48
andersoni, Pecten 28, 66
Anomia aculeata 6
    ephippium 6
    squamula 53, 62
Aphrodite groenlandica 39
Arca frielei 22
    glacialis 21
    minuta 14
arctatum, Mesodesma 6
arctica, Astarte 3, 6, **29**, 30, 52, 55, 61, 84
    Crassina 29, 30
    Cuspidaria **49**, 52, 55, 59, 61, 65, 94, 105
    Hiatella 3, 5, 6, **46**, 53, 54, 55, 61, 92, 105
    Leda 17
    Mya 46
    Naera 49
    Nucula 2, 17
    Portlandia 3, 5, **17**, 19, 20, 21, 22, 51, 52, 55, 60, 61, 78, 97
    Saxicava 46
    Yoldia 17
arenaria, Mya 4, 5, 6, **44**, 45, 53, 62, 91
arenosa, Lyonsia 3, 5, 6, **47**, 53, 55, 93, 105
    Pandorina 47
Astarte acuticostata 31, 100
    alaskensis 65
    arctica 3, 6, **29**, 30, 52, 55, 61, 84
    banksi 3, 5, 6, 33, 34
    borealis 3, 5, 6, 29, **30**, 31, 53, 54, 55, 84, 99
    compressa 32
    crebricostata 31, 53, 59, 85, 100
    crenata 3, 5, **31**, 32, 52, 55, 85, 99
    elliptica 3, 5, 6, **32**, 53, 55, 61, 62, 85
    esquimalti 33, 65
    fabula 3, 33, 34, 35, 36
    globosa 3, 31, 33, **34**
    lactea 30
    laurentiana 32, 33, **34**
    montagui 33, **34**, 35, 36, 53, 84
    polaris 65
    pulchella 33, 35
    rhomboidalis 31
    richardsoni 30
    scotica 3
    semisulcata 30
    soror **32**, 34, 52, 59, 65, 85, 100
    striata 3, 4, 6, 33, 34, **35**, 53, 54, 55, 56, 60, 61, 86, 100
    subaequilatera 31, 32
    warhami 3, 5, 33, 34, **35**, 36, 52, 54, 55, 60, 86, 100
Axinopsida orbiculata 3, 4, 6, **37**, 53, 55, 87, 101
Axinopsis orbiculata 37
Axinulus careyi 66
Axinus gouldii 38

balthica, Macoma 4, 5, 6, **40**, 41, 42, 53, 54, 55, 60, 61, 65, 89, 102
    Tellina 40
banksi, Astarte 3, 5, 6, 33, 34
    Nicania 33, 34
Bathyarca frielei 3, **22**, 52, 55, 65
    glacialis 3, 6, **21**, 22, 52, 54, 55, 60, 79, 98
    pectunculoides 3, 22
    raridentata 65
beckii, Liocyma 4, 40, 66
belloti, Nucula 3, 4, 5, 6, **9**, 10, 11, 52, 54, 55, 60, 74, 95
binominatus, Pseudamussium 28
Boreacola vadosa 66
borealis, Astarte 3, 5, 6, 29, **30**, 31, 53, 54, 55, 84, 99
    Cardita 36
    Cyclocardia 5, **36**, 53, 55, 59, 60, 62, 87, 101
    Tridonta 30
    Venericardia 6, 36
buccata, Leda 11, 12
    Nuculana 3, 5, 6, 95, 96

calcarea, Macoma 3, 5, 6, **41**, 43, 53, 54, 55, 60, 61, 90, 103, 104
    Tellina 41
californiense, Cardium 65
Cardita borealis 36
Cardium californiense 65
    ciliatum 5, 6, 38, 54, 61
    corbis 66
    elegantulum 53
    groenlandicum 39
    hayesi 6
    islandicum 38
    pinnulatum 6
careyi, Axinulus 66

Chlamys islandica 5, 6, **27**, 28, 53, 54, 55, 60, 61, 83, 99
ciliatum, Cardium 5, 6, 38, 54, 61
  Clinocardium 3, **38**, 39, 52, 55, 88, 102
Clinocardium ciliatum 3, **38**, 39, 52, 55, 88, 102
collinsoni, Nuculana 65
compressa, Astarte 32
  Venus 33
conradi, Thracia 6, 53
corbis, Cardium 66
corrugata, Modiolaria 25
corrugatus, Musculus 3, 5, 6, **25**, 26, 27, 52, 55, 61, 65, 81, 98
  Mytilus 25
Crassina arctica 29, 30
  elliptica 32
  semisulcata 30
crebricostata, Astarte 31, 53, 59, 85, 100
  Cyclocardia 66
crenata, Astarte 3, 5, **31**, 32, 52, 55, 85, 99
  Nicania 31
Crenella decussata 6, **24**, 53, 55, 59, 61, 80, 99
  faba 3, 5, 6, **24**, 25, 53, 55, 56, 59, 60, 61, 65, 80, 99
  glandula 6, **25**, 53
  pectinula 24, 25, 53
Cryptodon gouldii 38
  obesus 6
Cuspidaria arctica **49**, 52, 55, 59, 61, 65, 94, 105
  glacialis **49**, 52, 55, 59, 61, 65, 94
  subtorta 3, **50**, 52, 55, 59, 65, 94, 105
Cyamium minutum 37
Cyclocardia borealis 5, **36**, 53, 55, 59, 60, 62, 87, 101
  crebricostata 66
  novangliae 36
Cyrtodaria kurriana 3, 4, **6**, **45**, 46, 52, 55, 92, 105
  siliqua 6, 53

Dacridium vitreum 3, 4, **25**, 52, 55, 81, 99
decussata, Crenella **6**, **24**, 53, 55, 59, 61, 80, 99
decussatus, Mytilus 24
Delectopecten greenlandicus **28**, 52, 55, 60, 83, 99
delphinodonta, Nucula 3, 4, **11**, 53, 55, 59, 61, 62, 65, 74, 95
devexa, Thracia 3, **48**, 52, 55, 65, 93, 105
Diplodonta aleutica 66
directus, Ensis **6**, 53
discors, Modiola 26
  Modiolaria 26, 27
  Musculus 3, 5, 24, **26**, 27, 52, 55, 61, 82, 95, 99
  Mytilus **26**, 27

dunbari, Thyasira 3, 4, **37**, 38, 52, 55, 59, 60, 64, 65, 88, 101

edulis, Mytilus 3, 4, 5, 6, **22**, 23, 24, 25, 53, 54, 55, 60, 61, 62, 66, 79, 98
elegantulum, Cardium 53
elliptica, Astarte 3, 5, 6, **32**, 53, 55, 61, 62, 85
  Crassina 32
Ensis directus 6, 53
ephippium, Anomia 6
equalis, Thyasira 38, 51
esquimalti, Astarte 33, 65
expansa, Nucula 4, 9, 10, 11

faba, Crenella 3, 5, 6, **24**, 25, 53, 55, 56, 59, 60, 61, 65, 80, 99
  Modiolaria 24
  Mytilus 24
fabula, Astarte 3, 33, 34, 35, 36
flexuosa, Thyasira 38, 55
fluctuosa, Gomphina 40
  Liocyma 3, 4, 6, **39**, 40, 53, 54, 57, 61, 62, 87, 102
  Venus 40
fragilis, Anatina 48
  Macoma 40
  Periploma 47, **48**, 53, 55, 93
fraterna, Portlandia 15
  Yoldiella 3, **15**, 52, 55, 64, 74, 96, 97
frielei, Arca 22
  Bathyarca 3, **22**, 52, 55, 65, 79
frigida, Portlandia 16
  Yoldia 16
  Yoldiella 3, **16**, 52, 55, 64, 77, 96
fusca, Macoma 40
  Tellina 40

Gemma gemma 6
gemma, Gemma 6
gibbosa, Lyonsia 6, 47
glacialis, Arca 21
  Bathyarca 3, 6, **21**, 22, 52, 54, 55, 60, 79, 98
  Cuspidaria **49**, 52, 55, 59, 61, 65, 94
  Kennerlia 46
  Naera 49
  Pandora 3, 5, 6, **46**, 47, 52, 55, 65, 92, 105
  Portlandia 17
  Yoldia 17
glandula, Crenella 6, **25**, 53
  Modiola 25
globosa, Astarte 3, 31, 33, **34**

Glycimeris kurriana 46
siliqua 4, 46
Gomphina fluctuosa 40
gouldi, *Thyasira* 3, 6, **38**, 53, 55, 88, 101
gouldii, *Axinus* 38
Cryptodon 38
Lucina 38
grandis, *Placopecten* 6
greenlandicus, *Delectopecten* 3, **28**, 52, 55, 60, 83, 99
Pecten 5, 28, 60
groenlandica, *Aphrodite* 39
groenlandicum, *Cardium* 39
Propeamussium 28
groenlandicus, *Pecten* 28
Serripes 3, 5, 6, **39**, 53, 54, 55, 61, 89, 102

hayesi, *Cardium* 6
Hiatella arctica 3, 5, 6, **46**, 53, 54, 55, 61, 92, 105
hyalina, *Lyonsia* 5
hyperborea, *Yoldia* 3, 4, 5, **14**, 15, 53, 55, 56, 60, 61, 76, 96

inconspicua, *Macoma* **41**, 42, 52, 59, 61, 66, 89, 102
Tellina 41
inflata, *Macoma* 42
Nucula 4, 6, 9, 10, 11
intermedia, *Mya* 3, 4, 45
Portlandia 16
Yoldiella **16**, 20, 52, 55, 59, 61, 64, 77, 96
islandica, *Chlamys* 5, 6, **27**, 28, 53, 54, 55, 60, 61, 83, 99
Ostrea 27
islandicum, *Cardium* 38
islandicus, *Pecten* 27

jacksoni, *Leda* 11, 12
japonica, *Mya* 45

Kennerlia glacialis 46
kurriana, *Cyrtodaria* 3, 4, 6, **45**, 46, 52, 55, 92, 105
Glycimeris 46

lactea, *Astarte* 30
laevigata, *Modiola* 26
Modiolaria 26, 27
laevigatus, *Musculus* 4, 5, 6, 26, 27
laevis, *Modiolaria* 26
lama, *Macoma* 43
laurentiana, *Astarte* 32, 33, **34**
Leda arctica 17
buccata 11, 12
jacksoni 11, 12
minuta 14
pernula 11
rostrata 12
Ledella tamara 16, 17
lenticula, *Portlandia* 16
Yoldiella 3, **16**, 52, 55, 60, 64, 77, 96
Lima similis 29
subauriculata 6, **29**, 52, 55, 80
Limatula subauriculata 3, **29**
limatula, *Yoldia* 14, 15
Liocyma beckii 4, 40, 66
fluctuosa 3, 4, 6, **39**, 40, 53, 54, 57, 61, 62, 87, 102
viridis 4, 40, 66
loveni, *Macoma* 3, **42**, 52, 55, 60, 91, 103
Tellina 42
Lucina gouldii 38
Lyonsia arenosa 3, 5, 6, **47**, 53, 55, 93, 105
gibbosa 6, 47
hyalina 5

Macoma balthica 4, 5, 6, **40**, 41, 42, 53, 54, 55, 60, 61, 65, 89, 102
calcarea 3, 5, 6, **41**, 43, 53, 54, 55, 60, 61, 90, 103, 104
fragilis 40
fusca 40
inconspicua **41**, 42, 52, 59, 61, 66, 89, 102
inflata 42
lama 43
loveni 3, **42**, 52, 55, 60, 91, 103
moesta 3, 5, **42**, 43, 52, 54, 55, 60, 90, 103
oneilli 42, 43, 66
planiuscula **43**, 52, 59, 61, 66, 89, 104
subulosa 41
tenera 41
torelli 3, **43**, 44, 52, 55, 91, 102
magellanicus, *Pecten* 62
Placopecten 53
Mesodesma arctatum 6
minuta, *Arca* 14
Leda 14
Nuculana 3, 5, 6, **14**, 52, 55, 61, 75, 96
Turtonia 6, **37**, 53, 55, 65, 87
Venus 37
minutum, *Cyamium* 37

Modiola discors 26
glandula 25
laevigata 26
vitrea 25
Modiolaria corrugata 25
discors 26, 27
faba 24
laevigata 26, 27
laevis 26
nigra 27
substriata 26, 27
Modiolus modiolus 6, 53, 62
modiolus, Modiolus 6, 53, 62
moesta, Macoma 3, 5, **42**, 43, 52, 54, 55, 60, 90, 103
Tellina 42
Montacuta substriata 3, **36**, 51, 52, 55, 87
montagui, Astarte 33, **34**, 35, 36, 53, 84
Venus 34
Musculus corrugatus 3, 5, 6, **25**, 26, 27, 52, 55, 61, 65, 81, 98
discors 3, 5, 24, **26**, 27, 52, 55, 61, 82, 98, 99
laevigatus 4, 5, 6, 26, 27
niger 3, 5, **27**, 52, 55, 82, 98
substriatus 26
Mya arctica 46
arenaria 4, 5, 6, **44**, 45, 53, 62, 91
intermedia 3, 4, 45
japonica 45
pseudoarenaria 3, 4, 5, 44, **45**, 51, 52, 54, 61, 91
truncata 3, 5, 6, **44**, 45, 51, 53, 55, 91, 104
uddevalensis 5, 45, 104
myalis, Nucula 15
Yoldia 5, **15**, 53, 55, 57, 62, 76
myopsis, Thracia 3, 4, **6**, **48**, 49, 53, 55, 61, 94, 105
Mytilus corrugatus 25
decussatus 24
discors 26, 27
edulis 3, 4, 5, 6, **22**, 23, 24, 25, 53, 54, 55, 60, 61, 62, **66**, 79, 98
faba 24
pellucidus 22, 23, 98

Naera arctica 49
glacialis 49
subtorta 50
Nicania banksi 33, 34
crenata 31
striata 33, 35
niger, Musculus 3, 5, **27**, 52, 55, 82, 98
nigra, Modiolaria 27
novangliae, Cyclocardia 36
Nucula arctica 2, 17
belloti 3, 4, 5, 6, **9**, 10, 11, 52, 54, 55, 60, 74, 95
delphinodonta 3, 4, **11**, 53, 55, 59, 61, 62, 65, 74, 95
expansa 4, 9, 10, 11
inflata 4, 6, 9, 10, 11
myalis 15
portlandica 17
quirica 66
sapotilla 14
siliqua 17
sulcifera 20
tenuis 6, 9, 10, 11, 55
Nuculana buccata 3, 5, 6, 95, 96
collinsoni 65
minuta 3, 5, 6, **14**, 52, 55, 61, 75, **96**
pernula 3, 5, **11**, 12, 13, 14, 52, 53, 55, 60, 62, 75, 95
radiata 65

obesa, Yoldiella 3
obesus, Cryptodon 6
oneilli, Macoma 42, 43, 66
orbiculata, Axinopsida 3, 4, 6, **37**, 53, 55, 87, 101
Axinopsis 37
Ostrea islandica 27

Pandora glacialis 3, 5, 6, **46**, 47, 52, 55, 65, 92, 105
trilineata 6
Pandorina arenosa 47
papyratia, Periploma 6
Pecten andersoni 28, 66
greenlandicus 5, 28, 60
groenlandicus 28
islandicus 27
magellanicus 62
vitreus 3
pectinula, Crenella 24, 25, 53
pectunculoides, Bathyarca 3, 22
pellucidus, Mytilus 22, 23, 98
Periploma abyssorum 3, **47**, 48, 53, 55, 59, 61, 93, 105
fragilis 47, **48**, 53, 55, 93
papyratia 6
pernula, Leda 11
Nuculana 3, 5, **11**, 12, 13, 14, 52, 53, 55, 60, 62, 75, 95
pholadis, Saxicava 46
pinnulatum, Cardium 6
planiuscula, Macoma **43**, 52, 59, 61, 66, 89, 104

Placopecten grandis 6
magellanicus 53
polaris, *Astarte* 65
polynyma, *Spisula* 6, 62
Portlandia arctica 3, 5, **17**, 19, 20, 21, 22, 51, 52, 55, 60, 61, 78, 97
fraterna 15
frigida 16
glacialis 17
intermedia 16
lenticula 16
siliqua 3, 19, 78, 97
sulcifera 3, **20**, 21, 22, 52, 55, 59, 60, 76, 97
portlandica, *Nucula* 17
Propeamussium groenlandicum 28
proxima, *Tellina* 41
Pseudamusium ringnesia 3, 51
Pseudamussium binominatus 28
pseudoarenaria, *Mya* 3, 4, 5, 44, **45**, 51, 52, 54, 61, 91
pulchella, *Astarte* 33, 35

quirica, *Nucula* 66

radiata, *Nuculana* 65
raridentata, *Bathyarca* 65
rhomboidalis, *Astarte* 31
richardsoni, *Astarte* 30
ringnesia, *Pseudamusium* 3, 51
rostrata, *Leda* 12
rugosa, *Saxicava* 46

sapotilla, *Nucula* 14
Yoldia 4, 5, 6, 15, 33
Saxicava arctica 46
pholadis **46**
rugcsa 46
scissurata, *Yoldia* 65
scotica, *Astarte* 3
semisulcata, *Astarte* 30
Crassina 30
septentrionalis, *Thracia* 3, **49**, 53, 55, 61, 65, 94
Serripes groenlandicus 3, 5, 6, **39**, 53, 54, 55, 61, 89, 102
siliqua, *Cyrtodaria* 6, 53
Glycymeris 4, 46
Nucula 17
Portlandia 3, 19, 78, 97
similis, *Lima* 29
solidissima, *Spisula* 6
soror, *Astarte* **32**, 34, 52, 59, 65, 85, 100
Spisula polynyma 6, 62
solidissima 6
squamula, *Anomia* 53, 62
striata, *Astarte* 3, 4, 6, 33, 34, **35**, 53, 54, 55, 56, 60, 61, 86, 100
Nicania 33, 35
subaequilatera, *Astarte* 31, 32
subauriculata, *Lima* 6, **29**, 52, 55, 80
Limatula 3, **29**
substriata, *Modiolaria* 26, 27
Montacuta 3, **36**, 51, 52, 55, 87
Venus 36
substriatus, *Musculus* 26
subtorta, *Cuspidaria* 3, **50**, 52, 55, 59, 65, 94, 105
Naera 50
subulosa, *Macoma* 41
sulcifera, *Nucula* 20
Portlandia 3, **20**, 21, 22, 52, 55, 59, 60, 76, 97

tamara, *Ledella* 16, 17
Yoldiella 3, **16**, 52, 55, 77
Tellina balthica 40
calcarea 41
fusca 40
inconspicua 41
loveni 42
moesta 42
proxima 41
torelli 43
tenera, *Macoma* 41
tenuis, *Nucula* 6, 9, 10, 11, 55
Thracia adamsi 66
conradi 6, 53
devexa 3, **48**, 52, 55, 65, 93, 105
myopsis 3, 4, 6, **48**, 49, 53, 55, 61, 94, 105
septentrionalis 3, **49**, 53, 55, 61, 65, 94
Thyasira dunbari 3, 4, **37**, 38, 52, 55, 59, 60, 64, 65, 88, 101
equalis 38, 51
flexuosa 38, 55, 88
gouldi 3, 6, **38**, 53, 55, 101
torelli, *Macoma* 3, **43**, 44, 52, 55, 91, 102
Tellina 43
Tridonta borealis 30
trilineata, *Pandora* 6
truncata, *Mya* 3, 5, 6, **44**, 45, 51, 53, 55, 91, 104
Turtonia minuta 6, **37**, 53, 55, 65, 87

uddevalensis, *Mya* 5, 45, 104

vadosa, *Boreacola* 66
Venericardia borealis 6, 36

Venus compressa 33
fluctuosa 40
minuta 37
montagui 34
substriata 36
viridis, Liocyma 4, 40, 66
vitrea, Modiola 25
vitreum, Dacridium 3, 4, **25**, 52, 55, 81, 99
vitreus, Pecten 3

warhami, Astarte 3, 5, 33, 34, **35**, 36, 52, 54, 55, 60, 86, 100

Yoldia arctica 17
frigida 16
glacialis 17
hyperborea 3, 4, 5, **14**, 15, 53, 55, 56, 60, 61, 76, 96
limatula 14, 15
myalis 5, **15**, 53, 55, 57, 62, 76
sapotilla , 5, 6, 15, 53
scissurata 65
Yoldiella fraterna 3, **15**, 52, 55, 64, 74, 96, 97
frigida 3, **16**, 52, 55, 64, 77, 96
intermedia **16**, 20, 52, 55, 59, 61, 64, 77, 96
obesa 3
lenticula 3, **16**, 52, 55, 60, 64, 77, 96
tamara 3, **16**, 52, 55, 77

Recent Bulletins

190 Hydrodynamics and energetics of fish propulsion
PAUL W. WEBB
(1975, 158 p., cat. no. Fs 94-190; *Canada: $5.00/Other countries: $6.00*)

191 Computation and interpretation of biological statistics of fish populations
W. E. RICKER
(Reprinted 1978, 382 p., cat. no. Fs 94-191; *Canada: $10.50/Other countries: $12.60*)

192 Catalogue and synopsis of *Caligus*, a genus of Copepoda (Crustacea) parasitic on fishes
L. MARGOLIS, Z. KABATA, and R. R. PARKER
(1975, 117 p., cat. no. Fs 94-192; *Canada: $5.00/Other countries: $6.00*)

193 Nearctic and Palaearctic *Heterotrissocladius* (Diptera: Chironomidae)
OLE A. SAETHER
(1975, 67 p., cat. no. Fs 94-193; *Canada: $3.50/Other countries: $4.20*)

194 Living marine resources of Newfoundland-Labrador: status and potential
A. T. PINHORN [ed.]
(1976, 64 p., cat. no. Fs 94-194; *Canada: $4.00/Other countries: $4.80*)

195 Revision of *Hydrobaenus, Trissocladius, Zalutschia. Paratrissocladius*, and some related genera (Diptera: Chironomidae)
OLE A. SAETHER
(1976, 287 p., cat. no. Fs 94-195; *Canada: $7.00/Other countries: $8.40*)

196 Taxonomical studies on Chironomidae: *Nanocladius, Pseudochironomus*, and the *Harnischia* complex
OLE A. SAETHER
(1977, 155 p., cat. no. Fs 94-196; *Canada: $5.00/Other countries: $6.00*)

197 Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys
OLE A. SAETHER
(1977, 209 p., cat. no. Fs 94-197; *Canada: $6.00/Other countries: $7.20*)

198 Seismic sea waves—tsunamis
T. S. MURTY
(1978, 337 p., cat. no. Fs 94-198; *Canada: $10.00/Other countries: $12.00*)

199 Synopsis of the parasites of fishes of Canada
L. MARGOLIS and J. R. ARTHUR
(1979, 269 p., cat. no. Fs 94-199; *Canada: $12.95/Other countries: $15.55*)

200 Biology of the harbor seal, *Phoca vitulina*, in eastern Canada
J. BOULVA and I. A. MCLAREN
(1979, 24 p., cat. no. Fs 94-200; *Canada: $3.00/Other countries: $3.60*)

201 Biosystematic revision of the genus *Stenonema* (Ephemeroptera: Heptageniidae)
A. F. BEDNARIK and W. P. MCCAFFERTY
(1979, 73 p., cat. no. Fs 94-201; *Canada: $8.50/Other countries: $10.20*)

202 Shrimps of the Pacific coast of Canada
T. H. BUTLER
(1980, 280 p., cat. no. Fs 94-202; *Canada: $18.00/Other countries: $21.60*)

203 Circulation models of lakes and inland seas
T. J. SIMONS
(1980, 146 p., cat. no. Fs 94-203; *Canada: $12.00/Other countries: $14.40*)

204 Hydromedusae of British Columbia and Puget Sound
M. N. ARAI and A. BRINCKMANN-VOSS
(1980, 192 p., cat. no. Fs 94-204; *Canada: $13.00/Other countries: $15.60*)

205 Environmental effects of dams and impoundments in Canada: experience and prospects
R. M. BAXTER and P. GLAUDE
(1980, 34 p., cat. no. Fs 94-205; *Canada: $2.50/Other countries: $3.00*)

206 Palaeolimnology of the Bay of Quinte, Lake Ontario: 2800 years of cultural influence
W. F. WARWICK
(1980, 117 p., cat. no. Fs 94-206; *Canada $11.00/Other countries: $13.20*)

To obtain the publications listed above, at the prices indicated, write to:
Supply and Services Canada
Canadian Government Publishing Centre
Hull, Que., Canada K1A 0S9

Please make cheques and money orders payable to the Receiver General for Canada.
Advance payment is required.