Recent intertidal molluscs from the east-central coast of Ellesmere Island, Northwest Territories

Project 750063

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Abstract

Twenty-nine species of recent molluscs were collected along the east coast of Ellesmere Island in the intertidal and nearshore area. All were cold water species adapted to habitation in a harsh intertidal environment, with ice cover 10 months of the year and exposure to ice gouging and melt runoff the remaining two months. Five species of molluscs were new to Ellesmere Island.

The greatest mollusc densities were found in the midtidal zone (approximately 1 m above lowest low tide) where large numbers of mobile gastropods dwelled. Larger sedentary forms were more common lower or in protected intertidal areas. Some of the recent species have existed in the area for more than 8000 years.

Résumé

Vingt-neuf espèces de mollusques récents ont été recueillis dans la zone intertidale du littoral oriental de l'Île Ellesmere. Toutes les espèces observées sont adaptées à l'eau froide dans un habitat soumis à un milieu intertidal rigoureux, recouvert de glace dix mois par année et exposés au frottement des glaces et aux eaux de fonte au cours des deux autres mois. Cinq espèces de mollusques ont été découvertes pour la première fois sur l'Île Ellesmere.

Les plus grandes densités de mollusques ont été observées au centre de la zone intertidale (à environ 1 m au-dessus de la marée basse) où se sont installés un grand nombre de gastropodes mobiles. Les gastropodes sédentaires sont plus nombreux dans la partie inférieure des zones intertidales ou dans les zones intertidales protégées. Certaines espèces récentes existent dans la région depuis plus de 8 000 ans.

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Introduction

This report introduces a species list of recent intertidal molluscs collected along the east coast of Ellesmere Island. Collections were taken near Cape Herschel (78° 35'N, 74° 35'W) and at Alexandra Fiord (78° 53'N, 75° 45'W) from 1 June to 20 July, 1983 (Fig. 37.1). The only previously published faunal records for the area were made by Grieg (1909), who examined specimens dredged from shallow water during the first year of the Second Norwegian Arctic Expedition in the "Fram", 1898-1902. More recently Macpherson (1971) and Lubinsky (1980) have recorded the ranges of molluscs found in the Arctic. Ellis (1960, 1966) and Ellis and Wilce (1961) described fauna found in the subtidal and intertidal environments of Baffin Island, and Thomson (1982) studied the community structure of marine benthos in Lancaster Sound and Baffin Bay in the subtidal environment. Thorson (1936), Vibe (1939, 1950), and Madsen (1936, 1940) examined fauna along the west coast of Greenland in latitudes comparable to those of this study.

This report is contribution No. 21 from the Cape Herschel project.

Collection sites

Six locations were examined in the vicinity of Cape Herschel and Alexandra Fiord (Fig. 37.1). All sites experienced macrotidal, semi-diurnal tides with a mean tidal range of 2.9 m and a large range of 4.5 m (M. Krawetz, personal communication, 1983). A high potential for ice movement and corresponding sediment redistribution exists as a result of such large influxes of water. The sites varied in exposure to wave and sea ice action, as well as freshwater and sediment input. They ranged from low, broad intertidal flats to steep, rocky shorelines (Table 37.1).

The study was confined to the intertidal zone because of logistical limitations. This zone had not been studied previously in any detail in the Canadian High Arctic. Reconnaissance began in early June when the approximate limits of the intertidal zone could be determined by the presence of coastal sediments and shell debris in the sea ice. Molluscs that had been frozen into the sea ice during freezeup or that were subject to ice push activity became exposed at the ice surface as the sea ice ablated.

The intertidal ice cover had deteriorated by 1 July 1983, exposing the substrate during low tide and permitting random collections of live fauna. In addition, random cores were taken with a total surface area of 100 cm^2 to an average depth of 10 cm. The cores were sieved through a 0.5 mm screen (1.0 ϕ) and the fauna was preserved whole in buffered 10% formalin for 24 hours and then transferred to isopropyl alcohol. Estimates of mollusc density were calculated from the core results.

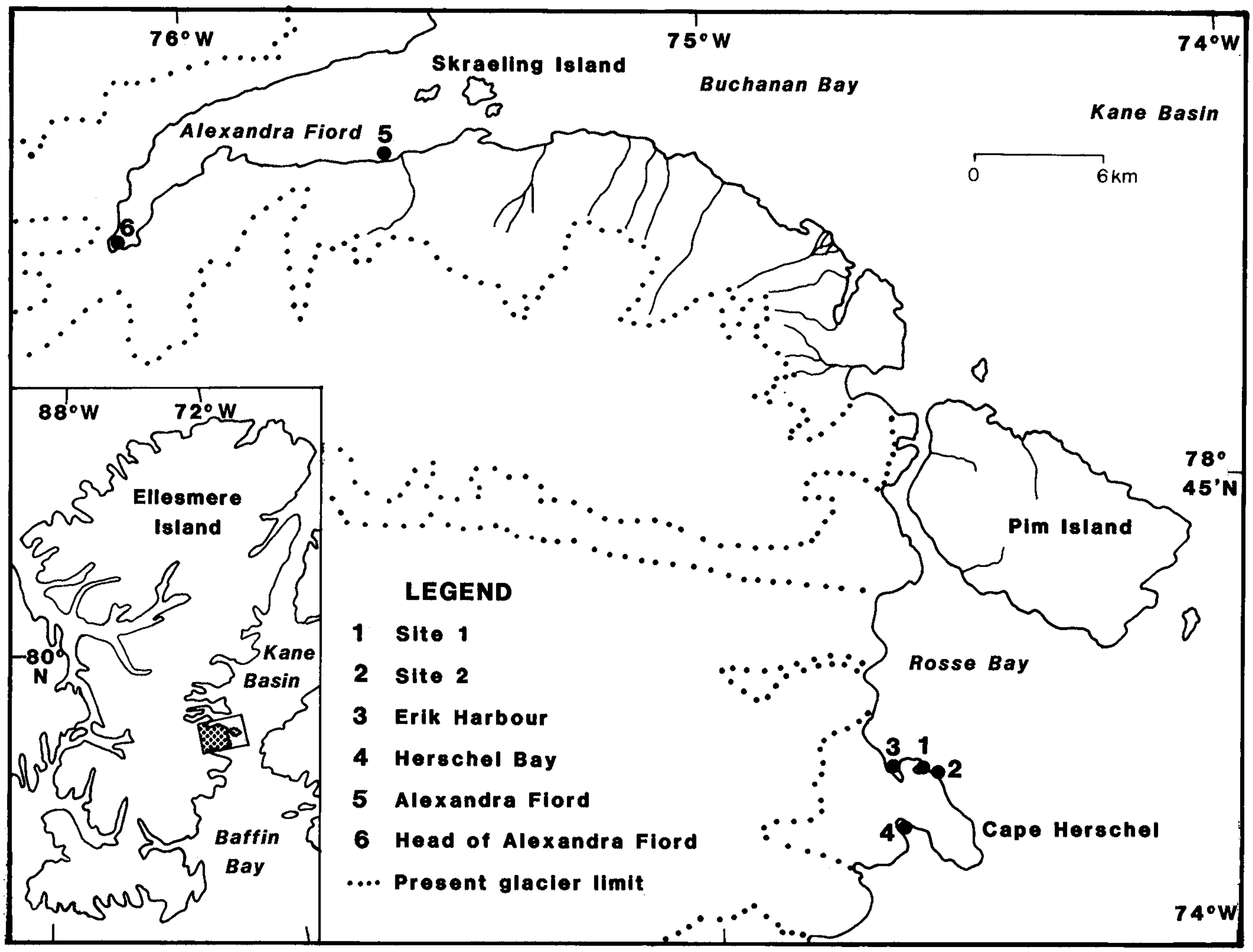

Figure 37.1. Location map, east-central coast of Ellesmere Island.

Table 37.1. Collection site characteristics

Sites	Aspect	Intertidal width (km)	Slope	Freshwater input	Shoreline	Intertidal characteristics
SITE 1	NE sheltered	0.8	Gradual	Ice; small stream	Bedrock	Boulder and sediment mounds with pool; silts on the upper flat and in pools; coarser sands and gravels seaward.
SITE 2	NE Exposed	0.10	Narrow bench, then steep	Ice	Bedrock	Large boulder and sediment mounds with pools; tidal channel with silt at shoreline; coarser sands seaward.
ERIK HARBOUR	N Sheltered	1.0	Gradual	Ice; small streams	Partially vegetated zone and beach	Broad intertidal zone with boulder mounds, tidal channels; fines with underlying gravels at high tide mark.
HERSCHEL BAY	SE Sheltered, except S winds	1.5	NA Under ice	Ice; small streams	Sandy Beach	Numerous ballycatters, indicative of boulder mounds.
ALEXANDRA FIORD	N Exposed	0.10	Gradual to boulder ridge, then steep	Ice; river to east	Bedrock and delta	Silts at shore coarsening seaward to sands at boulder ridge, <0.8 m ALLT; pools, sediment mounds, some boulders on inner flat.
HEAD OF ALEXANDRA FIORD	N Sheltered	1.0	Gradual	River	Delta sands	Sorted sands observed under ice.

Ice action affects the study sites throughout the season to varying degrees. The area has a solid cover of sea ice up to 10 months of the year, from approximately October to July (M. Krawetz, personal communication, 1983). From observations made in 1983, the presence of fast ice helped delay thawing of the frozen substrate at the inception of breakup, thus inhibiting larval settlement and faunal activity. Some infaunal benthos such as the **Mya truncata** and **Serripes groenlandicus** lived within the icefoot zone and were probably frozen within the substrate most of the winter. Once the coastal fast ice had ablated, offshore ice and multi-year ice continued to raft into the intertidal zone. Ice gouging of the substrate by this ice not only disrupted the sediment by dislodging the fine fractions, but also crushed fragile molluscs and barnacles on exposed sediment and rock surfaces. Ice melt resulted in lowered salinity and appeared to inhibit faunal activity (Dale, 1982).

Balanus crenatus (Bruguière, 1789), **Balanus balanus** L., and various species of macroalgae were also collected at the lower edge of the intertidal zone in protected crevices on boulders. Shell debris from the barnacles was found throughout the area at all sites indicating larger subtidal populations.

Observations and results

Twenty-eight species were collected in 1983, and one gastropod was sampled in 1979 (BS-79-24). The 29 species include 13 gastropods and 16 bivalves. Table 37.2 lists the family, genus, and species names, as well as the condition when collected (living or dead). Twelve species were collected live and thus are able to colonize the intertidal zone for at least a brief period. These species are **Margarites helicinus, Cingula castanea, Oenopota bicarinata, Cylichna alba, Retusa obtusa, Crenella faba, Musculus discors, Axinopsida orbiculata, Serripes groenlandicus, Macoma calcarea, Mya truncata,** and **Hiatella arctica.** The remaining species may have been transported into the intertidal zone from deeper sites by ice or wave action.

The table also includes collection site information and previous records for the area. The most common species found and the number of sites where collected are as follows: **Mya truncata** (6), **Hiatella arctica** (6), **Portlandia arctica** (5), **Cylichna alba** (5), **Oenopota bicarinata** (4), **Astarte borealis** (4), and **Axinopsida orbiculata** (4). Six of the molluscs were represented by single specimens: **Buccinum** cf. **hydrophanum, Buccinum** sp., cf. **Colus** sp., **Crenella faba,** cf. **Yoldiella** sp., and **Bathyarca glacialis.** These six plus **Cingula castanea** and **Retusa obtusa** were present at only one of the six sites.

The greatest number of live species was collected in the low broad intertidal zone where the accumulation of fine sediment enhanced living conditions (e.g., Site 1 (10 species), and Erik Harbour (8) (Table 37.2)). Fewer species were present on the coarser, steeper substrate at Site 2 (7) and the exposed narrow tidal flat at Alexandra Fiord (5). Unfavourable ice conditions hampered collection at Herschel Bay (4) and the delta at the head of Alexandra Fiord (3). In general, the sediments coarsen across the intertidal zone in a seaward direction. Finer sediments drape the upper flats where poorly drained pools have developed from ice microrelief structures. It is difficult to determine whether change in tidal height or grain size is the primary control on mollusc presence and frequency.

Cores were taken at Site 1, Site 2, and Alexandra Fiord in order to estimate mollusc densities (Table 37.3). The highest density of molluscs (41 organisms/100 cm^2) was obtained at Site 1, a narrow sheltered inlet which inclined gently seaward. This concentration was recorded on the slope of a fine grained sediment mound in the midflat region

Table 37.2. Intertidal species list (Gastropoda, Bivalvia), Eastern Ellesmere Island, N.W.T.[1]

Family, Genus, Species	Condition[2]	Site 1	Site 2	Erik Hbr.	Collection sites (cf. Fig. 37.1) Herschel Bay	Alex. Fd.	Head Alex Fd.	Grieg's samples (1909)
GASTROPODA								
LEPETIDAE								
Lepeta caeca (Müller, 1776)	D			X		X		
TROCHIDAE								
Margarites helicinus (Phipps, 1774)	L	X	X	X				X
Margarites umbilicalis[3] (Broderip & Sowerby, 1829)	L				X			X
RISSOIDAE								
Cingula castanea (Møller, 1842)	L	X						
TRICHOTROPIDAE								
Trichotropis borealis Broderip & Sowerby, 1829	D	X						X
BUCCINIDAE								
cf. **Colus** sp.	D					X		
Buccinum sp.	D					X		X
Buccinum cf. **hydrophanum** Hancock, 1846	D						X	
TURRIDAE								
Oenopota arctica (A. Adams, 1855)	D	X				X		
Oenopota bicarinata (Couthouy, 1838)	L	X		X		X	X	
Oenopota turricula (Montagu, 1803)	D					X		
CYLICHNIDAE								
Cylichna alba Brown, 1827	L	X	X	X	X	X		
RETUSIDAE								
Retusa obtusa (Montagu, 1807)	L	X						
BIVALVIA								
NUCULANIDAE								
Portlandia arctica (Gray, 1824)	D	X		X	X	X	X	
cf. **Yoldiella** sp.	D			X				
Yoldiella cf. **intermedia** (M. Sars, 1865)	D	X		X				
ARCIDAE								
Bathyarca glacialis (Gray, 1824)	D			X				
MYTILIDAE								
Crenella faba (Müller, 1776)	L		X					
Musculus discors (Linné, 1767)	L		X	X				X
ASTARTIDAE								
Astarte sp.	D	X		X	X	X		
Astarte borealis (Schumacher, 1817)	D	X		X	X	X		X
Astarte montagui (Dillwyn, 1817)	D	X		X				X
Astarte striata (Leach, 1819)	D			X				
THYASIRIDAE								
Axinopsida orbiculata (G.O. Sars, 1878)	L	X	X	X	X			
CARDIIDAE								
cf. **Clinocardium** sp.	D	X		X				
Serripes groenlandicus (Bruguière, 1789)	L	X				X		X
TELLINIDAE								
Macoma calcarea (Gmelin, 1791)	L	X		X				
MYIDAE								
Mya truncata Linné, 1758	L	X	X	X	X	X	X	X
HIATELLIDAE								
Hiatella arctica Linné, 1767	L	X	X	X	X	X	X	X

[1] Samples deposited at the National Museum of Natural Sciences, Ottawa, Canada. Accession No. IZ 1984-117

[2] L = Live; D = Dead

[3] Collected by W. Blake, Jr., 7.5 m below the sea ice surface (BS-79-24)

on 15 July 1983 and included **Axinopsida orbiculata** which accounted for 58% of the specimens, **Cylichna alba** 24%, and **Oenopota bicarinata** 17%. Replicate sampling at Site 1 showed that a faunal bloom occurred between 7 July and 15 July 1983, with average mollusc densities rising from 9.2/100 cm^2 to 17.3/100 cm^2. Increases in the number of **Axinopsida Oenopota** and **Cylichna** accounted for the rise in density.

The largest densities of molluscs were found in the midflat region at approximately 1 m above lowest low tide (ALLT). In general, at this tidal height, fine sediment had accumulated and sediment mounds with intervening tidal pools had developed. The largest mollusc populations were always at 1 m ALLT, even at more exposed collection sites where ice and wave action discouraged fine sedimentation and disrupted tidal pool development. However, within this tidal range the faunal distribution was highly variable due to the paucity of fauna found at some sites and, as illustrated by the high variations in standard deviations calculated from the mollusc densities (Table 37.3).

The smaller molluscs such as **Oenopota, Cylichna,** and **Axinopsida** were found in great numbers in the midflat region. The larger molluscs such as the infaunal **Mya** and **Hiatella** were found more commonly at the lower edge of the flats. Alexandra Fiord was an exception with **Mya** and **Hiatella** inhabiting the midflat zone. A discontinuous boulder ridge at the lower edge of these flats probably helped protect the inner zone from severe ice gouging and enhanced

Table 37.3. Core results, species numbers, and densities

Location		Site description	Sample date in 1983	Number of each species per 100 cm^2 **Axinopsida orbiculata**	**Cylichna alba**	**Hiatella arctica**	**Mya truncata**	**Oenopota bicarinata**	Total fauna per 100 cm^2	Average density per 100 cm^2
Site 1	83-JD-46	Midtidal sediment mound	July 6	5	3	-	-	2	10	
	83-JD-53	Silts between boulder mounds	July 7	2	5	-	-	-	7	
	83-JD-54	Silts and sands, side of boulder mound	July 7	1	3	-	-	-	4	
	83-JD-55	Silts, runnel between boulder mounds	July 7	5	3	1	-	3	12	
	83-JD-57	Silts and sands, side of sediment mound	July 7	7	3	1	-	2	13	
										9.2 std = 3.7
Site 1	83-JD-109	Same site as 83-JD-46	July 15	24	10	-	-	7	41	
	83-JD-117	Same site as 83-JD-55	July 15	11	4	5	-	3	23	
	83-JD-95	Low intertidal sands, some gravels	July 15	3	2	-	-	-	5	
	83-JD-94	Low intertidal, tidal channel	July 15	-	-	-	-	-	-	
										17.3 std = 18.7
Site 2	83-JD-83a	Inner pool, silts by icefoot	July 14	-	-	-	-	-		
	83-JD-83b	Low intertidal pool, landward of boulder ridge	July 14	-	-	-	-	-		
	83-JD-81	Silts, side of boulder mound, low intertidal	July 14	-	-	-	-	-		
	83-JD-82	Same as 83-JD-83b	July 14	-	-	-	-	-		
	83-JD-80	Silts and clay, low intertidal	July 14	-	-	-	-	-		
	83-JD-91	Same as 83-JD-81	July 14	-	1	1	-	-	2	
										0.3 std = .82
Alexandra Fiord										
	83-JD-102A	Midtidal pool	July 17	-	1	-	1	-	2	
	83-JD-102B	Low intertidal, seaward of boulder ridge	July 17	-	-	-	-	-		
	83-JD-110C	Shoreward side of boulder ridge	July 17	-	1	-	-	-	1	
	83-JD-111D	Midtidal pool	July 17	-	-	-	2	-	2	
	83-JD-11A	Fluvial delta, midtidal	July 18	-	-	-	-	-	-	
	83-JD-11B	Fluvial delta, low intertidal	July 18	-	-	-	-	-		
	83-JD-112C	Pool, shoreward side of boulder ridge	July 18	-	-	2	1	-	3	
										1.14 std = 1.2

sedimentation of fine material. The paucity and small size of the live **Mya** and **Hiatella** sampled, however, illustrates the continued severity of conditions resulting in short life spans and slow growth (see Hewitt and Dale, 1984 for further analyses of these same samples). In more suitable subarctic, intertidal environments **Mya truncata** specimens can reach a maximum age of 40 years and shell lengths up to 8.7 cm (Hewitt and Dale, 1984). The maximum age and length attained by **Mya truncata** collected live in this study was 16 years at 4.2 cm (Hewitt and Dale, 1984). A great number of larger empty valves were found on these same flats, probably washed up from the subtidal area by wave and ice action. A sizable walrus population in the area feeds on this species, making empty shells available for transport to the intertidal area in Alexandra Fiord.

Conclusions

All the molluscs collected are recognized as northern species. **Cingula castanea, Cylichna alba, Retusa obtusa, Oenopota arctica,** and **Oenopota turricula** are new to Ellesmere Island; the latter two were considered previously to occupy a range to northern Baffin Island. Twelve of the species collected are shallow-water forms capable of intertidal habitation. They can withstand a harsh marine environment with ice cover for 10 months of the year and exposure to ice gouging and freshwater input during the remaining two months. In this high arctic locale, the greatest densities are found in the midtidal zone around 1 m ALLT where large numbers of the smaller, more mobile gastropods dwell, such as **Oenopota** and **Cylichna** and the tiny bivalve **Axinopsida.** Larger sedentary forms such as **Mya, Hiatella,** and **Serripes** are found lower or in protected sites in the intertidal areas like Alexandra Fiord. The relatively small size of **Mya truncata** at this latter locale reflects their short life span and slow growth rate in what must be a marginally habitable environment (Hewitt and Dale, 1984).

Several of these recent species have been collected in raised strandlines on Ellesmere Island and their ages determined by radiocarbon dating. **Mya truncata** at the head of Alexandra Fiord have been dated at 7000 ± 70 BP (GSC-3288; Blake, 1982) and **Hiatella arctica** near Cape Herschel were dated at 8930 ± 100 BP (GSC-2519; Blake, 1981). As well as **Mya** and **Hiatella,** samples of **Portlandia arctica** (Blake, 1981), **Serripes groenlandicus, Macoma calcarea,** and **Clinocardium ciliatum** collected on Ellesmere Island, have had ages ranging from 8000 BP to the present (Blake, 1975). These findings appear to indicate fairly continuous habitation by these molluscs in high arctic waters. Again, this reflects their ability to adapt to severe and variable environmental conditions.

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