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Shallow-water molluscs of Isfjorden (West Spitsbergen, Svalbard).

ABSTRACT: The list of shallow–water molluscs: chitons (2 species), gastropods (33 species) and bivalves (36 species) of Isfjorden is presented. Distribution, frequency and domination structure are discussed and zoogeographical analysis is presented.

Key words: Arctic, Svalbard, benthos, molluscs.

Introduction

Molluscs constitute an important element of benthic assemblages in the near–shore waters of Svalbard (Różycki 1990, 1991a, Stempniewicz 1990). Mollusca inhabiting waters of this Arctic archipelago have been investigated for 150 years. During last 15 years the studies on the occurrence of Mollusca in numerous fiords and bays were concentrated mainly in the region of south–eastern coasts of West Spitsbergen (Różycki 1984, 1987, 1989, 1992). The fauna of west–eastern coasts of West Spitsbergen was also described (Różycki 1991b).

At the end of XIX and the beginning of XX centuries wide investigations on Isfjorden fauna were carried out; these studies included also Mollusca (Odhner 1915).

In 1990 hydrobiological studies in the tidal zone and sublittoral of Isfjorden were conducted (Węśławski et al. 1990) and molluscs have been also collected. Preliminary information on the Isfjorden molluscs was presented elsewhere (Różycki 1991c). The present work is a continuation of the author's previous studies on the distribution of Mollusca in near–shore waters of Svalbard.

Material

Samples of benthic macrofauna were collected along the Isfjorden coasts from 1 to 30 August 1990. Hand-picking for hard bottom and light triangle dredge for soft bottom were used. Material collected was sieved through the 0.5 mm mesh size sieve and sorted into higher taxonomic units.

Samples were collected from the depths from 0.2 to 12.0 m at 37 stations; their distribution is shown in Fig. 1.

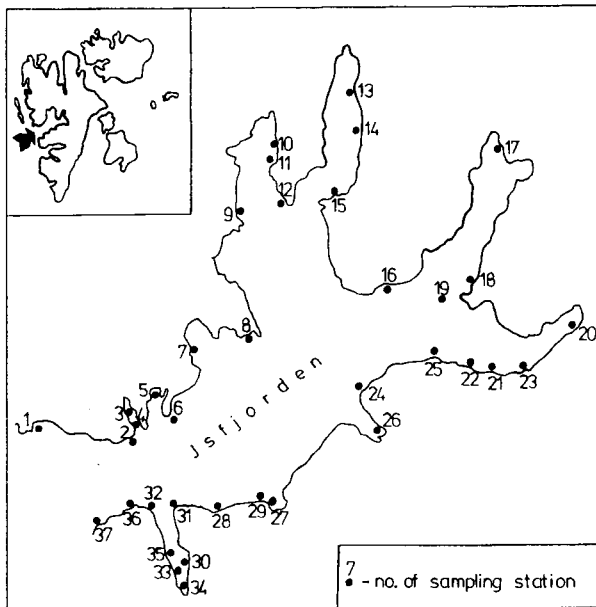


Fig. 1. Geographical situation of Isfjorden and the location of stations where the samples were collected in the littoral

Study area

Isfjorden is the largest fiord in West Spitsbergen (Fig. 1). Its coastal line is very diversified; 14 different types of this coast are described in detail by Węśławski et al. (1990). In the investigated region most common types were:

- incoherent slate cliff,
- steep rocky backshores with initial beach,
- rocky cliff,
- high skierra.

Tides in the fiord reach from 0.4 to 1.8 meters. The surface circulation is determined mainly by winds. Surface water salinity in the near-shore region, down to 10–15 meters in the inner bays, did not exceed 31.5‰

Results

The collected material consisted of 8825 individuals of Mollusca representing three groups: chitons (2 species), gastropods (33 species) and bivalves (36 species). Tab. I contains the list of molluscs inhabiting shallow waters of Isfjorden.

In the collected samples 4 gastropod species new for Svalbard were found: *Littorina obtusata*, *Onoba aculeus*, *Oenopota harpularia* and *Omalogyra atomus*; one bivalve species — *Spisula elliptica* — was new for this part of the archipelago.

The number of mollusc species found at one station varied from one (3 stations) to 21 (1 station). The mean value for Isfjorden shallow waters was 6.9 species of Mollusca per one station. The number of individuals of Mollusca collected at particular station also strongly differed.

The distribution of the number of species and the share (higher than 2%) in all collected molluscan material for particular stations is presented in Fig. 2.

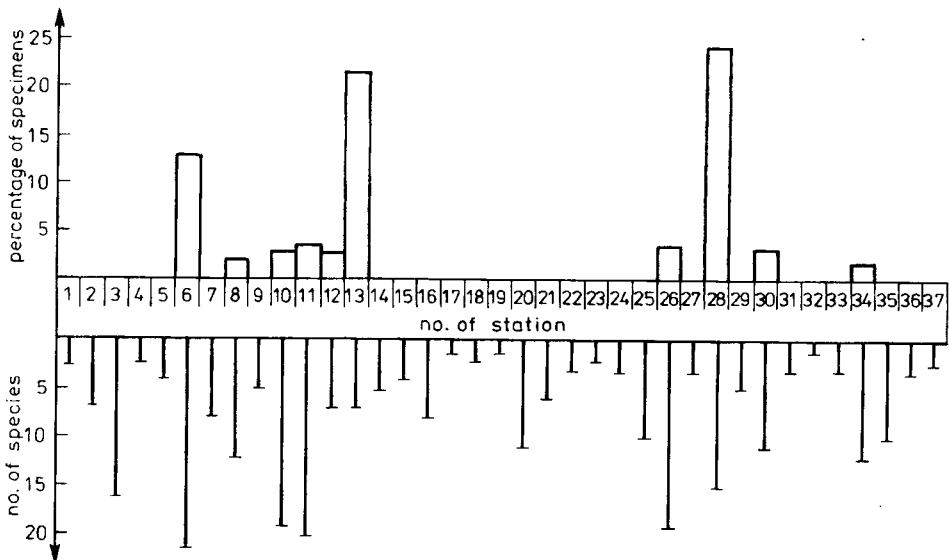


Fig. 2. The abundance of individuals and the mollusc species number at particular stations

At four stations the highest number of species were found (19–21 species), and the lowest number of Mollusca were found at 8 stations (1–2 species). Only at 10 stations the contribution of collected specimens in all molluscan material was

higher than 2%; 86.4% of all molluscs were collected there. The highest contribution was found at stations number 28 (24.5%), 13 (21.5%) and 6 (13.0%). Table II presents the dominance structure of Mollusca in some richest stations of Isfjorden.

In stations 8, 12, 13, 28 and 30 only one species clearly dominated (gastropod *Margarites groenlandicus* or bivalve *Liocyma fluctuosa*), whereas in stations 6, 10, 11 and 26 two or three species were dominant.

Bivalves dominated the investigated material; they constituted 70.3% of all molluscs; chitons were represented only by 10 individuals.

Taking into account the abundance in the investigated material, mollusc species can be arbitrarily divided into following groups: mass species (contribution higher than 10%), abundant species (5–10%), moderately abundant species (2–5%) and not numerous species (the contribution lower than 2%). Only the bivalve *Liocyma fluctuosa* and the gastropod *Margarites groenlandicus* were the mass species. Gastropod *Cylichna occulta* was an abundant species. Bivalves *Pandora glacialis* and *Musculus laevigatus* were moderately abundant species. The remaining 64 species were not numerous ones.

In general the above mentioned two species of gastropods and three species of bivalves clearly dominated the molluscan fauna of shallow waters of the fiord; their total contribution was 77.8% of all collected individuals. The remaining 31 gastropods and 33 bivalves were poorly represented in the investigated material; their importance for the littoral and sublittoral system is evidently low.

Taking into account the frequency of occurrence in the samples (F%) the species can be divided into 4 groups: common species ($F > 50\%$), frequent species ($F = 20-50\%$), sporadic species ($F = 5-20\%$) and accidental species ($F < 5\%$).

Margarites groenlandicus was a common species ($F = 70.3\%$). Frequently encountered were: *Mya truncata* and *Cylichna occulta* (for both $F = 40.5\%$), *Thyasira ferruginea*, *Serripes groenlandicus* and *Pandora glacialis* (all with $F = 29.7\%$), *Cylichna alba* and *Astarte montagui* (for both $F = 21.6\%$). The group of sporadic species consisted of 9 gastropods and 16 bivalves, whereas 23 gastropods and 12 bivalves were accidental species.

In the collected material there were cosmopolitan (1.5%), boreal (5.6%), boreal–Arctic (22.5%), Arctic–boreal (22.5%) and Arctic (47.9%) species, many of the latter of wide, circumpolar distribution. The group of Arctic species included both high- and low–Arctic ones. From zoogeographical point of view molluscan fauna of Isfjorden littoral and shallow sublittoral is of mixed character; Arctic forms are prevailing, but not surpassing the absolute dominance level of 50%. Therefore Isfjorden waters can be included to the transitional Svalbard faunistic province in the Arctic region. Among shallow water molluscs of Isfjorden there were species of Atlantic origin (4%) and of Pacific origin (17%). The origin of the remaining 25 species is interpreted differently by particular authors.

Discussion

The present author has found in the Isfjorden shallow waters 33 gastropod and 36 bivalve species. For comparison with these results in Tab. I a list

Table I
Check-list of littoral molluscs of Isfjorden

Taxa	1990 (present paper)	1908 (by Odhner 1915)	Zoogeographical status ¹ and origin ²
POLYPLACOPHORA			
<i>Leptochiton asellus</i> (Gmelin, 1791)	+		b-A
<i>Tonicella marmorea</i> (Fabricius, 1780)	+	+	b-A
<i>Tonicella rubra</i> (Linné, 1767)		+	A-b, cp
GASTROPODA			
<i>Lepeta caeca</i> (Müller, 1776)	+		A-b, cp
<i>Acmaea rubella</i> (Fabricius, 1780)		+	IA, cp, Atl.
<i>Margarites costalis</i> (Gould, 1841)		+	IA, Atl.
<i>Margarites groenlandicus</i> (Gmelin, 1791)	+	+	A-b, cp
<i>Margarites helicinus</i> (Phipps, 1774)	+	+	A-b, Atl.
<i>Margarites olivacea</i> (Brown, 1827)	+		A-b, cp
<i>Solariella obscura</i> (Cauthouy, 1838)	+		b-A, cp
<i>Lacuna pallida</i> (da Costa, 1778)	+	+	b
<i>Littorina obtusata</i> (Linné, 1758)	+		A-b, wd, Atl.
<i>Littorina saxatilis</i> Olivi, 1792		+	IA, Atl.
<i>Hydrobia ulvae</i> (Pennant, 1779)	+		b, wd
<i>Alvania scrobiculata</i> (Möller, 1842)	+		A-b, cp
<i>Onoba aculeus</i> (Gould, 1841)	+		IA, Atl.
<i>Onoba globulus</i> (Müller, 1842)	+		A, cp(?)
<i>Onoba mighelsi</i> (Stimpson, 1851)	+	+	b-A, Atl.
<i>Omalogyra atomus</i> (Philippi, 1841)	+		b, Atl. (?)
<i>Turritella reticulata</i> (Lamarck, 1799)		+	A-b
<i>Lunatia pallida</i> (Broderip et Sowerby, 1829)		+	b-A, cp
<i>Lunatia tenuistriata</i> (Lamarck, 1822)		+	A-b, wd
<i>Natica clausa</i> Broderip et Sowerby, 1829	+	+	b-A, cp
<i>Nucella lapillus</i> (Linné, 1758)	+		b, wd, Atl.
<i>Trophonopsis clathratus</i> (Linné, 1767)		+	A, cp
<i>Trophonopsis truncatus</i> (Ström, 1767)	+		A-b, cp, Atl.
<i>Astyris rosacea</i> (Gould, 1840)	+	+	I-A, Atl.
<i>Buccinum bromsi</i> Hagg, 1905)		+	A, cp(?)
<i>Buccinum cyaneum</i> Bruguière, 1792	+	+	IA, Atl.
<i>Buccinum glaciale</i> Linné, 1761	+	+	IA, cp
<i>Buccinum hydrophanum</i> Hancock, 1846	+		A-b, At.
<i>Buccinum maltzani</i> Pfeffer, 1886		+	A, cp
<i>Buccinum polare</i> Gray, 1839		+	IA(?), cp

<i>Buccinum scalariforme</i> Möller, 1842	+	+	A, cp
<i>Buccinum undatum</i> Linné, 1758	+	+	IA, Atl.
<i>Buccinum undulatum</i> Möller, 1842	+		IA, Atl.
<i>Colus islandicus</i> (Gmelin, 1791)	+		A, Atl.
<i>Colus latericeus</i> (Möller, 1824)		+	A, Atl. (?)
<i>Colus togatus</i> (Mörch, 1869)	+	+	hA
<i>Volutopsius norvegicus</i> (Gmelin, 1791)	+		IA, Atl.
<i>Admete viridula</i> (Fabricius, 1780)	+	+	b-A, wd, Pac.
<i>Oenopota harpularia</i> (Cauthouy, 1839)	+		b-A, cp
<i>Oenopota impressa</i> (Mörch, 1869)	+	+	A, cp
<i>Oenopota nobilis</i> (Möller, 1842)	+		b-A, cp, Atl.
<i>Oenopota pyramidalis</i> (Ström, 1768)	+	+	A-b, cp
<i>Oenopota simplex</i> (Middendorff, 1849)		+	IA
<i>Oenopota violacea</i> (Mighels et Adams, 1842)		+	b-A, cp
<i>Diaphana minuta</i> Brown, 1827		+	b-A (?)
<i>Philine lima</i> (Brown, 1827)		+	A, cp (?)
<i>Cylichna alba</i> (Brown, 1827)	+	+	b-A, cp
<i>Cylichna occulta</i> (Mighels et Adams, 1842)	+	+	IA, cp
<i>Dendronotus frondosus</i> (Ascanicus, 1774)		+	b-A, cp
<i>Coryphella borealis</i> Odhner, 1922		+	b-A (?)
<i>Coryphella bostoniensis</i> Bergh, 1846		+	b-A (?)

SCAPHOPODA

<i>Siphonodentalium tobatum</i> (Sowerby, 1860)		+	A-b, Atl. (?)
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BIVALVIA

<i>Nuculoma tenuis</i> (Montagu, 1808)	+	+	A-b, wd
<i>Yoldia hyperborea</i> Torell, 1859	+	+	A, cp, Pac.
<i>Nuculana pernula</i> (Müller, 1779)	+	+	A-b, cp, Atl.
<i>Portlandia arctica</i> (Gray, 1824)	+	+	hA, cp, Atl.
<i>Yoldiella fraterna</i> Verrill et Bush, 1898	+	+	IA, cp, Atl.
<i>Yoldiella frigida</i> (Torell, 1859)	+		hA, Atl.
<i>Yoldiella intermedia</i> (M. Sars, 1865)	+		hA
<i>Yoldiella lenticula</i> (Möller, 1842)	+		A, cp, Atl.
<i>Bathyarca glacialis</i> (Gray, 1824)		+	A, Atl.
<i>Musculus corrutagus</i> (Stimpson, 1851)	+	+	hA, cp, Pac.
<i>Musculus discors</i> (Linné, 1767)		+	IA, cp, Pac.
<i>Musculus laevigatus</i> (Gray, 1824)	+		b-A, cp
<i>Musculus niger</i> (Gray, 1824)	+	+	b-A, cp, Pac.
<i>Crenella decussata</i> (Montagu, 1808)	+	+	b-A, Pac.
<i>Dacrydium vitreum</i> (Möller, 1842)	+	+	A, cp, Atl.
<i>Chlamys islandica</i> (Müller, 1776)		+	A, cp, wd
<i>Arctinula groenlandica</i> (Sowerby, 1842)	+	+	hA, Atl.
<i>Astarte borealis</i> Schumacher, 1817	+	+	b-A, cp, Atl.
<i>Astarte crenata</i> (Gray, 1824)	+	+	IA, cp, Atl.
<i>Astarte elliptica</i> (Brown, 1827)	+	+	A-b, Atl.
<i>Astarte montagui</i> (Dillwyn, 1817)	+	+	A-b, cp, Atl.
<i>Thyasira flexousa</i> (Montagu, 1803)	+	+	b-A
<i>Thyasira ferruginea</i> (Forbes, 1851)	+		A-b
<i>Axinipsidea orbiculata</i> (G.O. Sars, 1878)	+	+	A-b, Pac.
<i>Diplodonta torelli</i> Jeffreys, 1847	+		IA

<i>Turtonia minuta</i> (Fabricius, 1780)	+	+	A, cp (?)
<i>Macoma calcarea</i> (Gmelin, 1790)	+	+	A-b, Pac.
<i>Macoma moesta</i> (Deshayes, 1854)	+	+	lA, cp, Pac.
<i>Macoma torelli</i> Jensen, 1904	+		lA, cp
<i>Liocyma fluctuosa</i> (Gould, 1841)	+	+	A, cp, Pac
<i>Ciliatocardium ciliatum</i> (Fabricius, 1780)	+	+	A, cp, Pac,
<i>Serripes groenlandicus</i> (Bruguère, 1798)	+	+	A, cp, Pac.
<i>Spisula elliptica</i> (Brown, 1827)	+		b-A (?)
<i>Mya truncata</i> Linné, 1758)	+	+	b-A, cp, Atl.
<i>Mya pseudoarenaria</i> Schlesch, 1931	+		A, wd, Atl.
<i>Hiatella arctica</i> (Linné, 1767)	+	+	cos., Pac
<i>Pandora glacialis</i> Leach, 1819	+	+	lA, cp (?), Atl.
<i>Lyonsia arenosa</i> (Möller, 1842)	+	+	A, cp, Pac.
<i>Tharcia myopsis</i> Möller, 1842	+	+	A, cp (?)
<i>Cuspidaria subtorta</i> (G.O. Sars, 1878)		+	A, Atl.

¹Zoogeographical status:

b — boreal

b-A — boreal-Arctic species

A-b — Arctic-boreal species

A — Arctic species

cp — circumpolar species

hA — high-Arctic species

lA — low-Arctic species

wd — widely distributed species

cos. — cosmopolite species

²Origin:

Atl. — Atlantic

Pac. — Pacific

of molluscs found in Isfjorden in 1908 by Odhner (1915) at the depths not exceeding 15 m is added (scientific names are updated). This author has found in these shallow waters 34 gastropod species and 27 bivalves. General numbers of molluscan species in both studies in both studies are rather similar; the present author has recorded 9 species of bivalves more and one gastropod species less than Odhner. The similarity index of species composition of both lists is 64.2%, with 43 species in common (16 gastropods and 27 bivalves). Both studies had only qualitative, faunistic character, of hardly comparable methods and intensity; therefore it is difficult to draw far reaching conclusion from the differences observed. It seems, however, that somewhat higher share of Arctic species in the list of Odhner (1915) might evidence for some change of the molluscan fauna of shallow waters of Isfjorden in last 80 years: from Arctic character to more sub-Arctic one.

The diversity of the dominance structure of the molluscan assemblages in particular station is well illustrated by Tab. II, where the composition of the dominants in the richest samples is presented. These 9 molluscan species (3 gastropods and 6 bivalves) were also most frequent and abundant in other Svalbard regions (Różycki 1984).

The average number of 6.9 species of Mollusca for one station in Isfjorden in general is similar to some respective averages for other Svalbard areas: Kongsfjorden — 7.6 (Różycki 1991c), Gipsviken — 7.4 (Różycki, in press), Hornsund — 2.01 (Różycki 1992).

Table II

The contribution of dominating (more than 10%) gastropod and bivalve species in the most numerous samples at particular stations in Isfjorden

Taxa	No. of stations								
	6	8	10	11	12	13	26	28	30
<i>Margarites groenlandicus</i>		85.8		21.2	97.3				
<i>Onoba aculesu</i>				12.7					
<i>Cylichna occulta</i>	21.6		11.3				43.0		
<i>Musculus laevigatus</i>			45.5	25.8					
<i>Musculus niger</i>	28.9								
<i>Astarte montagui</i>			19.0						
<i>Axinopsida orbiculata</i>							13.0		
<i>Liocyma fluctuosa</i>						96.4		85.6	86.1
<i>Pandora glacialis</i>	23.3								

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Streszczenie

Latem 1990 roku zebrano próby bentosu z mięczakami z 37 stacji rozmieszczonych w litoralu Isfjorden (Rys. 1). Łącznie zebrano 8825 egzemplarzy mięczaków, z czego 6193 to małże, 2622 — ślimaki oraz 10 — chitony. Próby zbierano z głębokości od 0,2 do 10-12 m, ręcznie oraz przy pomocy lekkiej trójkątnej drugi.

W zebranym materiale oznaczono 2 gatunki chitonów, 33 gatunki ślimaków i 36 gatunków małży (Tab. I). Zanotowano nowe dla wód Svalbardu 4 gatunki ślimaków: *Littorina obtusata*, *Onoba aculeus*, *Oenopota harpularia* i *Omalogyra atomus* oraz 1 gatunek małża, *Spisula elliptica*.

Na poszczególnych stacjach występowało od 1 do 21 gatunków mięczaków (Rys. 2, Tab. II); średnio na jedną stację w litoralu badanego fiordu przypadało 6,9 gatunków mięczaków. Na 10 stacjach występowało łącznie 86,4% wszystkich zebranych egzemplarzy mięczaków (Rys. 2).

W części stacji w próbach dominuje wyraźnie jeden gatunek, w innych 2-3 gatunki. Strukturę dominacji najliczniejszych gatunków na stacjach o największej liczebności przedstawiono w Tab. III.

Z uwagi na liczebność, w zebranym materiale wyróżniono gatunki masowe (*Liocyma fluctuosa*, *Margarites groenlandicus*), gatunki liczne (*Cylichna occulta*) i gatunki rzadkie (*Pandora glacialis* i *Musculus laevigatus*). Pozostałe 64 gatunki zaliczono do grupy nielicznych.

Z uwagi na częstość występowania w próbach wyróżniono: gatunki powszechne (*Margarites groenlandicus*), często spotykane (*Mya truncata*, *Cylichna occulta*, *Thyasira ferruginea*, *Serripes groenlandicus*, *Pandora glacialis*, *Cylichna alba* i *Astarte montagui*). Do grupy sporadycznie występujących należało 25 gatunków, a najliczniejszą grupę stanowią gatunki przypadkowe (35).

Współczesne dane o występowaniu litoralnych mięczaków Isfjorden porównano z danymi z roku 1908. Stwierdzono, że łączna liczba gatunków występujących współcześnie i 82 lata wcześniej jest niemal taka sama (odpowiednio 71 i 68), przy czym 43 to gatunki wspólne.

Litoral Isfjorden zasiedlają przedstawiciele różnych grup zoogeograficznych. Wcześniej fauna mięczaków miała charakter arktyczny, współcześnie ma charakter subpolarny (prześciowa prowincja faunistyczna).