7.0 INVERTEBRATES AND UROCHORDATES

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The occurrence, abundance, and ecology of invertebrates and urochordates in Hudson Bay and James Bay are not well understood. The task of surveying the region dwarfs the available research effort, precluding even geographical and phyletic coverage. Indeed, knowledge of the invertebrate species' distributions may better reflect research interests than actual species' occurrence. Most research has been conducted in summer in shallow subtidal (<50 m depth) and littoral zones, and consists of brief accounts of occurrence and/or simple listing of specific groups of organisms. Few studies have examined species abundance and community structure in relation to environmental variables such as salinity and temperature (e.g., Grenon 1982; Roff and Legendre 1986; Martini and Morrison 1987; Grainger 1988; Rochet and Grainger 1988; Runge et al. 1991; Lawrence and Baker 1995; Harvey et al. 2001); fewer still over more than one season or year (e.g., Fortier et al. 1995; Zrum 2000). Those that have run longer were typically conducted at estuaries downstream of existing or proposed hydroelectric developments, and are not representative of other nearshore or offshore habitats.

Species reported from the James Bay, Hudson Bay, Hudson Strait and Foxe Basin marine regions are listed in Appendix 2. This listing is not exhaustive. Rather, it provides a sense of the range of species that occur in the Hudson Bay marine ecosystem, or nearby. This occurrence data is summarized in Table 7-1. Because research coverage within and between regions is uneven, care must be taken in any biogeographical interpretations. Indeed, most species listed in the Appendix are likely present in the ecosystem wherever there is suitable habitat. Figures and tables that summarize the distributions of selected groups of invertebrates in other publications are listed in Table 7-2. Protozoan (single-celled) invertebrates are not discussed. Further information on Protozoa in the region is available in Cushman (1921), Wagner (1969), and Rogers et al. (1981).

At least 689 species of metazoan invertebrates and 25 species of urochordates occur in waters of the Hudson Bay marine ecosystem (Table 7-1; Appendix 2). Of these, 431 species have been reported from the James Bay marine region, which includes southeastern Hudson Bay, and 557 from the Hudson Bay marine region. The Arthropoda and Mollusca, which make up more than 50% of the known species, are the phyla best known. The Cnidaria, Bryozoa, Annelida, and Echinodermata are also well represented while the rest are each represented by few species. Each region has 18 species of urochordates, which strictly speaking are of the Phylum Chordata but are discussed here because they are invertebrates as adults (Barnes 1974). Many of these species are vital links in the food web between the primary producers and larger fish and marine mammals, but few are harvested (see Section 14.3).

7.1 ZOOGEOGRAPHY

Many of the invertebrate species in Hudson Bay and, to a lesser extent, James Bay are Arctic forms (Huntsman 1922; Osburn 1932; Clark 1937; Grainger 1968; Rochet and Grainger 1988; Harvey et al. 2001). Their presence reflects the extreme southerly penetration of Arctic waters, and the continuity of these areas with the primarily Arctic surface waters of the Canadian Arctic Archipelago and the surface of the Arctic Ocean. The invertebrate fauna of James Bay and southeastern Hudson Bay also has Atlantic and Pacific affinities, reflecting a former connection with the faunas of those oceans and illustrating the area's importance as a refugium (Fraser 1931; Squires 1967; Grainger and McSween 1976; Lubinsky 1980; Grenon 1982). Grainger (1963) cited the absence of *Calanus finmarchicus* as evidence that there is now no direct penetration of Atlantic surface waters into Hudson-James Bay. However, this species has since been reported at the Churchill River estuary (Baker et al. 1994). Estuarine species are distributed throughout James Bay and southeastern Hudson Bay, but are present in the highest density in or near river mouths. Freshwater species do not survive far from the rivers, and Arctic marine species become dominant as distance from the large estuaries increases.

7.2 INVERTEBRATE COMMUNITIES

Few benthic species inhabit the intertidal zone of James Bay or Hudson Bay on a permanent basis, likely due to ice scour, which can extend to a depth of 5 m (Dadswell 1974), and to freezing (Dale et al. 1989) (Figure 7-1.). Invertebrates such as clams, mussels, snails, barnacles, worms, sea anemones, amphipods, and sea squirts occupy the intertidal zone during the open water season. Most benthic invertebrates, including the echinoderms, sea spiders, most polychaetes, clams and snails, shrimps and crabs, hydroids and bryozoans live below the ice scour zone. Seafloor photographs taken during the 1961 cruise of the M.V Theta at a depth of 55 m show brittle stars, anemones, a shrimp, and a worm on the fine substrate of Omarolluk Sound in the Belchers (Barber et al. 1981). Central Hudson Bay supports a meager fauna (Fraser 1931; Willey 1931; Wagner 1969; Roff and Legendre 1986) with echinoderms--especially brittle stars, polychaetes, sea anemones and decapods being predominant (Grainger 1968; Barber et al. 1981).

Important benthic species in the Eastmain River estuary include the pelecypods *Macoma balthica* and *Mytilus edulis*, the gastropods *Cylichna alba* and *Margarites olivaceus*, the polychaetes *Terebellides stroemi* and *Aglaophamus neotenus*--the latter previously known only from the Atlantic coast, the cumacean *Diastylis rathkei*, and the amphipods *Atylus carinatus* and *Onisimus littoralis* (Grenon 1982). Distribution of the benthic organisms

Table 7-1. A comparison of the number[1] of invertebrate and urochordate species reported from the James Bay (including southeastern Hudson Bay=JB), Hudson Bay (HB), Hudson Strait (HS), and Foxe Basin (FB) marine regions (Figure 1-1). This comparison is based on the partial species list found in Appendix 2.

PHYLUM/Group	Common name	JB	HB	HS	FB	JB, HB, HS or FB	JB, HB, HS&FB	Only JB	Only HB	JB or HB
ANNELIDA										
Oligochaeta		0	19	0	0	19	0	0	19	19
Polychaeta	bristle worms	55	80	86	35	133	9	12	23	102
ARTHROPODA										
Amphipoda	scuds/side swimmers	83	91	157	101	209	35	10	11	120
Cirripedia	barnacles	4	3	4	5	6	3	1	0	4
Copepoda		47	52	15	4	77	2	22	27	74
Cumacea		11	8	9	9	20	3	5	2	14
Decapoda	shrimps/crabs	13	14	18	12	20	10	0	1	15
Euphausiacea	krill	1	2	2	1	4	0	0	0	2
Isopoda		4	5	9	8	15	2	1	2	7
Mysidacea	opossum shrimps	4	4	7	1	7	1	0	0	5
Nebaliacea		1	0	1	1	1	0	0	0	1
Ostracoda	seed spiders	4	3	4	1	6	0	2	0	5
Pycnogonida	sea spiders	3	6	9	13	16	3	0	2	6
Tanaidacea		4	0	0	0	4	0	4	0	4
ASCHELMINTHES										
Nematoda	round worms/thread worms	1	1	1	1	1	1	0	0	1
BRACHIOPODA	lamp shells	2	2	2	2	2	2	0	0	2
BRYOZOA	moss animals	15	46	83	39	94	6	1	10	53
CHAETOGNATHA	arrow worms	2	3	3	0	4	0	1	0	4
CHORDATA: Urochordata	tunicates									
Ascidiacea	sea squirts	15	16	24	20	30	8	3	1	22
Larvacea		3	2	2	2	3	0	1	0	3
CNIDARIA										
Anthozoa	sea anemones/soft corals	9	10	8	7	18	2	4	3	14
Hydrozoa	hydroids/medusae	28	46	52	26	75	8	4	10	55
Scyphozoa	jellyfish	1	1	1	0	1	0	0	0	2
CTENOPHORA	comb jellies	2	2	2	0	3	0	0	1	3
ECHINODERMATA										
Asteroidea	sea stars	9	17	15	14	20	7	1	3	18
Crinoidea	sea lilies/feather stars	1	1	1	1	1	1	0	0	1
Echinoidea	sea urchins	1	1	1	1	1	1	0	0	1
Holothuroidea	sea cucumbers	5	6	5	6	8	3	0	2	8
Ophiuroidea	brittle stars	9	10	11	9	13	7	0	1	11
MOLLUSCA										
Cephalopoda	squids/octopus	0	0	2	1	3	0	0	0	0
Gastropoda	snails	33	51	53	53	91	12	4	18	61
Pelecypoda	clams/mussels/scallops	47	42	43	28	65	23	9	6	54
Polyplacophora	chitons	2	3	2	2	3	2	0	1	3
Scaphopoda	tooth shells/tusk shells	0	1	0	0	1	0	0	1	1
NEMERTEA	proboscis worms/ribbon worms	1	1	1	1	1	0	0	0	1
PHORONIDA		0	1	0	0	1	0	0	1	1
PORIFERA	sponges	9	1	9	1	20	0	9	1	10
PRIAPULIDA	penis worms	1	2	2	1	3	1	0	1	2
SIPUNCULA	peanut worms	1	4	4	1	6	0	0	2	5
	Total:	431	557	648	407	1003	152	94	149	714

[1] Totals include mollusc records based on recently dead animals and/or empty shells. Organisms identified only to genus were included only if the genus was not otherwise reported from the region. They were included in the species counts for each region, but were only included in the overall species totals if no organisms of that genera had been identified to species.

Table 7-2. Some published distributions of selected invertebrates in James Bay and Hudson Bay.

Author/Year	Invertebrate group	Table/Figure	Page(s)
Kerswill 1940	Pteropoda	Fig. 4	29
Dunbar 1954	Amphipoda	Fig. 41+42	792-793
Dunbar 1962	Chaetognatha	Fig. 1	78
Grainger 1963	Copepoda	Fig. 6	78
Hedgepeth 1963	Pycnogonida	Fig.1-3 + 11	1316-1318, 1344
Johnson 1964	Isopoda	Fig. 6	86
Trason 1964	Ascidacea	Table 3	1510-1513
Grainger 1966	Asteroidea	Fig. 47-62	21-49
Squires 1967	Decapoda	Table 2; Fig. 3-7	1879-81, 1883-93
Grainger 1968	Copepoda/ Amphipoda/ Euphasiacea/Ascidiacea	Fig. 1	355
Pelletier et al. 1968	Mollusca/ Brachiopoda/ Cirripedia/Echinoidea	Table 2	573-577
Powell 1968	Ectoprocta	Fig. 2-9	2283-2310
Wagner 1969	Gastropoda/Pelecypoda	Table 6; Fig. 3	24, 25, 27
Calder 1970	Hydrozoa	Text	1503-1547
Macpherson 1971	Gastropoda	Fig. 2-54	6-122
Calder 1972	Hydrozoa	Text	218-226
Dadswell 1974	Polychaeta/ Amphipoda/ Mysidacea/ Gastropoda/ Pelecypoda/ Asteroidea	Table 1	479
Grainger and McSween 1976	Copepoda	Fig. 13-34	27-48
Lubinsky 1980	Pelecypoda	Fig. 1-42	74-94
Rogers et al. 1981	Protozoa	Fig. 1, Table 1	2361
Grenon 1982	Polychaeta/Pelecypoda	Fig. 3-5	797-799
Martini and Morrison 1987	Gastropoda/Pelecypoda	Fig. 3 + 4	52-55
Rochet and Grainger 1988	Copepoda/ Amphipoda/ Hydrozoa/Gastropoda/ Chaetognatha/Cirripedia	Tables 1 + 3, Fig. 4	1628-9
Dunbar 1988	Copepoda/ Euphasiacea/ Amphipoda	Fig. 15-20	not numbered
Grainger 1988	All groups	Table 1	134
Atkinson and Wacasey 1989	All groups	Tables 39-45, 51-79, 82-87, 93-102, 128	45-48, 52-67, 70-74, 79-83, 100.
Baker 1989	All groups	Fig. 24-39; Appendices 1a-2c	143-158, 169-179
Squires 1990	Decapoda	Fig. 90 ff	172ff
Morin 1991	All groups	Table 5	21
Ponton and Fortier 1992	Copepoda/ Chaetognatha	Table 2	218
Baker et al. 1993	All groups	Tables 5 + 7	40, 41, 43
Byers 1993	All groups	Taxanomic List	3-6
Baker et al. 1994	All groups	Appendices 3-6	74-81
Lambert and Prefontaine 1995	Pelecypoda	Figure 1	24
Lawrence and Baker 1995	All groups	Table 4+7	17-19, 22-24
Baker 1996	All groups	Appendices 3a+b	58-63
Simard et al. 1996	All groups	Annex 10	141-189
Horne 1997	All groups	Tables 4+5, Appendices A-2 + A-3	29-34, 63-64
Siferd et al. 1997	Amphipoda	Table 1	18
Horne and Bretecher 1998	All groups	Tables 4+5, Appendices A-2 + A-3	29-34, 65-68
Zrum 1999	All groups	Tables A-2 and A-3	64-71
Zrum 2000	All groups	Table 4+5, Appendix 1, Table A2-2 +A2-3	31-38, 57-62, 67-74

Figure 7-1. Sea ice turned on edge and scouring the shoreline and harbour bottom at Rankin Inlet (photo credit D.B. Stewart).

was positively related to the salinity gradient and the quantity of organic matter in the sediments. The dominant species of each group are very versatile in their occupation of different sediment types. Density of the benthic fauna in the brackish zone of the estuary was very low compared with freshwater or marine areas; the marine zone also had the most diverse benthic fauna.

The pelagic zone is characterized by comb jellies, arrow worms, copepods and amphipods, euphausids, and the pelagic sea butterflies. Grainger and McSween (1976) described the marine zooplankton of James Bay as being of "*moderate quantity and fairly high diversity for northern waters, reflecting the range of habitat provided by the 2-layer estuarine structure*". The ratios of species groups characteristic of fresh, brackish, and marine water vary over time, reflecting seasonal pulsations in the surface brackish water and saltier bottom water within the bay (Grainger and McSween 1976).

Four distinct species assemblages of zooplankton were identified along a sampling transect from the mouth of James Bay to eastern Hudson Strait in early September 1993 (Harvey et al. 2001; Figure 7-2 and Figure 7-3). Group A in Hudson Bay south of the Belcher Islands and further offshore west of the Sleeper Islands was strongly influenced by freshwater runoff entering James Bay and southern Hudson Bay. The circulation was typically estuarine with a relatively warm (8.5°C), dilute (24.5 ppt [≈psu]) surface layer 10-15 m deep, overlaying a colder (<1.0 °C), more saline (~31.0 ppt) deep layer. Chlorophyll ***a*** values were higher in the surface layer (>1.0 $\mu g \cdot L^{-1}$), but low relative to other areas. The zooplankton community in this area was characterized by the presence of two euryhaline copepod species (*Acartia longiremis* and *Centropages hamatus*) (Figure 7-4), with an integrated biomass ranging from 0.9 to 2.7 g $DM \cdot m^{-2}$. Group B, along the east coast of Hudson Bay, and Group C, at the northeast exit to Hudson Bay and in western Hudson Strait, were characterized by a typically Arctic fauna, related to the cyclonic circulation in central Hudson Bay. The water column in these areas was strongly stratified,

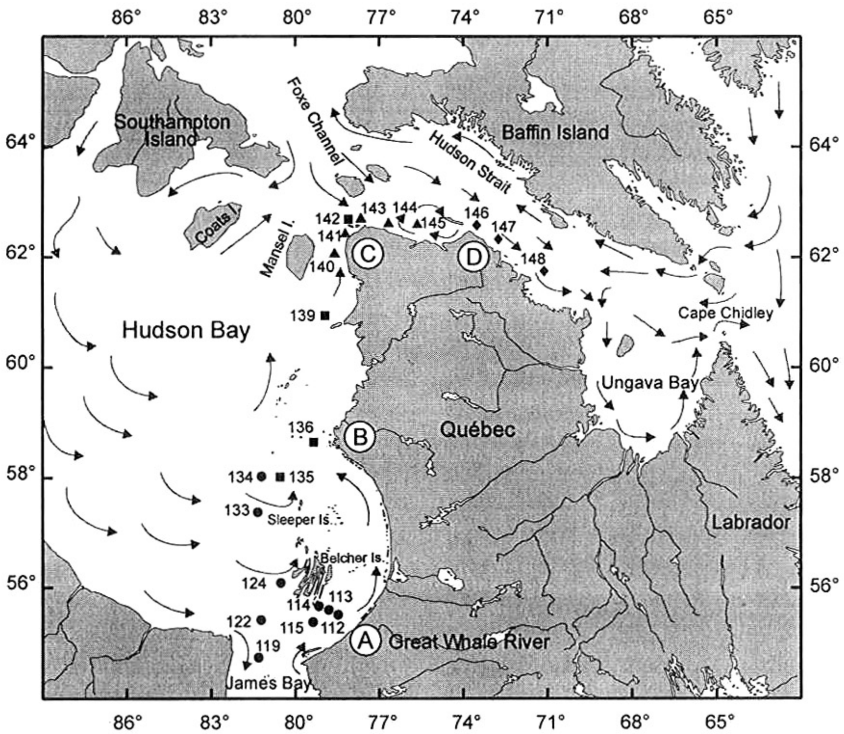

Figure 7-2. Sampling sites for zooplankton in Hudson Bay and Hudson Strait in September 1993, with arrows showing the general pattern of surface circulation and symbols the positions of four distinct groups of stations which were determined using cluster analysis (● group A; ■ group B, ▲ group C, ◆group D) (from Harvey et al. 2001, p. 483).

with a mixed surface layer that was deeper in the Bay (20 m) than in the Strait (15 m). Within this layer, the temperature (6-7°C) and salinity (27-28 psu) were relatively constant and chlorophyll ***a*** values were very low (<0.5 µg•L^{-1}). A strong subpycnocline Chlorophyll ***a*** maximum was also characteristic of these areas (see also Harvey et al. 1997). The integrated biomass of the Group B and C stations varied from 1.6 and 9.3 g DM•m^{-2}. Zooplankton species that contributed most to the segregation of Group B were the pteropods *Clione limacina* and *Spiratella helicina*, some unidentified crustaceans, the amphipods *Themisto libellula* and *T. abyssorum*, the euphasid *Thysanoessa rachii*, and the copepods *Calanus hyperboreus*, *Metridia longa* and *C. glacialis/C. finmarchicus* (species combined). The same species also contributed to the separation of Group C, but were typically more abundant and, in some cases such as *M. longa*, had a higher relative abundance. Group D, in central Hudson Strait, was characterized by a much higher zooplankton biomass, and by the greater abundance of the large herbivorous copepod *C. glacialis/C. finmarchicus* and of some unidentified euphasiids. The water column had a weaker stratification in the upper 40 m, with the coldest (~2.6°C) and most saline (~31 psu) surface waters encountered on the transect, and much higher chlorophyll ***a*** concentrations (~220 mg•m^{-2}) throughout the water column. The large-scale spatial structure of these assemblages corresponded closely to that observed in phytoplankton along the same transect (see also Harvey et al. 1997). This structure suggests that they are strongly influenced by local hydrodynamic features which, through their action on surface water temperature, salinity, stratification and mixing conditions, lead to spatial differentiation of the phytoplankton and zooplankton communities (Harvey et al. 2001).

The ice fauna is not as well known as the ice flora. In April 1983, offshore the mouth of Grande rivière de la Baleine, invertebrates living in the lower 3 cm of the sea ice consisted largely of planktonic nematodes, rotifers, ciliates, and copepods--in order of abundance (Hsiao et al. 1984; Grainger 1988). The sea ice fauna was generally denser but less diverse than the zooplankton occuring beneath the ice, both within and outside the river plume (Hsiao et al. 1984). The abundance was positively related to salinity, and to the presence of sea-ice microflora (Grainger 1988; Tourangeau 1989). Because the standing stock of sea-ice fauna is greater under marine conditions, it could be decimated by a winter expansion of the freshwater plume (Grainger 1988).

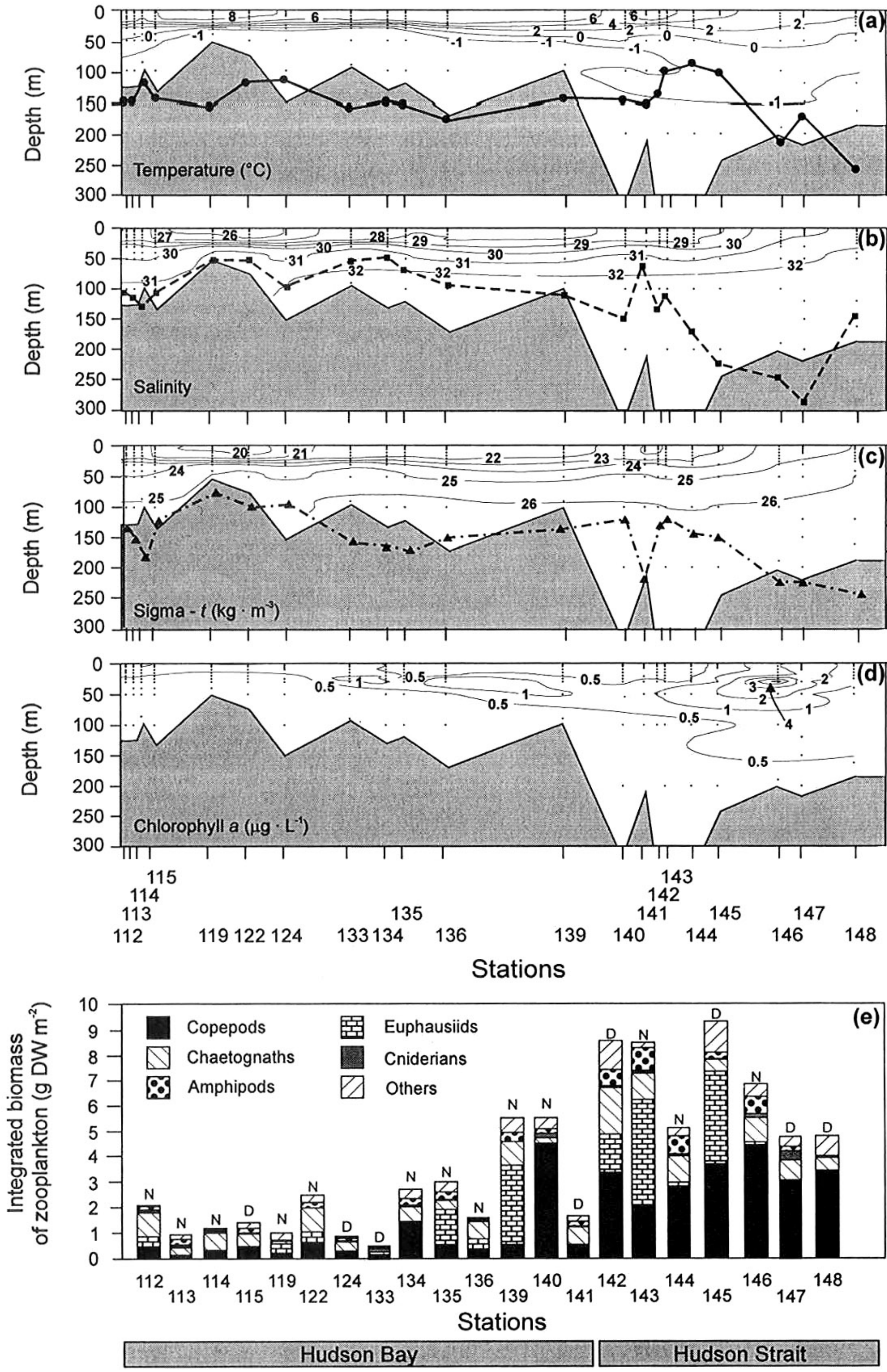

Figure 7-3. Vertical distribution of temperature, salinity (psu), σ_t, chlorophyll *a,* and the integrated biomass of zooplankton at sampling stations (see Figure 7-2) in Hudson Bay and Hudson Strait (D=day; N=night), with the depth of the surface thermal layer (STL; —), the depth of the upper mixed layer (UML; - - -), and the index of stratification ($\Delta\sigma_t$; — • —) shown for each site (from Harvey et al. 2001, p. 486).

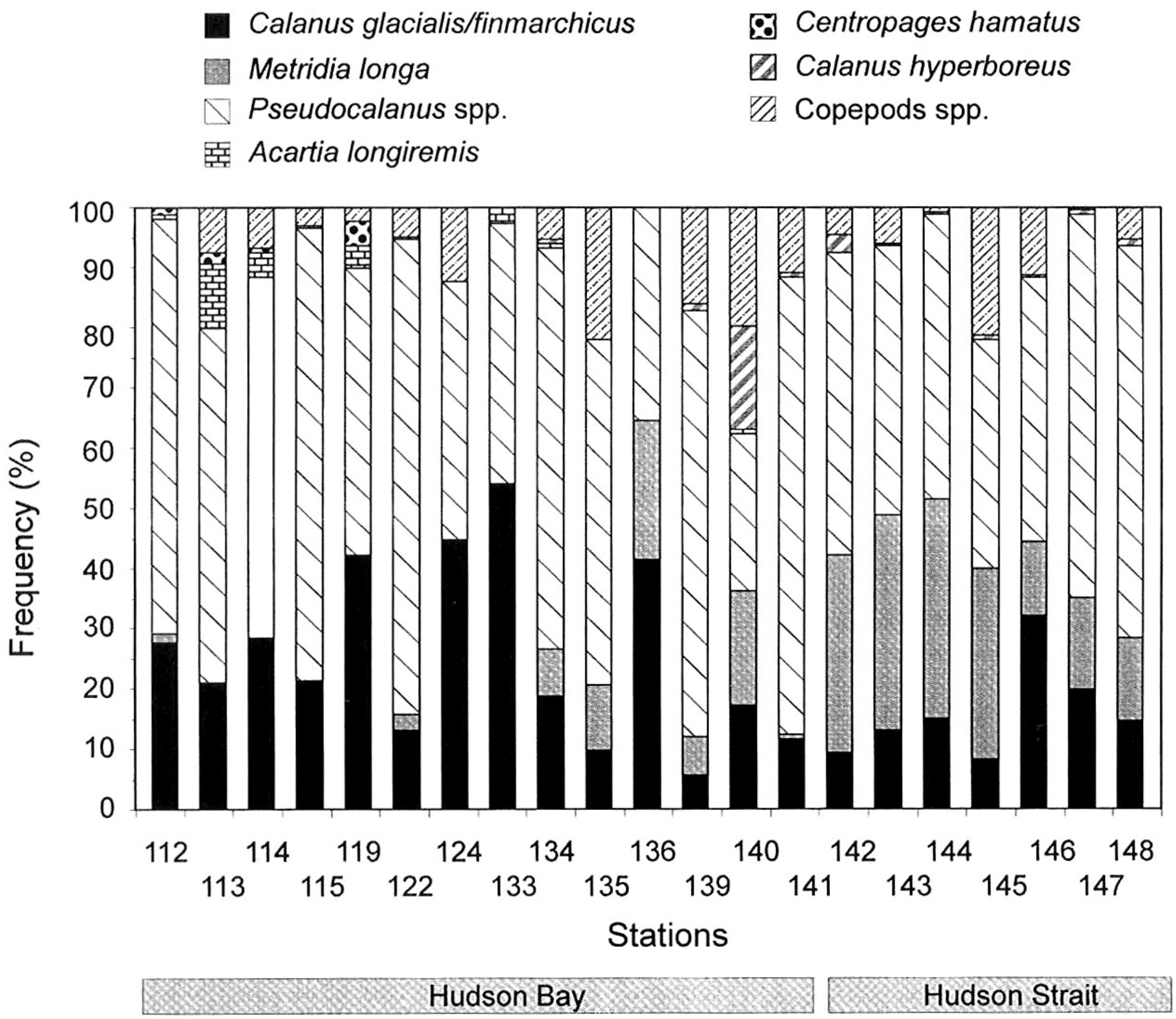

Figure 7-4. Relative frequency of occurrence of the most numerous copepod species along the sampling transect in Hudson Bay and Hudson Strait (from Harvey et al. 2001, p. 489).

Feeding activity increased significantly in mid-May, after the start of ice melt when ice algae were released in large quantities into the water column (Runge et al. 1991). Egg production was negligible during the ice algal bloom but by June had increased about two orders of magnitude. Major sources of food energy for copepod production during this period are sedimenting ice algae (during and immediately after the bloom at the ice-water interface), and diatoms seeded from the interfacial layer and actively growing in the water column in late May and June. The availability of copepod nauplii varies substantially between years, both in magnitude and timing, and may be related more to the dynamics of cyclopoid copepods during the previous winter than to the timing of the spring algal blooms (Fortier et al. 1995). These changes have a direct impact on the feeding success of larval Arctic cod and sand lance that hatch several weeks before ice break-up and feed heavily on the copepod nauplii in mid-June (Drolet et al. 1991; Ponton and Fortier 1992; Fortier et al. 1995, 1996).

Copepods, *Sagitta elegans*, and jellyfish were much more abundant in the deeper marine layer off Grande rivière de la Baleine in May 1989, than in the brackish under-ice plume (Figure 7-5)(Ponton and Fortier 1992). With the exception of *S. elegans*, which accumulate at the pycnocline at night, the vertical distributions of these zooplankters differ little between day and night. By affecting both prey density and light, plume thickness is an important determinant of feeding success by larval fishes (Fortier et al. 1995, 1996; see also Section 8.3).

Hudon (1994) found chaetognaths (*Sagitta elegans* and *S. maxima*), euphausiid and decapod larvae, cnidarians (*Aglanthe digitale*), and pterepods (*Spiratella helicina*) to be the most abundant marine invertebrates taken in 500 µm mesh plankton nets beneath the Grande riviere de la Baleine plume during and after break-up. Chaetognaths were by far the most abundant group, with up to 8 individuals•m^{-3}. These exclusively marine species are prevented from preying upon the fish and insect larvae in the overlying plume as long as stratified conditions prevail.

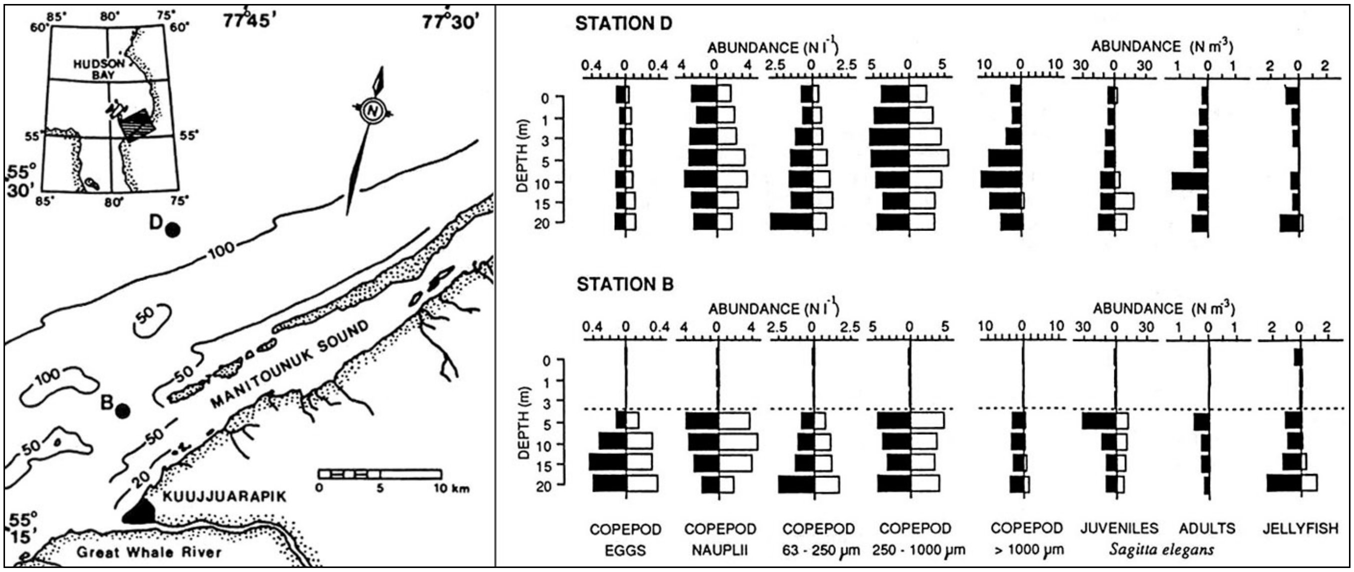

Figure 7-5. **Vertical distribution of zooplankton taxa by night (black histograms, n = 6 profiles) and day (open histograms, n=11 profiles) at stations D and B offshore Kuujjuarapik in May 1989 (from Ponton and Fortier 1992, p. 216+219). Dotted line for Station B indicates the depth of the sharp pycnocline between the brackish surface layer and deep marine layer. Note the compressed vertical scale.**

7.2.1 Phyla Porifera, Ctenophora, Nemertea, Brachiopoda, Phoronida, Priapulida, Nematoda, Sipuncula and Chaetognatha

These phyla are not well known in Hudson Bay and James Bay, and are generally represented by few species with unknown distributions. The exception is *Sagitta elegans*, a chaetognath or arrow worm that is common and widely distributed in Hudson Bay (Willey 1931; Dunbar 1962; Baker 1989). It was the most abundant species in most samples taken from eastern Hudson Bay and Hudson Strait during August 1993 (Simard et al. 1996). It was particularly abundant between the depths of 10 and 70 m, sometimes with counts of over 30 individuals•m^{-3}. Sponges have been collected from the Hudson Bay marine region but not identified (Barber et al. 1981). Species have been identified from Richmond Gulf (Dendy and Frederick 1922) and northern Hudson Bay (Wagner 1969). Three ctenophores have been reported; all common Arctic species (Willey 1931; Gaston et al. 1985; Percy and Fife 1985) (Figure 7-6). Mikhail and Welch (1989) reported a phoronid in the diet of Greenland cod from Saqvaqjuac Inlet. The specimen was not identified to genus, but Barnes (1974) indicates that the phylum consists of only 2 genera, *Phoronis* and *Phoronopsis*.

Figure 7-6. Ctenophore *Beroe cucumis* near Churchill, Manitoba (photo credit D. Rudkin, Royal Ontario Museum, all rights reserved)

7.2.2 Phylum Cnidaria (anemones, soft corals, hydroids, medusae, jellyfish)

The Cnidarians are mainly benthic invertebrates represented by at least 71 species in the Hudson Bay marine ecosystem, 38 of which occur in the James Bay marine region and 57 in the Hudson Bay marine region (Table 7-1, Appendix 2). The majority of these species are hydroids, which are restricted to rocky substrates. They are seldom found over the greater part of James Bay or Hudson Bay, where a muddy bottom occurs, but are locally common. They are very common in Richmond Gulf, where Fraser (1922, 1931) collected 17 species in a single dredge sample. The common Arctic medusae *Aeginopsis laurenti* and *Aglantha digitale* are widespread in Hudson and James bays. The sea anemone, *Tealiopsis stella* is found in the intertidal zone and in shallow water in southeastern Hudson Bay (Verrill 1922); anemones photographed on the bottom of southeastern Hudson Bay have not been identified (Grainger 1968; Barber et al. 1981). The group is also represented in deep water by the octocoral *Gersemia rubiformis* (Verrill 1922; Barber et al. 1981). The Scyphozoa are represented only by *Cyanea capillata*, the largest known jellyfish, which has been collected from southwestern Hudson Bay near the Churchill and Nelson estuaries (Baker et al. 1994; Lawrence and Baker 1995; Baker 1996; Zrum 2000; G. Young, MB Museum, pers. comm.), and likely (*Cyanea* sp.) near Cape Fullerton (Bigelow 1920) and southeast of the Belcher Islands (Simard et al. 1996) (Figure 7-7).

Figure 7-7. A large jellyfish (*Cyanea capillata*) stranded on the tidal flats in polar bear country near Churchill, Manitoba (photo credit G. Young, Manitoba Museum).

7.2.3 Phylum Bryozoa (moss animals)

Bryozoans, or moss animals, are common benthic invertebrates in Hudson Bay and James Bay. Fifty-three species have been reported from the Hudson Bay marine ecosystem (Table 7-1; Appendix 2). Of these, 46 species have been reported from the Hudson Bay marine region, mainly along the western coast, the coasts of the northern islands and in the southeastern portion of the bay (Osburn 1932, 1936; Powell 1968; Baker 1989; Baker et al. 1994; Lawrence and Baker 1995); and 15 species have been reported from James Bay and southeastern Hudson Bay (Osburn 1932; Powell 1968). Bryozoans predominate at depths greater than 30 m and prefer hard substrates (Powell 1968) that occur in a band from the northwest coast down to the southeastern part of the bay (Pelletier et al. 1968). Osburn (1932) found 20 species of byrozoans attached to large algae, mostly *Laminaria* sp., that had washed up on beaches near Churchill. Common species of bryozoans include *Cystisella saccata*, *Myriapora subgracila*, *Celleporella* (*Hippothoa*) *hyalina*, and the deepwater form *Eucratea loricata,* which occurs down to 160 m (Osburn 1932; Powell 1968).

7.2.4 Phylum Annelida (bristle worms)

Polychaete annelids, or bristle worms, are benthic invertebrates that prefer mud bottoms and occur in shallow to deep water, often in large numbers. Berkeley and Berkeley (1943) reported 57 species from Hudson Bay, but many of these species are likely from Hudson Strait and Ungava Bay. At least 102 species have been identified from Hudson Bay marine ecosystem but otherwise little is known about them (Table 7-1). Of these, 80 occur in the Hudson Bay marine region and 55 in the James Bay marine region. Of the latter, 23 have not been reported from Hudson Bay, Foxe Basin, or Hudson Strait (Table 7-1). *Aglaophomus neotenus*, the most abundant polychaete in the Eastmain River estuary, was previously known only from estuaries along the Atlantic coast (Grenon 1982), and may be a relict species. Baker (1989) found *Manayunkia aestuarina* to be abundant in the mud flats of the Nelson River estuary. In central Hudson Bay worm tracks, or *lebensspuren*, are conspicuous in the fine bottom sediments at station 130 of Barber et al. (1981). They identify *Onuphis* sp., a mobile tube dweller. From western Hudson Bay, Wagner (1969) identified *Cistenides* sp., the only species recorded from the area during the cruise of the CSS Hudson in 1965.

7.2.5 Phylum Arthropoda

Arthropods are represented in the Hudson Bay marine ecosytem by 6 species of pycnogonids and 251 species of crustaceans. Based on their distribution in relation to salinity and temperature they can be grouped into arctic, estuarine, and freshwater species. At least 6 species of pycnogonids and 182 species of crustaceans occur in the Hudson Bay marine region and 3 pycnogonid and 176 crustacean species in the James Bay marine region. Most are typical Arctic species with widespread distributions, and occupy a wide variety of habitats. The pycnogonids or sea spiders are small benthic carnivores, while the crustaceans may be planktonic, pelagic, or benthic in habit and range in feeding types from carnivores to filter-feeders. Many large and small species of crustaceans are important prey for larger animals including fish, birds, and mammals (e.g., Shoemaker 1926; Stephensen 1937; McLaren 1958b; Smith 1981; Gaston et al. 1985). None is known to be present in commercially exploitable quantities.

The amphipods are a group of laterally compressed crustaceans that can be benthic, pelagic, or sympagic (ice associated) in habit. They are widespread in Hudson Bay and James Bay. Amphipods can be voracious scavengers and congregate in large numbers in tidal pools to devour dead animals, functioning as the sea's "garbage disposal unit". Pelagic species such as *Themisto libellula* and *T. abyssorum* are common and numerous in samples taken offshore in eastern Hudson Bay; *T. libellula* at depths of 10-100 m and *T. abyssorum* from the surface to >200 m (Simard et al. 1996; Harvey et al. 2001)

Amphipods inhabit the underside of sea ice (sympagic) in the Chesterfield Inlet area of northwestern Hudson Bay (Siferd et al. 1997), and may also be present in shallow coastal areas around Hudson Bay and James

Bay. Twelve species were collected from the Chesterfield Inlet area, the most common being *Ischyrocercus anguipes*, *Pontogenia inermis*, *Apherusa megalops*, and *Weyprechtia pinguis*. Amphipods colonized the sea ice shortly after it formed, and their abundance was strongly affected by the underlying water depth. It increased gradually from shallow water to about 20 m, with a maximum recorded abundance of 1367 m^{-2}, and then decreased rapidly to near zero after 50 m. Ice amphipods followed the same pattern in seasonal abundance as the ice algae, increasing steadily from March through the 3rd week of April and then declining. Locally their grazing can significantly reduce the inshore ice algal biomass, but this is limited to the shallowest areas where amphipods are present in the greatest numbers.

Copepods are abundant and widespread in Hudson Bay but variable in their distribution, abundance, and species composition. Roff and Legendre (1986) found that the biomass of Copepoda decreased towards the centre of the bay. Copepods are important foods for fish, birds, and baleen whales. The substantial bowhead population that once summered in northeastern Hudson Bay suggests that dense concentrations of Copepoda may be present in that area, while the apparent historical absence of a substantial bowhead population suggests that dense concentrations of copepods may be uncommon in James Bay and southeastern Hudson Bay.

During the open water season in southeastern Hudson Bay:

> *"...the greatest copepod densities, consisting mainly of euryhaline species (*Acartia*, etc.) were found above the pycnocline near shore, where phytoplankton was probably present in its greatest density. Arctic species, in low overall numbers at the same locations, were few above the pycnocline, probably excluded by the low salinity. At stations farther from shore, the greatest concentration of copepods comprised arctic species (*Calanus*, etc.), found for the most part below the pycnocline depth, where the subsurface chlorophyll maximum was reported to occur." (Rochet and Grainger 1988)*

Freshwater species (e.g., *Diaptomus*) are restricted to the river mouths. Harvey et al. (2001) observed similar patterns in copepod abundance in southeastern and eastern Hudson Bay. In April 1983, the most abundant copepods in the sea ice were *Harpacticus superflexus*, followed by *Halectinosoma* sp., and then *Tisbe furcata* (Grainger 1988).

Twenty-two species of copepods found in James Bay have not yet been reported from Hudson Bay, Foxe Basin or Hudson Strait (Table 7-1; Appendix 2). The disjunct distributions of species such as *Monstrilla dubia* illustrate the special nature of the James Bay marine region within Arctic Canada. They show that it supports an estuarine fauna atypical of northern Canadian marine waters; that the fauna has strong Atlantic and Pacific affinities; and that this region remains as a refuge, reflecting a former connection with the faunas of the North Pacific-Chukchi-Beaufort Sea region and of the North Atlantic (Grainger and McSween 1988). The continued existence of these isolated, relict populations is precarious and depends upon the persistence of estuarine conditions and higher surface temperatures in the James Bay marine region.

Decapods are the largest of the crustaceans, and include the shrimps and crabs which are widespread in Hudson Bay and James Bay (Squires 1967). An exploratory commercial survey of northeastern Hudson Bay found their abundance to be low (M. Allard, Makivik Corp., Lachine, pers. comm.), however, they are important prey for ringed seal (McLaren 1958), bearded seal (Stephensen 1937; Smith 1981), sea birds (Gaston et al. 1985) and fish (Vladykov 1933; Mikhail and Welch 1989). Most of the species in James Bay marine region, including the brachyuran crab *Hyas coarctatus*, are smaller than their counterparts in other Arctic and Subarctic areas. The Inuit of this region do not commonly utilize decapods.

The euphausiids *Thysanoessa raschii* and *Furcillia* sp. are common and widespread. These pelagic, shrimp-like crustaceans are also known as krill. *T. raschii* are eaten by seabirds (Gaston et al. 1986). In September 1993, *Furcillia* sp. was common from the surface to a depth of about 50 m (Simard et al. 1996). It was found at concentrations of up to 3.5 individuals$\cdot m^{-3}$ in southeastern Hudson Bay, and can be very abundant in

Hudson Strait (170 individuals·m^{-3}). Pelagic amphipods (Hypiriidea) such as *Themisto* spp. can rival the euphausiids in abundance and pelagic significance.

The distributions of other groups of crustaceans that occur in Hudson Bay and James Bay, including the Cirripedia, Cumacea, Isopoda, Mysidacea, and Ostracoda are not well known. The Branchiopoda are only found near river mouths near river mouths in James Bay and southeastern Hudson Bay. They are not listed in Table 7-1 or Appendix 2.

7.2.6 <u>Phylum Mollusca</u>

There are at least 119 species of molluscs, representing 5 classes, in the Hudson Bay marine ecosystem (Table 7-1). Of these, 97 occur in the Hudson Bay marine region, and 82 occur in the James Bay marine region. Of the latter, 13 have not been reported from Hudson Bay, Hudson Strait, or Foxe Basin. Gastropods and pelecypods (bivalves) account for almost all of the species, and are found in all types of habitat ranging from the intertidal zone to the deeper areas of Hudson Bay. Most of the adult molluscs are benthic and uncommon in central Hudson Bay, where there are fewer gastropods than pelecypods (Macpherson 1971; Lubinsky 1980; Barber et al. 1981).

Ice scour may also limit molluscs along the shallow west coast of Hudson Bay (Macpherson 1971) but Martini and Morrison (1987) found the pelecypod *Macoma balthica* to be widely distributed and abundant along the west coast of James Bay in summer--primarily in the lower tidal flats. While the species is able to tolerate a wide range of salinities, it may be less tolerant of rapidly changing salinities since it is absent from major river estuaries. *Macoma balthica* tended to be smaller in the warmer waters of southern James Bay than in Hudson Bay, perhaps due to the lower salinity and the particle size of the substratum (Martini and Morrison 1987). However, parasitism may also play a role. Near Churchilll, Lim and Green (1991) observed that the more mobile individuals, and those living higher in the intertidal zone, were more heavily parasitized and grew faster than those that were more sedentary or living lower in the intertidal zone. They suggested that parasitic castration might account for their higher growth rate and mobility, and thereby increase the likelihood of the parasite completing its life cycle.

Molluscs common in the intertidal zone of Hudson Bay, which is generally depauperate, include the pelecypods *Hiatella arctica*, *Macoma balthica* and *Mytilus edulis*, the gastropods *Margarites costalis* and *Littorina saxitilis* and the chiton *Tonicella marmorea* (Macpherson 1971). Molluscs are more common and abundant offshore, where most of the species are typically Arctic. Their distribution in the bay as well as species composition is correlated more to substrate type than to water depth (Wagner 1969). Common and abundant molluscs that are widely distributed in the bay include the pelecypods *Nucula belloti*, *N. pernula*, *Portlandia lenticula*, *Musculus discors*, *Serripes groenlandicus*, *Macoma calcarea*, and *Chlamys islandica*. The pelecypod *Bathyarca glacialis* is abundant in the deep water of central Hudson Bay (Lubinsky 1980). Gastropods that have been reported from central Hudson Bay include *Lepeta caeca*, *Colus pubescens*, *Oenopota arctica* and *O. pyramidalis,* which are not very abundant (Wagner 1969; Macpherson 1971). *Lepeta caeca* and *M. costalis* are common and abundant nearshore along both east and west coasts of Hudson Bay; *Boreotrophon fabricii* is also common along the west coast while 6 other species are common along the east coast.

Some pelecypods in the James Bay marine region exhibit dwarfism relative to those in the Hudson Bay marine region (e.g., *Mytilus edulis*, *Astarte c. crenata*) (Lubinsky 1980). This may be related to differences in salinity and water temperature. In late autumn, many small *M. edulis* attach to the bases of eelgrass leaves in eastern James Bay (Lalumière et al. 1994). Iceland scallops (*C. islandica*) in eastern Hudson Bay also tend to be slow growing and small relative to other areas (Lambert and Prefontaine 1995).

The region appears to be a refugium for a number of typically Subarctic or boreal Atlantic pelecypods (e.g., *Mya pseudoarenaria*) whose distributions may be disjunct with those of their relatives elsewhere. Some species are rare in the Canadian Arctic (e.g., *Thracia devexa*, *T. septentrionalis*) and others are considered by

Lubinsky (1980) to be relict High Arctic populations that survive but may be close to extinction in James Bay and southeastern Hudson Bay (e.g., *Cuspidaria subtorta*, *Yoldiella intermedia*). The gastropod *Hydrobia minuta* occurs north to Akimiski Island along the west coast of James Bay, occupying the upper tidal flats up to and including the lower salt marshes (Figure 7-8). It flourishes in the warmer brackish to almost fresh water flats and may be a relict species.

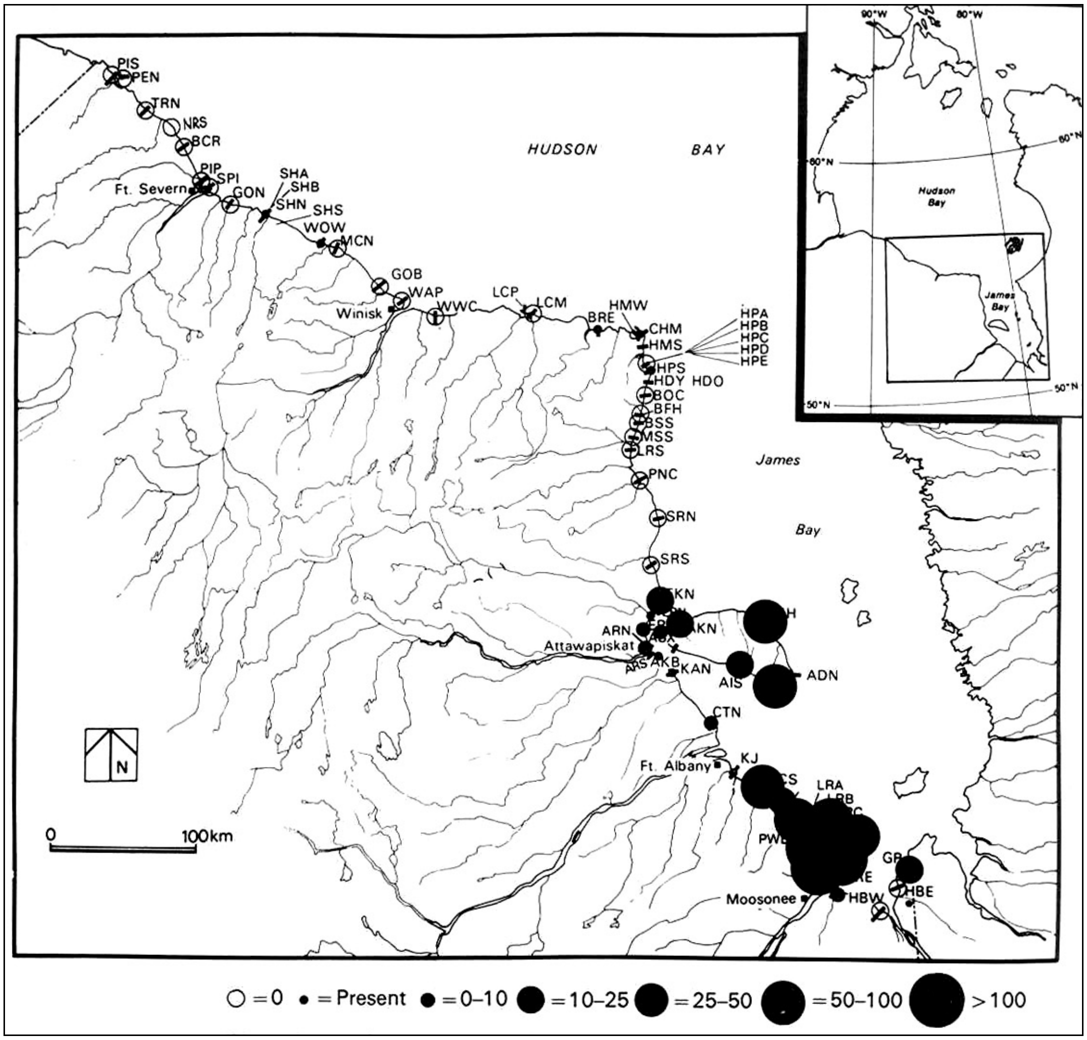

Figure 7-8. Distribution of *Hydrobia minuta* along the Ontario coast expressed as a mean number of individual per transect (individuals/no. of samples treated for macrobenthos) (from Martini and Morrison 1987, p. 53).

Molluscs are important prey for many fish, bird, and mammal species--including polar bear in James Bay that eat *Mytilus edulis* (Russell 1975). Pelecypods such as *Mya truncata*, *Serripes groenlandicus*, and *Clinocardium ciliatum* are important foods for walruses and bearded seals in Hudson Bay (Mansfield 1958; Smith 1981). Squid found in the stomachs of belugas and walrus from Hudson Bay were not identified (Doan and Douglas 1953; Mansfield 1958), but seabirds in northeastern Hudson Bay prey on *Gonatus fabricii* (Gaston et al. 1985). Seabirds in northeastern Hudson Bay also eat two species of pelagic gastropods, the pteropods or sea butterflies *Limacina helicina* (synonym *Spiratella helicina*) and *Clione limacina* (Gaston et al. 1985), both of which are common and widely distributed in James Bay and Hudson Bay (Willey 1931; Kerswill 1940). Inuit, particularly in the Belcher Islands, harvest the blue mussel (*M. edulis*) for food, and exploratory commercial fisheries have been conducted in eastern Hudson Bay for Iceland scallops (*C. islandica*) (see Section 14.3).

7.2.7 Phylum Echinodermata

Echinoderms are benthic invertebrates, represented in the Hudson Bay marine ecosystem by 5 classes comprising 39 species (Clark 1920, 1922, 1937; Grainger 1955, 1966). Of these, 35 occur in the Hudson Bay marine region and 25 in James Bay and southeastern Hudson Bay—most of which were reported from Richmond Gulf (Clark 1920, 1922; Grainger 1966). The echinoderms are distributed throughout Hudson Bay and James Bay and are not as restricted in distribution by substrate type as the molluscs. They are generally Arctic species and their regional abundance is not well known. Echinoderms are found on substrates ranging from mud to coarse gravel and rocks, some at depths less than 10 m but most at greater depths. Six species, the green sea urchin *Strongylocentrotus droebachiensis*; the sea cucumbers *Cucumaria japonica* and *Psolus fabricii*; and the sea stars *Urasterias lincki*, *Leptasterias groenlandica*, and *L. polaris* commonly inhabit the lower intertidal zone, and most also inhabit the deeper waters of Hudson Bay and James Bay (Clark 1920, 1922; Grainger 1965). The green sea urchin is perhaps the most common and abundant echinoderm in the James Bay and southeastern Hudson Bay (Clark 1922; Jamieson 1986; Giroux 1989; Morin 1991), while brittle stars may be the most common and abundant echinoderm in the rest of Hudson Bay (Barber et al. 1981). Polar bears on the Twin Islands eat these urchins in summer (Russell 1975), and Inuit from the Belcher Islands harvest the green sea urchin and six-rayed starfish for food (see Section 14.3).

7.2.8 Phylum Chordata: Sub-Phylum Urochordata

Urochordates or tunicates possess distinct chordate features as larvae and are invertebrates as adults (Barnes 1974). At least 22 species of ascidaceans (sea squirts), which are sessile filter-feeders as adults, and 3 species of larvaceans occur in the Hudson Bay marine ecosystem (Table 7-1; Appendix 2). All of the 15 species of ascidaceans and 3 larvaceans that occur in the James Bay marine region are Arctic forms, most with a circumpolar distribution (Huntsman 1922; Trason 1964; Barber et al. 1981).

Most of the ascidaceans inhabit the littoral zone, attaching by means of a filament or stalk mainly to rocky substrates, but also to clay/mud buttoms. *Boltenia echinata* and *B. ovifera* are common in southeastern Hudson Bay (Huntsman 1922; Trason 1964). *Rhizomolgula globularis* has been found in the stomachs of four-horn sculpin *Myoxocephalus quadricornis* in southeastern Hudson Bay (Huntsman 1922). The tiny, transparent larvaceans are neotenic as adults and specialized for a planktonic existence (Barnes 1974).

7.3 Summary

The invertebrate and urochordate fauna of the Hudson Bay marine ecosystem is poorly known. Little is known of the species composition of the water column, seafloor, or sea ice; or how species distribution, abundance, or biological productivity changes with the seasons or years—particularly offshore. Most of the detailed research has been conducted at estuaries downstream of existing or proposed hydroelectric developments in Quebec and Manitoba, either in open water during the summer or under the sea ice in the spring.

None of the 689 invertebrate and 25 urochordate species reported is unique to the Hudson Bay marine ecosystem, but 243 of them have not been reported from the Hudson Strait or Foxe Basin marine regions to the north. Of the latter, 94 species have only been reported from the James Bay marine region, which includes southeastern Hudson Bay. Some of these faunal differences will be artifacts of sampling. But, a number of species for which there is good sampling coverage appear to be relicts that survive in the warmer, less saline waters of James Bay but not in other Arctic marine regions. Most of the remaining invertebrate species are widely distributed outside this region, generally in Arctic waters. Estuarine species are distributed throughout James Bay and southeast Hudson Bay but are present in the highest density in or near river mouths, while freshwater forms do not survive far from the rivers. The Arctic marine species become dominant moving away from the large estuaries.

Few benthic species inhabit the intertidal zone on a permanent basis, likely due to ice scour, which can extend to a depth of 5 m, and to freezing. While most of the benthic invertebrates live below the ice scour zone, central Hudson Bay has a meagre benthic fauna that consists mostly of echinoderms, especially brittle stars, polychaetes, sea anemones and decapods. In estuaries, such as that of the Eastmain River, the marine zone has the most diverse benthic fauna, while the density of the benthic fauna in the brackish zone is very low compared with freshwater or marine areas.

The pelagic zone is characterized by comb jellies, arrow worms, copepods and amphipods, euphausids, and the pelagic sea butterflies. Species assemblages of marine zooplankton in James Bay and southeastern Hudson Bay reflect the massive freshwater inputs and estuarine character of the circulation. They are characterized by the presence of two euryhaline copepod species, *Acartia longiremis* and *Centropages hamatus*. Species assemblages to the north and offshore are characterized by typically Arctic species, related to the cyclonic circulation of Arctic water in central Hudson Bay. In James Bay, the varying ratios of zooplanktonic species characteristic of fresh, brackish, and marine water reflect seasonal pulsations in the surface brackish water and saline bottom water within the bay. The substantial bowhead population that once summered in northeastern Hudson Bay suggests that dense concentrations of Copepoda may be present in that area.

The ice fauna is not as well known as the ice flora. In April 1983, offshore the mouth of Grande rivière de la Baleine, it consisted largely of planktonic nematodes, rotifers, ciliates, and copepods--in order of abundance. The sea ice fauna was generally denser but less diverse than the zooplankton under the ice, both within and outside the river plume. The abundance was positively related to salinity, and to the presence of sea-ice microflora. Zooplankters beneath the ice are much more abundant below the brackish river plume than within it. They are important foods for larval fishes. Because the standing stock of sea-ice fauna and zooplankton is greater under marine conditions, it could be decimated by a winter expansion of the freshwater plume. This could have important effects on the marine food chain in the affected area.

Few species are of direct value to man, but many are indirectly valuable as food for fish, birds, and mammals. Belcher Islanders harvest and eat marine invertebrates to a greater extent than most other Inuit in Arctic Canada (see Section 14.3).