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Distribution of Arctic Marine Isopods of the *Mesidotea* (= *Saduria*) Complex in Relation to Depth, Temperature, and Salinity in the Southern Beaufort Sea

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ABSTRACT. Three benthic isopods of the *Mesidotea* (= *Saduria*) complex are common in the coastal waters of the southern Beaufort Sea. Their relative distribution in relation to water depth, temperature, and salinity was studied by means of 146 trawl, grab, and trap samples. *Mesidotea entomon* is restricted to the warm, brackish nearshore estuarine zone, in water depths of less than 10 m. *M. sibirica* is most commonly encountered at intermediate depths of 5-25 m. *M. sabini* is the most common marine form, occuring at depths from 10 to 441 m. This distribution pattern is similar to that reported for these species in the European Arctic.

Salinity fluctuations caused by wind-induced shifts in the location of the river plume, and the occurrence of deep, high-salinity water close to shore, result in overlaps in distributions of the isopods in some areas adjacent to the delta.

Key words: isopods, Beaufort Sea, *Mesidotea entomon*, *Mesidotea sibirica*, *Mesidotea sabini*, *Saduria*, distribution

RÉSUMÉ. Trois isopodes benthiques du complexe *Mesidotea* (*Saduria*) sont communs dans les eaux côtières dans le sud de la mer de Beaufort. On a étudié leur distribution relative par rapport à la profondeur, la température et la salinité de l'eau au moyen d'échantillons obtenus par piège, chalut et benne. On ne trouve le *Mesidotea entomon* que dans la zone estuaire saumâtre et assez chaude près du littoral, dans des eaux d'une profondeur de moins de 10 m, tandis que le *M. sibirica* est plus communément trouvé dans les profondeurs intermédiaires entre 5 et 25 m. Le *M. sabini* est la forme marine la plus commune, trouvée à des profondeurs d'entre 10 et 441 m. Cette distribution est semblable à celle que l'on signale pour ces espèces dans l'Arctique européen.

Les fluctuations de salinité entraînées par des changements dans l'emplacement de le panache de la rivière causés par le vent, ainsi que la présence d'eau profonde à haute salinité près du littoral, occasionnent des chevauchements dans la distribution d'isopodes dans certaines régions près du delta.

Mots clés: isopodes, mer de Beaufort, *Mesidotea entomon*, *Mesidotea sibirica*, *Mesidoteau sabini*, *Saduria*, distribution

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INTRODUCTION

Three large marine isopods of the genus *Mesidotea*, *M. entomon* (L), *M. sibirica* (Birula), and *M. sabini* (Krøyer), are common in the coastal waters of the Beaufort Sea adjacent to the Mackenzie River delta. A reproducing population of a freshwater variant of *M. entomon* occurs in at least one lake in the delta. They form an important component of the benthic community, acting as both predators and omnivorous scavengers and serving as food for a variety of fish, birds, and marine mammals.

All three species are widely distributed in coastal areas of both the Eurasian and North American Arctic. However, gaps in their circumpolar distribution and the existence of morphologically, and possibly physiologically, distinct races around the periphery of the Arctic Basin (Gurjanova, 1933, 1934, 1946; Bray, 1962) complicate studies on their zoogeography and physiological ecology.

Information about their taxonomy, morphometry and general ecology in the Beaufort Sea was obtained by Bray (1962) and McCrimmon and Bray (1962). They suggest that although the type of bottom influences population density (highest in mud and lowest in sand and gravel), it is probably a combination of temperature and salinity that determines the distribution of each species. In European arctic waters *M. sabini* is considered to be a marine species (with a possible brackish-water subspecies), *M. sibirica* an inhabitant of water of intermediate salinities, and *M. entomon* a brackish-water species with a freshwater variant (Zenkevitch, 1963). In the North American Arctic, two and occasionally all three species are taken in the same collection (MacGinitie, 1955; Menzies and Mohr, 1962; Bray, 1962; Crane, 1974; Crane and Cooney, 1974), and there is uncertainty about the degree of overlap in their distribution in coastal areas.

The presence of all three species in the coastal waters of the southern Beaufort Sea provides an excellent opportunity for comparative studies. A study of the salinity tolerance and osmoregulatory physiology of these isopods has recently been completed (Percy, in prep.). During that study complementary information was obtained about their occurrence near Herschel Island, the principal collecting site. This distributional data, along with additional information from collections taken during fishery and benthic ecology surveys, is used in the present study to examine the distribution of these isopods in the southern Beaufort Sea in relation to each other and to depth, temperature, and salinity.

MATERIALS AND METHODS

This study is based on 146 samples of isopods collected between 1960 and 1977 (Table 1). Depth, temperature, and salinity data for each of the collecting sites, as well as informa-

TABLE 1. Number of trawls, grab, dredge and trap collections examined, number of collections containing each species; and total number of each isopod species collected (in parentheses)

	Trawl	Grab	Dredge	Trap
Depth range (m)	1.5-335	1.3-441	32-65	0.5-25
No. of collections	67	57	3	23
Mesidotea entomon	32(5227)	23(136)	0(0)	14(1398)
M. sibirica	32(1805)	4(6)	1(1)	9(1251)
M. sabini	39(2372)	29(51)	3(17)	2(4)
Other isopods	6(271)	7(42)	2(35)	0(0)

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tion about species composition, size frequency, and sex ratio in individual collections are available in a data report (Percy and Fife, 1980).

Trawl samples were collected from the M.V. *Salvelinus* using a 7.6 m otter trawl. Grab samples (Petterson, Ponar and Ekman grabs) were collected during benthic surveys (Wacasey *et al.*, 1977). Two to ten grabs of 0.023-0.09 m² each were collected at each station. Only those collections containing isopods are considered here.

To examine the distribution of isopods in nearshore areas at Herschel Island, wire mesh minnow traps with enlarged openings were placed at various distances from shore during two consecutive summers. The presence of heavy sea ice during the second year required that the two transects be located about 1 km apart. Three baited traps (about 25 m apart) were placed on the bottom at each of the selected depths, which ranged from 0.5 m to 25 m. They were retrieved after five hours and contents of traps from the same depth were pooled for analysis. Bottom temperature and salinity were measured with a 1/10°C thermometer and a Bissett Berman salinometer at each of the trap locations.

RESULTS

Since samples were collected by different techniques no attempt was made to analyze the results in terms of absolute abundance or biomass. The principal interest is in the occurrence and relative proportions of the species at each of the collecting sites.

The collections and the total numbers of each species examined are summarized in Table 1, and locations of all collections are shown in Figure 1. Trawl collections were generally confined to shallower areas, whereas grab collections dominated deeper samples. One deep-water (335 m) trawl collection (not included in Fig. 1) was obtained in Franklin Bay (70°33.8'N 126°53'W) just east of Cape Bathurst.

Collecting sites at which each species dominated (>90% of the *Mesidotea* species present) are summarized in Figure 2.

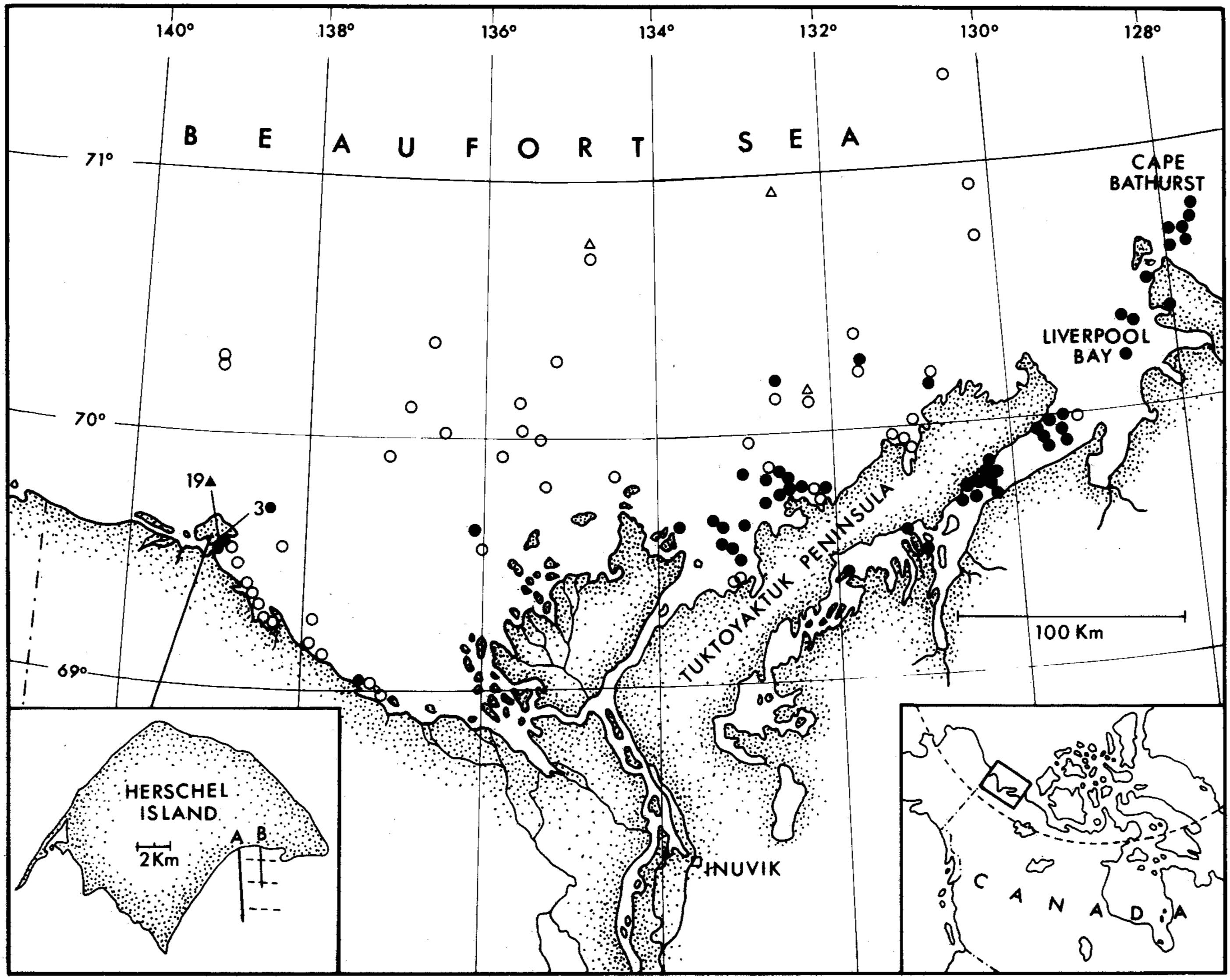

FIG. 1. Location of isopod collections from the Southern Beaufort Sea (○ grab, ● trawl, △ dredge, ▲ trap). Inset: Herschel Island showing the location of the trap transects (A and B). The broken lines at right angles to the transects indicate the location of the Ptarmigan Cove trawl collections.

The numbers of collections from different depths and the frequency of occurrence of each species at each depth are presented in Figure 3. Approximately 70% of the collections are from water < 15 m deep.

Mesidotea sabini occurs over a broader area and a wider depth range than either of the other species, and is the only one of the three found in deeper areas. It was collected at depths ranging from 3 to 441 m (the deepest sample collected) and its frequency of collection was uniformly high at nearly all depths greater than 10 m. It is absent from waters immediately adjacent to the delta, but is common in deeper water, as well as nearshore in the vicinity of Herschel Island to the west of the delta and in Liverpool Bay to the east of the delta.

In contrast, both *M. entomon* and *M. sibirica* are restricted to nearshore areas, with the former occupying a shallower zone than the latter. *M. sibirica* was not found deeper than 55 m or shallower than 4 m, and was most commonly encountered in collections from 5 to 25 m. *M. entomon* occurred most frequently at depths between 0.5 and 10 m, and only rarely in deeper water. One trawl sample from 30-40 m depth contained two *M. entomon*, the deepest occurrence noted in this study.

M. sibirica, like *M. sabini*, is not found in coastal areas immediately adjacent to the delta that are most strongly influenced by the river outflow. In contrast, *M. entomon* occurs much nearer to the mouth of the river than either of the other species.

The only other isopod commonly encountered was *Synidotea bicuspida*. It occurred in 15 of the 146 samples and was taken in significant numbers only at stations from 25-150 m deep, and thus most often in conjunction with *M. sabini*.

The frequency of occurrence of each of the *Mesidotea* species in collections from different salinity ranges is presented in Figure 4. *Mesidotea entomon* occurs over a wide salinity range, although it is most frequently encountered in collections from areas of less than 20‰ salinity. The lowest habitat salinity recorded for the marine form of *M. entomon* was 1‰ and the highest 32‰. *M. sibirica* is found most frequently at salinities between 20 and 30‰, and only rarely at lower salinities. The lowest record was 2‰; however, this involved only a few animals collected in traps located in the

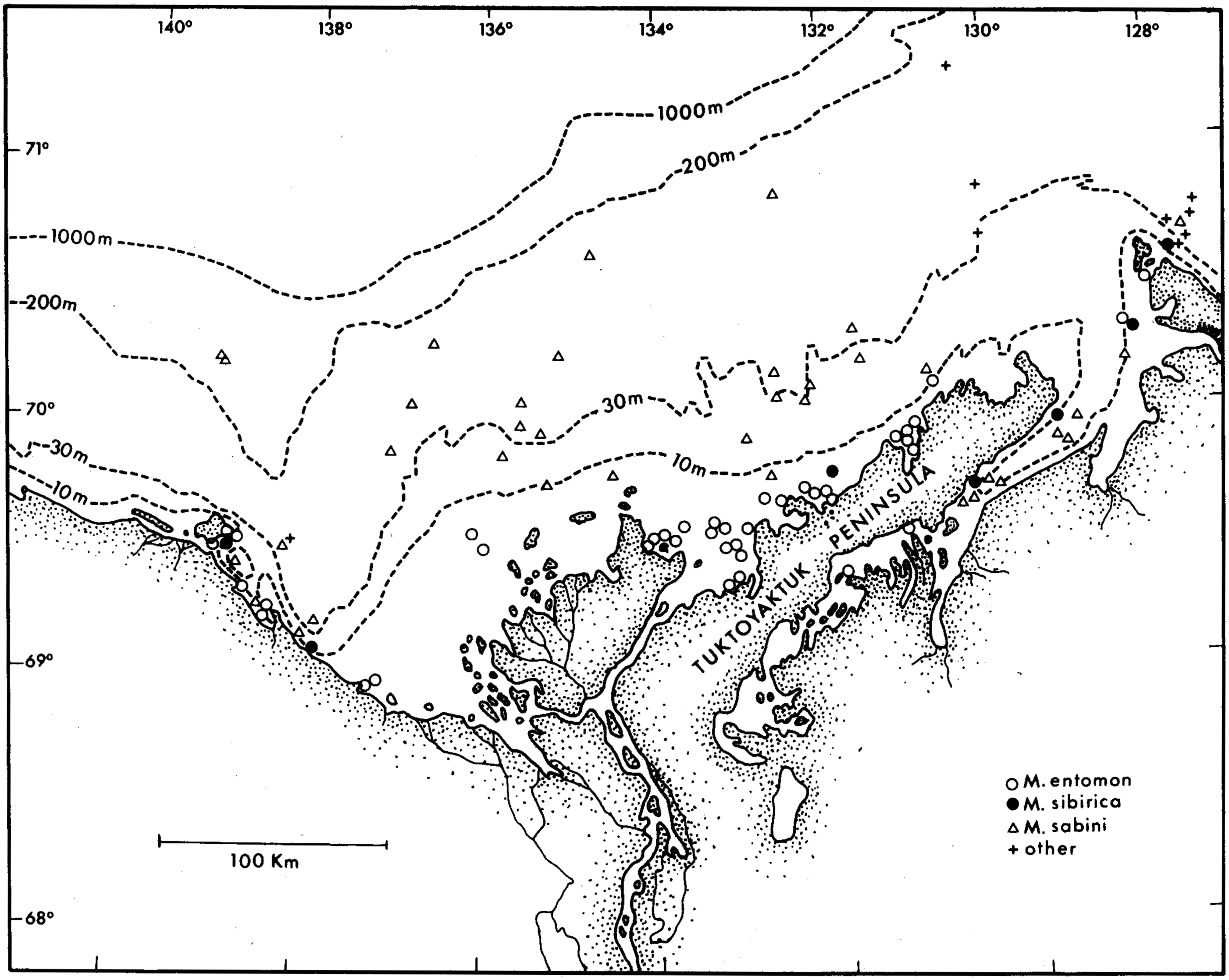

FIG. 2. Location of isopod collections in which the indicated species comprised more than 90% of the number of isopods in the sample. The broken lines indicate depth contours.

vicinity of a pronounced halocline, in an area where bottom salinities appear to be particularly variable. The lowest salinity at which *M. sibirica* was collected in either grab or trawl collections was 9.6‰ and the highest was 32.0‰.

The frequency of occurrence of each of the *Mesidotea* species in collections from different habitat temperature ranges are summarized in Figure 5. *M. entomon* was encountered over the broadest temperature range, from a minimum of −1.1 °C to a maximum of 12.2 °C. However, it was collected more frequently in warmer water, generally above 4 °C, and only rarely at temperatures below −1.0 °C. *M. sabini* was found to occur over a slightly narrower temperature range (−1.8° to 10.5 °C) than *M. entomon*, but a broader one than *M. sibirica*. It was most frequently found at temperatures below 4 °C. *M. sibirica*, in turn was collected in areas where the bottom temperatures measured from −1.5° to 7.0 °C, but appears to occur most commonly at temperatures between 1° and 6 °C. All of the above temperatures were during the open water season in July-August.

The relationship between relative abundance of each species in trawl samples and the collection depth, temperature, and salinity, expressed in terms of the Spearman rank correlation coefficients, are presented in Table 2. Significant correlations between abundance and depth occurred for all three species. The negative coefficient for *M. entomon* indicates that abundance tends to be higher in shallower water and decreases with depth, whereas the positive values for *M. sibirica* and *M. sabini* suggest that abundance is low in shallow water and increases with depth. No significant correlation was found between species abundance and either bottom temperature or salinity.

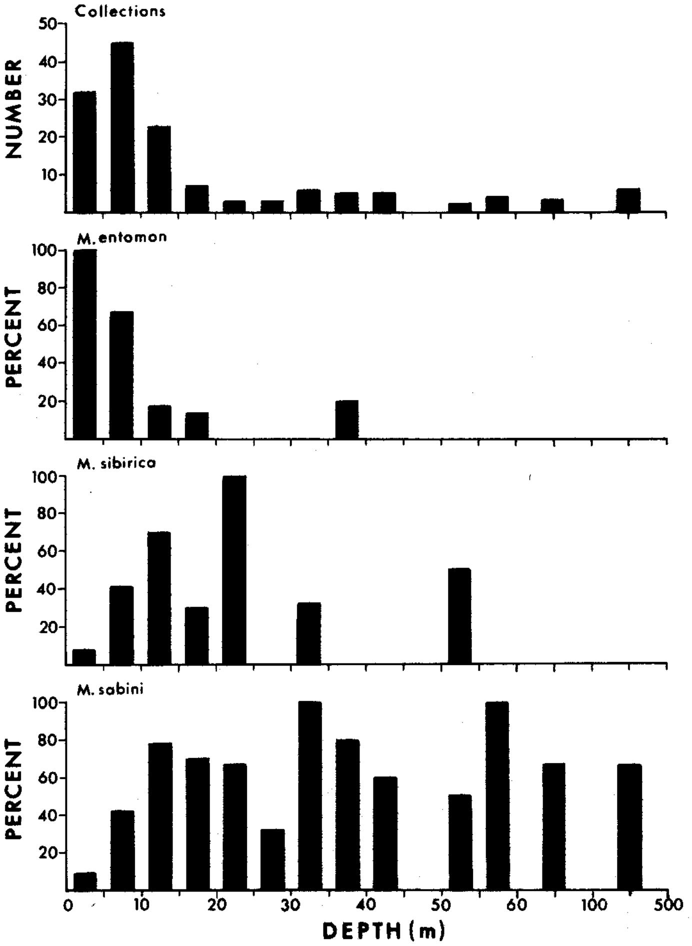

FIG. 3. The distribution of isopod collections according to water depth, and the proportion of collections from each depth containing the indicated species.

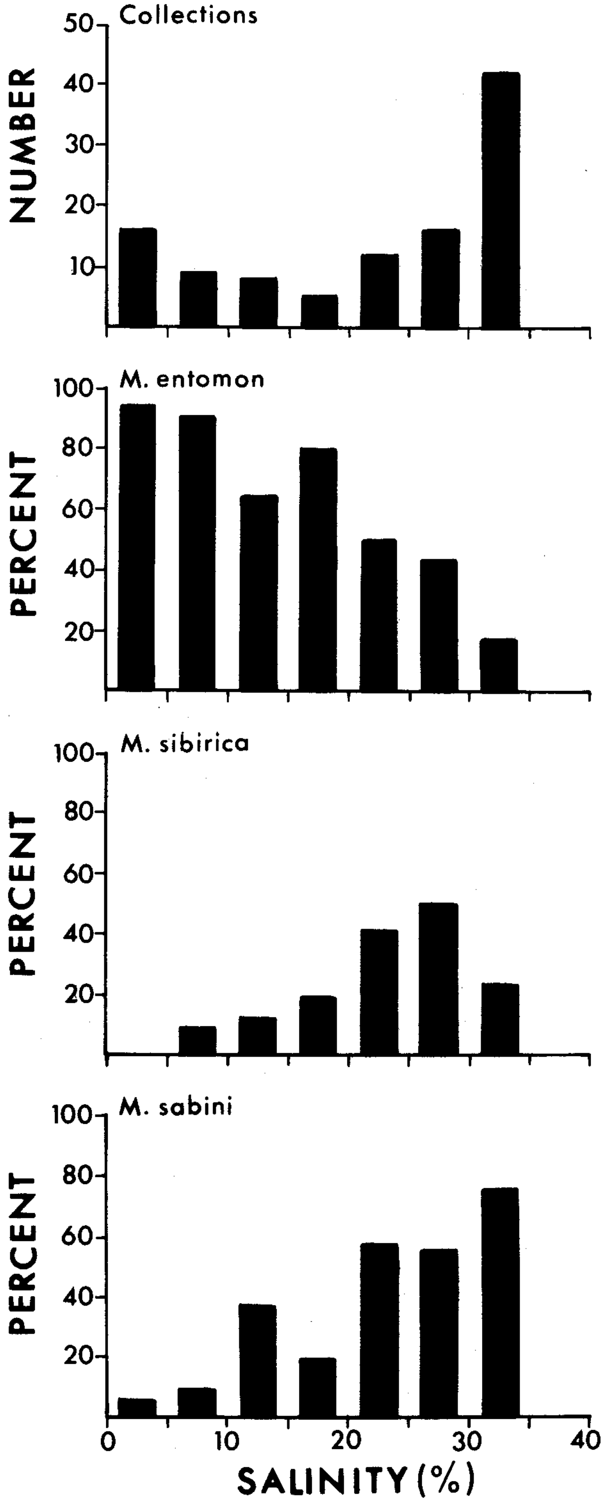

FIG. 4. Distribution of isopod collections according to habitat salinity, and the proportion of collections from each salinity containing the indicated species.

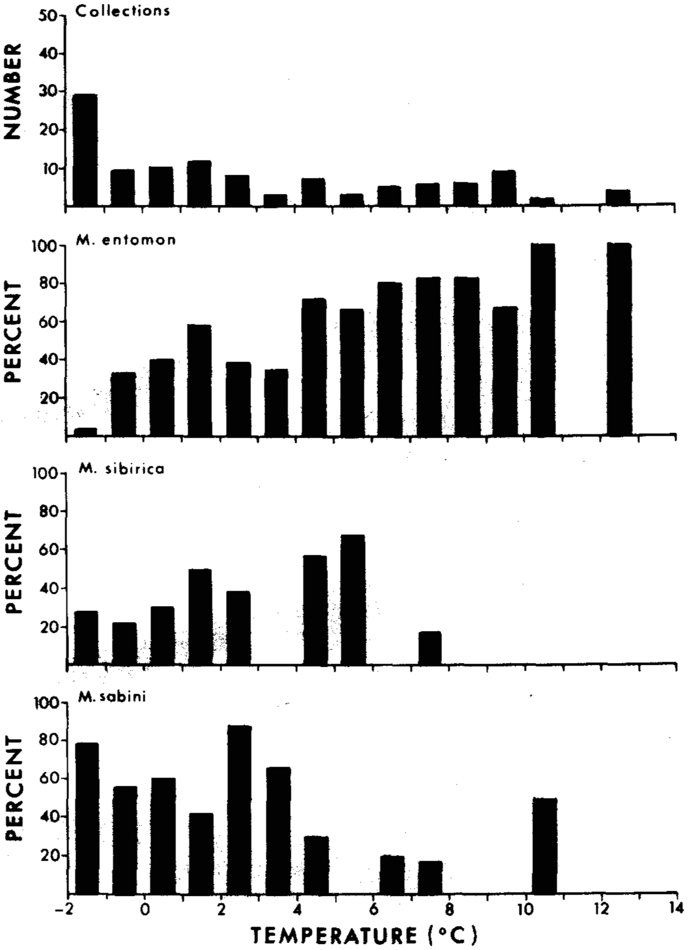

FIG. 5. Distribution of isopod collections according to habitat temperature, and the proportion of collections from each temperature containing the indicated species.

TABLE 2. Spearman rank correlation comparison of abundance of *Mesidotea* species in trawl samples with habitat depth, salinity, and temperature

Species	Depth (2.5-335 m) n=61 r_s*	Salinity (12-34‰) n=29 r_s	Temperature (−1.4-10.5°C) n=30 r_s
M. entomon	−0.609**	−0.152	0.130
M. sibirica	0.412**	−0.030	0.027
M. sabini	0.558**	0.136	−0.223

* Spearman rank correlation coefficient.
** Significant ($p < 0.01$).

In some nearshore areas distributions of the three species overlap. The frequency of occurrence of collections in which each of the species occurred alone and in combination with the other species is presented in Table 3. Fewer than 6% of the collections contained all three species together. Both *M. entomon* and *M. sabini* occurred alone in a high proportion of the collections. *M. entomon* occurred alone in ~75% of the collections in which it was present. *M. sabini* was found by itself in ~50% of the collections in which it occurred. In contrast, *M. sibirica* was most often collected in association with the other species. Fewer than ~25% of the collections contained only *M. sibirica*. In examining the occurrence of pairs of species in collections it is apparent that the degree of overlap between *M. entomon* and either of the others is small. Only 10% of the collections contained *M. entomon* as well as either *M. sabini* or *M. sibirica*. In contrast, *M. sibirica* and *M. sabini* often occurred in the same collection. They were found together in 30% of the collections in which either occurred. This overlapping distribution is even more apparent if one considers the collections from depths <30 m, the area to which *M. sibirica* is largely restricted. Here, the two were found together in 45% of the collections.

TABLE 3. Frequency of occurrence of each *Mesidotea* species alone and in conjunction with other species in all collections ($n = 146$), and rank correlation coefficients for relative abundances of pairs of species in the trawl collections ($n = 63$)

Species	No. of Collections	% Frequency A[1]	% Frequency B[2]	r_s[3]
M. entomon (alone)	51	34.9	73.9	—
M. sibirica (alone)	10	6.8	21.7	—
M. sabini (alone)	37	25.3	50.7	—
M. entomon/ *M. sibirica*	13	8.9	12.0	−0.284
M. entomon/ *M. sabini*	13	8.9	9.0	−0.461*
M sibirica/ *M. sabini*	31	21.2	29.8	0.510**
M. entomon/*M. sibirica*/*M. sabini*	8	5.5	5.9	—

[1] Percentage of the total number of collections.
[2] Percentage of the total number of collections in which the particular species occur.
[3] Spearman rank correlation coefficient.
* Significant ($p < 0.05$)
**Significant ($p < 0.01$)

The Spearman rank correlation coefficient was used to determine if there was any evidence of a significant correlation between the relative abundances in the trawl collections of pairs of *Mesidotea* species (Table 3). Only in the case of *M. sibirica* and *M. sabini* was there a significant positive correlation in relative abundance of the two species. For *M. entomon* and *M. sabini* there was a negative correlation in the relative abundances of the two species, while no significant correlation was apparent for the relative abundances of *M. entomon* and *M. sibirica*.

To obtain a clearer understanding of the relationship between the occurrence of each *Mesidotea* species and the depth, temperature, and salinity, more detailed studies were carried out at Herschel Island, located at the western extremity of the survey area (Fig. 1). A large 80-m deep depression is located southeast of the island and as a result the nearshore seabed slopes more steeply here than in other areas. One would normally have to go 50-100 km offshore to find similar water depths. This deep basin contains high-salinity seawater that is frequently overridden by a layer of water diluted by the river outflow. This results in a pronounced halocline that intersects the bottom over a narrow horizontal range.

Three trawls were made parallel to the coast at depths of 9 m, 13 m, and 30-40 m (Table 4). These trawls indicated that *M. sibirica* dominates at depths between 9 and 40 m, but abundance declines with increasing depth. *M. entomon*, although present at 9 m, is less abundant than *M. sibirica* and is absent at greater depths. In contrast, *M. sabini* is present consistently at all depths sampled, although in low numbers. The relative proportion of *M. sabini* in the samples increases with depth as the abundance of the other two species declines.

TABLE 4. Numbers of each species of *Mesidotea* collected in trawls at different depths in Ptarmigan Cove. (Numbers in parentheses indicate values expressed as percentages of total isopods in the collection.)

Species	9	13	30-40
	Depth (m)		
M. entomon	389(37%)	4(1%)	2(1%)
M. sibirica	634(60%)	546(89%)	137(74%)
M. sabini	30(3%)	61(10%)	45(25%)
Total isopods	1053	611	184

The distribution of the isopods in the area was examined by setting baited traps along a transect at right angles to the shore. The results of these trap surveys are presented in Figure 6.

The abundance of *M. entomon* was greatest near shore, in water of 1 m or less in depth. The numbers declined rapidly with increasing depth, and none were caught in traps set deeper than 10 m. There appears to be a relatively narrow zone from 6 to 10 m depth in which *M. entomon* and *M. sibirica* occur together, although in low numbers. At depths >10 m, *M. sibirica* was caught in large numbers while *M. entomon* was absent. One additional trap sample collected at 14 m on the second transect is not included in the graph, because the traps could not be retrieved at the proper time. However, when they were recovered, 24 hours later, they contained several hundred *M. sibirica* and two *M. sabini*, but no *M. entomon*. Collections from the first transect, which extended into deeper water than the second, also indicated a decline in density of *M. sibirica* with increasing depth beyond 15 m. *M. sabini* was rarely collected in the traps.

Females of *M. entomon* move into the shallows to release their young. At Herschel Island, 37 of the 44 gravid females obtained in the trap collections during two summers were from water <2 m deep, while 31 were collected in <1 m of water.

The upper 8-10 m of the water column is extremely variable in both temperature and salinity, a result of the continually changing influence of the river outflow on the water to the east of Herschel Island. At greater depths conditions are more uniform; the salinity approaches 32‰ and the temperature −1.4°C.

DISCUSSION

In the southern Beaufort sea three *Mesidotea* species live in

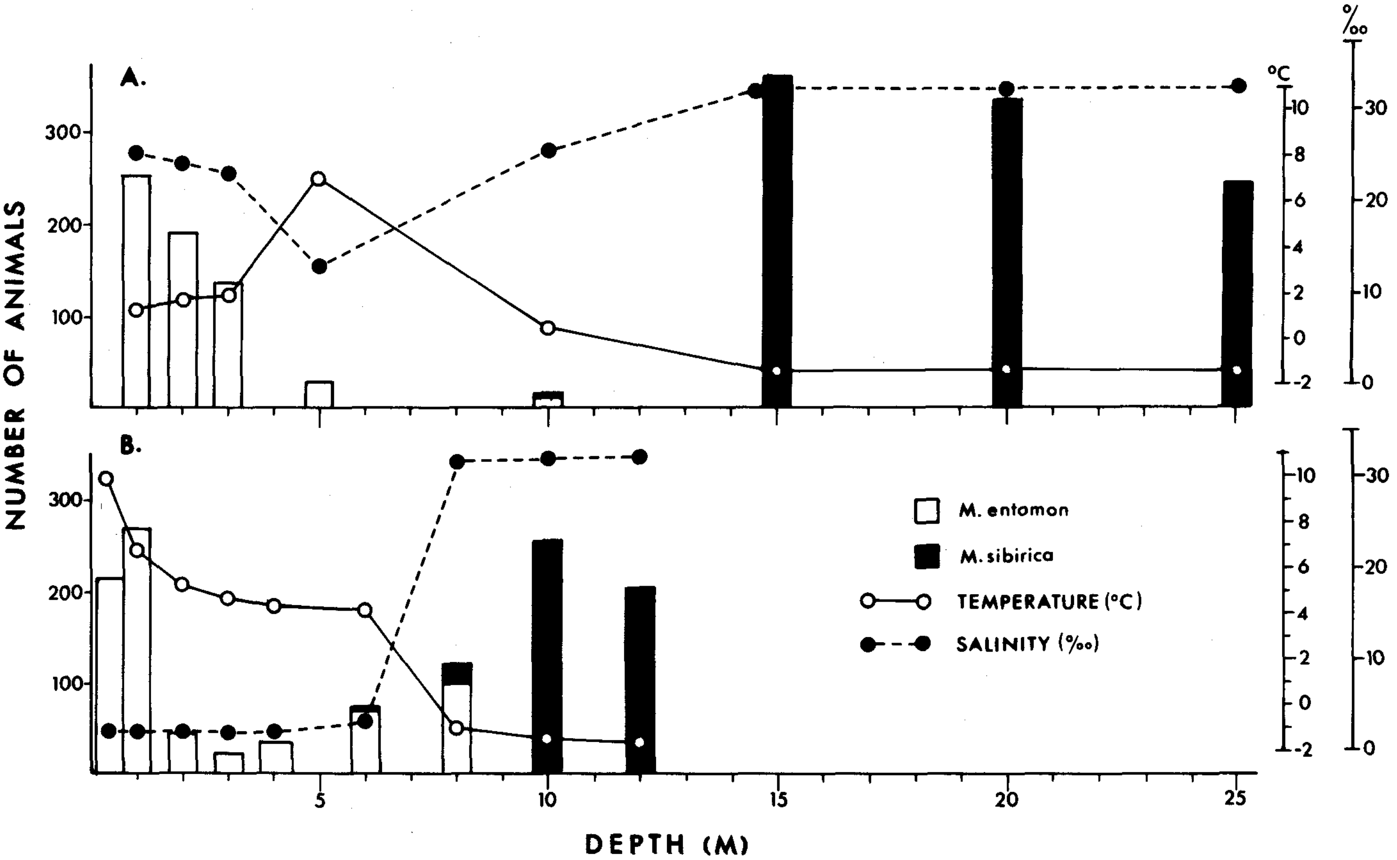

FIG. 6. Numbers of *M. entomon* and *M. sibirica* caught in traps at different depths along transect in Ptarmigan Cove during the summers of 1976 (A) and 1977. (B). Temperatures and salinities at each of the collecting sites are indicated.

close proximity. *M. entomon* is the most abundant in nearshore low-salinity water. It was also reported to be the dominant isopod at Point Barrow (MacGinitie, 1955) and other points along the Alaskan coast (Crane and Cooney, 1974; Robilliard and Busdosh, 1979). Odum (1959) and others have pointed out that related organisms having similar habits or life forms generally do not occur in the same habitat. However, there may be localities where the ranges of such species overlap and they are found to coexist. The occurrence of all three *Mesidotea* species in the southern Beaufort Sea is probably related to the pronounced spatial and temporal variability in the temperature and salinity regimes in the vicinity of the Mackenzie River. There is a number of distinct habitat zones and each of the isopod species tends to exploit a different one. Wacasey (1975) has distinguished, on the basis of physical and biological characteristics, four distinct benthic zones in the southern Beaufort Sea. An estuarine zone, which occupies about 25% of the shelf area, extends from the shore out to about the 15-m depth contour. It is characterized by low salinities (0.1 to 20‰) and elevated temperatures (up to 16.6°C). A marine zone, encompassing almost 50% of the shelf, extends from depths of 30 m out to approximately 200 m. In this zone salinities are consistently high (30-33‰) and temperatures are continuously below zero (−0.1 to −1.58°C). Between these two zones, at depths between 15 and 30 m, lies a transitional zone characterized by intermediate and variable salinities (20-30‰) and temperatures (−1.58 to 7.0°C). Beyond the shelf lies the continental slope zone at depths of 200 to 900 meters, with uniformly high salinity (34 to 35‰) and low temperature (−0.31 to −0.40°C). The distributions of the three *Mesidotea* species tend to be associated with each of the three shelf zones.

M. entomon is restricted to the nearshore estuarine zone. Most were collected in < 10 m of water and none were found in water deeper than 40 m. This is comparable to the 44 m maximum depth reported for this species in the same area by McCrimmon and Bray (1962). A similar nearshore distribution has been reported in Alaskan coastal waters. At Point Barrow, for example, the majority of *M. entomon* were found in <5 m of water (MacGinitie, 1955). At Prudhoe Bay this species was rare at depths >8 m and at distances >10 km from shore (Robilliard and Busdosh, 1979). The subspecies occurring in the European Arctic has a similar nearshore pattern of distribution (Gurjanova, 1934).

What is the precise factor that limits the seaward distribution of *M. entomon*? The abrupt transition from *M. entomon* dominance to *M. sibirica* dominance revealed by three trap transects at Herschel Island suggests the existence of a well defined boundary. It is unlikely that depth *per se* is the limiting factor. In the Baltic Sea, adult *M. entomon* are characteristically found at depths of 30 m or more (Green, 1957). In the northern Baltic, Haahtela (1978) obtained one of his largest collections (3500 animals) with two baited traps set in 62 m of water. Very large isopods are also abundant in the central basin of the Gulf of Bothnia at depths in excess of 100 m (Haahtela, 1975). There are no reports from arctic seas of *M. entomon* occurring at comparable depths.

The Baltic is a brackish sea (<16‰) and *M. entomon* penetrates into the deepest areas. In the Arctic Ocean, on the other hand, it is restricted to shallow brackish areas. It is usually assumed that this is because the isopods are not able to tolerate more marine conditions. The coincidence of the pronounced halocline observed at Herschel Island and the transition from *M. entomon* to *M. sibirica* dominance also implicates high salinity as a factor preventing the seaward spread of *M. entomon*. However, it is difficult to reconcile this with the experimental observations on salinity tolerance.

In the laboratory, the animals survive for at least 10 days in 35‰ seawater with no apparent distress (Percy and Fife, 1980). Both the brackish Baltic forms and the freshwater variants from a Swedish lake were able to survive for at least five days, with no apparent ill effects, in full-strength Plymouth seawater (Lockwood and Croghan, 1957). Furthermore, in a long-term laboratory study of *M. entomon* from Alaskan waters, George (1977) observed a salinity tolerance range of 5-48‰. He also reports that in his year-long study the animals survived indefinitely in a hypertonic medium of 48‰ salinity.

There are some indications that the species encounter elevated salinities in the natural habitat. Bray (1962) collected *M. entomon* in water of up to 31.6‰, comparable to the maximum of 32‰ observed in the present study. Shallow coastal lagoons delimited by chains of barrier islands are a common feature along the Alaskan coast of the Beaufort Sea. The greatest numbers of adult *M. entomon* are found on the outer side of such barrier islands where the bottom salinities range from 22 to 29‰ (Crane, 1974; Griffiths and Craig, 1978). Only recently released juveniles were common in the lagoon during the summer. In late winter some of these shallow (<3 m) lagoons become extremely hypersaline as brine excluded from thickening sea ice accumulates in the pockets of seawater remaining beneath the ice. Salinities may range as high as 54.0‰ (Craig and Haldorsen, 1980) and occasionally even 66‰ (Kinney *et al.*, 1972). Crane and Cooney (1974) speculated that the isopods migrate out of the lagoon in winter to escape the high salinities. However, winter collections by Griffiths and Dillinger (1980) suggest that some *M. entomon* persist in the lagoons during the winter. It is clear from these reports that *M. entomon* is capable of tolerating high salinities.

Low temperature cannot play a significant role in restricting the seaward spread of *M. entomon*, since during winter they are exposed to subzero temperatures for prolonged periods.

It appears that neither depth, high salinity, nor low temperature is sufficient to impede the seaward spread of *M. entomon*. MacGinitie (1955) speculated that the animals simply prefer warm shallow water of low salinity. Temperature and salinity preference studies might prove enlightening in this regard. MacGinitie (1955) further suggested that *M. entomon* may move shorewards into water of low salinity to breed. There is some evidence to support this idea. Bray (1962) reported a greater incidence of ovigerous females in inshore collections. Similarly, in the Herschel Island trap collections, over 80% of the gravid females collected were from water <2 m deep.

M. sibirica occurs primarily in the transitional zone. It is a more marine form than *M. entomon* (Zenkevitch, 1963; Ekman, 1967). In the present study it was found at depths between 4 and 55 m, but most commonly in collections from 5 to 25 m. Bray (1962) reported a depth range of 9-80 m for this species in the western Arctic. In Prudhoe Bay juvenile *M. sibirica* have been collected in <4 m of water (Robilliard and Busdosh, 1979). In the European Arctic it generally occurs at depths between 8 and 50 m although in the Kara Sea it has been taken in depths up to 160 m (Gurjanova, 1933).

M. sibirica may be prevented from invading the nearshore zone occupied by *M. entomon* by high temperature or low salinity. Bray (1962) reported a habitat temperature range of -0.50 to -1.32°C for *M. sibirica*. However, in the present study animals were collected in water as warm as 7°C, although the majority were found at temperatures between 1° and 6°C. Although laboratory studies demonstrate that *M. entomon* has a higher thermal tolerance than *M. sibirica*, it is unlikely that it is temperature alone that limits the shoreward extension of *M. sibirica*, since the 96-hour LC_{50} for both species is far higher than the maximum temperature encountered in the nearshore habitat (Percy and Fife, 1980).

Salinity may be the principal factor limiting the shoreward spread of *M. sibirica*. Bray (1962) reports that the range of salinities under which *M. sibirica* have been taken is 26.78 to 30.62‰. In the present study *M. sibirica* was found most frequently at salinities between 20 and 30‰, and only rarely at lower salinities. In the laboratory, significant mortalities occurred during exposures to salinities less than 15‰ for 10 days (Percy and Fife, 1980), although there is evidence that animals can be adapted to lower salinities.

M. sabini is the only one of this group commonly found in the marine zone. It was also collected at 441 m, well into the slope zone. This is deeper than the 81 m maximum suggested for this species by Bray (1962) who trawled in depths up to 150 m in the Beaufort Sea. It is not known how far down the continental slope *M. sabini* penetrates. It has not been reported from abyssal areas where it seems to be replaced by *M. megalura* (Menzies, 1963). In the southern Beaufort Sea *M. sabini* penetrates into the transitional zone and even occurs in the outer fringes of the estuarine zone in areas where deep water extends in close to shore. Bray (1962) reports a minimum depth of 6 m for this species, but in the present study it was collected in as little as 3 m of water. In Harrison Bay and Simpson Lagoon along the Alaskan coast it has been found in even shallower water (Crane, 1974). At Prudhoe Bay, however, *M. sabini* was collected only at depths greater than 6 m (Robilliard and Busdosh, 1979). MacGinitie (1955) reports that at Point Barrow *M. sabini* was taken in shallow water along the coast, generally in depths of 3-5 m, though it was found in greatest abundance at Eluitkak Pass in about 15 m of water. He did not obtain any in his deeper samples from water up to 250 m.

Although the distributions of the isopods tend to be related to the distinct habitat zones, there is nevertheless evidence of a considerable degree of overlap. Two and occasionally all three species occur in the same collection (MacGinitie, 1955; Bray, 1962; Crane and Cooney, 1974; Robilliard and Busdosh, 1979). In the present study, the most frequently encountered combination was *M. sibirica* and *M. sabini*. There was also evidence of a significant positive correlation in their abundances in areas where they co-exist. In contrast, *M. entomon* was caught only rarely in combination with either of the other two species. Clearly, the distributions of *M. sibirica* and *M. sabini* overlap to a considerable degree, but overlap that of *M. entomon* only minimally. These overlaps may be attributable to the continually shifting pattern of warm freshwater input into the coastal waters adjacent to the Mackenzie River (Wadhams, 1976). This results in large areas of the seabed being subjected to a succession of different thermal and osmotic regimes within a brief period. To the west of the delta near Herschel Island, and to the east, in Liverpool Bay, deeper water extends closer to shore, permitting even greater overlap among the three species.

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