

POLISH POLAR RESEARCH	8	2	121—134	1987
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Distribution of Decapoda (Crustacea) in South Spitsbergen coastal waters with remarks on their ecology and breeding biology

ABSTRACT: 10 species of decapod crustaceans were found in Hornsund fiord and adjacent waters of South Spitsbergen. Habitat preferences are given for the species observed as well as distribution maps. Length — weight relationship, length frequency distribution and estimation of life cycles is given for most common species.

Key words: Arctic. Spitsbergen. Decapoda.

1. Introduction

The distribution of decapod crustaceans in Svalbard area was studied by Doflein (1900), Birula (1906), Hofstein (1916), Grieg (1927), Blacker (1957) and in other areas of Arctic by Sivertsen (1935), Heegaard (1941), Nesis (1959), Kobjakova (1960), Menšutkina (1977), Menšutkina and Caban (1985).

The studies on the biology and productivity of Arctic decapods are rare and concerned mainly the commercial species like *Pandalus borealis* (Haynes, Wigley 1969, Hopkins, unpubl. data). The biology of non-commercial species *Sabinea septemcarinata* and *Lebbeus polaris* was studied at Franz Josef Land by Menšutkina (1977) and in White Sea by Menšutkina and Čaban (1985).

Decapods from coastal regions of Svalbard are important food item for many vertebrate species, especially sea birds (Hartley and Fisher 1936, Lovenskjøld 1964, Ivašin et al. 1972), Lydersen, Gjertz and Węślawski 1985.

As a part of wide ecological study carried out by Polish expeditions

in South Spitsbergen the present work is going to contribute to the knowledge of the biologically important group with regard to its distribution and biology.

2. Material and methods

For the distribution analysis and ecological description materials collected by the University of Gdańsk expeditions were used; they were collected

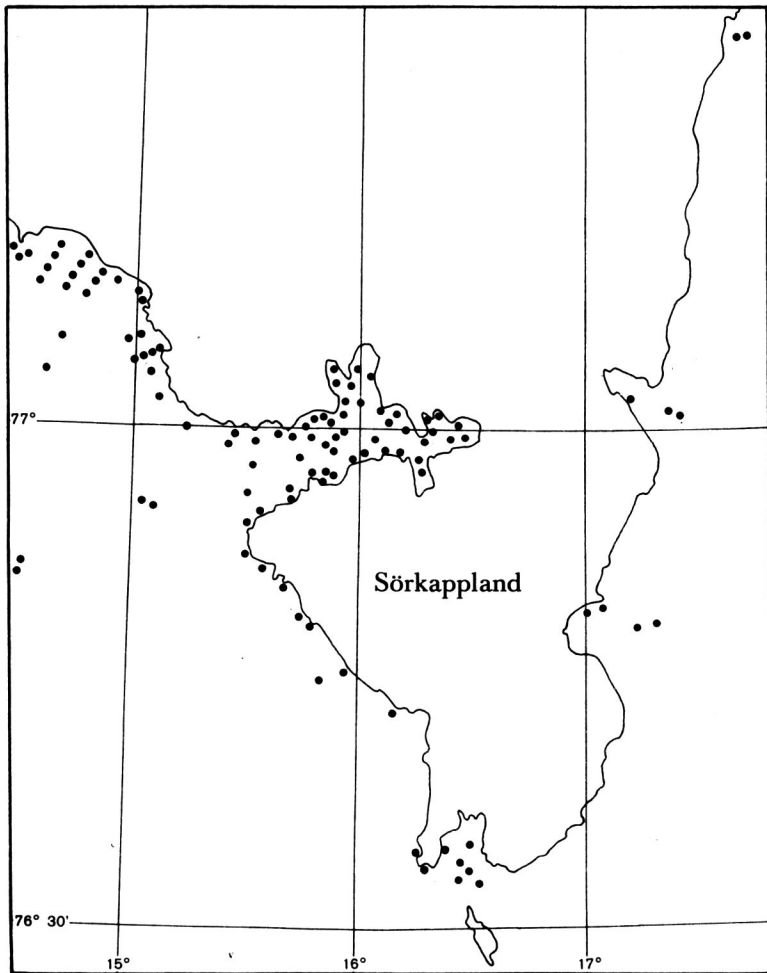


Fig. 1. Sampling stations in the investigated area in 1975—1984

in 1977, 1979 and in 1981/82 by the present author and in 1980 by Mrs. S. Gromisz. In 1984/85 wintering expedition of Polish Academy

of Sciences there were collected materials used for the analysis of biology. Decapods were picked out from all available samples of zooplankton (over 200), of zoobenthos taken by light dredge (over 500) and stomachs of birds, fishes, seals collected for trophic studies (Lydersen, Gjertz and Węśławski 1985). Sampling stations grid is shown in Fig. 1. Animals were preserved in 4% formaline, then measured from the tip of the rostrum to the end of telson and weighed wet (formaline wet weight). Eggs were measured under stereo microscope with an accuracy of 0.01 mm and set of 10 eggs was weighed wet with an accuracy of 0.2 mg, result was calculated for single egg.

Determination of species was made with the use of keys of Gaevskaja (1948), Blacker (1957), Allen (1967) and Christiansen (1972).

Part of the materials (those from 1979 and 1980) were determined by Magdziarz (unpubl.) with the help of the present author.

Environmental conditions in the study area are described by Urbański et al. (1980), Swerpel (1985) and Zajączkowska (unpubl.).

3. Results and discussion

Fam. Pandalidae

Pandalus borealis Krøyer, 1844

Only 13 specimens in 3 samples were found in dredge material. Single larvae were found in August plankton. 11 out of 13 specimens were found in the depth of 45 m on stony and muddy bottom at the West Coast of South Spitsbergen (Figs. 2 and 3).

Birula (1906) reported this species from West and South Spitsbergen, Heegaard (1941) noted it from Greenland in the depths from 45 to 100 m. Blacker (1957) regards *P. borealis* as an eurythermic, non littoral boreo-arctic species.

Fam. Hippolytidae

Eualus gaimardi (Milne Edwards, 1837)

667 species in 51 dredge samples were found, 12 specimens were caught in baited traps. Larvae and juveniles up to 12 mm length were found in plankton from July to September (Tab. 1). This is the most common decapod species in the investigated area, occurring mainly in the depths of 2–50 m, but it was found also in the tidal zone as well as in the depth of 150 m.

E. gaimardi was found also in stomachs of eiders, ringed and bearded seals.

Birula (1906) and Hofstein (1916) reported this species as a most common all over the Spitsbergen area. According to Heegaard (1941)

E. gaimardi is a circumarctic, widely distributed species, noted to the south as far as British Islands and Cape Cod in the depths of 10 to 300 m. *Lebbeus polaris* (Sabine, 1821)

16 specimens were collected in 5 dredge samples in two localities — near Sörkapp and at the West Coast of South Spitsbergen, in depths of 80 and 30 m on stony bottom (Figs. 2 and 3).

Birula (1906) noted this species in most of Spitsbergen localities in the depth of 8 to 195 m. According to Heegaard (1941) it is a circumpolar boreo-arctic species.

Spirontocaris spinus (Sowerby, 1806)

30 specimens were collected in 5 samples around Hornsund and West Coast of South Spitsbergen. Single larvae and juvenile specimens were

Table 1

Occurrence of decapod larvae in coastal waters plankton of South Spitsbergen

Species	Pelagic occurrence
<i>Pandalus borealis</i> — mysis	August
<i>Eualus gaimardi</i> — mysis	July — September
<i>Spirontocaris spinus</i> — mysis	July — August
<i>Sabinea septemcarinata</i> — mysis	May — September
<i>Hyas araneus</i> — zoea	April — August
<i>Hyas araneus</i> — megalopa	July — September
<i>Eupagurus pubescens</i> — zoea	April — September

found in near bottom plankton. *S. spinus* occurs in the investigated area on stony bottom with red algae and hydroids in the depths of 50 to 100 m.

Birula (1906) noted this species around Spitsbergen, Heegaard (1941) in Greenland waters and in North Atlantic as far as to Cape Cod. According to Blacker (1957), Nesis (1959) and Kobjakova (1960) *S. spinus* is an indicator of Arctic water masses.

Spirontocaris turgida (Krøyer, 1842)

75 specimens from 17 dredge samples were found in most of the investigated localities. *S. turgida* occurs in the depths of 20—50 m on various bottom types.

Birula (1906) found this species along south and west coasts of Spitsbergen. Sivertsen (1935) and Heegaard (1941) regarded *S. turgida* as a panarctic, circumpolar form. Nesis (1959) considered this species as an Arctic element of Spitsbergen fauna.

Fam. Crangonidae

Sclerocrangon boreas (Phipps, 1774)

77 specimens were found in 12 samples collected in the outer part

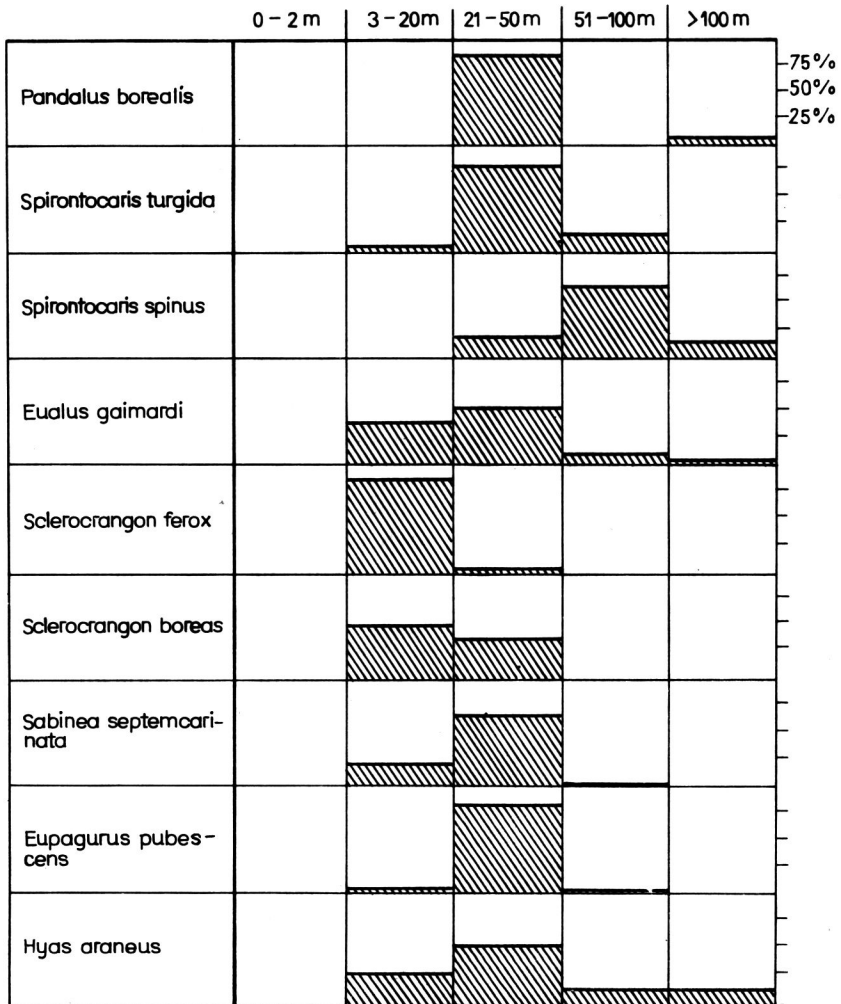


Fig. 2. Depth preferences of examined species. Expressed as % of the total number of individuals of particular species found at given depth interval

of Hornsund (Fig. 3). The species was found in the depth of 2—50 m on various bottom types. The remnants of this species were found in the stomachs of eiders and bearded seals.

Birula (1906) noted this species in Hornsund, Isfjord, Storfjord, Bjørnøya, NW Spitsbergen. Heegaard (1941) considered this species as a panarctic, boreal species occurring in the depth of 0 to 150 m. According to Blacker (1957) this species is an indicator of increasing influence of West Spitsbergen Current on Svalbard region.

Sclerocrangon ferox (G. O. Sars, 1877)

80 specimens were found in 9 dredge samples and one specimen in bearded seal stomach.

The species was found mainly in the inner part of the Hornsund fiord in the depths from 2 to 20 m, in muddy or stony bottom with algae (Figs. 2 and 3). Smallest specimens ranging 9—10 mm in length were found in September.

Birula (1906) noted this species at North and East Spitsbergen coasts. Heegaard (1941) reported it from Greenland waters. Blacker (1957) and Nesis (1959) regarded *S. ferox* as an indicator of cold Arctic waters in Svalbard area.

Sabinea septemcarinata (Sabine, 1821)

331 specimens from 48 dredge samples were found in the investigated area. Several specimens were noted in eiders and bearded seals stomachs. This species was found in almost all investigated stations belonging to the most abundant and common species of decapods.

Adult and immature specimens were found in the depths of 20—50 m mainly on muddy bottom. Larvae and juveniles 10—12 mm in length were found in plankton from May to September (Tab. 1).

Birula (1906) noted this species in the whole Spitsbergen island area from the depth of 20 to 100 m. Heegaard (1941) considered *S. septemcarinata* as a panarctic, circumpolar species. Blacker (1957) and Nesis (1959) regarded *S. septemcarinata* as an Arctic form and indicator of cold waters.

Fam. Majidae

Hyas araneus (Linné, 1758)

56 specimens from 21 bottom samples were found. They were collected commonly but never abundant in dredge samples and in baited traps from depths exceeding 50 m. Most of adult specimens were found in the depths 2—50 m in the laminarian belt and among stones with red algae. Smallest non-pelagic specimens of the carapax length of 12 mm were found in November in phytal zone in the depth of 5 m. Pelagic zoea larvae were noted in plankton since April to August, whereas megalopa larvae from July to September (Tab. 1). No egg-bearing females were found. This species was found also in the stomachs of eiders, glaucous gull, ringed and bearded seals.

Hyas araneus was noted by Dyer (1985) as an abundant species along West Spitsbergen coasts. Birula (1906) reported this species from Hornsund, Isfjord and Bjørnøya and generally from North Atlantic as far south as the coasts of France and north to Novaja Zemlja, however it was not found in Greenland (Heegaard 1941). This species was recorded in the depths from 14 to 350 m. By most authors *Hyas araneus* is regarded as boreo-arctic species.

Eupagurus pubescens (Krøyer, 1838).

59 specimens from 16 bottom dredge samples and 8 from baited traps

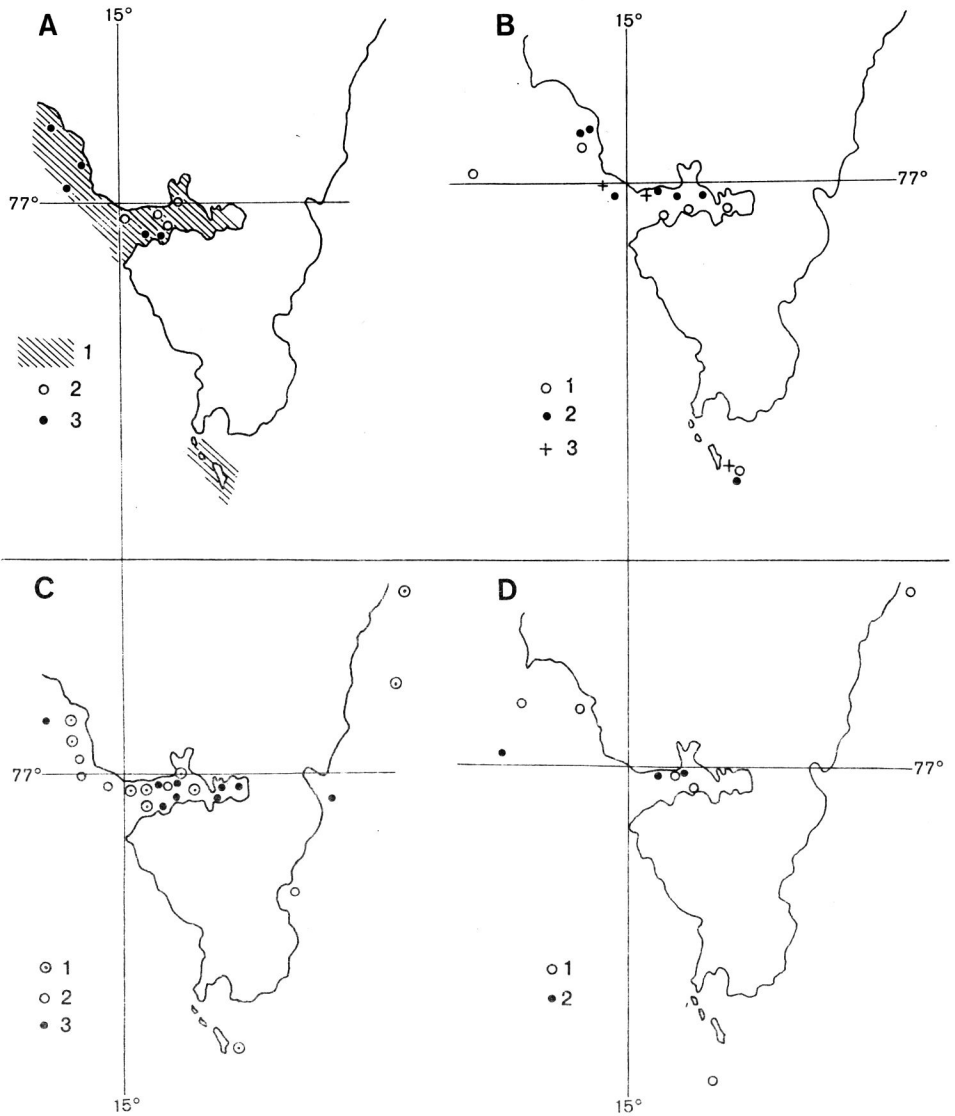


Fig. 3. Occurrence of species found in present study. A. 1 — *Hyas araneus*, 2 — *Sclerocrangon ferox*, 3 — *Sclerocrangon boreas*. B. 1 — *Spirontocaris spinus*, 2 — *Spirontocaris turgida*, 3 — *Lebbeus polaris*. C. 1 — joint occurrence of both species, 2 — *Eualus gaimardi*, 3 — *Sabinea septemcarinata*. D. 1 — *Eupagurus pubescens*, 2 — *Pandalus borealis*

were found. Species was found from 20 to 100 m depth, mostly in the bottom of stones and red algae, but also on muddy bottom and in the phytal zone. Schizopod larvae were found in plankton from April to

September (Tab. 1). Two egg-bearing females were found in September in the depth of 20 m (Tab. 2). Birula (1906) has found this species in Hornsund, Storfjord, Isfjord, Bjørnøya and North West of Spitsbergen. Heegaard (1941) noted this species in West Greenland, North Atlantic to Cape Cod, Kattegat and Skagerrak in the depths of 20 to 350 m. *E. pubescens* is considered as boreo-arctic species.

Comparison of scarce data on egg-bearing females (Tab. 2) with data about decapod larvae appearance in plankton (Tab. 1) permits us to say that most if not all of 10 species presented above incubate eggs in winter

Table 2

Parameters of egg carrying decapod females found in Hornsund in August–September 1984

Factor	Species						
	<i>Eualus gaimardi</i> n = 3			<i>Spirontocaris turgida</i> n = 2		<i>Eupagurus pubescens</i> n = 2	
length (mm)	47	52	64	52	54	+	+
weight (mg)	631	1249	3300	1500	2040	1002	1750
number of eggs	270	400	187	500	117	500	1000
wet weight of single egg (mg)	0.27	0.38	2.75	0.43	1.85	0.30	0.35
diameter of egg (mm)	0.96	1.10	1.68	1.09	1.53	0.95	1.0
estimated period of eggs incubation	August — April			September — April		August — April	

n — number of specimens
+ — not measured

and hatch larvae in spring. Length frequency presented for most abundant August samples (Fig. 4) shows that *S. turgida* during first year of its life reach about 28 mm in length (in August), when the maximal length of 4 years old specimens was 61 mm.

S. septemcarinata larvae of 5–12 mm were observed in spring and summer plankton and in August the biggest specimens of that year reached the length of 30 mm (Figs. 4, 5). *E. gaimardi* with similar timing of larvae appearance in plankton is represented in April both by newly hatched larvae and by smallest overwintering specimens of the length of 15–18 mm; the length of juveniles of the year reached in August 9 to 16 mm. That would suggest also 3–4 year long life span (Fig. 4).

The species composition of the decapod fauna in the investigated area did not differ from the results of earlier studies (Birula 1906, Hofstein 1916, Blacker 1957, Nesis 1959, M. Christiansen and B. O. Christiansen 1962, Dyer 1985).

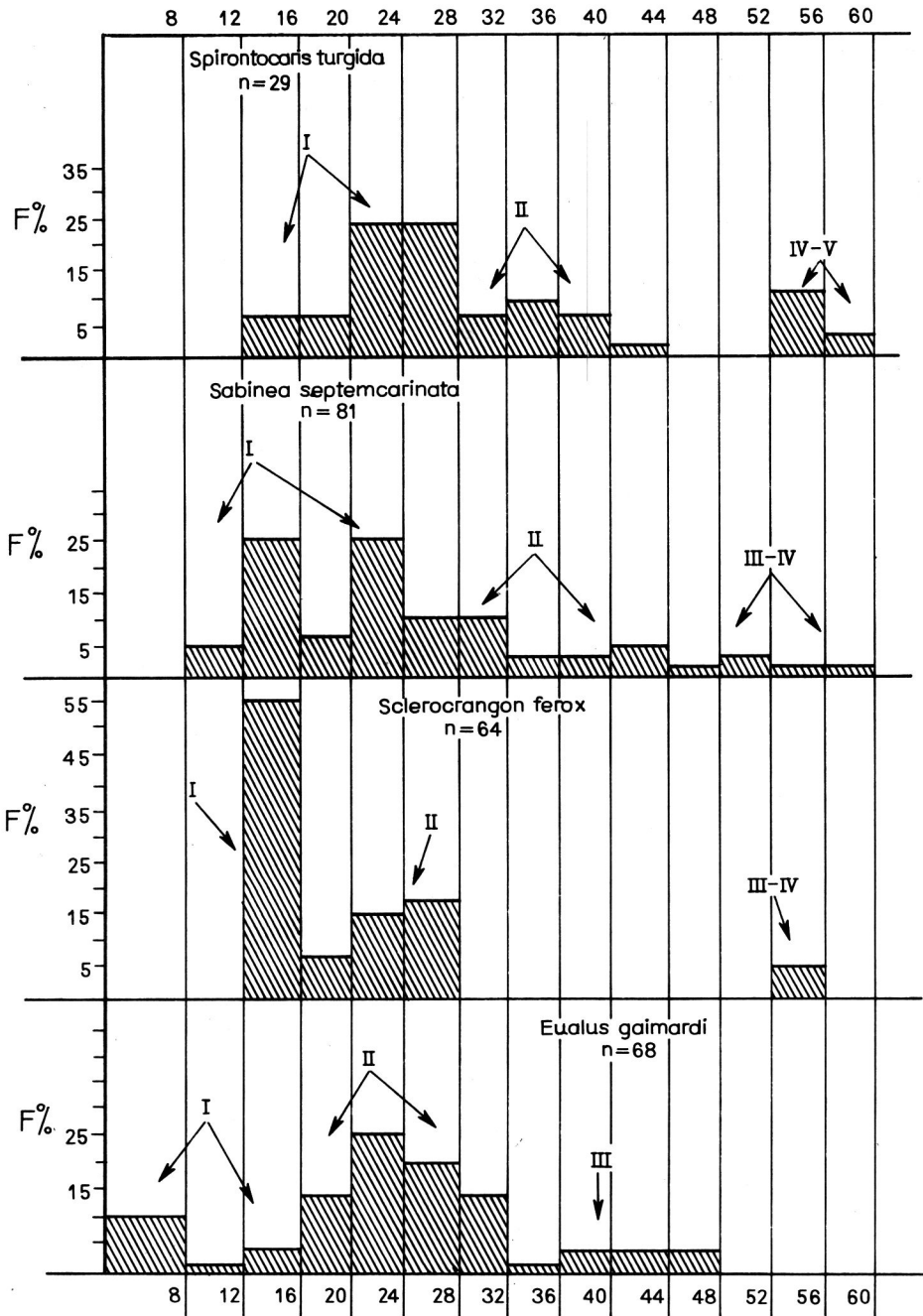


Fig. 4. Length frequency of most common Hornsund decapods. All data from August 1984. Arrows with Roman number indicate age of the size group (in years). F %—frequency in percent; horizontal scale—length of specimens in mm; n—number of specimens

Sabinea sarsi and *Lithodes maja* supposed to be the indicators of the warming up to the Spitsbergen area (Blacker 1957) were not recorded in the investigated area at present, in contrast to the Arctic waters indicator — *Sclerocrangon ferox* inhabiting commonly innermost fiord basins.

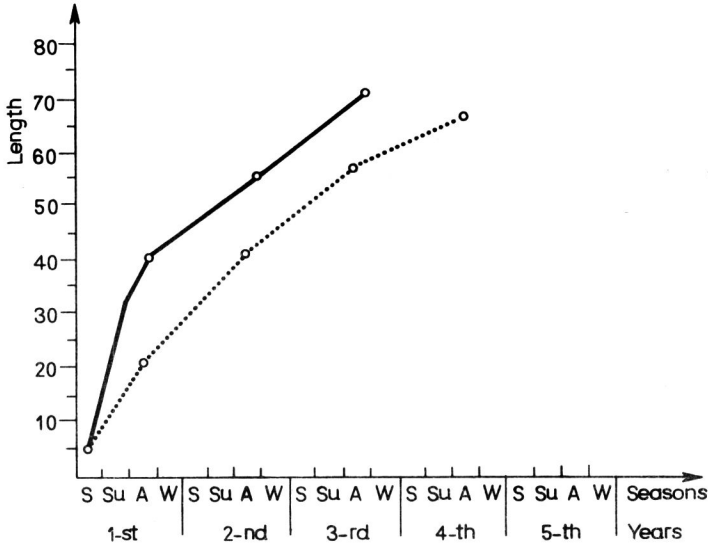


Fig. 5. Estimated growth of *Sabinea septemcarinata*; population from Franz Josef Land — data from Menšutkina (1977) — solid line; population from Hornsund — present work — dotted line; horizontal scale — length of specimens in mm; S — spring, Su — summer; A — Autumn; W — winter

Hyas coarctatus found in many localities along the West Spitsbergen shelf by Dyer (1985) was not recorded in Hornsund nor in other coastal areas both by M. Christiansen and B. O. Christiansen (1962) and by present author.

Above mentioned data confirm the opinion that Hornsund is a West Spitsbergen fiord of a relatively cold character in comparison to Isfjorden.

The data on the biology of decapods presented in this paper although based on rather scarce material can be compared with other studies. The biology of decapod crustaceans was studied in Barents and White Seas by Kuznecov (1964), Menšutkina (1977), Menšutkina and Čaban (1985). The life span and seasonality of breeding observed in Hornsund is similar to those reported by mentioned authors (Fig. 5). *Sabinea septemcarinata* and *Eualus gaimardi* populations from three different regions exhibited different length/weight relationships (Tab. 3, Fig. 5). Both species are of 3—4 years life span, but the weight increase is slower for Hornsund population of *S. septemcarinata* compared to those of White Sea and Franz Josef Land (Fig. 5). In contrast, *Eualus gaimardi*

in Hornsund grows faster than White Sea population (Tab. 3). Since all data considered are based on scarce materials any further hypothesis requires further studies.

The breeding parameters found for few females with brood pouches are comparable with data for other cold water species (Clarke 1979). Number of eggs and their size as well as the reproductive effort is similar for examined species, which seems to represent typical K-breeding strategy (large yolky eggs of relatively low number). Such a tendency typical for cold water marine animals (Thorson 1953, Dunbar 1968, Clarke 1979) seems to be changeable during the animal life—as does (suggest an example of females of *E. gaimardi* of different size (Tab. 2). With the increasing body volume of female from one year to another a significant increase in eggs diameter was observed with decreasing number of eggs laid. This would suggest an increasing tendency to K-strategy with an increasing age of the animal.

The comparison of species presented in Tab. 2 suggests that *E. pubescens* is the only species representing r-breeding strategy (numerous small eggs, faster development). The presence of small larvae of *E. pubescens* in early spring plankton in comparison with large larvae of Hippolytidae occurring in summer plankton would confirm this supposition. Similarly among Hornsund Amphipoda the only r-strategy breeding species was

Table 3

Coefficients of the length-weight relationship ($W = a \cdot L^b$) for different populations of Arctic decapods. W = weight (mg); L = length (mm); a, b = coefficients; n = number of specimens examined

Species	a	b	n	locality	author
<i>Sabinea septemcarinata</i>	0.00489	3.243	79	Hornsund	present data
	0.0063	3.04		Franz Josef Land	Menšutkina (1977)
	0.046	2.35		White Sea	Menšutkina and Čaban (1980)
<i>Eualus gaimardi</i>	0.00856	2.995	106	Hornsund	present data
	0.061	2.64		White Sea	Menšutkina and Čaban (1980)
<i>Lebbeus polaris</i>	0.01	2.89		Franz Josef Land	Menšutkina (1977)
	0.026	2.18		White Sea	Menšutkina and Čaban (1980)
<i>Spirontocaris turgida</i>	0.078	3.169	20	Hornsund	present data
<i>Sclerocrangon ferox</i>	0.0184	2.998	62	Hornsund	present data
<i>Spirontocaris spinus</i>	0.039	2.41		White Sea	Menšutkina and Čaban (1980)
<i>Sclerocrangon boreas</i>	0.097	3.15		White Sea	Menšutkina and Čaban (1980)

Hyperoche medusarum — a pelagic species (Węśławski, unpubl. data).

In conclusion: Decapoda found in Hornsund belong to the well known and common species noted previously for this area and common in the whole Spitsbergen region. Most of them represent wide ecological valency with regard to habitat. The species recorded belong to three main groups: cold water Arctic species inhabiting innermost fiord basins (*Sclerocrangon ferox*). Atlantic water forms distributed in outer fiord parts and along the SW Spitsbergen coast (*Sclerocrangon boreas*, *Pandalus borealis*) and wide tolerant subarctic species distributed commonly all over the investigated area (*Eualus gaimardi*, *Hyas araneus*, *Eupagurus pubescens*, *Sabinea septemcarinata*, *Lebbeus polaris*, *Spirontocaris spinus*, *S. turgida*).

As was estimated from the obtained material *E. gaimardi*, *S. turgida*, *S. septemcarinata* and *S. ferox* live up to 4—6 years, breeding for the first time in the 3-rd year of life and represent a K-breeding strategy.

The author is greatly indebted to doc. dr hab. E. Styczyńska-Jurewicz, dr K. W. Opaliński and doc. dr hab. K. Jazdźewski for their valuable comments and critical reading of the manuscript.

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Received October 10, 1986

Revised and accepted January 15, 1987

Streszczenie

W wodach przybrzeżnych Południowego Spitsbergenu (Rys. 1) zebrano w latach 1977—1985 próby fauny dennej, w których oznaczono 10 gatunków skorupiaków dziesięcionogich. Przedstawiono ich preferencje głębokościowe (Rys. 2) oraz rozmieszczenie w badanym akwenu (Rys. 3). Najliczniejszymi gatunkami są *Eualus gaimardi* i *Sabinea septemcarinata* występujące w całym badanym rejonie. Badane gatunki składają jaja późnym latem, wczesną wiosną następnego roku następuje wylęg pelagicznych larw, które obserwowane są w planktonie od kwietnia do września (Rys. 4, Tab. 1). Dane dotyczące płodności niektórych gatunków zestawiono w Tab. 2.

Obserwowane gatunki należą do trzech różnych grup zoogeograficznych:

— zimnolubnych form arktycznych — *Sclerocrangon ferox*.

- względnie ciepłolubnych gatunków borealnych — *Pandalus borealis*, *Sclerocrangon boreas*,
- najliczniejszej grupy gatunków subarktycznych — *Eualus gaimardi*, *Spirontocaris spinus*,
Spirontocaris turgida, *Lebbeus polaris*, *Hyas araneus*, *Eupagurus pubescens*.

Większość badanych gatunków żyje w wodach Hornsundu 4—5 lat, osiągając dojrzałość płciową w 3 roku życia. Ich wzrost wydaje się być powolniejszy w porównaniu z populacjami Morza Białego (Tab. 3).