Vital role of drift algae in the life history of the pelagic harpacticoid *Parathalestris croni* in the northern North Atlantic

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Abstract. The harpacticoid copepod *Parathalestris croni*, a widespread pelagic species of the northern North Atlantic, was found to be closely associated with seaweed originating in the intertidal zone floating on the surface of the sea around Iceland. The abundance of the copepod increased with distance from the shore and it showed a special affinity for the brown alga *Ascophyllum nodosum*. The copepods in the macroalgal clumps were mostly ovigerous females, and the seaweed clearly serves a nest function. The eggs were deposited on the seaweed where the nauplii, which are unable to swim, crawl on the algae until they metamorphose into the first copepodite stage (CI). The CI copepodites leave the floating weed, and the juvenile stages may eventually disperse widely in the water column until floating weed is colonized, probably by adults or juveniles in the last one or two copepodite stages. *Parathalestris croni* is one of a group of very few species known or suspected to be dependent for survival on the extremely unpredictable habitat of floating weed in the northern North Atlantic.

Introduction

Harpacticoids (Crustacea: Copepoda) are primarily benthic animals, but a total of 17 harpacticoid species belonging to seven families are regarded as true planktonic forms in the north-eastern Atlantic Ocean (Boxshall, 1979). Most of these species belong to families whose members are all planktonic and to two genera within the family Tisbidae. Isolated members of other families (four species) have secondarily invaded the pelagic zone (Huys and Boxshall, 1991), and *Parathalestris croni* (Krøyer) is the only pelagic member of the family Thalestridae. Many other harpacticoids have been recorded from the plankton, but they have usually been found in the neritic zone and can be regarded as temporarily displaced littoral forms (Wells, 1970a). Littoral harpacticoid species have also been brought into oceanic waters by drifting algae (Yeatman, 1962).

Parathalestris croni is among the largest harpacticoids (females 2.8–4.2 mm, males 2.7–3.3 mm, including furca). It has a wide distribution in the North Atlantic north of 42°N, which extends up to northern Norway and Svalbard (Lang, 1948; Wells, 1970a). Records of the species are scarce in spite of its wide distribution and it is only occasionally found in continuous plankton recorders (Edinburgh Oceanographic Laboratory, 1973). Records from the continuous recorders show that it can be found in mid-ocean as well as in coastal waters. Almost nothing is known about its ecology. A female with eggs was obtained near Greenland in July (Lang, 1948), and Wells (1970a) notes that the species is often associated with floating seaweed, without giving further particulars or references. *Parathalestris croni* has also been recorded from stomachs of the fish *Alosa spadissima* (Willey, 1923) and *Sebastes marinus* (Steele, 1957). The only benthic record of the species known to us is that of Wells (1970b) from muddy sand at 26 m in the Isles of Scilly.

Large numbers of *P.croni* were noted in association with seaweed during a study

of macroalgae originating in the intertidal and floating on the surface of the sea around Iceland (Ingólfsson, 1995). This prompted a further study of the association of the species with floating weed and an attempt to elucidate its life cycle.

Method

Floating seaweed was collected with a zooplankton net (ring diameter 0.465 m, mesh size 0.1 mm) from around Iceland as follows, in chronological order (Table I, Figure 1). (A) Seven clumps were taken off the coast of north-western Iceland, on 8 July 1990. (B) Thirteen clumps were taken in the Bay of Faxaflói, western Iceland on 6 June 1991. (C) Six clumps were taken off south-western Iceland, just outside the Bay of Faxaflói, on 10 June 1991. (D) Fifteen clumps were taken off northern Iceland on 4–8 July 1992 . (E) In all, 130 clumps were taken in the Bay of Faxaflói on 25 May 1993 (55 clumps), 7 July 1993 (35 clumps) and 6 August 1993 (40 clumps). In addition, a total of 41 control samples were taken on these dates, where the plankton net was manipulated as when collecting clumps, but in a weed-free area, thus filtering a similar volume of surface water. A survey was additionally conducted on 18 October 1992; however, no clumps were located. (F) Five clumps were taken off the coast of north-western Iceland on 11–13 July 1993.

The plankton net was dipped under each clump and hauled up in one quick sweep whenever possible. The net was then emptied into a bucket with seawater and the contents preserved in 4% formaldehyde. Usually, every clump encountered was collected (small fragments were, however, ignored). However, when clumps were numerous within a small area, collecting in that area was discontinued after obtaining 5–10 clumps. When collecting from Håkon Mosby (samples D and F), only a few of the clumps seen could be retrieved due to the limited

Table I. Summary of sampling programme around Iceland

| Area	Date	Map designation (Figure 1)	Distance from shore (km)	Number of samples
Floating weed				
South-west	1991 June	C	0.9–1.8	6
Faxaflói	1991 June	B	0.9–16.7	13
Faxaflói	1993 May	E	0.2–30	55 + 13 control samples
Faxaflói	1993 July	E	0.2–30	35 + 15 control samples
Faxaflói	1993 August	E	0.2–30	40 + 13 control samples
North-west	1990 July	A	4.1–5.9	7
North-west	1993 July	F	34 –53	5
North	1992 July	D	58 –117	15
Bongo hauls				
Faxaflói	1991 April		47 –50	2
Faxaflói	1992 June		50	1
North	1993 February		63 –167	3
North	1993 April		11 –130	4
North	1993 October		11	1
North	1993 November		41	1
North	1994 February		41 –63	2
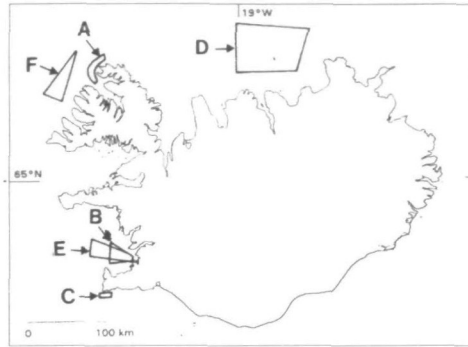
Fig. 1. Sampling areas of seaweed clumps around Iceland, 1990–1993 (cf. Table I).

manoeuvrability of the ship. In the laboratory, the algae were thoroughly rinsed in water, identified and weighed wet. The liquid used for rinsing was then usually sieved through two sets of sieves (0.5 and 0.063 mm) and the animals retained placed in a 70% isopropanol or ethanol solution. However, for samples A, B, C and D, 0.5 mm sieves only were used. A selection of 30, 0.063 mm fractions were examined from algal clumps taken in Faxaflói in 1993, i.e. 10 from each sampling month, as well as 33 such fractions from Faxaflói control water samples.

Plankton samples (oblique Bongo net hauls, usually from 0 to 100 m, 0.3 mm mesh) taken off northern Iceland in February, April, October and November 1993, and February 1994, and off the Bay of Faxaflói in April 1991 and June 1992 (Table I), were scanned for *P.croni*.

Parathalestris croni individuals from the 0.5 mm sieve fractions were classified as non-ovigerous females, ovigerous females, males and copepodites under a dissecting microscope. The presence of spermatophores on females and the numbers of eggs per egg sac were analysed under a high-power compound microscope. The 0.063 mm fractions were examined for *P.croni* nauplii and copepodites under a dissecting microscope. Nauplius larvae were transferred to anhydrous glycerol, mounted on microslides and the naupliar stage estimated for each individual under a high-power compound microscope. Prior to this analysis, naupliar developmental stages were examined from *P.croni* cultures so that *P.croni* nauplii found on floating weed could be distinguished from other nauplii and classified into developmental stages.

On 29 June 1995, weed clumps were taken in the Bay of Faxaflói and transported in seawater to the laboratory for the study of live animals. One *Ascophyllum nodosum* clump with abundant ovigerous females as well as nauplii was kept in a bucket in Faxaflói seawater in the refrigerator at 8–9°C and inspected regularly. Copepodites were sampled from the bucket (using a Petri dish) at approximately weekly intervals for 17 weeks. After 17 weeks, very few copepodites were still alive. Ovigerous females from this clump were transferred on 5 July to four Petri dishes (2–3 females per dish) containing small pieces of *A.nodosum* taken high on the shore. The Petri dishes were inspected and larval stages sampled

17

approximately every second day for 4 weeks, by which time the cultures had become weak.

Pearson correlation tests have been used unless otherwise stated. Numbers and densities of *P.croni* have been log transformed in all correlation tests.

Results

Occurrence

The results are given separately for the Faxaflói region (samples B, C, E and G) and for north-western and northern Iceland (samples A, D and F).

Faxaflói and south-west Iceland. Only one *P.croni* was found in 19 samples of floating weed taken in the Faxaflói region and off south-western Iceland in June 1991 (samples B and C) (Table II). However, *P.croni* was common in samples E taken in 1993 on 25 May and 7 July, but scarce on 6 August (Table II). A *t*-test did not indicate a difference between densities (numbers per 100 g of algae) in the May and July samples. In May and July, the mean number of copepods caught per sample of floating weed (not included in Table II) was 7.28 (SE = 1.91, N = 90), whereas 28 control samples (i.e. samples not intentionally including floating weed) during these months yielded a total of four copepods (mean = 0.14 copepods per sample, SE = 0.07). In August, the mean number of copepods per clump was only 0.2, while no copepods were found in 13 control samples taken at that time.

In the Bay of Faxaflói (samples E), the density of *P.croni* increased significantly with distance from the nearest shore (May plus July samples: r = 0.48, N = 90, P < 0.001) (Figure 2). The relationship was also significant when May and July samples were treated separately. The mean density in 22 samples taken in May and July at a distance of 25–30 km from the shore was 15.7 animals per 100 g of algae (SE = 3.55), while for 16 samples taken within 5 km of the shore the mean was 1.4 (SE = 1.16).

The number of *P.croni* per algal clump (May plus July samples) was significantly correlated with the weight of the clump in Spearman rank correlations tests (r = 0.24, N = 90, P < 0.02), but not in Pearson correlations (Figure 3). There was no consistent indication of a correlation between the density (number per 100 g of

Table II. Frequencies (percentages of clumps) and densities (numbers per 100 g of algae) of *P.croni* in floating clumps of seaweed around Iceland

	N	Frequency (%)	Density mean ± SE	Range
South-west, June 1991	6	17	<0.01	
Faxaflói, June 1991	13	0	0	
Faxaflói, May 1993	55	58	6.5 ± 1.7	0–69.0
Faxaflói, July 1993	35	72	4.1 ± 1.1	0–28.2
Faxaflói, August 1993	40	7	0.02	0–0.5
North-west, July 1990	7	100	62.2 ± 15.6	17.8–140.0
North, July 1992	15	100	138.9 ± 33.2	12.7–454.5
North-west, July 1993	5	100	74.7 ± 63.3	1.0–327.5
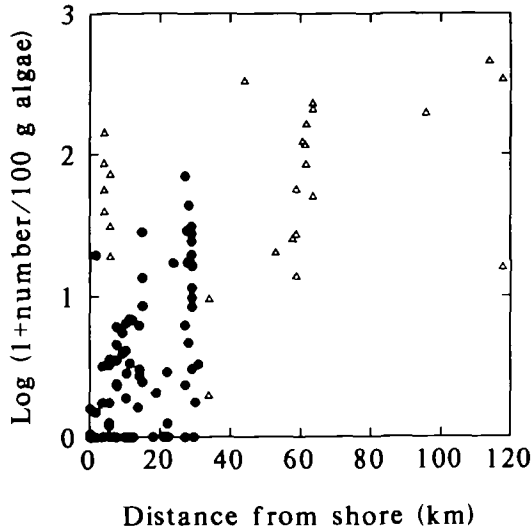
Fig. 2. Densities of *P.croni* (numbers per 100 g of algae) in algal clumps at varying distances from the nearest shore. Data are shown separately for the Bay of Faxaflói (May and July 1993) (•) and for the north and north-west (July 1990, July 1992 and July 1993) (△).
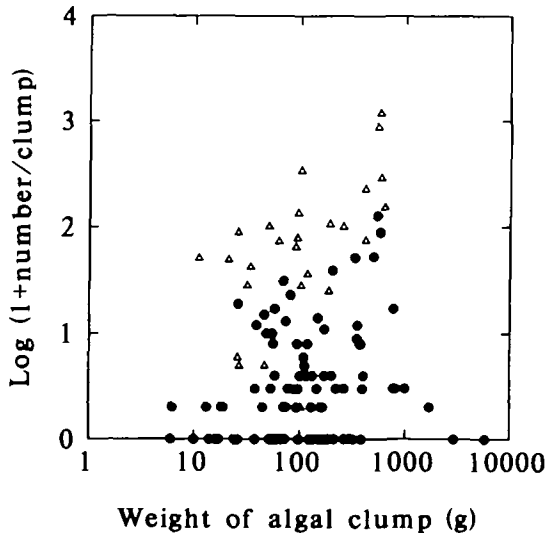
Fig. 3. The numbers of *P.croni* in algal clumps in relation to the wet weight of algal clumps. Data are shown separately for the Bay of Faxaflói (May and July 1993) (•) and for the north and north-west (July 1990, July 1992 and July 1993) (△).

algae) of *P.croni* and the weight of clump. There was a significant correlation between numbers of *P.croni* and weight of the alga *A.nodosum* ($r = 0.24$, $N = 90$, $P < 0.05$), which constituted 35.6% of total algal weight of the clumps, but the

19

correlation was non-significant with the weight of the other main constituents, i.e. *Fucus vesiculosus* (35.7% of total algal weight), green filamentous algae (18.0%), *Fucus distichus* (4.7%) and *Chorda filum* (2.2%). The correlation with *A.nodosum* becomes more marked in partial correlation with the total weight of algal clump kept constant ($r = 0.40$, $P < 0.001$). When the weight of *A.nodosum* is kept constant, the correlation between *P.croni* and the weight of the clump becomes significantly negative ($r = -0.33$, $P < 0.01$). The correlation was then also negative with the weight of the major constituent *F.vesiculosus* ($r = -0.27$, $P < 0.01$). Nevertheless, *P.croni* was found in a number of clumps in which *F.vesiculosus* was the only constituent. When samples closer than 10 km from the shore were omitted, the numbers of *P.croni* were also positively correlated with weight of *Polysiphonia lanosa* ($r = 0.36$, $N = 52$, $P < 0.01$), an epiphyte of *A.nodosum*. This correlation remains significant in partial correlation tests when the total weight of algae and the weight of *A.nodosum* were kept constant.

Numerous other animal species were identified from the seaweed clumps. When searching for correlations between the density of *P.croni* and the density of other species in the May and July samples, no instance of significant correlation was found. When samples taken closer than 10 km from the shore were omitted, however, a significant negative correlation appears with the density of the predatory fry of the fish *Cyclopterus lumpus* (log-transformed data) ($r = -0.31$, $N = 52$, $P < 0.05$).

North and north-west Iceland. Only samples from July are available, taken in 3 years (samples A, D and F). *Parathalestris croni* was recorded from all 27 algal clumps examined. The density (number per 100 g of algae) was found to be much higher than in the Faxaflói samples (Table II), with a mean of 107.1 (SE = 22.6) for all 27 clumps.

Density was positively correlated with distance from shore in Spearman rank correlations when the 15 clumps taken in July 1992 were considered ($r = 0.56$, $P < 0.05$), but not quite so when analysing all 27 clumps ($r = 0.26$, $0.1 > P > 0.05$). Pearson correlations were non-significant.

The number of *P.croni* per clump was significantly correlated with weight of the clump when samples were lumped ($r = 0.62$, $N = 27$, $P = 0.001$) (Figure 3), while density was not. The correlation was still significant when only the 15 samples taken in July 1992 were considered ($r = 0.75$, $P = 0.001$). The following algae were the major components of the clumps: *A.nodosum* (56.0% of total), *F.distichus* (23.5%) and *F.vesiculosus* (19.6%). Numbers of *P.croni* were found to be significantly correlated with weight of *A.nodosum* when all 27 samples were considered ($r = 0.64$, $P < 0.001$), but not with the other constituents. The correlation with *A.nodosum* was not quite significant in partial correlation keeping the total weight of algal clumps constant ($r = 0.35$, $0.1 > P > 0.05$), whereas the correlation with total weight of the clump became definitely non-significant in such tests when *A.nodosum* was kept constant ($r = 0.26$, $P >> 0.05$).

No correlation was found between the density of *P.croni* and the density of other animal species in these samples. In six of the 27 clumps examined, *P.croni* was the only macrofauna present.

0.063 mm fractions

No *P.croni* copepodites were found in the 30 algal clumps examined from the Bay of Faxaflói, whereas one of the 33 water samples, from July, contained ~50 copepods in the first copepodite stage (CI). *Parathalestris croni* nauplii were found both in the May and July samples, while they were absent in the August samples. On 6 May, 10 algal clump samples contained nauplii, all belonging to one of the first three naupliar stages of *P.croni*. Four of the 10 samples from July had *P.croni* nauplii, most belonging to the fourth naupliar stage, with a few in the third and fifth stages. No larvae examined were at the last (sixth) naupliar stage.

Observations of live animals

Adult *P.croni* moved around a great deal in the weed clumps. They attached themselves to the weed primarily by the big claw on the maxillipeds, but also used the first two pairs of legs (thoracopods). They sometimes crawled in an ungainly fashion, but more frequently swam. They are easily induced to leave the macroalgal clump by disturbing the weed. They swam rapidly with small jerks, keeping their long furca almost parallel. Periodically, they stopped their swimming motions and spread their furca so they were almost perpendicular to each other and extended their swimming legs directly outwards from the body. When motionless, the animals sank quite rapidly. The copepods were clearly photophobic and tended to attach to the algae in the shade, away from a bright light.

Parathalestris croni eggs were attached to the algae singly or in loose groups. They were easily detached. Eggs laid in the refrigerator (8–9°C) hatched into nauplii within 5 days. These crawl on the algae and are in constant motion from the time they hatch. They became swifter in their movements as they developed and were reminiscent of mites. The nauplii never swam, and individuals that were dislodged sank. The *P.croni* nauplii in the refrigerator metamorphosed into swimming copepodites 15–18 days after they hatched from the eggs.

Many nauplii present on the *A.nodosum* clump retrieved from the sea metamorphosed into copepodites while stored in the refrigerator and the following is based on observations of these. The nauplius exoskeleton appeared to remain attached to the algae after metamorphosis. The copepodites (CI) did not remain attached to the weed, but swam around in the bucket. However, the copepodites did sometimes attach themselves to the alga when it was encountered and crawled along the surface more adeptly than the adults. The copepodites swam well but remained motionless for prolonged periods and then sank. The CI copepodites were initially positively phototactic and swam towards a bright light. After ~20 days, however, they no longer oriented with respect to light. CII individuals were first noted in numbers ~40 days after the first CI copepodites appeared and CIII copepodites started to appear after approximately a further 35 days. No CIV stages appeared in the culture. The CII and CIII copepodites did not apparently differ in their behaviour from the CI larvae, and no affinity for algae was noted.

21

Population structure

The algal clumps were dominated by female *P.croni*, regardless of time or area sampled (Table III). In the Bay of Faxaflói, the proportion of ovigerous females increased from 25% of the population in May to 43% in July. A high proportion of ovigerous females was also noted in July samples from other areas (Table III). Excluding samples from Faxaflói taken in August, the proportion of males in the clumps varied from 3 to 24% of the total numbers. Copepodites were only found in samples from Faxaflói in May, comprising 4% of the total numbers. These were either at the last or the penultimate (CIV or CV) copepodite stage.

Three Bongo plankton samples from Faxaflói taken in April 1991 and June 1992 contained 19 individuals of *P.croni* with a very similar sex ratio to individuals in the weed samples from 1993, i.e. the majority being females (Table IV). However, none of these females were carrying egg sacs. The four individuals found in control water samples taken in May and June 1993 in Faxaflói were all non-ovigerous females. The Bongo net plankton samples from the northern area contained 24 individuals of *P.croni*; 19 (79%) were males, while 5 (21%) were non-ovigerous females (Table IV).

Most females in the drifting clumps had attached spermatophores, as did females in the water from spring and summer months. However, of the five females recorded from the water in winter, three were without spermatophores.

The average number of eggs per egg sac was 156 ($n = 5$; range 128–203).

Discussion

Adults of the copepod *P.croni* are much more common in seaweed clumps than free in the water during summer off the coast of Iceland, and their numbers are positively correlated with the size of clumps. The high ratio of females, especially ovigerous females, in the clumps is consistent with the hypothesis that the clumps have a nest function for these harpacticoids. *Parathalestris croni* nauplii are unable to swim, as is true of all Thalastridae species and most benthic and phytal

Table III. Percentages of females, ovigerous females, males and juveniles (CIV + CV copepodites) of *P.croni* from algal clumps from three areas around Iceland (*N*, number of individuals examined)

	Total females	Ovigerous females	Males	Juveniles	*N*
Bay of Faxaflói					
May 1993	93	25	3	4	539
July 1993	90	43	10	0	99
August 1993	100	29	0	0	7
North-west					
July 1990	87	42	13	0	116
July 1993	76	40	24	0	336
North					
July 1992	95	42	5	0	309
Total	89	35	10	2	1406

Table IV. Numbers and percentages of males and females of *P.croni* in Bongo plankton hauls from two areas off Iceland

	Number of hauls	Males	Females	Total
Bay of Faxaflói				
April 1991	2	2	15	17
June 1992	1	0	2	2
Total percentages			11	89
North				
February 1993	3	10	3	13
April 1993	4	4	1	5
October 1993	1	1	0	1
November 1993	1	1	0	1
February 1994	2	3	1	4
Total percentages			79	21

harpacticoid species (H.-U.Dahms, personal communication). The clumps obviously provide the necessary substrate for the development of naupliar stages.

The data indicate that *P.croni* show a special affinity for the brown alga *A.nodosum*, a major constituent of floating weed clumps. However, these copepods are by no means confined to clumps containing *A.nodosum*. This affinity could be due in part to the frequent presence of the red epiphyte *Polysiphonia lanosa* on *A.nodosum*. The intricate structure of this epiphyte may provide the nauplii with an especially well-suited substrate, and the adults may find it easier to cling to the epiphyte than to the smoother brown seaweed itself.

Parathalestris croni is uncommon near coasts, and the abundance data invariably indicate an increase in density with distance from land, and presumably with increase in floating time of clumps from the intertidal zone. The very high density of *P.croni* in clumps off north-western and northern coasts may be the result of longer floating times of clumps in that region than in the Bay of Faxaflói region. Consideration of the clockwise coastal current system around Iceland makes it likely that clumps off northern Iceland often originate from the distant shores of western Iceland (Ingólfsson, 1995). Seaweed-covered shores are, however, scarce in an anti-clockwise direction from the Bay of Faxaflói (Ingólfsson, 1975), and clumps afloat there probably originate mostly from adjacent shores. Probabilities of copepods locating a clump of algae will increase with the time the clump is afloat. In addition, both the microflora and fauna of the algal clumps change markedly with time afloat, which may alter living conditions for *P.croni*.

Data from the Bay of Faxaflói indicate that adult *P.croni* leave the floating algal clumps in the autumn after a peak abundance of ovigerous females in July. Observations of live cultures show that juveniles leave the algal clumps in the first copepodite stage as soon as they hatch from the nauplius. This is consistent with the complete absence of the first copepodite stages (CI–CIII) from clumps and the presence of CI copepodites in a water sample from July. Presumably, the juvenile stages develop in the water mass during autumn and winter. As the CI

copepodites do not react to light after some time in the water, they may disperse widely in the water column. It is plausible that they behave in similar fashion to many calanoid species by migrating to deep waters during winter (e.g. Schnack-Schiel and Mizdalski, 1994). The ability to locate weed clumps later in life appears quite remarkable, but may be aided by the shadow-seeking tendencies observed in adult copepods. We observed no copepods in precopula, but hypothesize that copulation occurs in the water column with females in the last copepodite stages (copulation stage). This hypothesis is supported by the observation that these females were rare in the algal clumps. It is also quite likely that this species has a life cycle longer than 1 year, as adults were found in the water mass during all seasons. It is interesting to note that all females recorded in the water column were without egg sacs, which gives further evidence of the nest function of the algal clumps.

A somewhat similar pattern has been observed in the pelagic harpacticoid *Macrosetella gracilis*. This species is closely associated with the epipelagic filamentous cyanobacteria *Trichodesmium (Oscillatoria)* spp. which serve as food for adults (Roman, 1978) and substrate for the non-pelagic juveniles (Björnberg, 1965). Böttger-Schnack and Schnack (1989) came to the conclusion that reproduction occurs only in the surface water during blooms of *Trichodesmium* when the nauplii can find a substrate. Indeed, the nauplii are highly adapted to clinging on filaments of cyanobacteria (Figure 4A) (Dahms, 1990). This species belongs to the family Miraciidae in which all four members are planktonic.

Parathalestris croni is the only pelagic species of the large family Thalestridae. Other members of the family are either benthic or phytal in habitat (Lang, 1948). It therefore seems probable that the species has secondarily invaded the pelagic zone, and the dependency of the naupliar stages on floating substrates may reflect the life habits of its ancestors. The *P.croni* adults are much bigger than ordinary *Parathalestris* species (Figure 5A and B) and have developed long furca, an adaptation to float (Figure 5A). However, they have kept the massive claw on the maxillipeds (Figure 5D) and the strongly prehensile first swimming legs (Figure 5C), adaptations for grasping the substrate. The structure of the *P.croni* nauplii (Figure 4A) is very similar to that of other nauplii of *Parathalestris* (cf. Dahms, 1990), showing no signs of adaptation to a pelagic mode of life. However, three other harpacticoid species (*Microsetella norvegica*, *M.rosea* and *Euterpina acutifrons*) that have secondarily invaded the pelagic zone have nauplius larvae with long appendages and setae (Figure 4B and C), adaptations for swimming.

We know of only one previous study where floating seaweed has been studied for the presence of harpacticoid copepods. Yeatman (1962) examined floating *Sargassum* on a transect across the North Atlantic between ~36 and 38°N. Several littoral harpacticoids were identified, however not *P.croni*.

Floating seaweed is an unpredictable habitat. The clumped dispersion of the weed is obvious (Ingólfsson, 1995), and the present study shows large variations in the amount of floating weed in the Bay of Faxaflói region. Not surprisingly, therefore, the densities of *P.croni* in clumps are very variable. The variability noted included differences between years (Faxaflói 1991 and 1993) and between regions (Faxaflói and North Iceland).

24
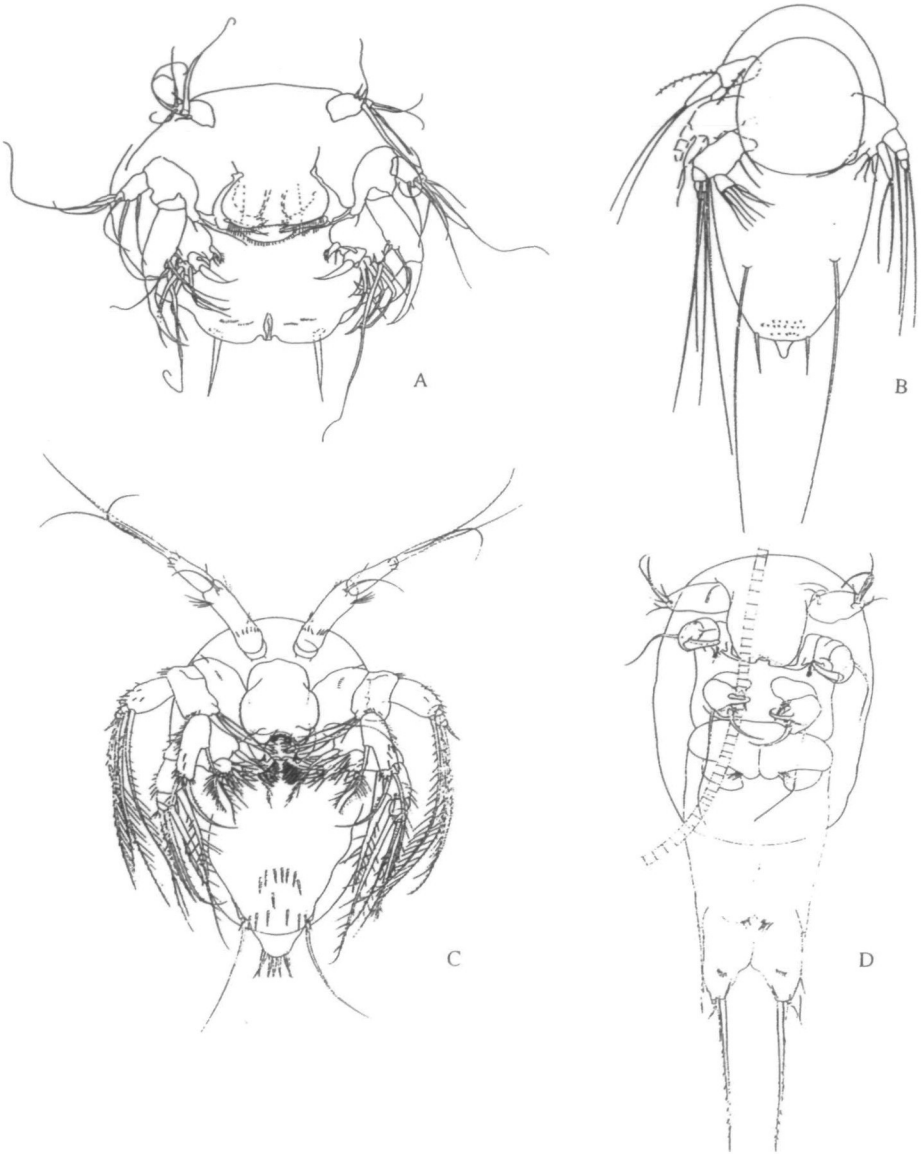
Fig. 4. Nauplius larvae of *P.croni* (**A**), *Microsetella norvegica* (**B**) (after Diaz and Evans, 1983), *Euterpina acutifrons* (**C**) (after Dahms, 1990) and *Macrosetella gracilis* (**D**) with trichome of the cyanobacterium *Trichodesmium* spp. (after Dahms, 1990).

Very few animal species appear to be associated in an obligate or semi-obligate fashion with floating seaweed in the northern North Atlantic. Only two additional species are known that seem to have adapted to such a degree to this unpredictable habitat. One is the lumpsucker (*Cyclopterus lumpus*), the fry of which obviously seek out patches or clumps of floating weed, where their density is much
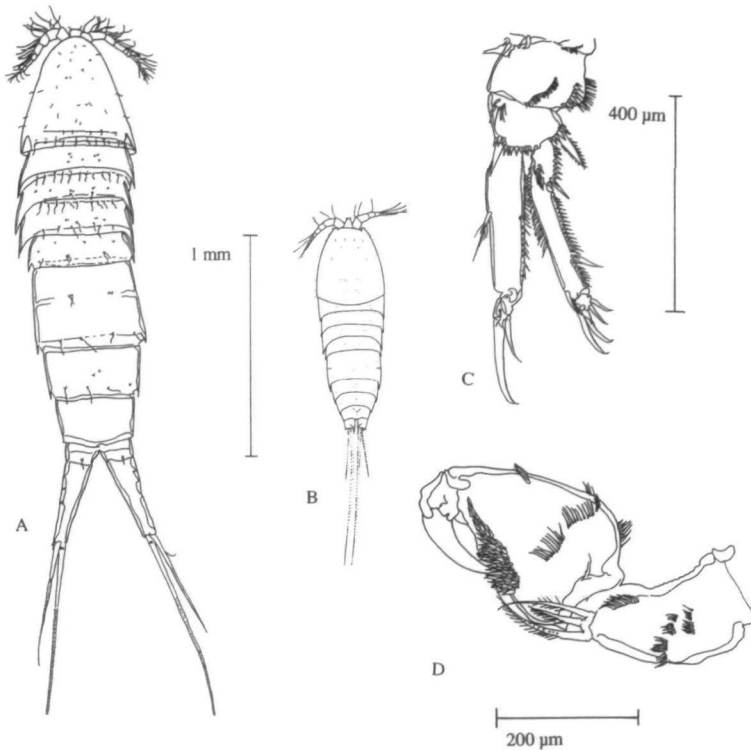
Fig. 5. *Parathalestris croni* adult female (**A**), *Parathalestris plumiseta* adult female (**B**) (after Moore, 1976), first leg of *P.croni* (**C**), maxilliped of *P.croni* (**D**).

greater than in the water mass (Tully and Ó Céidigh, 1989; Davenport and Rees, 1993; Ingólfsson, 1995). The fry are known to prey on adult *P.croni* as well as on other animals found in the clumps (B.K.Kristjánsson, personal communication). The other example is the isopod *Idotea metallica*. This species has a very wide distribution in the world oceans (Poore and Lew Ton, 1993), but is only a vagrant in the northern part of the North Atlantic (Naylor, 1957), and has not been recorded with certainty from Iceland. A few additional species, such as the amphipods *Gammarellus angulosus* and *Calliopius laeviusculus*, seek out floating clumps of weed, although they are more common in other habitats (Ingólfsson, 1995). Several obligate floating-weed inhabitants are, however, known from the Sargasso Sea in the south-western North Atlantic (e.g. Stoner and Greening, 1984) where floating weed is a much more extensive and predictable habitat.

Acknowledgements

this paper. The manuscript also improved significantly from comments by Dr H.-U.Dahms. The constructive comments of two anonymous reviewers are acknowledged with gratitude. We thank Dr Ó.S.Ástthórsson for placing Bongo samples from around Iceland at our disposal. We owe H.Pettersson, B.Kr.Kristjánsson and I.Agnarsson thanks for diligently sorting animals from weed samples.

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