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EPIZOITES ON *CANCER IRRORATUS* SAY FROM THE GULF OF ST. LAWRENCE

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Abundance and distribution of invertebrate macroepizoites on the rock crab *Cancer irroratus* Say from Northumberland Strait in the Southern Gulf of St. Lawrence are described.

A convenient 3-digit code was devised for recording 66 surface locations on the crabs. Ten categories of epizoites were defined and then counted on 6,145 *C. irroratus*. Only 5 species had previously been reported on this crab. Ectoprocts, hydroids, bivalves and tunicates were frequent, whereas spirorbids, barnacles, gastropods, amphipods, anemones and limpets were less so.

Fifty-three taxa were identified on a subsample of 7 crabs. Ectoprocts, coelenterates and polychaetes had the highest species diversity. Their microdistribution upon the crab shell was influenced by the occurrence of setae on the shell. Patches of setae influenced the microdistribution of epizoites by accumulating detritus and providing a substrate suitable for small motile species like polychaetes and mites, while inhibiting the growth of some sessile forms such as barnacles, hydroids and ectroprocts. The blue mussel *Mytilus edulis* and the ectoproct *Alcyonidium polyoum* were the only deleterious epizoites noted. Although more female (76%) than male (58%) crabs were host to 1 or more epizoite categories, individual males supported as many as 6 kinds of epizoites, whereas the maximum for females was 3.

The number of epizoites on the crab was largely determined by the moult stage of the host, and seasonal abundance patterns of the 4 dominant epizoite groups reflected the moulting periods of the host. Males grew larger than females, and larger crabs of both sexes supported more kinds of epizoites than did smaller crabs.

Introduction

The purpose of the present study was to identify the epizoites of *Cancer irroratus*, describe their microdistribution upon the shell, and determine the seasonal incidence of the 10 most common kinds of epizoites. The crabs were from the Northumberland Strait in the southern Gulf of St. Lawrence.

Crustacean shells support fouling organisms such as ectoprocts, barnacles, bivalves and tunicates (DeTurk 1940; Dexter 1955). Invertebrate epizoites have been used as indicators of moulting (Van Engel 1958; Butler 1961; Terretta 1973; Haefner 1976) since newly moulted animals are uncontaminated and become more colonized through the intermoult period. *Cancer irroratus*, because of its relatively large size, hard exoskeleton, and its accessible, current-generating branchial chamber (Pearse 1947), supports a diverse epifauna.

Terretta (1973) found only 5 species in branchial chambers and on the exterior of over 1800 *Cancer irroratus*, and Haefner (1976) also reported 5 in a similar study of 254 *C. irroratus*. Apart from Heath (1976), who described the distribution of *Balanus crenatus* on *Carcinus maenas* and *Cancer pagurus* in Wales, there have been no quantitative studies on the composition and comparative distribution of epibionts upon the exoskeleton of *Cancer* species.

Methods

A total of 6,145 *C. irroratus* were captured, mostly from May to October 1975, in lobster traps set at 9 stations in Northumberland Strait near St. Edouard-de-Kent, New Brunswick (Fig 1). Depth and bottom type were verified at the start of each sampling period using depth sounder and bottom grab (Stasko et al. 1977).

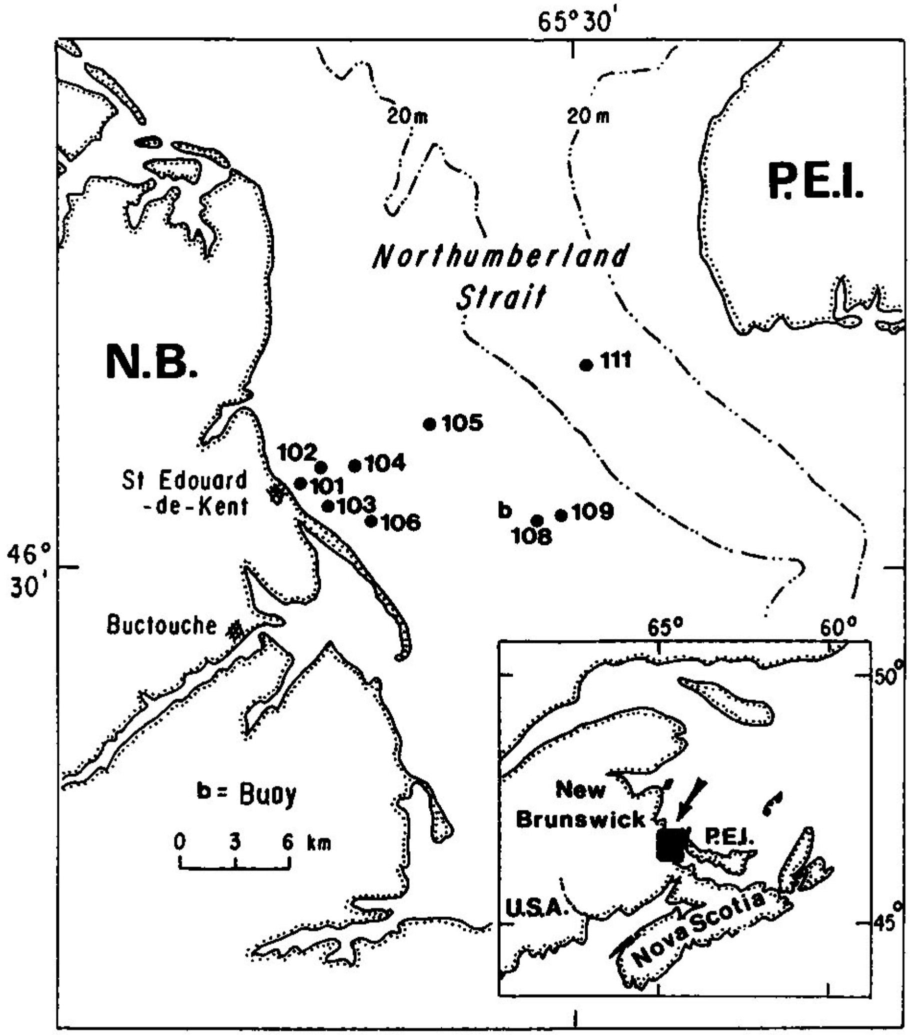

Fig 1. Location of sampling stations.

Crabs were preserved in 8% neutral formalin. Sex and carapace width were determined and intermoult stages were based on shell hardness determined by thumb pressure on the sub-branchial region, base of the legs, and telson (Haefner 1976). After a preliminary examination of approximately 50 crabs, 10 conspicuous epizoite categories were evident (Table I) and these were then used to assess epizoites on the sample of 6,145 crabs. Owing to their minute size and ubiquity, peritrichs, foraminifera, and diatoms, although usually present, were excluded from this analysis.

Seven large, hard-shelled crabs collected on May 26 were examined to determine the microdistribution of the overwintering epizoite species. A binocular microscope with ocular micrometer was used to examine the shells, and claws and legs were removed and examined individually.

Table I. List of 10 selected epizoite categories and their percent occurrence on 3,036 male and 3,109 female crabs.

Epizoite category	% Occurrence on males	% Occurrence on females
Ectoprocts	57.0	81.0
Tunicates	26.0	2.0
Hydroids	20.0	10.0
Bivalves	10.0	3.0
Limpets	1.0	1.0
Barnacles	0.5	0.7
Gastropods	0.5	0.4
Spirorbids	0.1	0.1
Amphipods	0.1	0.0
Anemones	0.1	0.0

Locations on the shell were defined by dividing the shell into 5 areas, each with 4 regions, and these in turn into 3 types of body surface. This generated a 3-digit code for all 66 potential locations (Table II; Fig 2), thus facilitating computer sorting and tabulation. Abundance, size, and location of epizoites were recorded and the epizoites removed and stored in 70% ethanol-5% glycerin for later identification.

Results

General Incidence of Epizoites

The mean widths of the 6,145 crabs examined (107 ± 10.6 mm for males and 84 ± 5.4 mm for females) are representative of commercial catches but not of the general population, due to selectivity of the traps (Stasko 1975).

Of the 10 selected epizoite categories (Table I), only the hydroids, ectoprocts, bivalves and tunicates were present on more than 2% of the crabs. The percent occurrence of these 4 epizoite categories (Fig 3) illustrates that ectoprocts were more common than hydroids, and these more so than bivalves. Tunicates ranked second to ectoprocts on males, but ranked lowest on females.

Seasonal abundance patterns of the 4 categories (Fig 4) show a rise in abundance of all 4 categories in late May followed by a decline in early June except for hydroids. From late June onward, for both males and females, ectoproct colonization increased and remained high. The percent occurrence of the other 3 categories remained stable except for an autumn peak of tunicates on male crabs.

Table II. Coding for designated locations on crab shells (also Fig 2). Each location was identified by 3 digits: area (1 to 5), region (1 to 4) and surface type subregion (0 to 2). For 7 crabs examined in detail, the total numbers of epizoite taxa, of the 53 identified, are recorded for each body location.

Area	Region		Number of Taxa/ Surface Type Subregion: 0 (Setae absent)	1 (Setae present)	2 (Indentation of surface)	Total Species/Area
1. Dorsal	1—	carapace	7	0	3	
	2—	eye socket	2	3	0	14
	3—	antenna	3	1	0	
	4—	antennule	1	1	0	
2. Claws	1—	shell portion of segments	24	13	1	
	2—	dactylus-propodus joint	6	9	0	28
	3—	other joints	14	12	1	
	4—	coxal-thorax joint	0	1	0	
3. Legs	1—	shell portion of segments	19	22	2	
	2—	dactylus-propodus joint	1	0	0	29
	3—	other joints	12	7	0	
	4—	coxal-thorax joint	0	3	0	
4. Branchial chamber	1—	sub-carapace	1	0	0	
	2—	gill	2	2	0	4
	3—	hepatopancreas septum	1	0	0	
	4—	epidoites	1	3	0	
5. Ventral	1—	third maxilliped and buccal cavity	4	5	0	
	2—	thoracic sterna and abdomen	4	3	0	33
	3—	sub-abdominal thoracic area	0	0	0	
	4—	sub-hepatic and sub-branchial area	12	33	3	

Fifty-eight percent of males and 76% of females supported at least 1 taxon from the 10 categories. Nearly half of the crabs without epizoites were soft-shelled animals that had recently moulted. Of the crabs with epizoites, over 90% were hard-shelled accounting for 70% of all males and 84% of females. The maximum number of epizoite categories on individual crabs was 3 for females and 6 for males; 3 males had 5 categories and only 1 male had 6.

Microdistribution of Epizoites

Seven crabs collected in late May were thoroughly examined to determine diversity and distribution of epizoite taxa. Fifty-three taxa were distinguished, of which 35 were identified to species and an additional 7 to genus (Table III). The 53 taxa colonized 41 of the 66 potential locations (Tables II & III). Ectoprocts, coelenterates and polychaetes were the three most important categories in terms of numbers of species. *Alcyonidium polyoum* was the most widespread organism, occurring at 27 locations and on every crab. *Mytilus edulis* was almost as abundant, occurring at 26 locations. More than half the epizoite taxa were found only at 1 or 2 locations and on 1 or 2 of the 7 crabs. The number of epizoite taxa per shell location is shown in Table II. Ventral areas, legs, and claws supported the most species. Location 5-4-1,

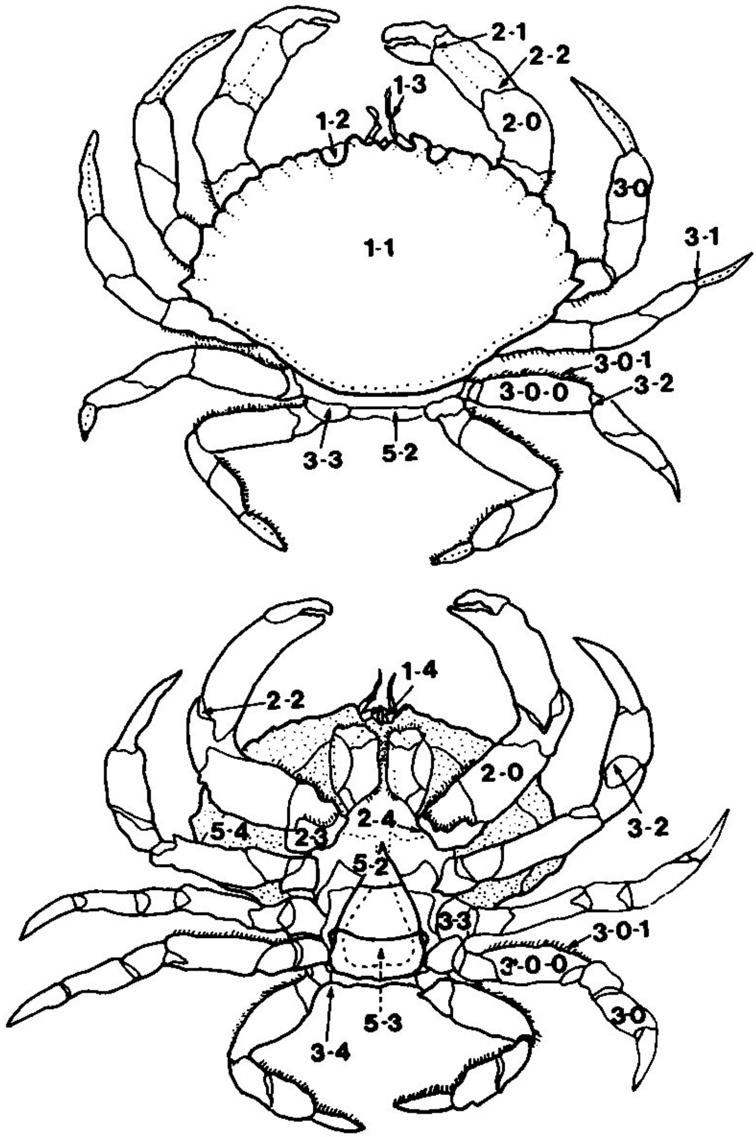

Fig 2. Dorsal and ventral aspects of *Cancer irroratus* depicting the shell areas, regions and surface type subregions, each denoted by one digit. The numbers of epizoite taxa found at each location are listed in Table III.

sub-hepatic and sub-branchial with setae, was richest, supporting 33 epizoic taxa. The branchial chamber had the least diversity: *Mytilus edulis, Alcyonidium polyoum, Obelia commissuralis* and a nemotode.

The top 2 or 3 most abundant epizoites from each major taxon (asterisk, Table III) were selected for further microdistribution analysis relative to shell substrate type (Table IV). In general, surfaces without setae favoured sessile organisms such as hydroids, barnacles and ectoprocts, while surfaces with setae favoured motile animals and nestlers such as mites, polychaetes, nematodes, turbellarians, and amphipods.

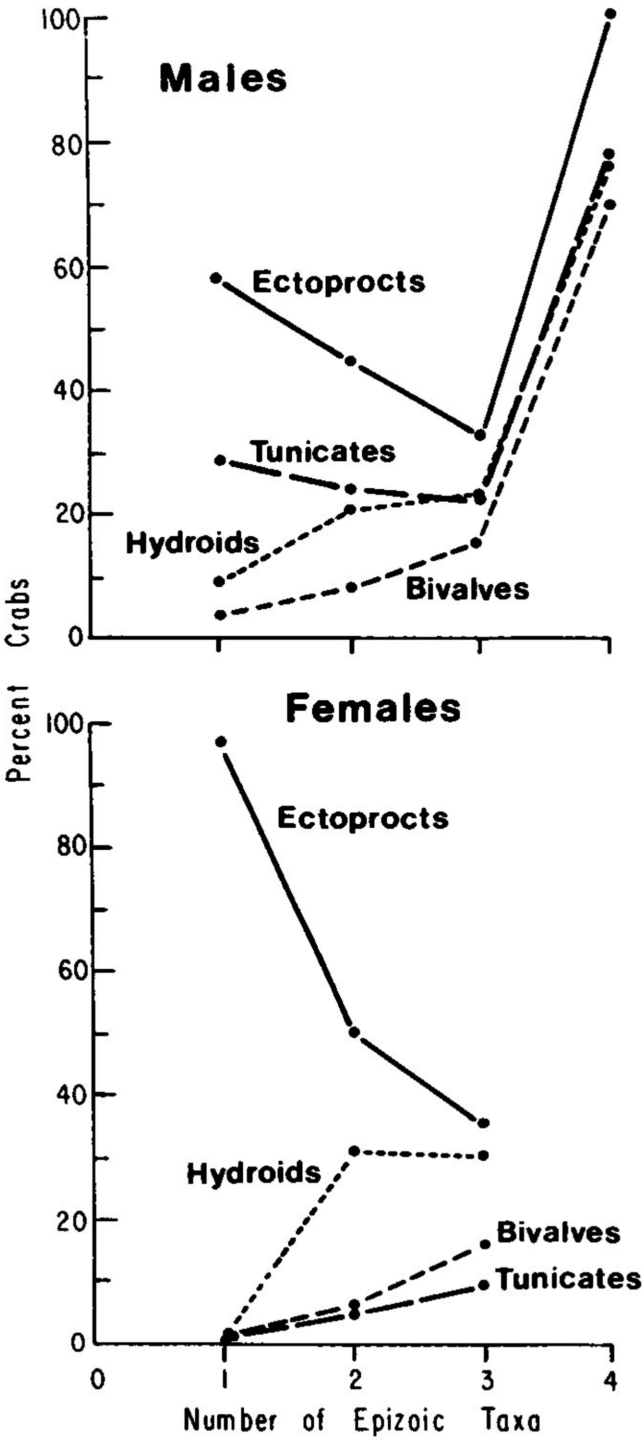

Fig 3. Percent occurrence on 3036 male and 3109 female crabs of the 4 major epizoite categories. Note that no individual females had all 4 categories.

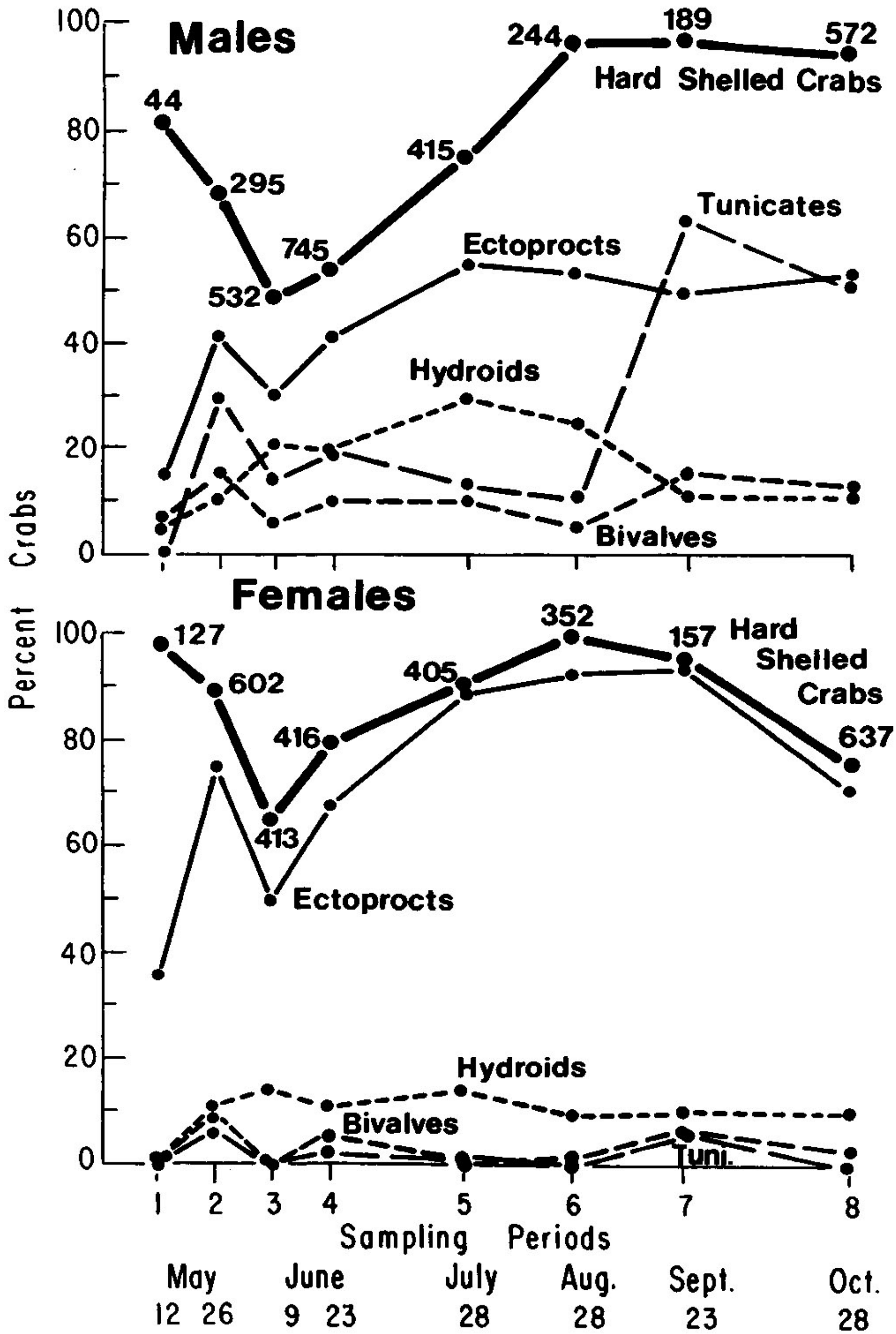

Fig 4. Relationship between seasonal percent occurrence of the 4 major epizoite categories and seasonal percent of hard-shelled crabs in each sample. Absolute numbers of hard shells for each date are indicated.

Table III. List of the 53 epizoite taxa and the number of crabs and locations colonized. Abundance is expressed as mm^2 for encrusting forms, as number of hydranths for erect hydroids, as number of zooids for ectoprocts and entoprocts, and as number of individuals for remaining epizoite species. Asterisk indicates 23 taxa included in a microdistribution analysis (Table IV).

Epizoic species	No. of crabs n=7	No. of locations n=66	Abundance
HYDROZOA			
Hydractinia echinata	7	11	1362*
Calyptospadix cerulea	7	21	1297*
Obelia commissuralis	6	14	836
Lafoea pygmaea	5	14	2183*
Thuiaria latiuscula	4	5	153
Calycella syringia	1	1	2
ANTHOZOA			
Actinaria (Tribe: Thenaria)	3	9	57
PLATYHELMINTHES			
Alloeocoela			
Plagiostomum sp.	4	9	30*
Egg cases	3	13	214*
ENTOPROCTA			
Barentsia sp.	1	1	12*
AMPHIPODA			
Corophium bonelli	2	2	4*
Proboloides nordmanni	1	1	1*
Gammaropsis sp.	1	1	1*
GASTROPODA			
Crepidula plana	1	1	2*
Crepidula fornicata	1	1	1*
Nitrella lunata	1	1	1*
Unidentified juvenile	1	1	1*
BIVALVIA			
Mytilus edulis	6	26	209*
Anomia simplex	3	2	12*
Hiatella arctica	2	1	2
Nucula sp.	2	2	2
Unidentified	2	2	2

Epizoic species	No. of crabs n=7	No. of locations n=66	Abundance
ECTOPROCTA			
Alcyonidium polyoum	7	27	43078*
Unidentified	5	10	718
Electra pilosa	5	7	1321*
Cribrillina punctata	5	5	121
Callopora aurita	2	5	143
Callopora craticula	2	4	32
NEMATODA			
Enoploidea	6	11	75*
POLYCHAETA			
Lepidonotus squamatus	5	7	11*
Polydora socialis	2	2	2
Circeis amoricana	2	1	5*
Polydora websteri	2	2	2
Capitella capitata	1	1	1
Nicomache lumbricalis	1	1	1
Terebellidae larvae	1	1	1
Unidentified sp. 1	1	1	1
Unidentified sp. 2	1	1	2
ACARINA			
Halacarus (*Thalassarachna* sp.)	6	9	37*
COPEPODS			
Pseudothalestris nobilis	1	1	1
OSTRACODA			
Unidentified	2	1	2
CIRRIPEDIA			
Balanus balonoides	3	10	123*
Balanoid cypris	3	6	17*
Haplota clavata	2	2	11
Electra monostachys	1	4	213
Parasmittina sp.	1	2	132
Stomachestosella sinuosa	1	2	70
Tubulipora sp.	1	2	9
Lichenopora verrucaria	1	1	32
Tricellari peachii	1	1	1
Crisia eburnea	1	1	1
Tegella unicornis	1	1	10
ASCIDIACEA			
Molgula citrina	5	6	41*

Table IV. The 23 epizoite taxa, found on 7 crabs, grouped according to percent occurrence on each of the 3 types of body surface. No epizoite had its greatest abundance in subregion 2.

Epizoite species	Body Surface Subregion 0 (Setae absent)	Body Surface Subregion 1 (Setae present)	Body Surface Subregion 2 (Indentation of surface)
1) Abundance greatest in subregion 0			
Hydractinia echinata	90.1	9.9	0
Lafoea pygmaea	61.3	38.4	1
Alcyonidium polyoum	95	4	1
Electra pilosa	99.3	1.7	0
Circeis amoricana	100	0	0
Balanus balanoides (adult)	90	9	1
Balanus balanoides (cypris)	88	6	6
2) Abundance greatest in subregion 1			
Actinaria (Tribe: Thenaria)	33	65	2
Calyptospadix cerulea	31	69	0
Plagiostomum sp. (adult)	36	64	0
Plagiostomum sp. (egg cases)	46	54	0
Barentsia sp.	0	100	0
Nematode	11	87	0
Unidentified ectoproct	19	81	0
Lepidonotus squamatus	27	73	0
Halacarus (Thalassarachna) sp.	12	88	0
Amphipoda: 3 spp.	14	86	0
Gastropoda: 3 spp.	25	75	0
Anomia simplex	27	73	0
Mytilus edulis	28	72	0
Molgula citrina	10	90	0

Discussion

Relative to similar studies on decapod crustacean epizoites (Table V), *Cancer irroratus* from Northumberland Strait is exceptional in supporting 53 taxa of macroinvertebrates.

Crabs for the microdistribution analysis of epizoite species were collected in May so as to represent the overwintered epizoites before the spring moulting. Sampling later in the year might yield higher species densities or more recently settled species, but would not indicate competitive species capable of surviving through the intermoult period.

Seasonal abundance patterns of the 4 most abundant groups reflected the moulting periods of the host. When large numbers of recently moulted crabs were caught in mid-June (Fig 4) the percentage of crabs colonized by epizoites decreased. However, at the end of May there was an increase in all epizoite groups at a time when the percentage of hard crabs decreased. This indicates a period of rapid growth and/or settlement of epizoites.

The ectoprocts, especially *Alcyonidium polyoum*, are excellent indicator species of intermoult stages because of their rapid rate of colonization. They were the only epizoite group occurring on females at a higher frequency than on males, thus accurately reflecting the fact that a larger percent of females were hard-shelled.

In the present study, the 23 species whose microdistribution was examined were most influenced by the presence or absence of setae. This distribution is largely a reflection of the organisms' tolerance to accumulation of detritus. Low-profile encrusting ectoprocts are generally intolerant of sediment buildup (Hughes 1975) and regions which possess setae accumulate detritus since setae serve primarily as strainers (Pearson 1908). With a buildup of detritus, a suitable microhabitat is created for motile species such as turbellarians, amphipods and polychaetes. Thus setae serve a structural function analogous to sessile organisms of the general fouling community, which have been considered to be a pre-requisite to the establishment of motile animals (McDougall 1943).

Mytilus edulis and *Alcyonidium polyoum* were the only deleterious epizoites found in this study. Within the branchial chamber *M. edulis* caused considerable distortion of gill lamellae, as well as sediment accumulation. Where it occurred in the eye socket and at limb joints, movement of appendages was restricted. *A. polyoum* also grew in the branchial chamber, on both gills and epipodites. Both species lower respiratory efficiency and increase the risk of tissue damage and infection. To our knowledge, *M. edulis* has not previously been reported growing on *Cancer irroratus* or any other crustacean.

Table V. Number of epizoite species on crustacean hosts reported in previous studies.

Host species	Epizoite species	Reference
Homarus americanus	15	Dexter (1955)
Callinectes sapidus	9	Pearse (1947)
Porcellana platycheles	6	Smaldon (1974)
Porcellana platycheles	5	O'Donohue (1935)
Callinectes sapidus + 13 other spp.	5	DeTurk (1940)
Cancer irroratus	5	Terretta (1973)
Cancer irroratus	5	Haefner (1976)

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