

Some observations on the occurrence and vertical distribution of mites (Arachnida : Acari) and other epifaunal associates of intertidal barnacles on two contrasted rocky shores in North Wales

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Résumé : L'épifaune associée aux balanes intercotidales (principalement *Semibalanus balanoides* L.), est décrite sur deux côtes rocheuses physiquement contrastées au Nord du pays de Galles. Au total 36 espèces associées ont été enregistrées, mais ne sont pas considérées spécifiques de l'habitat de balanes. Les acariens (12 espèces) représentent le groupe dominant numériquement, tandis que les petits crustacés et les escargots littorinides forment la plus grande partie de la biomasse de cette communauté, à cause de leur grande taille. La zonation est évidente dans la distribution de chaque espèce à travers le gradient intercotidal. L'acarien *Hyadesia tumida* Benard est décrit pour la première fois en Grande Bretagne.

Abstract : The epifaunal communities associated with intertidal barnacles (mainly *Semibalanus balanoides* L.) on two physically contrasted rocky shores in North Wales are described. A total of 36 associated taxa were recorded but these are not considered to be specific to the barnacle biome. Mites (12 species) were the dominant group numerically whilst small crustaceans and littorinid snails accounted for most of the biomass by virtue of their larger size. Evidence of zonation in each species distribution across the intertidal gradient was obtained. The acarine *Hyadesia tumida* Benard is recorded for the first time in Britain.

INTRODUCTION

The rocky intertidal zone has been thoroughly investigated, at least at the macroscopic level (e.g. Lewis, 1964 ; Stephenson and Stephenson, 1972 ; Moore and Seed, 1985). More specifically, several studies have focussed on the faunas associated with macroalgal fronds (e.g. Seed and O'Connor, 1981 ; Hicks, 1985), with kelp holdfasts (e.g. Scarratt, 1961 ; Moore, 1974) with rock crevices (e.g. Glynne-Williams and Hobart, 1952 ; Kensler, 1965) and to a lesser extent with mussels (e.g. Suchanek, 1985 ; Tsuchiya and Nishihira, 1985) and barnacles (e.g. Gorvett, 1958 ; Raffaelli, 1978). However, apart from several rather general surveys (see Baker, 1982 ; Pugh and King, 1985 a, b for references) few investigations have been concerned with the distribution of littoral mites, a group which includes both "aquatic" (halacarid) and "terrestrial" (non halacarid) species. More detailed systematic and ecological studies of littoral acarines include the important works of Newell (1947), Bartsch (1979) and Pugh and King (*loc. cit.*).

Barnacle aggregations, which are such a striking feature of the rocky intertidal zone worldwide, provide numerous favourable microrefuges that can be successfully

exploited by a wide variety of small epifaunal invertebrates, together with the juvenile stages of species which reach larger body size elsewhere. This paper reports briefly on the fauna, in particular the mites, found in association with littoral barnacles on two physically contrasting rocky shores in North Wales.

THE STUDY SITES AND COLLECTION OF MATERIAL

Scrapings of barnacles were collected from two rocky shores in North Wales between late July and late September, 1985. Bangor, situated towards the northern end of the Menai Strait, is sheltered from the prevailing wind and wave action is therefore negligible. Strong water currents, turbidity and the accumulation of sediment are probably the major limiting physical factors at this site. At the study area the shore is dominated by successive zones of furoid algae. Barnacles are patchily distributed largely reflecting the local heterogeneous nature of this particular site; they occur on stones and exposed bedrock, often beneath dense algal canopies, as well as on the shells of the mussel *Mytilus edulis* L. The dominant species is *Semibalanus balanoides* L. which here grows to a large size (c. 1.5 cm diameter) but intermixed with it at lower densities is the much smaller *Elminius modestus* Darwin. Both species range approximately between MHWN and MLWN. In the lower shore bedrock and stones gradually give way to sand and mud. Cable Bay (Porth Trecastell) is located on the open, wave-exposed S.W. coast of Anglesey. Here barnacles are the most prominent organisms in the intertidal zone, ranging from above MHWS to below MLWN. *Chthamalus montagui* Southward occurs sparsely in the upper reaches of the barnacle zone but around MHWN it gives way to *Semibalanus*, which then forms a dense carpet extending beyond MLWN. The lower limit of *Semibalanus* is marked by the appearance of the kelp *Laminaria digitata* (Huds.) Lamour.

At each site a gently sloping rock face was sampled. Seven approximately equidistant stations were selected along a transect line between the highest (Station 1) and lowest (Station 7) occurring barnacles. A total of 27 samples (each of 25 cm²) were collected. At all stations samples were collected from areas where barnacle cover was maximal. At the highest and lowest stations replicate samples (4 at Bangor, 3 at Cable Bay) were taken; elsewhere collections consisted of single samples. At the wave-exposed site, however, three additional samples were collected from a vertical rock face corresponding approximately to stations 4 - 6 on the main transect. The tidal heights of all sampling stations are shown in Tables 1 and 2. All samples were photographed *in situ* immediately prior to their collection thus providing a record of the identity and density of both living and dead barnacle shells. In order that the associated fauna could be viewed alive, all samples were hand-sorted within 48 hours of collection using a stereobinocular microscope. For purposes of identification mites were mounted in polyvinyl lactophenol; all other fauna were retained in 75 % ethyl alcohol.

RESULTS AND DISCUSSION

The abundance and vertical distribution of the fauna associated with barnacles at the two study sites is illustrated in Tables 1 and 2. A total of 36 taxa were recorded not including the barnacles or the parasite *Hemioniscus balani* (Bate), two specimens of which were found in low shore barnacles at Cable Bay. The marked differences which are clearly evident between these two contrasting rocky shores are probably due at least in part to the greater accumulation of sediment and the more patchy distribution of barnacles within the Menai Strait. The dominant taxonomic groups (mites and gastropods) however, were similar at both sites. The community present on the vertical rock face at Cable Bay was rather more diverse than that from a comparable level along the main transect. This face, however, had a slightly more protected aspect and the densely-packed, more elongate barnacles effectively increased the structural heterogeneity of this microhabitat.

One of the most striking features of these epifaunal communities is the predominance of mites both in terms of species and numbers of individuals present (but not their biomass). Twelve species were recorded of which seven were terrestrial (Table 1). These non halacarid mites include species which differ significantly in their tolerance of wetting and dependence upon air pockets (Pugh and King, 1985 a). The populations of some species (e.g. *Hyadesia furcillipes* Benard, *Ameronothrus bilineatus* (Michael) and *A. marinus* (Banks)) are highly clumped and occurred, often at high density, in only a few samples. *H. furcillipes* was easily the most abundant species present, attaining a maximum density of 1080 individuals. 25 cm². Comparable densities of mites (unidentified) were reported from intertidal barnacles on the west coast of Scotland by Gorvett, (1958). *H. tumida* Benard, a species first described by Benard (1961), on the Atlantic coast of France, but hitherto unrecorded from British shores, occurred at moderate densities in the mid and upper shore (Stations 2-5) at Cable Bay. *Halotydeus hydrodromus* (Berlese and Trouessart), *Cyrtidrolaelaps hirtus* Berlese and *Balaustium areneoides* Berlese, three predatory mites, were recorded only occasionally from the high shore. No terrestrial mites were found below MTL.

The aquatic, halacarid, mites are represented in these communities by *Halacarellus balticus* Lohmann together with four species belonging to the sub family Rhombognathinae (viz. *Isobactrus levis* (Viets), *I. unguilatus* Bartsch., *Metarhombognathus armatus* (Lohmann) and *Rhombognathides merrimani needleri* Newell). Whilst all four were well represented at Cable Bay, they were sometimes difficult to separate in view of the presence of many juvenile stages; accordingly they are considered collectively in Table 1. Only *Isobactrus levis* and *Metarhombognathus armatus* were found at Bangor whilst *Halacarellus balticus* occurred in the lower intertidal at both sites.

The rough-textured shell plates of intertidal barnacles support a complex microscopic epiflora and this, together with accumulated detrital material, probably

TABLE 1 : Distribution and abundance (numbers per 25 cm²) of mites and other taxa associated with intertidal barnacles at Cable Bay, S.W. Anglesey

Tidal height 1 Station Number	5.29 1		4.88 2	4.23 3	3.85 4	3.17 5	2.39 6		1.82 7			Vertical face (midshore)		Total	
Barnacles :															
<i>Semibalanus balanoides</i>	-	-	-	229	194	118	88	143	126	101	92	166	166	188	1611
<i>Chthamalus montagui</i>	96	97	89	4	-	-	-	-	-	-	-	-	-	-	286
Arachnida : Acari :															
<i>Hyadesia furcillipes</i> 2	-	-	-	-	-	1080	699	-	-	-	-	-	-	-	1779
Rhombognathinae (4 species)	-	-	-	36	8	116	444	17	5	2	2	12	35	73	750
<i>Halacarellus balticus</i>	-	-	-	-	-	-	-	5	41	3	2	57	2	-	110
<i>Ameronothrus bilineatus</i> 2	-	-	-	-	-	91	12	-	-	-	-	-	-	-	103
<i>Hyadesia tumida</i> 2	-	-	-	18	65	8	5	-	-	-	-	-	-	-	97
<i>Ameronothrus marinus</i> 2	-	-	-	-	-	74	4	-	-	-	-	-	-	-	78
<i>Halotyolus hydrodromus</i> 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Cyrtodrolaelaps hirtus</i> 2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Balaustium araneoides</i> 2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Other associated taxa :															
Littorinids 3 (juv.unident.)	9	18	13	78	69	69	63	36	58	19	17	16	61	23	549
<i>Littorina neglecta</i> 3	5	-	2	36	41	37	30	57	66	44	53	22	54	42	489
<i>Mytilus edulis</i> 6	-	-	-	-	1	3	1	18	58	9	4	9	2	3	108
<i>Campecopea hirsuta</i> 5	-	-	-	1	17	25	3	-	-	-	-	-	41	16	103
<i>Hyale nilsoni</i> 5	-	1	-	-	5	4	-	-	-	-	-	17	19	56	102
Harpacticoids 5 (unident.)	-	-	-	11	7	3	-	1	-	4	-	22	3	31	82
<i>Littorina saxatilis</i> 3	16	22	8	5	2	-	1	-	-	-	-	-	4	6	64
Turbellaria (unident.)	-	-	-	-	-	-	-	-	28	1	-	28	1	-	58
<i>Nucella lapillus</i> 3	-	-	-	-	-	1	-	7	18	17	7	4	2	1	57
Ostracoda 5 (unident.)	-	-	-	1	2	1	3	12	4	-	-	14	7	1	44
Chironomid larva 4	-	-	-	1	4	7	1	3	-	-	-	10	8	2	36
<i>Lasaea rubra</i> 6	1	-	-	-	-	4	-	-	-	-	-	14	9	3	31
<i>Skeneopsis planorbis</i> 3	-	-	-	-	-	-	-	1	5	7	8	2	-	-	23
Nemertines (unident.)	-	-	-	-	-	-	-	1	-	-	-	11	1	4	17
Dipteran larva 4	-	-	-	2	-	1	1	-	-	-	-	4	6	-	14
Dipteran pupa 4	-	-	-	1	-	-	-	-	2	-	-	9	-	1	13
<i>Littorina neritoides</i> 3	-	5	3	1	-	-	-	-	-	-	-	-	1	1	11
Foraminiferans (unident.)	-	-	-	-	-	-	-	-	3	3	-	3	-	-	9
Collembola 4	-	-	-	-	-	1	-	-	-	-	-	2	1	3	7
<i>Amphithoe rubricata</i> 5	-	-	-	-	-	-	-	-	6	-	-	-	-	-	6
<i>Patella vulgata</i> 3	-	-	-	-	-	-	-	2	1	1	1	-	-	1	6
<i>Jaera</i> spp. 5	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
<i>Mycralimma marina</i> 4	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1

1 Metres above Chart Datum ; Mean tidal range, 4.4 m (Spring tides), 3.6 m (Neap tides) ; MTL 2.9 m.

2 Terrestrial mites ; 3 Gastropods ; 4 Insects ; 5 Crustaceans ; 6 Bivalves.

provides the major source of energy input into these epifaunal communities. Littoral mites are known to have varied food requirements (see for e.g. Andre, 1946 ; Benard, 1961 ; Schulte, 1976 ; Krantz, 1978). Some species (e.g. *Hyadesia furcillipes* and *H. tumida*) graze the surface epiflora of green unicellular algae, bacteria and diatoms, others (e.g. *Ameronothrus marinus* and *A. bilineatus*) are scavengers feeding mainly on algal detritus as well as on bacteria, fungi and yeasts. The four halacarids belonging to the sub family Rhombognathinae suck the fluids of green algae. *Crythydroaelaps hirtus*, *Balaustium areneoides* and *Halotydeus hydrodromus* are predators consuming microfaunal organisms including other species of mites ; *Halacarellus balticus* is thought to be a necrophage eating prey which is about to die.

Although numerically subordinate to mites, molluscs, particularly the small grazing littorinids, account for much of the biomass of these communities. *Littorina neglecta* Bean, the second most abundant species in this survey, is widely distributed throughout Britain occurring principally within the barnacle zone on exposed shores. Because of its small size (rarely exceeding 5 mm in shell height) it is the only littorinid capable of exploiting the barnacle microhabitat throughout its entire life. It was present at moderate densities throughout the littoral zone at Cable Bay increasing progressively in mean shell height from 1.65 mm at around MLWN to 2.45 mm around MHWS. This increase in size with increasing tidal height has been reported by other workers (e.g. Fish and Sharpe, 1985) and probably reflects the greater availability of suitably sized microrefuges (e.g. empty barnacle shells) in the upper shore. *Littorina neritoides* (L.) and *L. saxatilis* (Olivi) were significantly less abundant than *L. neglecta* and were restricted mainly to the mid and upper shore. *Skeneopsis planorbis* (Fabr.), a small gastropod often found in abundance in coralline pools (Fretter, 1948), was largely confined to the lower intertidal whilst the small apomictic bivalve, *Lasaea rubra* Mont., a regular and often prominent community member of several intertidal microhabitats, here occurred only at low density mainly on the vertical rock faces. Juvenile stages of molluscs which in other habitats attain a larger body size were also present ; these include dogwhelks (*Nucella lapillus* (L.)), an important predator of barnacles, mussels (*Mytilus edulis* L.) and limpets (*Patella vulgata* L.).

Small crustaceans, especially the harpacticoid copepods, the amphipod *Hyale nilssoni* (Rathke), and the isopod *Campeopea hirsuta* (Mont.) are also prominent within these communities. Chironomid larvae were the most abundant insects on both shores. Raffaelli (1978) found that collembolan insects were the dominant group amongst the fauna associated with *Semibalanus balanoides* at Llanddwyn Island (a site very close to Cable Bay). *Littorina neglecta* and *Campeopea hirsuta*, which compete for empty barnacle shells, were the most important species in terms of biomass whilst mites appeared to be less abundant and were not identified in Raffaelli's study.

TABLE 2 - Distribution and abundance (numbers per 25 cm²) of mites and other taxa associated with intertidal barnacles at Bangor in the Menai Strait.

Tidal height 1 Station Number	5.35 1				4.69 2		4.24 3	3.81 4	3.29 5	2.64 6		2.30 7		Total
Barnacles														
<i>Semibalanus balanoides</i>	100	90	83	82	76	164	142	130	116	98	133	162	87	1463
<i>Elminius modestus</i>	6	6	4	10	-	-	-	3	2	4	17	1	-	53
Arachnida : Acari :														
<i>Isobacterus levis</i>	-	-	-	1	30	-	3	5	5	-	21	1	1	67
<i>Halacarellus balticus</i>	-	-	-	-	-	-	-	-	-	17	1	-	-	18
<i>Metarhombognathus armatus</i>	-	-	4	-	-	-	-	-	-	-	-	-	-	4
<i>Balaustium areneoides</i> 2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Other associated taxa :														
Littorinids 3 (juv. unident.)	4	3	2	8	5	1	-	-	-	1	-	1	-	25
Chironomid larvae 4	-	-	3	-	-	1	-	3	1	13	-	-	3	24
Harpacticoids 5 (unident.)	-	-	-	-	-	-	-	-	-	-	18	3	-	21
<i>Mytilus edulis</i> 6	-	-	-	-	-	-	-	-	-	1	1	-	-	2
<i>Nereis</i> spp. 7	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Oligochaete (unident.)	-	-	-	-	-	-	-	-	-	1	-	-	-	1

1 Metres above Chart Datum ; Mean tidal range ; 6.7 m (Spring tides) ; 3.6 m (Neap tides) ; MTL 4.0 m.

2 Terrestrial mites ; 3 Gastropods ; 4 Insects ; 5 Crustaceans ; 6 Bivalves ; 7 Polychaetes.

Although intertidal barnacles can therefore support diverse communities of small epifaunal invertebrates there is no apparent reason to suspect that this associated fauna is in any way specific to the barnacle biome. Many, if not all, of the associated species reported here, are also found elsewhere in the intertidal zone, for example in rock crevices, amongst lichens such as *Lichina pygmaea* Ag. and on various species of algae. Even *Littorina neglecta*, a species which is often supposed to have evolved its small size in order to exploit the barnacle biome, is known to occur in saltmarshes, kelp holdfasts, coralline algae and eelgrass meadows (Fish & Sharp, 1985). Baker (1982) however, suggests that *Ameronothrus marinus* and *Hyadesia fusca* (Lohmann) (a species not found in this investigation), the two dominant mites associated with *Semibalanus balanoides* at Robin Hood's Bay on the North Sea coast of England, may play an important role in controlling algal growths on barnacle shells. Amongst the British halacarid mites, Pugh and King (1985 b) found that only *Isobactrus ungulatus* and *Halacarellus balticus*, together with two species not recorded in our samples (viz. *Agauopsis brevivalpus* (Trouessart) and *Rhombognathus magnirostris* Trouessart, showed any significant association with *Semibalanus balanoides*.

Sumario : La epifauna asociada con balánidos del intermareal (principalmente *Semibalanus balanoides* L.), es descrita en dos orillas distintas de la costa rocosa del norte de Gales. Un total de 36 especies asociadas fueron registradas, pero estas no se consideran específicas del habitat de los balánidos. Los ácaros (12 especies) fueron numericamente el grupo dominante, mientras que los pequeños crustáceos y los caracoles litorinidos componían la mayor parte de la biomasa de esta comunidad debido a su mayor tamaño. Se obtuvo evidencia de zonación en la distribución de cada especie a lo largo del gradiente del intermareal. El ácaro *Hyadesia tumida* Benard ha sido registrado por primera vez en Gran Bretaña.

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