THE HABITATS OF THE BRISTLE-TAIL *PETROBIUS MARITIMUS* (INSECTA, THYSANURA) ON LUNDY

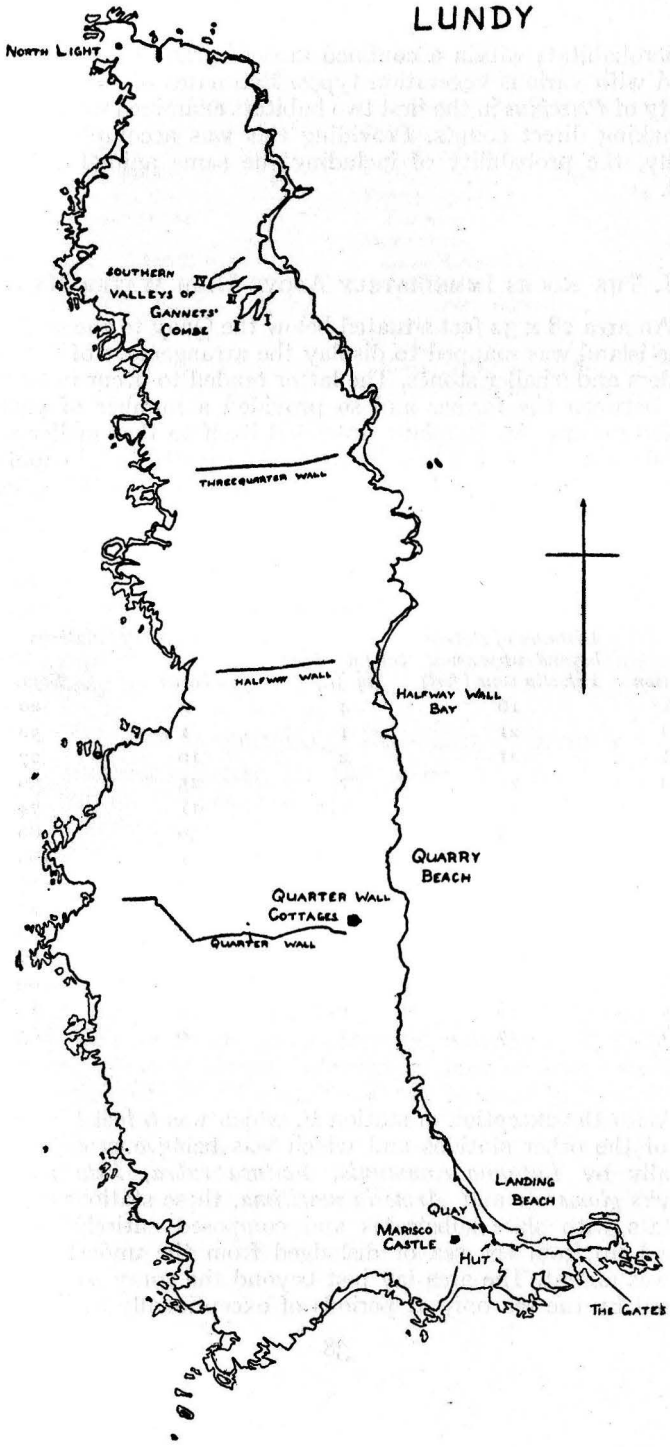
By M. J. Delany

Petrobius maritimus (Leach) is a Thysanuran or bristle-tail of widespread occurrence in coastal areas around the British Isles and particularly amongst the rocks above high water mark. It is one of the two indigenous British species, and up to the present is the only one that has been observed on Lundy. Previous work on this genus has been almost exclusively taxonomic ; the only notable exception being a brief account by Willem (1924) on the habitats of *P. maritimus* in the area of Cap Gris-Nez, France. The abundance of this insect and the absence from Lundy of the other species were sufficiently favourable conditions to stimulate further study on the island.

The data have been accumulated in the course of three visits to Lundy, totalling approximately five weeks, in 1951 and 1952. The preliminary surveys were made in March 1951 and this work was developed and extended in September 1951 and August 1952. Throughout this period the study aimed at determining the extent and pattern of distribution of *P. maritimus* as well as the geological and biological constitution of the habitats in which it occurred. A brief note on this insect in the 1948 Annual Report of the L.F.S. (p. 39) stated that it was a frequent inhabitant of slate and granite rubble up to 150 feet above sea level. The initial survey in March 1951 attempted to confirm and supplement these findings by making collections, mostly on the east coast, from a variety of habitat types from the lowest to highest elevations.

Of the two beach areas investigated, the Landing Beach and Quarry Beach (see map for these and other localities mentioned in the text), *Petrobius* was common beneath the stones some distance above the *Pelvetia* zone. Further inland, the isolated areas of granite rubble on the east coast between the Quarter and Halfway Walls all supported populations of the insect but examination of the surrounding *Pteridium* did not bring any to light. Whilst it was quite common amongst granite rubble and outcrops of granite and slate provided with crevices into which the insect could retire, its absence was particularly apparent from solitary boulders not possessing these facilities. On the flat upper surface of the island *Petrobius* was taken along the lengths of the Quarter, Halfway and Threequarter Walls as well as the inside walls of outbuildings from as far north as the North Light to as far south as Marisco Castle. Hand searching of the vegetation, particularly the *Calluna* and *Festuca*, has not shown the insect to be present.

In view of this marked petrophilous habit of *Petrobius*, further investigation was focused upon determining its abundance and the nature of its associated faunas in three types of rock habitat, finally leading to an assessment of the extent of isolation and the selection


LUNDY
NORTH LIGHT
SOUTHERN VALLEYS OF GANNETS' COMBE
IV
III
II
I
THREEQUARTER WALL
HALFWAY WALL
HALFWAY WALL BAY
QUARRY BEACH
QUARTER WALL COTTAGES
QUARTER WALL
LANDING BEACH
QUAY
MARISCO CASTLE
HUT
THE GATES

of microhabitats within a confined area of granite outcrops intermixed with various vegetation types. Estimates of the population density of *Petrobius* in the first two habitats examined were obtained by making direct counts. Providing this was accomplished fairly rapidly, the probability of including the same animal twice was small.

I. The Rocks Immediately Above High Water Mark

An area 28 x 32 feet situated below the Quay to the south-east of the island was mapped to display the arrangement of the larger boulders and smaller stones. The latter tended to occur in localized piles between the former and so provided a number of partially isolated groups. As *Petrobius* restricted itself to the smaller stones several compact, workable units were made available for population estimates. The results of surveys made in March and September 1951 are shown in Table I.

Table I

Station	*Distance of station beyond uppermost Pelvetia zone (feet)*	*Surface Area (sq. ft.)*	1951 *Populations* *March*	*Sept.*
A	16	4	2	20
B	21	1	1	50
C	21	2	10	27
D	21	2	25	30
E	22	1.5	11	74
F	24	6	50	86
G	12	14	1	160
H	19	0.3	3	17
I	16	1	0	20
J	13	1	0	20
K	16	1	0	22
L	11	1	0	69
N	16	0.3	3	14
O	17	1	0	65

With the exception of station F, which was 6 feet higher than any of the other stations and which was being encroached upon laterally by *Lapsana communis, Festuca rubra, Beta maritima, Dactylis glomerata* and *Armeria maritima,* these stations represent habitats with slate substrates and composed entirely of stones washed up from the sea or dislodged from the underlying rock. Soil was absent. The area lay just beyond the spray zone and was covered by the sea only at periods of exceptionally high tides.

The associated faunas included the following :—

Station J (March 1951)

Crustacea
Ligia oceanica (5)
Orchestia gammarella (5)
Myriapoda
Scoloplanes maritimus (1)

Station F (March 1951)

Myriapoda
Glomeris emarginata (1)

Station F (September 1951)

Crustacea
Oniscus asellus (1)
Orchestia gammarella (5)
Hymenoptera
Formica rufa (4)
Myriapoda
Lithobius melanops (4)
Araneida
Drassodes pullosus (15)
Erigone sp. (2)
Mollusca
Goniodiscus rotundatus (1)
Clausilia rugosa (1)
Vitrina pellucida (2)

(Figures in parentheses represent the number of specimens observed)

Even within this small area a distinct trend from the marine to terrestrial habitat is becoming apparent with *Ligia* and *Orchestia*, so typical of the high littoral fauna, accompanying *Petrobius* at its lower levels and tending to be displaced by the more typically terrestrial species at station E. The population increase of *Petrobius* between March and September is not insignificant whilst its dominance of the habitats as far as actual numbers are concerned, is particularly noteworthy.

II. The Intermediate Rock-Soil Habitat

The situation selected for this series of collections was an artificial habitat composed of a soil substrate covered by a mixed vegetation and scattered piles of slates. Located between 15 feet and 20 feet above the Landing Beach, the area originally constituted the floor of a hut but it must have been some time since it possessed a roof and intact walls, as only vestiges of the latter now remain. The interior was mapped (fig. 1) and arbitrarily subdivided into a number of smaller areas. The latter provided units on which to base assessments of the *Petrobius* and its associated populations. Apart from the distinct patches of *Armeria maritima* the vegetation appeared as a heterogenous assemblage composed of *Crithmum maritimum*, *Daucus carota*, *Matricaria inodora* var. *maritima*, *Leontodon pinnatifida*, *Plantago coronopus*, *Sonchus* sp., and *Rumex aquatica* dominated by *Festuca rubra*. Within this small area succession was evident. To the centre of the hut vegetation was well established whilst peripherally, although the ground was covered by soil, the assumption of a plant cover had still to be accomplished. Here then, was a *Petrobius* habitat of slate piles being encroached upon laterally and basally by the components of a vegetational complex. The March and September 1951 populations are given in Table II.

TABLE II

Station	Surface area (sq. ft)	1951 Populations March	Sept.
HA	15	1	4
HB	16	12	7
HC	11	1	1
HD	17	7	9
HE	5	4	9
HF	6	0	1

Petrobius can never be considered restricted to any one of these stations as interconnection is always guaranteed by the surrounding hut walls. The most striking feature in the above data is the comparatively low population of *Petrobius* in this habitat as compared to the previous one investigated. On the other hand the associated mesobiotic species are both richer in species and numbers as the following lists show :—

Station HB (March 1951)

Crustacea
- *Armadillidium vulgare* (1)
- *Oniscus asellus* (3)
- *Orchestia gammarella* (7)

Mollusca
- *Goniodiscus rotundatus* (1)

Station HA (Sept. 1951)

Crustacea
- *Oniscus asellus* (1)

Araneida
- *Ciniflo* sp. (3)
- *Segestria senoculata* (1)

Mollusca
- *Goniodiscus rotundatus* (2)

Station HB (September 1951)

Crustacea
- *Armadillidium vulgare* (1)
- *Oniscus asellus* (7)
- *Orchestia gammarella* (3)
- *Philoscia conchii* (2)

Collembola
- *Pogonognathellus longicornis* (1)

Hemiptera
- *Philaenus spumarius* (2)

Myriapoda
- *Lithobius melanops* (1)
- *L. variegatus* (3)

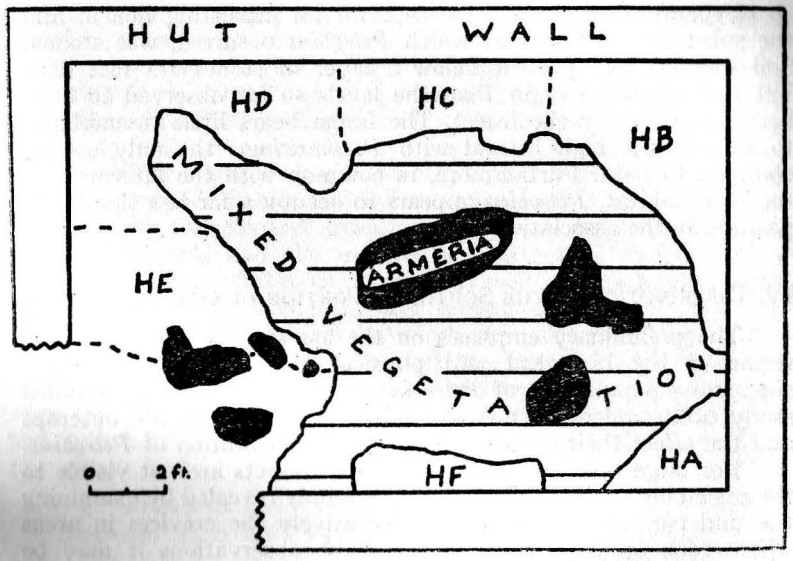
Araneida
- *Leptyphantes* sp. (2)
- *Theridion* sp. (1)

Mollusca
- *Goniodiscus rotundatus* (9)
- *Lacinaria biplicata* (4)
- *Trichia hispida* (1)

The animals beneath the stones can probably best be regarded as representing a synthesis of two faunal types, composed of those individuals normally resident beneath the stones and those visiting them from the adjoining vegetation. *P. maritimus* was confined to the former group. Although only as little as 15-20 feet above high water mark the fauna here has far greater affinities with one of an inland association than one of littoral origin. The remnants of the latter remain in the presence of *Orchestia gammarella.*

III. THE INLAND ROCK HABITAT

Along the east coast terraces just below the disused quarries a number of piles of granite stones and chippings, 150-200 feet above sea level, are stretched in isolated groups from north of the



Plan of hut interior to show disposition of vegetation and sampling stations.

Quarterwall Cottages to south of Halfway Wall Bay. As these assemblages of rock were too large and uniform to permit subdivision into groups small enough for making population assessments an alternative, relative estimate had to be applied. This was accomplished by collecting all mesobiotic species, including *Petrobius*, from beneath the stones thereby obtaining a picture of the relative abundance of *Petrobius* in this locality. Two such piles of stones were examined in September 1951 and their faunas listed below :—

Granite Rubble—(i)		Granite Rubble—(ii)	
Crustacea		Crustacea	
Oniscus asellus	(43)	*Oniscus asellus*	(2)
Thysanura		Thysanura	
Petrobius maritimus	(2)	*Petrobius maritimus*	(4)
Dermaptera		Hymenoptera	
Forficula auricularia	(1)	*Formica rufa*	(2)
Coleoptera		Myriapoda	
Otiorrhynchus sulcatus	(1)	*Lithobius lapidicola*	(1)
Hymenoptera		Araneida	
Formica rufa	(2)	*Ciniflo similis*	(2)
Araneida		*Drassodes pullosus*	(1)
Drassodes pullosus	(3)	*Lycosa* sp.	(1)
Opilionida		*Segestria senoculata*	(2)
Opilio pratensis	(2)	Mollusca	
		Goniodiscus rotundatus	(1)

Vegetation was absent, except for an incrusting lichen, and the substrate at depths at which *Petrobius* occurred, was stoney. Soil was possibly present below a layer of stones 1-2 feet deep but this would be lower than the levels so far observed to have been inhabited by the insect. The fauna bears little resemblance to that of the high littoral with *P. maritimus* the only species common to both. Furthermore, in common with the intermediate rock-soil habitat, *Petrobius* appears to occupy a far less significant position in the association.

IV. Distribution in the Southern Portion of Gannets' Combe

The preliminary emphasis on the assessment in fairly broad terms of the biological and physical constitution of habitats supporting populations of *Petrobius* now leads to a more detailed study of the microhabitats of an inland area of granite outcrops and the effect their structure has on the distribution of *Petrobius*.

For large portions of the year these insects are not visible to the casual observer and their presence is only revealed by examining the undersurfaces of stones or alternatively the crevices in areas where rock outcrops occur. From these observations it may be inferred that rocks in themselves do not constitute the only necessary physical feature of the *Petrobius* habitat but must also be so arranged as to form some form of cover for the animal.

The survey undertaken in August 1952 was made in the four most southern valleys of Gannets' Combe. With the aid of an Ordnance Survey 25 inches to 1 mile map it was possible to obtain the broader outlines of the valleys. Unfortunately, the arrangement of the rocks on this map did not coincide with their arrangement in the field and their precise locations were inserted following personal observation of the area. The granite outcropping occurs where the flat upper surface of the island, in this section covered by Callunetum, meets the Pteridetum from the sheltered slopes of the east coast. In addition to *Pteridium*, the floors of the valleys were covered by the grasses *Festuca* and *Molinia*. The presence of *Petrobius* was assumed on seeing either the living animal or the exuviae within the areas being searched. The detailed distribution of *Petrobius* is displayed on a map in the author's possession and rather than consider in detail the structure, flora and *Petrobius* population of each rock it has been decided to present only the empirical results. Firstly, in all the areas where *Petrobius* was present the crevices were generally dry, free from soil and vegetation and having, at least in part, a height between ½ and 2 inches. Although the boulders of the south-east bank of Valley I had this latter characteristic *Petrobius* was not present. This can possibly be correlated with the presence of wet soil and moss in them, whilst the larger portion of the south bank of Valley III being free from *Petrobius* might well be associated with crevice width,

as here, when not being colonized by vegetation they were between 6 and 9 inches wide.

The reasons for such highly specific habitat requirements still remain a matter of conjecture. Protection from climatic extremes and larger predators such as birds, may be afforded by the more secluded niche. The tendency for *Petrobius* to vacate cracks with the influx of soil and vegetation is in accord with its strictly petrophile habit. As this insect is wingless and also loathe to enter any soil covered areas, a considerable degree of isolation appears probable and the method and extent of transportation from one stoney habitat to another, as well as the rapidity with which this may be achieved, still remain unanswered. The egg laying habits of this species have not been described but in the allied species *P. brevistylis* the eggs are known to be deposited amongst accumulated dirt and soil in the very small cracks scattered over the rock surfaces. Should *P. maritimus* be of similar habit the probability of an outside agency transporting this stage does not appear high.

V. Temperatures in *Petrobius* Microhabitats

Between 1400 and 1500 hours G.M.T. on September 2nd, 1951, temperature measurements using an F. 1512/300 thermistor (see Delany, 1953), where made in *Petrobius* microhabitats in the vicinity of the Gates. Temperatures were taken beneath small pieces of slate, on their upper surfaces and in the air above them. The temperatures taken beneath the slates were always as near the centre of the stone as possible. The readings are shown in Table III.

Table III

Stone	*Maximum thickness of stone (ins)*	*Temperature ° C*			
		1 *in above*	*Upper surface*	*Beneath*	*Petrobius*
1	2	27.4	32.0	28.3	Present
2	1	25.2	29.2	28.6	Present
3	2.5	24.3	29.6	28.3	Present
4	0.25	26.4	32.0	33.5	Absent
5	0.25	27.5	29.6	31.5	Absent
6	1.5	19.4	19.2	19.4	Present
7	2	18.1	18.1	18.8	Present
8	1	17.9	17.9	19.0	Present
9	0.5	17.6	17.6	17.6	Absent
10	0.5	17.9	17.9	17.9	Absent

Slates 1-5 were in direct sunlight and 6-10 a few feet away in the shadow of nearby cliffs. The low uniform temperatures about the shaded stones are in striking contrast to the higher and more variable temperatures of those in direct sunlight. The air beneath the slates was invariably as warm or warmer than that 1 inch above them with a greater temperature difference where the slates in direct sunlight were very thin. It is of note that under these conditions, when temperatures reached 33.5° C. no *Petrobius* were present. It would appear, then, that at times the temperature

beneath the thinner stones must become comparatively high and the absence of *Petrobius* from stones 9 and 10 could suggest an avoidance of this microhabitat on this account.

The foregoing accounts are probably best regarded as a rather loosely united assemblage of field notes and observations on the bristle-tail *Petrobius maritimus*. It was not possible to develop a concerted research project in the time available for this study, but the data are felt to be of value in providing additional information on the Lundy fauna and flora and particularly on the ecology of *P. maritimus*.

The distributional range of this insect, as known within the limits of Lundy, is wide. Providing rocks are available, whether they be slate or granite, capable of offering the appropriate cover, populations of *Petrobius* will survive. The factors, and their differential effects, responsible for the maintenance of the population balance of *Petrobius* in various localities have still to be determined. On account of the size and location of Lundy it cannot be stated with certainty whether this species occurs beyond maritime influences and it is only by study elsewhere that this can be ascertained.

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