NOTES ON THE FRESHWATER ORGANISMS OF LUNDY WITH ESPECIAL REFERENCE TO THE CRUSTACEA AND ROTIFERA

By A. L. Galliford

The ponds of Lundy seem to be divisible into two main groups from an ecological standpoint. All, or nearly all, are wholly or partly artificial and result either from the flooding of old quarries and lesser excavations in the rock or from dammed-up springs; but the Rocket, Aclands Moor and Quarterwall Ponds (nos. 1, 4 and 5) exhibit characteristics markedly different from the rest—characteristics indeed which one would not normally associate with granite rock covered by peat. In these three ponds the density of microscopic organisms is such that the water is more or less opaque and consequently the usual floating and submerged plants are absent. The principal organism colouring the water in the Rocket Pond is *Microcystis*, one of the Myxophyceae (Blue-green algae); but the algae *Arthrodesmus* and *Pediastrum* are also very abundant here and seem to be the principal algae in the other two ponds. The Cladoceran, *Bosmina longirostris*, and the Rotifer, *Keratella quadrata*, were quite abundant in the Rocket Pond (especially the former species), yet were found nowhere else on the island. Other organisms associated mainly with the three ponds referred to above are the species of *Brachionus* and *Filinia*.

In most of the remaining ponds the water is clear and *Potamogeton*, *Ranunculus* and other pondweeds are well developed. In some (such as the Hotel Reservoir Pond and the Lighthouse Field Pond, nos. 3 and 14) filamentous algae and duckweed choke the surface at times. Pondsbury, surrounded by *Sphagnum* bog and containing much *Sphagnum* and other mosses, produced the greatest number of species, including some which were found nowhere else on the island.

The pH of the water was determined colorimetrically by means of the B.D.H. Universal Indicator. The figures are probably not very accurate and no doubt there is in some cases considerable diurnal and seasonal variation in this factor. However, in general it may be said that the Rocket, Quarterwall and Aclands Moor ponds are alkaline and the remainder more or less acid. As might be expected the bog-pools, Pondsbury and the Widows Tenement Pond (nos. 9 and 12), seemed to be the most acid.

List of Ponds Examined

(The figures for the number of species recorded refers only to the Cladocera and Rotifera as other species were not fully identified for each pond.)

(1) *Rocket Pond.* A fairly deep tank excavated in the rock near South-West Point, containing Golden Carp and other fish.

Very green with Myxophyceae, especially in summer. pH (of filtered water) 7.0 to 7.5. No submerged or floating vegetation. No. of species 12.

(2) *Golden Well.* Tank with cement sides near Castle Hill, containing many leeches. pH 6.5. No. of species 3.

(3) *Pond in Lighthouse Field.* Many pond weeds including *Potamogeton*, Duckweed and blanket (filamentous) algae. pH 6.5. No. of species 12.

(4) *Pond, Aclands Moor.* Pool in old excavation about quarter of a mile north of Old Light. Water very green with algae (mainly *Scenedesmus* and *Pediastrum*), bottom muddy. Evidently much used by cattle, etc. pH 7.5. No. of species 10.

(5) *Quarterwall Pond.* Another excavation in the rock. Water yellow-brown, turbid. pH 7.5. No. of species 14.

(5a) *Small Quarterwall Pond.* Weedy pond with fairly clear water. pH 6.0. No. of species 12.

(6) Pool in dammed stream in combe, Western Sidings near telegraph pole no. 69. Vegetation—duckweed, crowfoot, and filamentous algae. Water peaty-coloured. pH 5.5. No. of species 6.

(7) Pool in dammed stream, west side of Middle Park, near telegraph pole no. 54. pH about 7.0. No. of species 7.

(8) *Old Quarry Pond, Eastern Sidings,* just north of Quarterwall. Partially surrounded by trees and bushes. Water clear but dark in appearance owing to overshadowing by rock walls and trees. Not much aquatic vegetation except *Fontinalis* (Willow Moss). pH 6.5. No. of species 19.

(9) *Pondsbury.* Pool in *Sphagnum* bog in the centre of the island. Probably natural but increased in size and depth by damming. Water peaty, fairly deep in parts. Much floating *Sphagnum* and other mosses, and filamentous algae. pH 5.5. No. of species 32.

(10) Temporary pools near the North End. No. of species 1.

(11) Temporary pool near Rocket Pond. Vegetation—*Potamogeton pectinatus* (or similar form). pH 6.0. No. of species 11.

(12) *Widow's Tenement Pond.* In boggy area due east of telegraph pole no. 66. pH 5.0. No. of species 6.

(13) *Spring in Friar's Garden Field,* due south of Old Light. Fauna mainly Annelids, *Asellus*, Copepods and Protozoa (including compound Vorticellids). No. of species 1.

(14) *Pond adjacent to Hotel Reservoir.* Choked with vegetation —*Potamogeton* and other pond weeds and filamentous algae. pH 6.0. No. of species 11.

(15) Pool in dammed spring above Battery Reservoir. pH. 6.0. No. of species 2.

(16) *Battery Reservoir.* Much duckweed and a small clover-leaved Crowfoot. pH 6.0. No. of species 7.

(17) Stream down combe between telegraph poles 41 and 42. *Fontinalis* on stones, *Sphagnum* and Crowfoot in pools. No. of species 11.

(18) Small pond 25 yards east of telegraph pole no. 62, near Threequarter Wall. No. of species 2.

(19) Small pond near sheep dip, east side of Home Park. Shallow and muddy with many leeches. pH 6.0. No. of species 1.

LIST OF SPECIES

(The figures refer to the ponds as listed above.)

Arachnida

Argyroneta aquatica Linn. Water Spider. 9 (May 1953). Quite abundant among the vegetation.

Insecta

Chaoborus sp. ('Phantom larvae'). 8 (July 1952.)

Crustacea—Isopoda

Asellus meridianus Rac. 2 and 9 (July 1952).

Asellus sp. 2 (March 1953).

Asellus spp. (Water or Hog Slaters) are probably present in all the ponds, especially those with *Potamogeton* and other higher vegetation.

Crustacea—Copepoda

Cyclopoida

Cyclops agilis s.str.Koch. 3 and 7 (July 1952).

C. fimbriatus s.str. Fischer. 3 (July 1952).

C. prasinus Fischer, Schmeil. 1, 6 and 7 (July 1952).

C. vernalis s.str. Fischer. 3, 4, 5 and 9 (July 1952).

Cyclops spp. (not determined). 8 (July 1952); 6 and 7 (May 1953); 12 and 16 (August 1953).

Harpacticoida

Canthocamptus crassus Sars. 9 (July 1952).

C. pygmaeus (Sars). 3 (July 1952).

C. staphylinus (Jurine). 3 (July 1952).

No records were obtained of any *Calanoid* Copepods (e.g. *Diaptomus* spp. which are common on the mainland in ponds, bog-pools and lakes, especially in the winter months). All the Copepods were identified by Mr G. Fryer, B.SC., to whom I wish to express my thanks. Unfortunately, owing to his appointment to a fisheries post in East Africa, he was unable to study the later samples.

Daphnia obtusa Kurz. 1 (November 1953) ; 3 (July 1952 ; March, August and November 1953) ; 4 (March, May and November 1953) ; 5 (March, May, August and November 1953) ; 5a (November 1953) ; 6, 7, 8 and 9 (July 1952) ; 11 (March, May and November 1953) ; 14 (May 1953).

Males were observed in 3 (July 1952) and in 11 (March 1953).

Simocephalus vetulus (O.F.M.). 3 (August 1953) ; 4 (May 1953) ; 5a (May and August 1953) ; 9 (November 1953) ; 11 (March, May and November 1953). Males observed in 11 (March 1953).

Bosmina longirostris (O.F.M.). 1 (July 1952 ; March, May, August and November 1953).

Alona rectangula Sars. 1 (July 1952 ; August 1953).

A. rustica T. Scott. 8 (March 1953) ; 9 (May 1953).

Alonella nana (Baird). 1 (March 1953) ; 3 (July 1952 ; August and November 1953) ; 5 (May 1953) ; 7 (March 1953) ; 8 (July 1952 ; March, August and November 1953) ; 9 (July 1952 ; May and November 1953) ; 14 (August 1953) ; 16 (May and Aug. 1953) ; 17 (August 1953) ; 19 (May 1953).

Chydorus sphaericus (O.F.M.). 1 (May and August 1953) ; 2 (March 1953) ; 3 (July 1952 ; March, August and November 1953) ; 4 (March and May 1953) ; 5a (August and November 1953) ; 6 (July 1952 ; May and November 1953) ; 7 (July 1952 ; May 1953) ; 8 (July 1952 ; March, May, August and November 1953) ; 10 (March and November 1953) ; 11 (May and November 1953) ; 12 (March, May and August 1953) ; 14 (May and August 1953) ; 15 and 16 (May 1953) ; 17 (August 1953) ; 18 (May 1953).

On Lundy as on the mainland, probably the commonest of the Cladocera.

ROTIFERA

? *Proales gigantea* (Glasscott). 3 (August 1953).

Proales sp. 8 (July 1952) ; 11 (March 1953) ; undetermined, not necessarily the same species in each case.

Notommata pachyura (Gosse). 6 (July 1952) ; 9 (July 1952 ; May and November 1953) ; 12 (May 1953).

Notommata sp. 5a (August 1953).

Cephalodella auriculata (Müller). 8 (July 1952).

Cephalodella sp. 1 (July 1952) ; 9 and 14 (May 1953).

Monommata sp. 8 (July 1952).

Itura aurita (Ehr.). 15 and 17 (May 1953).

Synchaeta tremula (Müller). 8 (July 1952 ; May and November 1953) ; 9 (May and August 1953).

Polyarthra dolichoptera Idelson. 5 (March 1953).

Gastropus hyptopus (Ehr.). 9 (March 1953).

Chromogaster ovalis (Bergendal). 9 (July 1952).

Trichocerca bicristata (Gosse). 9 (July 1952 ; March and May 1953).

T. dixon-nuttalli (Jennings). 1 (March, August and November 1953) ; 4 (July 1952) ; 5 (July 1952 ; March, May and November 1953).

T. elongata (Gosse). 9 (May 1953) ; 16 and 17 (August 1953).

T. longiseta (Schrank). 5 (May 1953) ; 5a (November 1953) ; 6 (July 1952) ; 7 and 8 (May 1953) ; 9 (August 1953) ; 16 (May 1953) ; 17 (May and August 1953).

?*T. rattus* (Müller). 9 (July 1952).

Brachionus angularis Gosse. 1 (March, May and November 1953) ; 4 (May 1953) ; 5 (July 1952 ; March, May and November 1953) ; 11 (November 1953).

B. rubens Ehr. 1 (July 1952; May, August and November 1953) ; 4 (July 1952 ; March, May and August 1953) ; 5 (July 1952 ; May, August and November 1953).

This species is frequently found in company with *Daphnia obtusa* on which it is epizoic or commensal (but not parasitic in the true sense).

B. urceolaris Müller. 4 (August 1953).

Keratella quadrata (Müller). 1 (March, May, August and November 1953).

K. serrulata (Ehr.). 3 (July 1952) ; 4 (May 1953) ; 5 (May and August 1953) ; 6 (July 1952 ; May 1953) ; 8 (July 1952 ; March, May, August and November 1953) ; 9 (July 1952 ; March, May and August 1953) ; 11 (March 1953) ; 12 (March, May, August, November 1953) ; 18 (May 1953). This species is common in *Sphagnum* bogs and other acid waters, but rare elsewhere.

K. valga (Ehr.). 3 (November 1953) ; 4 (July 1952 ; March, May, August and November 1953) ; 5 (July 1952 ; March, May, August and November 1953) ; 8 (March, August and November 1953) ; 9 (May 1953) ; 11 (March, November 1953).

Very variable in form. One of the commonest rotifers on Lundy but rather local in distribution on the mainland. In contrast the species *Keratella cochlearis* (Gosse), which is common in lakes and ponds on the mainland, is apparently absent from Lundy.

Euchlanis dilatata Ehr. 5a (May, November 1953) ; 6 and 8 (November 1953).

E. proxima Myers. 17 (May 1953).

E. triquetra Ehr. (=*E. pellucida* Harring, not *E. triquetra* Hudson and Gosse). 6 (November 1953) ; 9 (July 1952 ; May and August 1953) ; 17 (May and August 1953).

Dipleuchlanis propatula (Gosse). 9 (July 1952 ; May and August 1953). Rare on the mainland (see later remarks).

Lecane ploenensis (Voigt). 8 (August 1953) ; 9 (July 1952 ; March, May and August 1953).

L. flexilis (Gosse). 3 (July 1952) ; 8 and 9 (May 1953) ; 12 (November 1953).

L. intrasinuata (Olofsson). 12 (March and November 1953).

Lecane (*Monostyla*) *closterocerca* (Schmarda). 3 (July 1952); 9 (May 1953); 14 (August 1953).

L. (*M.*) *lunaris* (Ehr.). 5 (May 1953); 9 (July 1952; March, May and August 1953); 16 (May 1953); 17 (August 1953).

Lepadella acuminata (Ehr.). 8 (July 1952); 9 (May 1953).

L. ovalis (Müller). 3 (July 1952); 9 (May 1953).

L. patella (Müller). 14 (May 1953).

Squatinella longispinata (Tatem). 9 (May 1953).

Trichotria tetractis (Ehr.). 8 (July 1952; August and November 1953); 9 (July 1952; March, May and August 1953); 11 (March and May 1953); 14 (May 1953); 17 (May and August 1953).

Filinia longiseta (Ehr.). 1 (March, May, August and November 1953); 4 (July 1952; May, August and November 1953); 5 (July 1952; March, May and August 1953); 9 (May 1953).

Testudinella patina (Hermann). 1, 3 and 5 (March 1953); 5a (May 1953); 8 (November 1953); 11 (March and November 1953); 14 (May and August 1953); 16 (May 1953).

T. caeca (Parsons). 2 and 5 (March 1953); 5a (May, August and November 1953); 7 (May and November 1953); 9 (July 1952; March and May 1953); 13 (May 1953); 14 (August 1953).

Commensal or epizoic on *Asellus* spp.

Ptygura brachiata (Hudson). 9 (May 1953).

Collotheca sp. 9 (May 1953). An unidentifiable specimen in preserved material.

Rotaria magna-calcarata (Parsons). 9 (July 1952).

R. rotatoria (Pallas). 17 (August 1953).

R. socialis (Kellicott). 3 and 5 (March 1953); 5a (May and August 1953); 9 (May 1953); 14 (August 1953).

Commensal or epizoic on *Asellus* spp.

Dissotrocha sp. 9 (May 1953).

Bdelloids (unidentified). 2 (May 1953); 5a (August 1953); 7 (March 1953); 8 (August 1953); 12 (November 1953); 14 (May 1953); 16 (August 1953); 17 (May 1953).

Bdelloids are common in *Sphagnum* and other mosses but, apart from the more striking forms, are difficult to identify when alive and can seldom be identified in preserved material.

GASTROTRICHA

Chaetonatus sp. 9 (July 1952).

Tardigrades (Water-bears) were seen in no. 2 pond but were not studied. They are likely to occur in other parts of the island, especially among mosses.

DISCUSSION

The writer was informed by Peter Davis that fish were introduced into several ponds before the war. These (or their off-spring) are still to be found in the Rocket Pond but have apparently disappeared from the other ponds. As the fish must

have been brought over to Lundy in water, that water is certain to have contained some microscopic organisms. It is therefore, impossible to decide now which organisms reached the Island by natural means of dispersal and which were introduced, however unwittingly, with the fish. This alone may be the cause of the peculiar characteristics of the Rocket, Quarterwall and Aclands Moor ponds, but other factors must also be considered. As Davis pointed out, all three ponds are at a high level and will, therefore, receive little or no surface drainage. Perhaps, a more important factor, however, is the lack of any outlet. Thus any nourishment received in the shape of decaying plant or animal life, animal droppings, etc. will not be washed out but will tend to build up to an ever increasing amount as each new generation of organisms dies and decays. In contrast all the other ponds seem to have continuous through drainage (except perhaps in abnormally dry weather), and much of the fertilizing products of decay will be lost.

The rotifer *Dipleuchlanis propatula* was found only in Pondsbury and is evidently rare even there (only some half-dozen specimens were found in all the samples from this pool). It appears to be rare also elsewhere in the British Isles and in Europe generally, but is stated to be common in North America. One is tempted, therefore, to conclude that it is more likely to have reached Lundy from the west than from the east ; but, as has already been remarked, one cannot now be certain that any species has reached the island by natural means of dispersal. What those means of dispersal might be is also a matter of conjecture. Some species of Rotifera and Crustacea are known to be capable of survival in the form of resting eggs or even as encysted adults in dried mud and may thus be transported by birds, etc., from pond to pond ; but the number of species that have actually been revived artificially from dried mud is very small and, as regards the Rotifera, is limited to a comparatively few species of the Bdelloida. No doubt also some forms may survive in moisture among the feathers of swimming or wading birds, but this has not been confirmed and, in the present state of our knowledge, one cannot therefore presume that more than a few species have reached the island in this way. On the other hand, the fact that there are few (if any) endemic species or even varieties postulates fairly frequent renewal of stock from the mainland. The abundance of *Keratella valga*, a species which is infrequent on the mainland, may be due to the absence of natural enemies ; it is significant, for example, that species of *Asplanchna* —probably the only rotifers capable of swallowing such spiky morsels—appear to be absent from Lundy.

In concluding, I would like to express my thanks to Mr Harman for permission to visit Lundy and to Peter Davis for general assistance and encouragement during my all too brief visits. To Peter and to Professor Harvey I am also indebted for the material collected in March, August and November 1953.