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STADIAL DISTRIBUTIONS OF *OMMATOIULUS MORELETI* AT DIFFERENT ALTITUDES IN MADEIRA WITH REFERENCE TO LIFE HISTORY PHENOMENA (DIPLOPODA; JULIDAE)

by

HELEN J. READ

*Zoology Department, University of Manchester, Manchester, England**

ABSTRACT

Ommatoiulus moreleti is a julid millipede native of Spain and Portugal. It has been introduced into Australia, where it has become a considerable pest, and also into Madeira, where it is now reported to be the commonest species of millipede.

In April and August 1981 an expediton from the University of Manchester Zoology Department visited Madeira and collections of the species were made in a variety of locations and habitats. The sex, instar and dimensions of each individual were later determined.

The stadial distributions at different altitudes are given for April and August.

A pattern is found with difference in altitude which varies between the times of the year studied. This variation is discussed with reference to the climate of different parts of the island.

INTRODUCTION

Ommatoiulus moreleti (Lucas) is a julid millipede, indigenous to Spain and Portugal where it is considered comparatively rare. In 1953 it was discovered in South Australia at Port Lincoln. Since then it has spread at an estimated rate of 200 m per year (Baker, 1978a), and has become very troublesome in south-eastern Australia, by infesting food and destroying crops. The species has also been introduced at an earlier date into South Africa, the Azores and Madeira. On the latter archipelago, Enghoff (1982) reported *O. moreleti* to be by far the commonest species of millipede.

The post-embryonic development, life cycle and habits of this species in Australia have been studied by Baker (1978b) with a view to finding some method of controlling the spread of the pest.

During the present study, several aspects of the ecology of *O. moreleti* were investigated, with special emphasis on life cycle features.

* Present address: Departments of Botany and Zoology, University of Bristol, Woodland Road, Bristol, England.

METHODS

In 1981, Madeira was visited by expeditions from the University of Manchester Zoology Department. Collections were made in April and from July to September, in 21 locations on Madeira (mostly towards the east side of the island), 5 on Deserta Grande and 5 on Porto Santo. Collections were made by pitfall trapping, hand and litter sampling and encompassed a range of habitats and altitudes.

The sex, instar and dimensions of each individual were determined (the instar in this species can be identified using the ocular field method described by Vachon (1947) and Saudray 1953)).

STADIAL DISTRIBUTIONS

Effect of altitude in April

Fig. 1 illustrates the stadial distributions in April. Two patterns are evident in this set of histograms.

Firstly, at each altitude there appear to be two peaks, the first at stadia V, VI or VII and the second at stadia VIII, IX or X. These probably correspond to two generations of animals. *O. moreleti* is thought to oviposit in autumn (Baker, 1978b, and Metchnikoff, cited by Halkka, 1958), thus by April 1981, the 1980 young will have reached stadia V-VIII and the 1979 young stadia VIII-X. At the highest altitude there is a further peak at stadia XIII-XIV which may be a third generation.

Secondly, at low altitudes (<200 m) the first generation has succeeded in reaching stadia VI

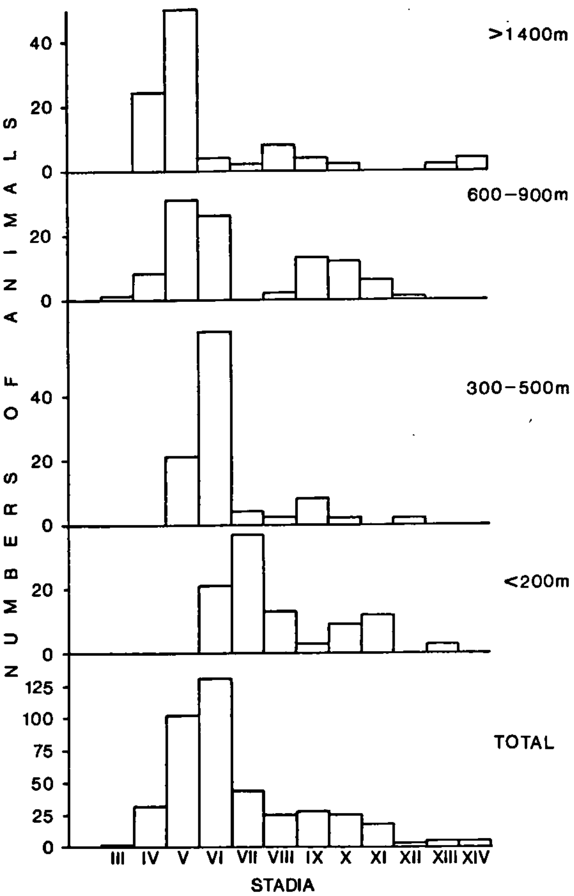

Fig. 1. Stadial distributions of *Ommatoiulus moreleti* collected at different altitudes in April 1981.

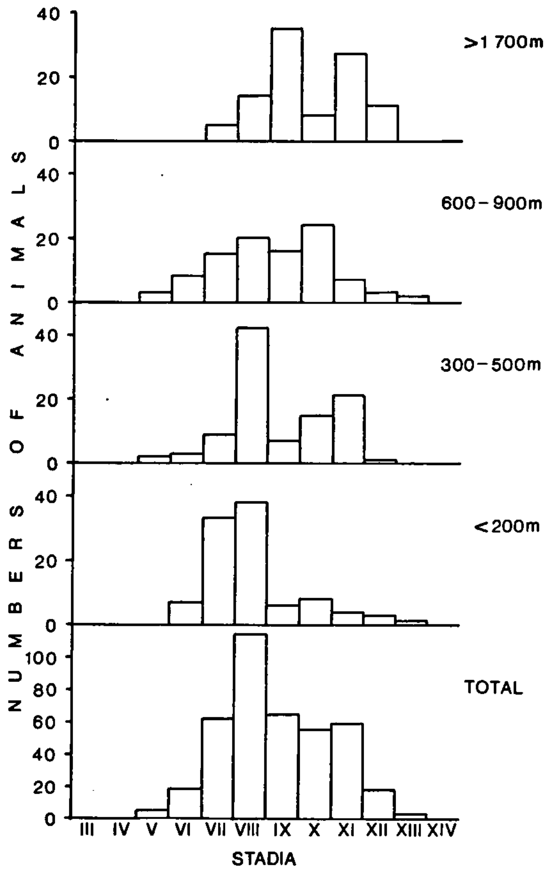

Fig. 2. Stadial distributions of *Ommatoiulus moreleti* collected at different altitudes in August 1981.

to VIII, whereas at 600-900 m it has only reached V to VI. Thus as altitude increases the younger generation is represented by earlier stadia; this is also true for the second generation. Statistically this correlation of altitude and stadia is significantly negative when tested using a Spearman rank correlation coefficient (r_s = -0.4266, *df* = 272, p = <0.001).

The older the generation the lower the numbers, perhaps due to mortality or to a sampling bias, as only a representative sample of older animals was taken. This is unlikely to affect the reliability of the histograms greatly, as it applies only to stadia above those where the peaks occur.

Effect of altitude in August

Fig. 2 shows stadial distributions in August. Two generations are again present. At the lowest height range the youngest generation has only advanced one stadium from April to August. As altitude increases, more stadia have been passed through between these dates, so at 600-900 m three stadia have been covered. Animals at higher altitudes catch up with those lower down and may even surpass them. Thus in August there is a significant shift to later stadia with rising altitude (Spearman rank correlation coefficient r_s = 0.3722, *df* = 467, p = <0.001).

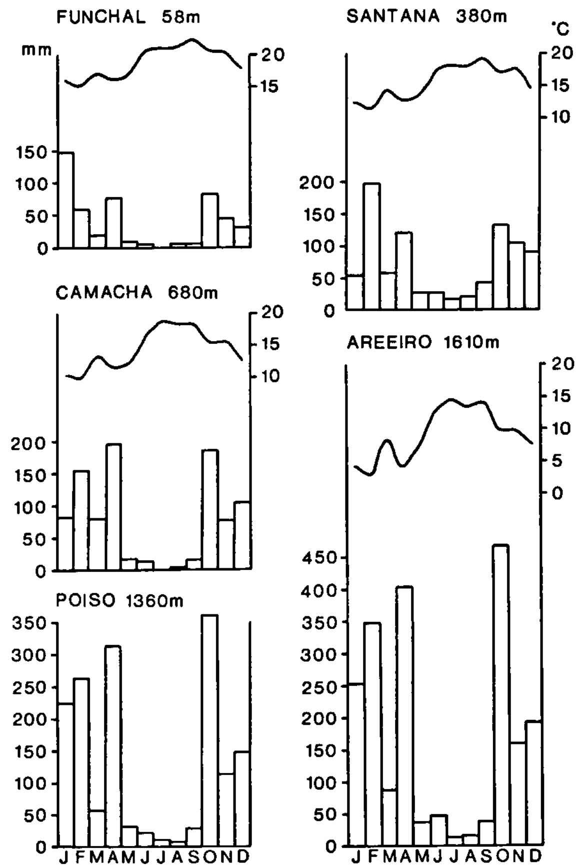

Fig. 3. Climate graphs for five places of differing altitude (metres), showing total rainfall per month (mm) and mean monthly temperature (°C) (data from the Observatorio Meteriologico do Funchal).

THE ALTITUDE EFFECT AND CLIMATE

The island of Madeira is 58 km long by 23 km wide, reaching a maximum height of 1862 m. The coastal areas are usually warmer than the inland regions. For example Funchal has the hottest mean monthly temperature of 22°C, and there is a reduction in temperature of 1°C per 155 m. At the middle altitudes a layer of cloud exists, above this, in summer, there is often bright sunlight, whereas between November and May the mean temperature is less than 10°C and can drop below 0°C. The climate graphs (fig. 3) show data from 1981 for places of different altitude.

Table I summarises the climatic features of the altitudinal ranges for the months when collections were taken. Locations of weather stations and collecting sites are not identical, however weather data are present for each height range used in the analysis.

TABLE I

Summary of climatic data for April and August 1981 according to altitude.

Height	April		August	
m	Temp. °C	Rainfall mm	Temp. °C	Rainfall mm
<200	16.1	76.2	21.5	3.1
300-500	12.9	121.6	17.9	22.6
600-900	11.4	196.8	18.4	6.1
>1400		312.9		
>1700			13.4	16.2

Assuming that the millipedes thrive in warm moist conditions (as seems to be the case in culture experiments, unpubl. obs.) it could be presumed that during the winter and early spring the animals grow best in the lower altitudes as these are warm, with temperatures around 16°C and have some rainfall, the higher altitudes are probably too cold for much growth. During the late spring and summer, the low altitudes have an increased temperature and decreased rainfall so animals slow their growth to a negligible rate and probably aestivate to stop excessive water loss. A more equable climate occurs higher up with a temperature similar to that found at low altitudes during the winter; there is also an abundance of water during this time. Growth proceeds more rapidly here and "catches up" with that of the aestivating animals lower down.

The differences in rates and periods of growth observed at varying altitudes may be one of the factors enabling successful colonization. This species can respond to advantageous conditions with increased growth and to adverse conditions by reduction in rate of growth; and may therefore exist in a wide range of areas and habitats.

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