

***PACHYMERIUM FERRUGINEUM* (C.L. Koch, 1835) – TWO DISTINCT FORMS IN CRETE?**

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INTRODUCTION

According to Eason (1979), it seems that geophilomorph species from cold and temperate regions tend to be smaller with fewer leg bearing segments than those from warmer regions. As pointed out by Meinert (1870), Attems (1902, 1929) and Brölemann (1930), a considerable geographical variability exists in the number of leg bearing segments (LBS) in *Pachymerium ferrugineum* (C.L. Koch, 1835). LBS vary between 41-55 in males and 43-57 in females. A rather extensive Eastern Fennoscandian material investigated by Palmén (1949) indicated that LBS seems to be considerably smaller than stated by several authors for S. European and African specimens. For instance, Meinert (1870) found the same species in N-Africa to have a modal number for females of 55 LBS. Northern European populations have 41 to 47 LBS whilst specimens from Palestine 67 or 69 LBS. Thus, according to Lewis (1981), widely distributed geophilomorphs are highly variable.

The main aim of this work is to present a preliminary study on the geographic pattern of variation in the segment number of *Pachymerium ferrugineum* (C.L. Koch, 1835) between Crete and its small satellite islands in the south.

MATERIALS AND METHODS

We present here data for *Pachymerium ferrugineum* of which we compare populations from small islands adjacent to Crete (satellite islands, such as Gavdos, Chrysi and the island group of Koufonisia), and the island of Crete (Table 1). Comparisons between populations were made using chi-square (X^2) contingency table tests (Table 2).

The examined material belongs to the centipede collection of the Natural History Museum of Crete - NHMC (University of Crete). Specimens were collected by hand or by pitfall traps and were preserved in 70% alcohol. In total, 31 sites were studied on the island of Crete and the satellite islands. Centipedes were sorted in the arthropod laboratory and were identified by the first author. The identification of the samples was based on Kanellis (1959). Maps were drawn with Arc View GIS version 3.1. and Corel Draw 9.

Map 2 presents the known distribution of *Pachymerium ferrugineum*. The bibliographic references to Crete (BIBL) are shown with flags, the studied material belonging to the NHMC with full circles.

RESULTS

Geographical distribution (Map 1): Mainland and insular Greece, Turkey, Cyprus, Albania, Bulgaria, Romania, Slovenia, Croatia, Bosnia Herzegovina, FYR Macedonia, European Russia, Palestine, Iran, Caucasus, Turkestan, Azores, Madeira, Canary Is., Tunisia, Algeria, Morocco, Central Sahara, Cyrenaica, Tripolitania, Portugal, Spain, Balearic Is., France, Corsica, Italy, Sardinia, Sicily, former Czechoslovakia, Austria, Hungary, Poland, Latvia, Finland, Norway, United Kingdom, Netherlands, Alaska, Pribilof Is (Zapparoli, 2002).

CHOROTYPE: W - PALEARCTIC (ZAPPAROLI, 2002).

Table 1.

Segment number data for Cretan populations of *Pachymerium ferrugineum*.

Males

LBS	41	43	45	55	57	59	Total
CRETE	1	8	10	2	1	0	22
Satellite Islands	0	0	0	7	3	3	13
Total individuals	1	8	10	9	4	3	35

Females

LBS	43	45	47	55	57	59	Total
CRETE	3	12	18	0	7	3	43
Satellite Islands	0	0	0	9	10	11	30
Total individuals	3	12	18	9	17	14	73

Table 2.

X^2 test for differences in leg bearing segments of *Pachymerium ferrugineum*.

	SEX	df	p
<i>Pachymerium ferrugineum</i>			
	Males	5	<0.001
	Females	5	<0.001

DISCUSSION

In Europe (Finland), *Pachymerium ferrugineum* was found to have 45 LBS (modal number) for females (Palmén, 1949). However, the same species in North Africa and E-Mediterranean has a greater modal number (55 LBS for females). Based on scanty information about the frequencies of the different forms of *P. ferrugineum*, Eason (1979) referred to "...a rather tentative suggestion of a geographical cline", suggesting that it would be reasonable to divide the species into subspecies along the cline. In contrast, Zapparoli (2002) believes that there is only a unique species.

Considering Crete, it seems to be that temperature is not the only environmental factor responsible for the noted difference in the number of trunk segments. Crete consists of an island formation placed between the southern (N. Africa) and the northern (Finland) extremes of the range of *P. ferrugineum*. It is noteworthy that the North-central European short form is widely distributed in the island whilst the southern satellite islands have the East Mediterranean long form. Moreover, looking through the existing ecological data, we could say that the two forms have distinct habitat preferences. *P. ferrugineum* (short form) is widespread on Crete, occurring from western to eastern places, up to 2000 m, but mainly between 1000 and 2000 m. It is collected in man-made habitats, in *Pinus brutia* forests, in mixed phryganic - maquis areas with *Corydthymus capitatus*, *Sarcopoterium spinosum*, *Pistacia lentiscus* and *Nerium oleander*, as well as in mountainous areas dominated by *Quercus coccifera*. It has been also found on subalpine and alpine phrygana with *Berberis cretica*, *Astragalus angustifolius* and *Satureja spinosa*. In contrast, the long form of *P. ferrugineum* is almost absent from Crete, only being collected from a plateau dominated by *Berberis cretica*, *Genista acanthoclada*, *Phlomis* sp. and some *Quercus coccifera* and *Acer sempervirens*. It occurs mainly at the small satellite islands on the South, preferring coastal phryganic areas, man made habitats and sand dunes.

Recent works on *Geophilus carpophagus* in United Kingdom are relevant to the findings reported here for *Pachymerium ferrugineum*. Eason (1979) found that populations of *Geophilus carpophagus* living in man made areas had higher segment numbers than those living in the wild, suggesting that the phenotypic plasticity of the LBS is caused by higher temperature. However, it has recently been shown that the form found in buildings is a distinct species (Arthur et al., 2001). In spite of the fact that the last work retracts the only apparent evidence for plasticity of segment number in geophilomorphs, Kettle et al. (2001) suspects that there will be still a small plastic effect.

Based on the distinctive geographical distribution and different ecological records of each form, we could accept that Crete and the surrounding islands constitute a unique geographic “meeting place” and “dipole” simultaneously (separating the short Cretan populations in the north from the long ones in the south). Therefore the hypothesis that there is a geographic cline in *P. ferrugineum* with segment numbers gradually increasing from north to south is partially confirmed. According to that, it would be reasonable to hypothesize that the different environmental pressure between Crete and the small surrounding islands has brought about genetic changes, or selected for one form rather than the other. Therefore, as concerns the form of selection produces this differentiation we could agree with Kettle et al. (2002), supporting that more segments give greater maneuverability, and hence prey catching and predator avoidance ability, and that in warmer and drier climates (such as on the surrounding islands of Crete) with longer periods of activity there is stronger selection for this pattern.

Nevertheless, the facts presented here suggest that the distribution and taxonomic status of these forms needs to be further investigated.

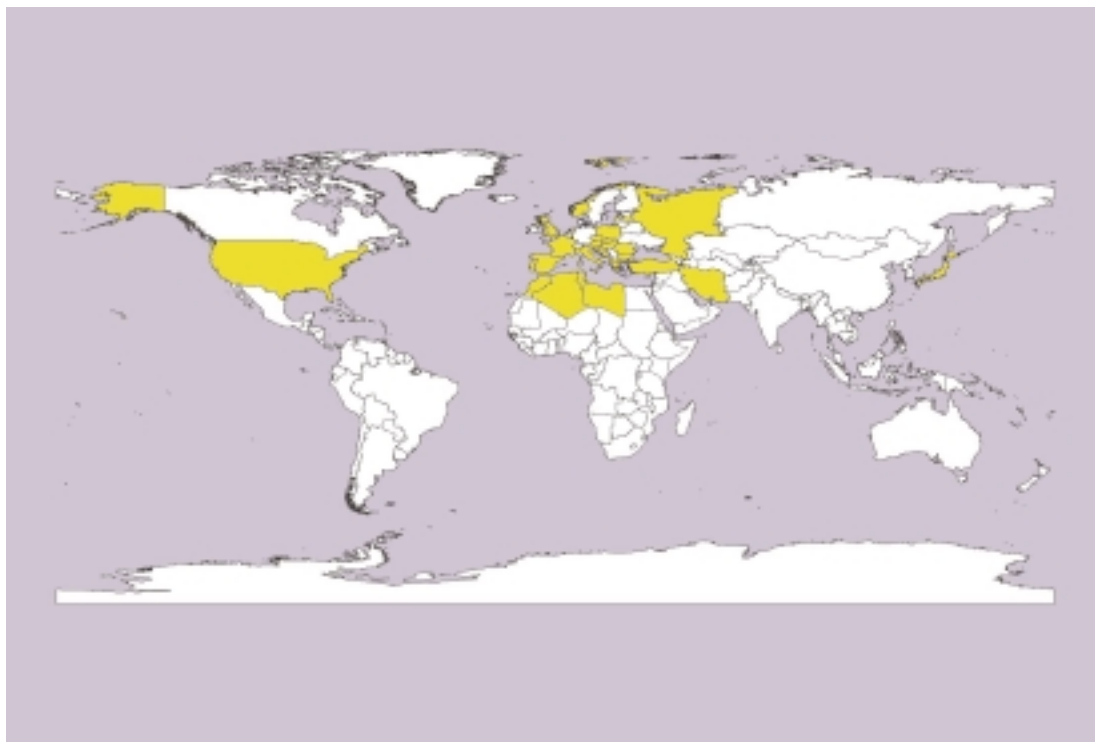
CONCLUSIONS

Pachymerium ferrugineum exists in two forms. The “short” form (*P. ferrugineum*), with 41, 43, 45 and 47 pairs of legs, is widely distributed on the island of Crete but not on the small satellite islands of the south. The “long” form (*P. f. insularum*) with 55, 57 and 59 pairs of legs is abundant on the satellite islands of the south (Gavdos island, Koufonisia islets, Chrysi islet), and in two isolated population in SW-Crete. It seems to be that temperature is not the only environmental factor responsible for the noted difference in the number of trunk segments.

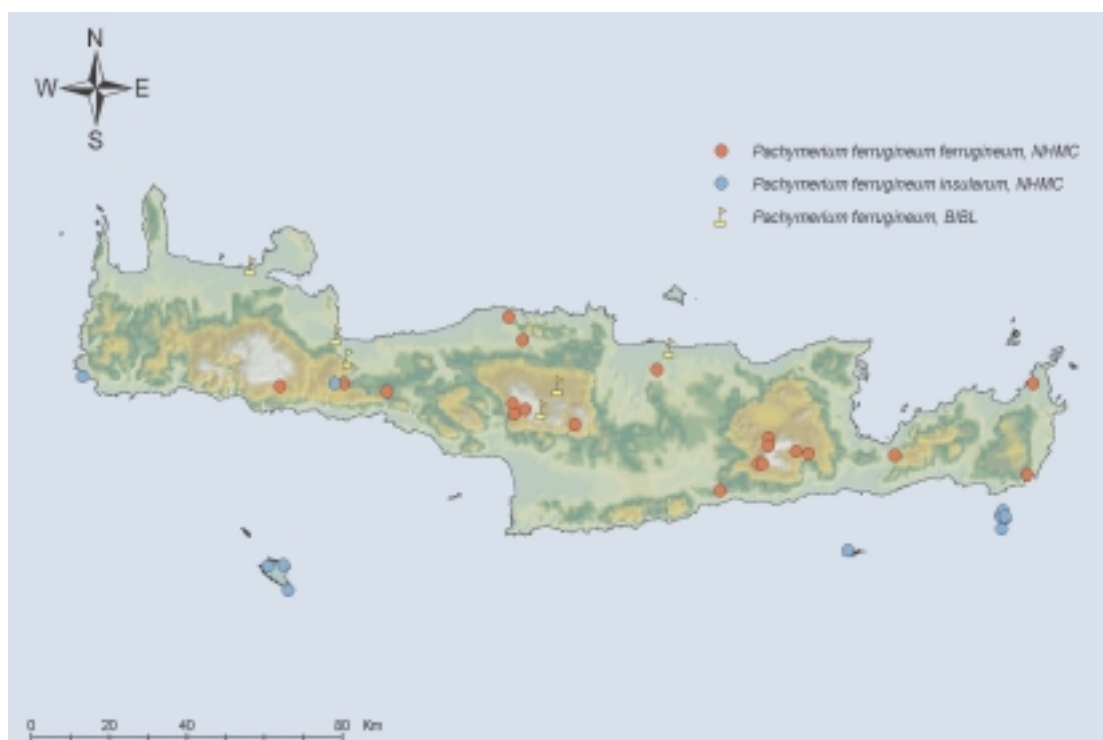
The short form has wide ecological range on Crete while the long form occurs at specific habitats mainly on the surrounding small islands.

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Map 1. Geographical distribution..



Map 2. Distribution in Crete.

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