

THE POSSIBLE FACTORS AFFECTING THE DISTRIBUTION AND ABUNDANCE OF THE CENTIPEDES *LITHOBIUS VARIEGATUS* LEACH AND *LITHOBIUS FORFICATUS* (LINN.) IN THE BRITISH ISLES.

J. G. E. Lewis

Manor Mill Farm, Halse, Taunton, Somerset, TA2 3AQ.

In two recent publications both on the distribution of centipedes in Yorkshire (Richardson, 1993 and Richards, 1995) attention has been drawn to the fact that the distribution of *Lithobius variegatus* Leach in the British Isles has not yet been fully explained. It seems appropriate, therefore, to review the current state of knowledge on this topic and the possible relationship between *L. variegatus* and *L. forficatus* (Linn.).

Eason (1964) noted that *Lithobius forficatus* "is the most familiar and widely distributed British centipede, being frequently found in gardens and suburban areas and, owing to its habit of wandering in the open at night, often finding its way into outbuildings and houses. It cannot, however, be regarded as synanthropic as it occurs commonly in woodland, grassland and moorland, well away from houses and villages: it has been found on the sea-shore above high-tidemark and also as high as 1,500 feet in the mountains of Scotland." It occurs in Europe generally, the Mediterranean region, the Caucasus and North Africa and has been frequently introduced elsewhere. In the British Isles *Lithobius variegatus* is a woodland species, also common in grassland and moorland, mountainous country and coastal areas but relatively uncommon in gardens, buildings and suburban areas (Eason, 1964). It was thought to be endemic to the British Isles but is now known to occur on the continent. Eason and Serra (1986) distinguished two subspecies: *L. variegatus* from the British Isles, northern France, north-west Spain and northern Portugal and *L. variegatus rubriceps* Newport from the rest of the Iberian Peninsula, southern Italy and Sicily and North Africa. The authors suggested that climate is an important factor affecting the distribution of this species but is unlikely to be the sole factor, pointing out that it is difficult to explain the absence of the species from south-west France on grounds of climate alone. They observed that a competing species from the east which had failed to penetrate Brittany and failed to cross the Pyrenees into the Iberian Peninsula might possibly have played some part as well. Kime, Lewis and Lewis (1987) suggested *Lithobius piceus* L. Koch as a possible competing species in Normandy.

Eason (1964) observed that in the British Isles the two species are frequently found together but there are few records of *L. variegatus* east of the 38°F (3.0°C) winter isotherm in England and none from a similar area in eastern Scotland. This suggests that temperature may be an important factor. Blower (personal communication) has pointed out that these are also areas of low rainfall. Eason (personal communication) writes "Judging from the climate maps in Tansley The British Isles and their vegetation Vol. 1 (1949) figs. 11 & 27, the 38° F winter isotherm fits the distribution of *L. variegatus* better than mean annual rainfall, specially in Scotland. Barber and Keay's (1988) map also supports my theory."

Gregory and Campbell (1996) wrote of *L. variegatus* in Oxfordshire "can be locally abundant in woodlands and scrub on both acidic and calcareous soils... in the clay vales it has proved unexpectedly rare and confined to ancient woodlands." *L. forficatus* "despite a strong preference for urban sites,.... can also be found in most rural habitats except where *L. variegatus* is common".

Roberts (1956) showed that in Hampshire *L. variegatus* was less tolerant of low temperature than *L. forficatus*. In February 1956, of 23 immaturus and 96 maturus *L. variegatus* collected from dead logs, four immaturus and 52 maturus individuals were dead. The dead specimens were all under bark on the upper sides of logs where temperatures were as low as - 3°C. Living specimens were either in or beneath logs. Similarly, Lloyd (1963) found large numbers of dead *L. variegatus* in decayed logs after exceptionally cold weather in Oxfordshire. *L. variegatus* was uncommon in dry Chestnut wood in Hampshire but common in a damper Beech dominated wood. Roberts (1956) suggested that weather and predators were two of the more important factors controlling the number of *L. variegatus* in these Hampshire woodlands but the low numbers of *L. forficatus* (which can survive for long periods in a saturated atmosphere) in a damp wood were due to some additional factor not directly related to microclimate. Lewis (1967) in a rather tenuous argument suggested that the number of gregarine parasites could be Roberts' "additional factor" as parasite numbers were higher in the damper woods in the study area at Shipley Glen in Yorkshire where *L. forficatus* was less common but, if parasites were the cause, *L. forficatus* would have to be less resistant to the infection than *L. variegatus*. The similarity in the diet of these two species seemed to eliminate food as being important in their distribution (Lewis, 1965). It was also suggested that the prolonged period of oviposition in *L. variegatus* might be a safeguard against the loss of the brood during a dry season indicating that the species was less resistant to climatic extremes than *L. forficatus*.

Turk (1946) reported *L. forficatus* to be rare above 800 feet in southern England, being 'replaced' at higher altitudes by *L. variegatus* but at Bolistone in Scotland *L. forficatus* was the dominant species above 1000 feet. Barber (1985) in a discussion of *L. variegatus* wrote: "Any relationship between distribution and winter temperatures is clearly not a straightforward one. The tendency of the species apparently to favour upland areas may in fact be more due to the fact that it does not occur in urban and suburban sites in general, areas from which a higher proportion of lowland, compared with upland, records are made."

Richards, (1995) suggested that *L. variegatus* might compete with *Lithobius forficatus* at higher altitudes but the reason for the absence of *L. forficatus* from some upland and other localities may be that the species has not yet arrived. Pocock (1893) noted that "in the South of England *L. forficatus* is found most abundantly under bricks and planks, in or near yards, outhouses etc. *L. variegatus*, on the contrary, is found under stones and tree-trunks in woods or the open country. These facts in distribution suggest that *L. forficatus* has been introduced into the British Isles later than *L. variegatus*".

In West Somerset *L. variegatus* is by far the most common centipede in woodland: *L. forficatus* is rarely present (Lewis, unpublished data). The latter species is usually found in habitats associated with human activity past, such as long disused quarries and

ruins, and present. In some cases it is difficult to imagine what factors associated with human habitation remain. It would seem that once transported by man it persists after human activity has ceased. The rarity of *L. forficatus* in the woodlands of west Somerset suggests that it is still spreading as Pocock (1893) had supposed. Indeed the paucity of centipede species in west Somerset despite the wide variety of habitats and mild climate suggests that it has yet to be colonised by species common elsewhere.

The absence of *L. variegatus* from areas of human habitation is difficult to account for. It may be due to predation, possibly by *L. forficatus*, although the two species are often found together in rural habitats. *L. forficatus* will certainly take small *L. variegatus* and Johnson (1952) reported that it takes small specimens of its own species. *L. variegatus* appears not to do so. This may be the reason why both immature and mature *L. variegatus* are frequently found together whereas immature and mature *L. forficatus* are not. Thus Lewis (1965) noted that very few immature *L. forficatus* were found during an investigation in some Yorkshire woodlands in contrast to *L. variegatus* where immature and mature individuals were common. It is odd that *L. variegatus* with its large head and powerful poison claws may be less aggressive than *L. forficatus*.

Fründ (1992) suggested that the frequency of scars in centipedes may indicate predator intensity or general ecological stress and his method might usefully be employed in further investigating the situation in *L. forficatus* and *L. variegatus*. Work on *L. forficatus* in Germany shows it to be common at woodland edges. Scar frequency is higher in the forest floor than in urban localities (Fründ, Balkenhol and Ruszkowski, 1996)

Other differences between the two species are that *L. forficatus* has stout legs and burrows whereas *L. variegatus* with a broad head and slender legs appears not to do so. The weighted data of Barber and Keay (1988) expressed as a "standardised percentage" gave 20.1% in soil for *L. forficatus* as compared with 4.9% for *L. variegatus*. There are behavioural differences between the species: *L. forficatus* runs away when exposed, as when a log or stone is turned but *L. variegatus*, as Eason (1964) pointed out, has colour-markings that "make it inconspicuous against its natural background of leaves and stones and, like so many protectively coloured animals it tends to remain motionless when disturbed." It is often found clinging ventral side uppermost to the underside of stones and bark whereas *L. forficatus* rests face-downwards. Similar behaviour when under leaves would be an effective defence against bird predation as blackbirds, for example, when hunting through dead leaves flick them aside to expose prey on the ground beneath. A specimen of *L. variegatus* clinging to the underside of the leaf would go unnoticed if it remained motionless.

The colour-markings of *L. variegatus* may be due to a reduction in the pigment lithobioviolin beneath the cuticle and it is possible that this may render it less resistant to low oxygen tensions in the soil.

CONCLUSIONS

The geographical range of *L. variegatus* may be limited by climatic factors: low temperature and, or, dry conditions and by competing species or predators of which *L. forficatus* may be one. Its absence from urban localities may be due to predators characteristic of such localities and possibly the shortage of litter and humus.

L. forficatus appears to have been a more recent arrival in the British Isles. Man appears to be important in distributing it and it is probably still spreading. Its penetration of woodland may be partially limited by woodland predators. The problem remains a complicated one. No doubt a number of factors operate at the same time and different factors may be of importance in different areas at different times.

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