Bulletin of the British Myriapod Group 15 (1999)

LIMITED VARIATION IN SEGMENT NUMBER IN POPULATIONS OF *BRACHYGEOPHILUS TRUNCORUM* AND *GEOPHILUS INSCULPTUS* IN NORTHUMBERLAND AND DURHAM

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INTRODUCTION

A great deal of information has been compiled, over many years, on the extent of variation in the number of trunk segments in geophilomorph centipedes (see review by Minelli & Bortoletto 1988). However, most of this information relates simply to the overall variation within each species, either in a particular country or over the whole of the species' range (e.g. Eason 1964). Little is known about the way the intraspecific variation is geographically structured. Whether populations living in particular localities should exhibit the same range of variation as the species as a whole, or just a small subset of it, is in most cases not known. This is sometimes problematic from a species-identification viewpoint, and it restricts the usefulness of the currently available data in answering questions about evolutionary change in segmentation, despite the many potential advantages that geophilomorphs possess in this respect.

With regard to the amount of variation within a single local population, Misioch (1978) argued that sufficient intensity of sampling might reveal *more* variation than thought to characterize the species as a whole, and gave three examples. But whether this is true of most species is not yet known. With regard to differences in segment number between populations living in different places, the best example of this is *Strigamia maritima* (Lewis 1962), though the cause of the differences observed is still obscure. There are also differences between populations within *Geophilus carpophagus* and *Pachymerium ferrugineum* (Eason 1979) which have been attributed respectively to (a) the environmental differences between natural and synanthropic sites (see also Keay 1994 on *Haplophilus subterraneus*) and (b) a possible effect of latitude - but whether these are the correct explanations is not yet clear.

To generate some new data on this problem, we sampled populations of two species, *Brachygeophilus truncorum* (Bergsöe & Meinert) and *Geophilus insculptus* Attems, at several localities in Northumberland and Durham, and examined the amount of variation within and between populations.

METHODS

Twelve sites (see Table 1) were sampled between August and November 1998. In each case, an area no bigger than 300 x 100 m was used, and a search was conducted for about 2-3 hours. Four types of microhabitat were examined - soil (top 20cm), leaf litter, the undersides of stones, and rotting wood (generally underneath the bark or underneath the piece of wood itself). All centipedes found were identified to species in the laboratory. Although *B. truncorum* and *G. insculptus* were generally the commonest geophilomorphs, other geophilomorph species, and several lithobiomorph species, were also collected - these data will be presented and analyzed in a separate paper.

Small juveniles in which sex could not be determined with certainty were omitted from the study. The remaining individuals were sexed and the number of leg-bearing, or trunk, segments was counted for each.

TABLE 1

SAMPLING SITES

County	Locality	Grid ref.	*B. truncorum*	*G. insculptus*
Northumberland	Harwood	NY 964 908	+	-
Northumberland	Allen Banks	NY 799 634	+	+
Northumberland	Allenheads	NY 824 434	+	-
Northumberland	Darras Hall	NZ 151 703	-	+
Northumberland	Gosforth Park	NZ 244 714	-	+
Northumberland	Linden Hall	NZ 154 966	-	+
Durham	Muggleswick	NZ 028 453	+	-
Durham	Chopwell	NZ 133 578	+	-
Durham	Thornley	NZ 179 603	+	+
Durham	Hamsterley	NZ 067 298	+	-
Durham	Sedgefield	NZ 346 257	-	+
Durham	Redworth	NZ 229 234	-	+

The county name given correspond to Vice-Counties 66 and 67. The 'urban county' of Tyne & Wear is not utilized here. Also, none of the samples were from North Northumberland (Vice County 68).

RESULTS

Each species was found at a total of seven sites. Tables 2 and 3 show the results for the relevant sites for *B. truncorum* (74 individuals) and *G. insculptus* (45 individuals) respectively. These tables also show, for comparison, the range of segment numbers given by Eason (1964) as characteristic of these species. It is apparent that, for both species, the range of variation observed is somewhat less than (and slightly displaced from), the variation given by Eason (1964). This result is, in a sense, the opposite to what Misioch (1978) found.

The lack of variation is most pronounced in *B. truncorum*. Here, only a single male out of 27 has other than the 'normal' 37 segments, while only two females out of 47 have other than the 'normal' 45 segments. The majority of local populations show no within-sex variation at all, though they exhibit the expected sexual dimorphism. Although *G. insculptus* shows a little more variation in the males, it is still more restricted than might have been expected, with only one male lying outside the 47/49 segment categories.

TABLE 2

NUMBER OF TRUNK SEGMENTS IN MALE AND FEMALE *BRACHYGEOPHILUS TRUNCORUM* FROM SEVEN SAMPLING SITES IN NORTHUMBERLAND AND DURHAM

Site	Males				Females			
	35	37	39	41	35	37	39	41
Harwood	0	4	0	0	0	0	10	0
Muggleswick	0	2	0	0	0	0	6	0
Chopwell	0	3	0	0	0	0	4	0
Allen Banks	0	6	0	0	0	0	2	0
Allenheads	1	1	0	0	0	1	5	0
Thornley	0	7	0	0	0	0	13	0
Hamsterley	0	3	0	0	0	1	5	0
TOTAL	1	26	0	0	0	2	45	0
EASON	-	+	+	-	-	-	+	+

TABLE 3

NUMBER OF TRUNK SEGMENTS IN MALE AND FEMALE *GEOPHILUS INSCULPTUS* FROM SEVEN SAMPLING SITES IN NORTHUMBERLAND AND DURHAM

Site	Males					Females				
	45	47	49	51	53	45	47	49	51	53
Sedgefield	0	0	2	0	0	0	0	0	2	0
Redworth Wood	0	0	2	0	0	0	0	0	2	0
Allen Banks	0	1	1	0	0	0	0	0	2	0
Thornley Wood	0	0	1	0	0	0	0	0	1	0
Darras Hall	0	0	7	0	0	0	0	0	6	0
Gosforth Park	0	3	1	0	0	0	0	0	5	0
Linden Hall	0	1	1	1	0	0	0	0	5	1
TOTAL	0	5	15	1	0	0	0	0	23	1
EASON	+	+	+	-	-	-	-	+	+	+

DISCUSSION

Clearly, the data-set presented has its limitations: it involves only two species and only one region (NE England) ; also, the sample sizes from individual localities are relatively small. Nevertheless, it reveals that in at least some cases the amount of variation in segment number within and between local populations of a geophilomorph species can be very limited. How common this situation is, in comparison to Misioch's (1978) finding of considerable local variation, is not yet clear.

To some extent, different species may show different patterns. Nevertheless, the same species may show different patterns in different places. An example of this is *Geophilus carpophagus* where both males and females are almost constant in segment number in Danish populations (with 53 and 55 segments respectively: H. Enghoff, pers. comm.), while both sexes exhibit considerable variation in Britain (Eason 1979). Another example is *B. truncorum,* as this was one of the three species studied by Misioch.

Whatever the extent of variation within and between populations in each species, its cause is still unknown. Differences between individuals may be hereditary, as

suggested by Prunescu & Capuse (1972), in which case they may be subject to genetic drift and founder effects (Lewis 1962) and/or to natural selection. Alternatively, differences may be partly or wholly due to phenotypic plasticity (Eason 1979), as a result of the direct effects of environmental factors, such as temperature, an embryogenesis. Some apparent intraspecific variation may not even be that at all, but may be due to the presence of as-yet-unidentified cryptic species (Lewis 1985)

These questions are of considerable interest, but a concerted experimental approach is required if they are to be answered. Breeding experiments are necessary, and attempts to rear broods under different environmental conditions (e.g. different temperatures) to explore possible plasticity may also be informative. We are intending to conduct studies of this kind in the near future. However, the species examined in the present paper do not provide good material for such experiments, due to (a) the difficulty of obtaining large samples from individual localities, and (b) the difficulty of telling the sexes apart reliably in live specimens. To obviate these difficulties, our experiments will involve *Strigamia maritima*.

ACKNOWLEDGEMENT

We thank Chris Kettle for his helpful comments on the manuscript.

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