Isopoda (1987) 1, 21-36

BIOGEOGRAPHY OF WOODLICE IN BRITAIN AND IRELAND

S.P. HOPKIN
Department of Pure & Applied Zoology, University of Reading,
Whiteknights, PO Box 228, Reading, RG6 2AJ

INTRODUCTION

A detailed analysis of the distribution and habitat of each of the thirty four species of terrestrial isopods which occur in Britain and Ireland has been presented previously by Harding & Sutton (1985). The distribution maps included in Harding & Sutton's analysis were drawn from records submitted to the Non-marine Isopod Survey Scheme to April 1982. Records submitted after this date have mostly filled in gaps in the maps which would have been expected from the continuous activity of recorders. However, our perception of the ranges of some species have altered in the period since 'Woodlice in Britain and Ireland' was published. In this article, updated distribution maps are presented for fourteen species and a preliminary attempt is made to classify the distribution of terrestrial isopods into six broad categories based on records submitted to the Non-marine Isopod Survey Scheme to March 1987.

FACTORS WHICH CONTROL THE RANGES OF WOODLICE SPECIES

Factors controlling the ranges of woodlice species are either physical or biological. These will modify the growth, fecundity (production of offspring) and survival of each species and limit the number of habitats which they are able to colonise.

1) PHYSICAL FACTORS

a) Climate

Temperature and rainfall are probably the most important factors controlling the distribution of terrestrial isopods in Britain and Ireland. January isotherms run roughly north-west to south-east (Fig. 1) whereas July isotherms run roughly south-west to north-east (Fig. 2). This allows Britain and Ireland to be divided into four quadrants with differing temperature regimes (Fig. 3). Isohyets (lines joining sites with equal rainfall) run roughly north to south so that the west is generally much wetter than the east (Fig. 4).

Presentation of climatic data in this way may however be misleading since extremes of weather are much more likely to control the distribution of a species than annual means. For example, on 12 January 1987, the weather station on Reading University campus recorded the lowest mean temperature for any

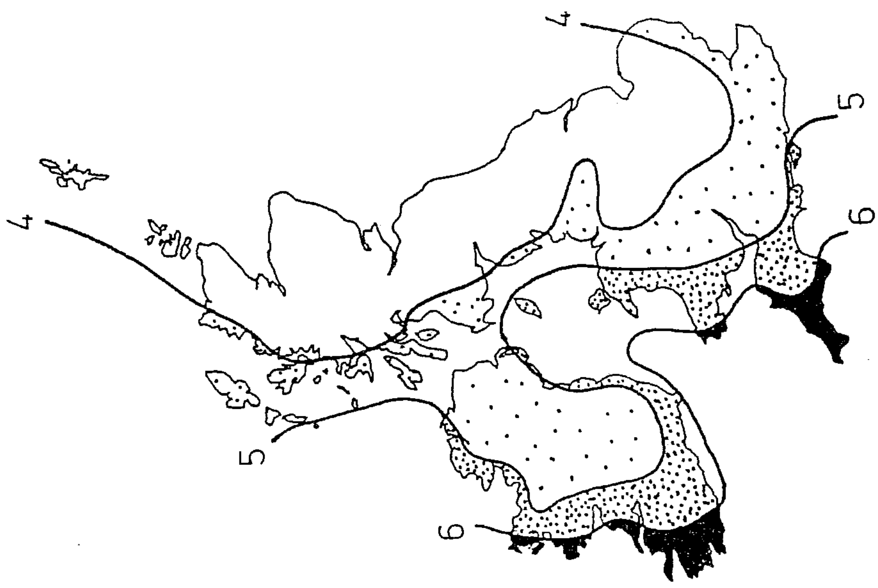

Fig 1 : Mean January Isotherms (^{o}C)

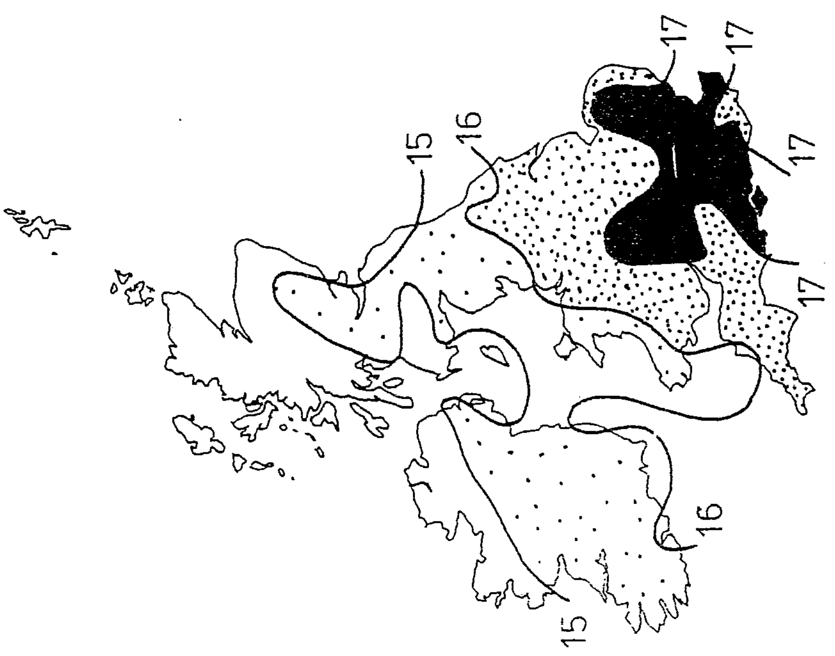

Fig. 2 : Mean July Isotherms (^{o}C)

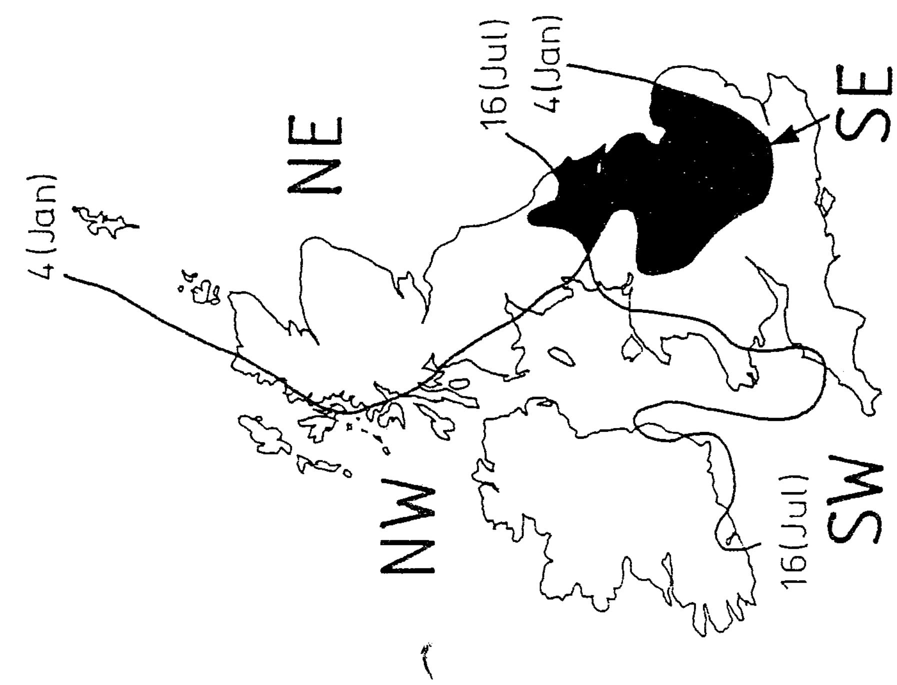

Fig. 3 : Temperature regime quadrants (SM = Summer Mean, WM = Winter Mean)

NE = SM < 16 ^{o}C; WM < 4 ^{o}C
SE = SM > 16 ^{o}C; WM < 4 ^{o}C
SW = SM > 16 ^{o}C; WM > 4 ^{o}C
NW = SM < 16 ^{o}C; WM > 4 ^{o}C

day of the year since 1921 (-8.3 ^{o}C). The minimum temperature that day (or rather night) was -9.8 ^{o}C and the maximum -6.8^{o}C, the lowest maximum since before 1960. The aggregate rainfall was only 8.7 mm, the lowest for January since 1921 and the number of rain days (0.2 mm or more) the second lowest since 1921. There were more sunless days than in any January since 1973; fourteen of these were 14-27 January inclusive, the longest period without measurable sunshine since before May 1958. Such combinations of climatic extremes which may occur only once every 50 years in this area, may be the factor which controls the spread of species which appear on current knowledge to be on the edge of their ranges near to Reading (eg. Armadillidium pulchellum, Fig. 9; Armadillidium depressum, Fig. 12; Trachelipus rathkei, Fig. 16; Trichoniscoides albidus, Fig. 19).

Some species may require a minimum time above a certain temperature to complete their life cycle. For example, only a small area of Britain and Ireland has nine months or more with an average monthly temperature of 6 ^{o}C or greater (Fig. 5). This area shows a remarkable correlation with the known distribution of the ´Lusitanian´ species Porcellionides cingendus (Fig. 11) and the coastal Halophiloscia couchi (Fig. 8) suggesting that temperature is the most important factor controlling the distribution of these species.

b) Geology

Woodlice do not like acidic habitats since calcium, which they require for their exoskeleton, is usually in short supply in such areas. Calcareous rocks occur mainly in south-east and northern England and central Ireland (Fig. 6). Some species appear to proliferate in areas with calcareous rocks. Armadillidium vulgare (Fig. 13) and Porcellio spinicornis (Fig. 10) are much more common on the chalk and limestone respectively than on other inland sites in the south of England. The presence of calcium in mortar and building stone also appears to enable Porcellio spinicornis (Fig. 10) to colonise synanthropic sites outside its natural "anti-Atlantic" range. All sites in Cardiganshire (Vice County 46) where Porcellio spinicornis has been extensively recorded (Fig. 10) are synanthropic sites (Chater 1986).

c) Altitude

Very few woodlice seem to be able to survive on the highest peaks although it should be pointed out that not many recorders have climbed mountains in search of isopods! I have searched several peaks over 700 m in the English Lake District and although centipedes, spiders, harvestmen (opilionids), mites and Collembola are quite common, I have yet to find a single woodlouse. The combined effects of low temperature and the drying effects of the wind in these exposed areas presumably prevents woodlice from the slopes of such peaks from colonising

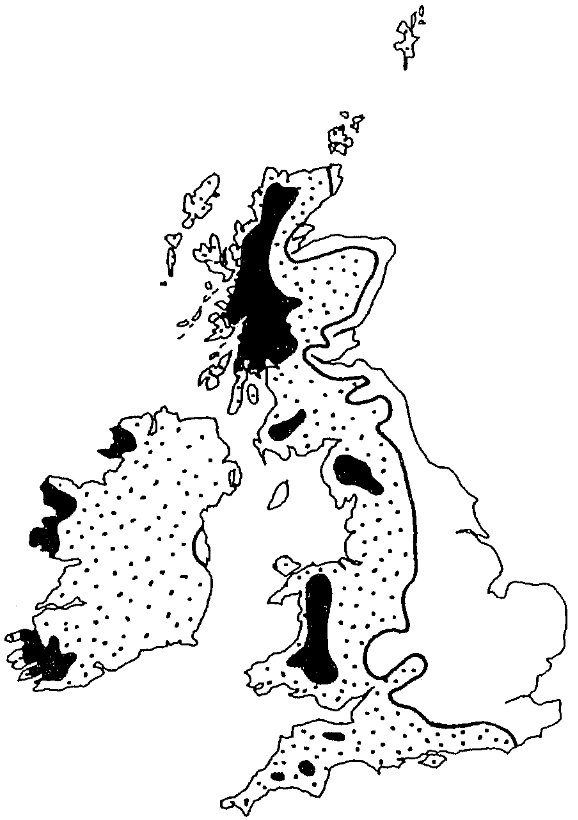

Fig 4 : Isohyets (annual mean mm)

- > 1500 mm
- 750-1500 mm
- < 750 mm

Fig. 5 : 'Growing season' (no. of months) with mean temp. > 6 °C)

- ⩾ 9 months > 6 °C
- < 9 months > 6 °C

Fig. 6 : Main areas of calcareous rocks (chalk and limestone)

the summits.

d) Synanthropy

Woodlice are probably the archetypal urban invertebrates. They reach such numbers in gardens in Reading that the Environmental Health Officer responds to an average of two requests a week from worried members of the public to come and exterminate woodlice from their gardens. Before man started to modify the landscape with buildings, quarries and rubbish tips (official and unofficial!), some species which are currently common and widespread in such sites were probably quite rare. Species such as *Cylisticus convexus* (Fig. 16) are most numerous in natural habitats when these are subject to frequent disturbance, particularly eroding coastal cliffs. This ability to survive and expand in numbers in such sites probably explains why most inland records for *Cylisticus convexus* are from synanthropic sites (Harding & Sutton 1985). Human rubbish, derelict buildings etc. provide a rich variety of niches resulting in the species list for "mature" rubbish tips often exceeding lists of species in natural habitats. Synanthropic species may also be spread rapidly, particularly if they are associated with material which is frequently moved (eg. *Porcellionides pruinosus*, a common resident of dung heaps).

2) BIOLOGICAL FACTORS

a) Competition

There is currently much debate in ecological circles as to whether the distribution of invertebrates is ever limited by competition between species. It is argued that the niches of all species are unique and do not overlap in the wild. Very little experimental work appears to have been carried out on competition between different species of woodlice so conclusions based on distribution data are speculative. However species which may compete in the wild and which would be worth examining in detail in the laboratory are *Armadillidium depressum* (Fig. 12), *Armadillidium vulgare* (Fig. 13) and *Cylisticus convexus* (Fig. 16). *Armadillidium depressum* is very common in gardens in Bristol for example, and does appear to replace *Armadillidium vulgare* in such habitats. *Cylisticus convexus* is frequently common in synanthropic and coastal sites in Scotland and northern England, but is present in much fewer numbers in the south. This is possibly due to competition with *Armadillidium vulgare* which is rare in north-west England and Scotland (Fig. 13). Similar competition may limit the spread of other species into regions which they would otherwise be able to exploit more fully.

b) Disease and Parasitism

Relatively little appears to be known about whether diseases and parasites might limit the distribution of woodlice. Terrestrial isopods are known to carry an iridovirus (which is probably the cause of the purple colour often seen in Trichoniscus pusillus and occasionally other species), a rickettsia, a yeast like organism and parasitic nematodes (Federici 1984). I once pulled horsehair worm (Phylum Nematophora) of 8 cm in length from an Oniscus asellus of 1.2 cm in length. The larvae of several species of dipteran flies have also been found in woodlice and there are some interesting differences in the extent to which different species are parasitised (Bedding 1965). Mites are often present on the external surface of woodlice but they probably do little harm to their hosts in the wild (Colloff & Hopkin 1986). In the laboratory it is probably a different matter and it is likely that many cultures of isopods die out due to disease and parasitism.

c) Symbiotic Relationships with other Invertebrates

In Britain and Ireland, the small white woodlouse Platyarthrus hoffmannseggi is invariably found associated with ants (Hames 1987). Locally, its distribution will be affected by the presence of ant colonies in which it can live. Nationally, there appears to be an additional climatic component controlling its distribution as Platyarthrus hoffmannseggi is very rare in Scotland despite the fact that apparently suitable ant colonies are present.

PROVISIONAL CLASSIFICATION OF WOODLOUSE DISTRIBUTION

The distribution of woodlice species in Britain and Ireland can be divided into six broad categories. A seventh category is reserved for those species on which we have insufficient information to draw any firm conclusions.

1. Coastal

Six species are limited to the coast. Records to date suggest that Armadillidium album, Ligia oceanica, Miktoniscus patiencei and Trichoniscoides saeroeensis (Fig. 7) occur all around the coast of Britain and Ireland in suitable habitats but that Halophiloscia couchi (Fig. 8) is restricted to the south-west. All records for Stenophiloscia zosterae have been from coastal sites but these are insufficient to be sure of its range.

2. North-western distribution

Armadillidium pulchellum (Fig. 9) appears to be the only species with this distribution although further recording in "extreme" habitats such as ant nests (where I have found this species with Formica rufa in the Forest of Dean) and coniferous plantations (where I have found this species under bark in north Hampshire), may reveal it to be much more widespread in southern England. Haplophthalmus mengei may also follow this distribution as recent studies have shown that some inland records for this species in south-east England are in fact of another species of Haplophthalmus new to Britain (Hopkin & Roberts 1987). Expansion of the ranges of ´north-western´ species may be limited by intolerance to high summer temperatures in the south-east (Fig. 2).

3. North-eastern distribution

Porcellio spinicornis (Fig. 10) appears to be the only species with an ´anti-Atlantic´ tendency (Harding & Sutton 1985), perhaps preferring drier areas with mean winter temperatures above 4 ^{o}C (Figs. 1, 4). Records for this species in the west are predominantly synanthropic. It has recently been recorded from a bath in a holiday flat in the Scilly Isles! (Jones & Pratley 1987).

4. South-western (Lusitanian) distribution

Porcellionides cingendus (Fig. 11) exhibits an archetypal Lusitanian distribution (as does the coastal Halophiloscia couchi, Fig. 8). The remarkable resemblance between the area which has a "growing season" of nine months or greater (Fig. 5) and the distribution of this species suggests that Porcellionides cingendus is intolerant of frosts and requires a lengthy period of warm wet weather in which to complete its reproductive cycle. Armadillidium depressum is most common in the south and west (Fig. 12) but there is a strong synanthropic component to its distribution. The range of this species may be expanding if it is an old introduction (Harding & Sutton 1985) and it is worth looking for beyond the edge of its current known range.

5. Southern/South-eastern distribution

Six species fall into this category which may prefer sites with hot summers and cold winters (Fig. 3) with moderate rainfall (Fig. 4), namely Armadillidium nasatum, Armadillidium vulgare (Fig. 13), Haplophthalmus danicus, Ligidium hypnorum (Fig. 14), Platyarthrus hoffmannseggi and Trachelipus rathkei (Fig. 15). The distribution of Trachelipus rathkei is perhaps the most difficult to explain. It is often found in synanthropic sites and may be spreading in a similar manner to that suggested for Armadillidium depressum. Trachelipus rathkei has recently been found in two further 10 km squares in Worcestershire by P.F. Whitehead.

6. Widespread distribution

Eight species are widespread in Britain and Ireland, Androniscus dentiger, Cylisticus convexus (Fig. 16), Oniscus asellus, Philoscia muscorum, Porcellio scaber, Porcellionides pruinosus, Trichoniscus pusillus and Trichoniscus pygmaeus. Porcellio dilatatus was certainly widespread in the past but appears to have become much less common in recent years (Harding & Sutton 1985). All these species appear to be native with the exception of Porcellionides pruinosus which may have been introduced in animal dung.

7. Insufficient records

Too few records have been submitted for eight species, to allow firm conclusions on their distribution to be made (with the possible exception of Oritoniscus flavus which on current evidence seems to be restricted to south-east Ireland). Armadillidium pictum, Buddelundiella cataractae, Eluma purpurascens (for which several new sites in Kent have been added since 1982, Fig. 17), Metatrichoniscoides celticus (found at an inland site in 1986 by Arthur Chater, Fig. 18), Porcellio laevis, Trichoniscoides albidus (Fig. 19) and Trichoniscoides sarsi (discovered under snow in Wytham Wood near Oxford in March 1987, Fig. 20) should all be specifically searched for to increase our knowledge of the ranges of these little-known isopods.

CONCLUSIONS

Records from new and previously-visited sites are needed if we are to determine the true ranges of woodlice in Britain and Ireland, and to monitor possible changes in the distribution patterns of the different species. The speed at which woodlice can spread should not be under-estimated. Experiments carried out on the desert woodlouse Hemilepistus reaumuri have shown that an individual can walk continuously for 7 kilometres on a rotating ball without stopping and can cover over 100 km if removed every day and allowed to feed (Hoffmann - personal communication). There seems no good reason to suppose that the larger species of British and Irish woodlice are any less able at long distance walking than their desert cousins!

ACKNOWLEDGEMENTS

I am grateful to Paul Harding for allowing access to pre- and post-April 1982 records, George Fussey who was responsible for checking record cards from 1982 to 1985 and to the recorders who supplied the data which enabled the 1982 maps to be updated.

REFERENCES

BEDDING, R.A. (1965). Parasitism of British Terrestrial Isopoda by Diptera. PhD Thesis, Imperial College of Science and Technology, London.

CHATER, A.O. (1986). Woodlice in Ceredigion. Dyfed Invertebr. Grp. Newslett., No. 2, June 1986, 3-10.

COLLOFF, M.J. & HOPKIN, S.P. (1986). The ecology, morphology and behaviour of *Bakerdania elliptica* (Acari: Prostigmata: Pygmephoridae), a mite associated with terrestrial isopods. J. Zool., Lond. (A), 208, 109-123.

FEDERICI, B.A. (1984). Diseases of terrestrial isopods. Symp. zool. Soc. Lond., No. 53, 233-245.

HAMES, C.A.C. (1987). Provisional atlas of the association between *Platyarthrus hoffmannseggi* and ants in Britain and Ireland. Isopoda, 1, 9-19.

HARDING, P.T. & SUTTON, S.L. (1985). Woodlice in Britain and Ireland : Distribution and Habitat. Abbots Ripton, Institute of Terrestrial Ecology. 151 pp.

HOPKIN, S.P. & ROBERTS, A. (1987). A species of *Haplophthalmus* new to Britain. Isopoda, 1, 37-48.

JONES, R.E. & PRATLEY, P. (1987). Woodlice of the Isles of Scilly. Isopoda, 1, 49-54.

WOODLICE DISTRIBUTION MAPS (FIGS. 7 - 20)

The maps show the recorded occurrence in Britain and Ireland of selected species, using the 10 km squares of the British and Irish National Grids, for records received to March 1987. The maps were prepared by adding post-April 1982 records to maps copied by hand from those published by Harding & Sutton (1985).

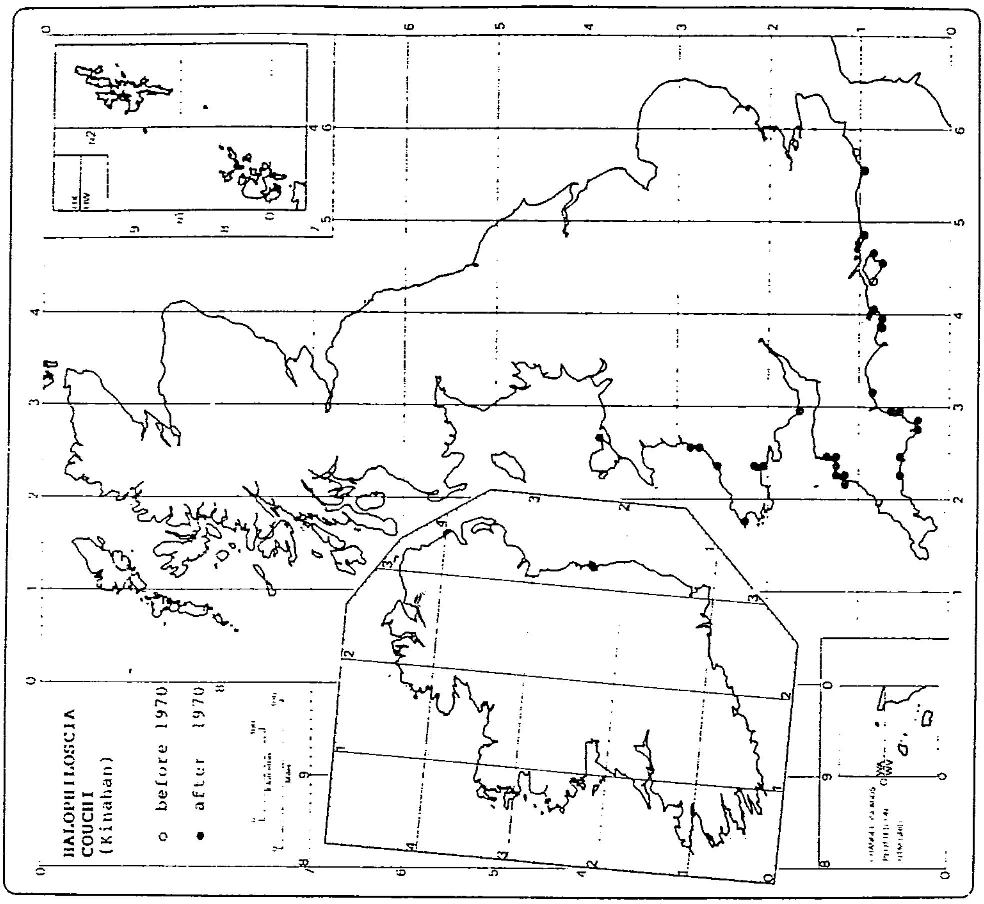

Fig. 8 : Halophiloscia couchi
COASTAL (LUSITANIAN)

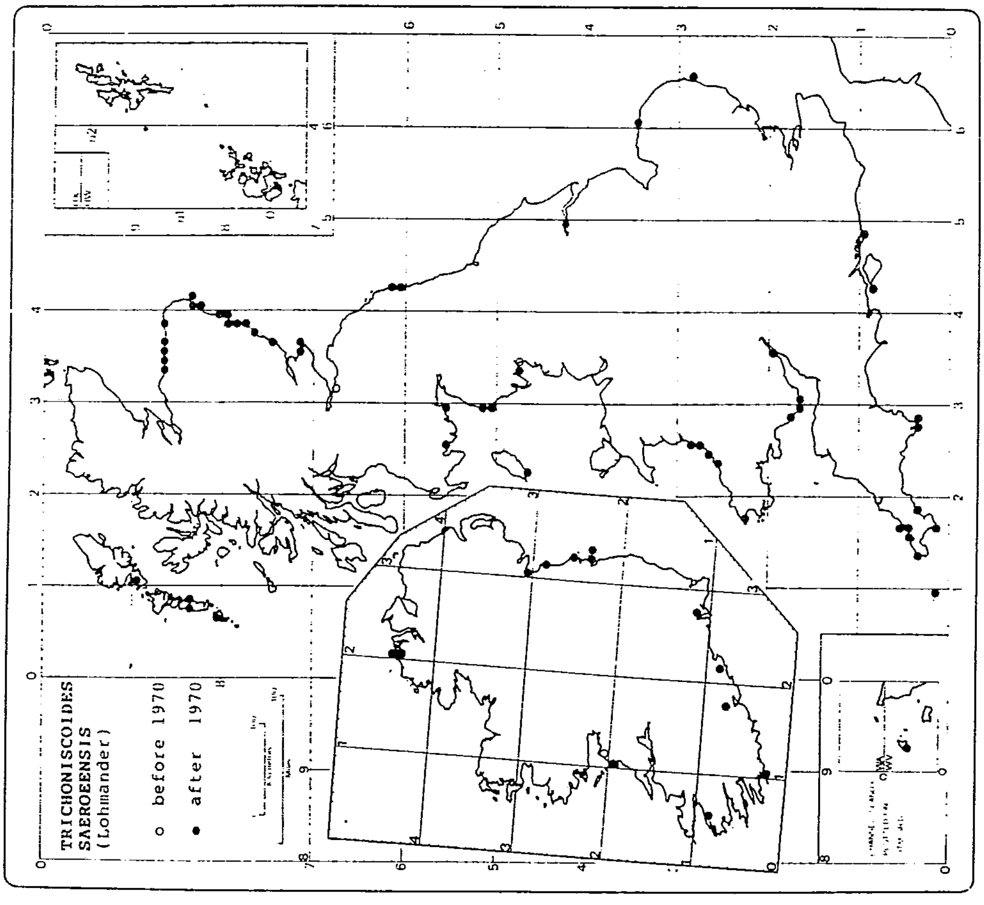

Fig. 7 : Trichoniscoides saeroeensis
COASTAL

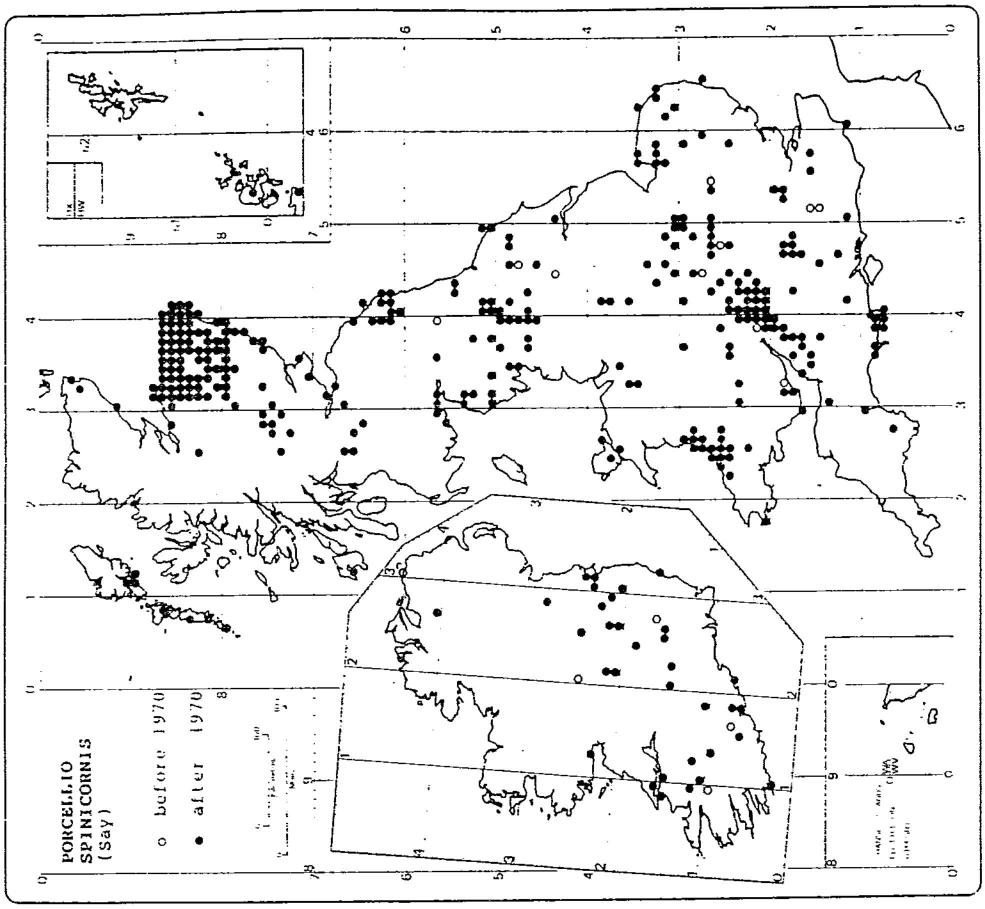

Fig. 10 : Porcellio spinicornis
NORTH-EASTERN

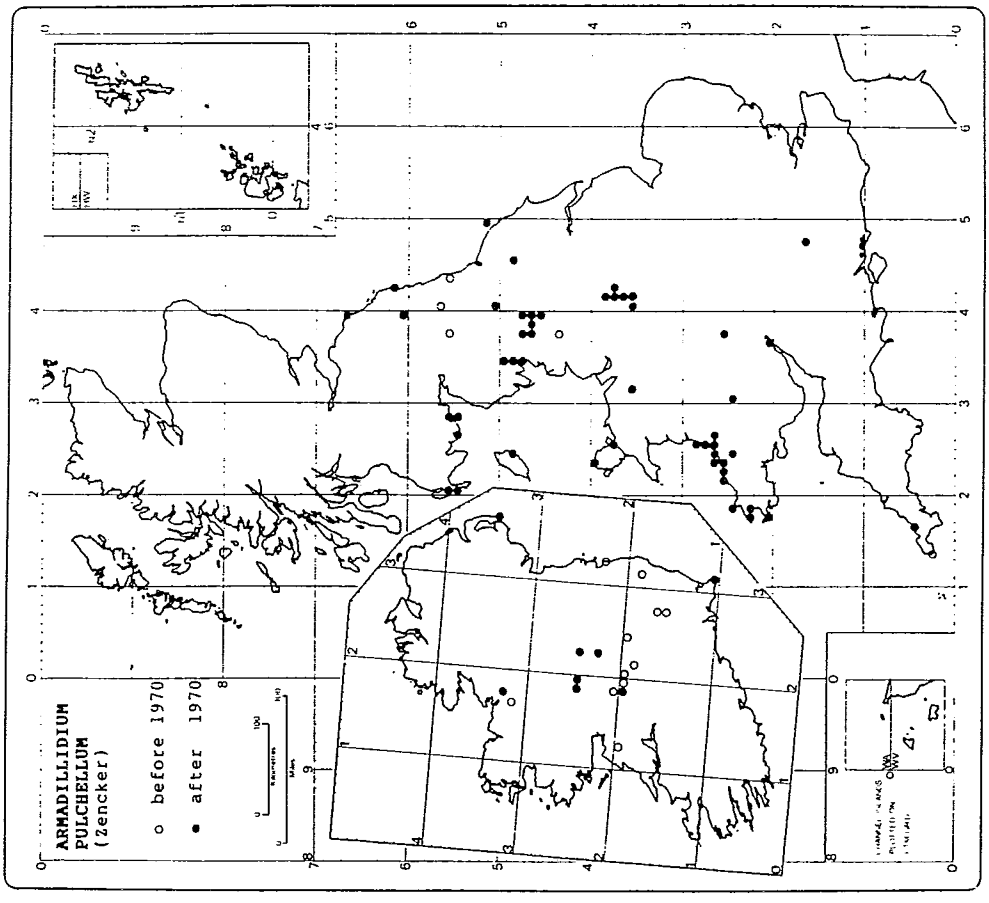

Fig. 9 : Armadillidium pulchellum
NORTH-WESTERN

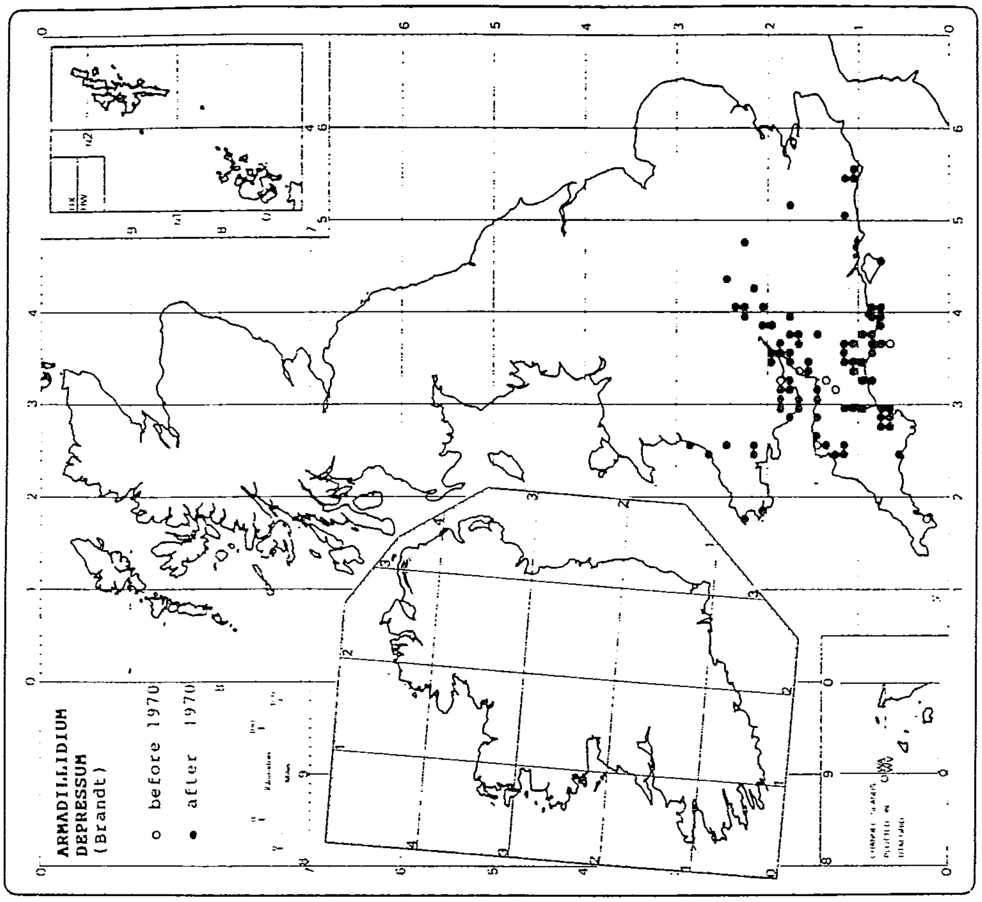

Fig. 12 : *Armadillidium depressum*
SOUTH-WESTERN

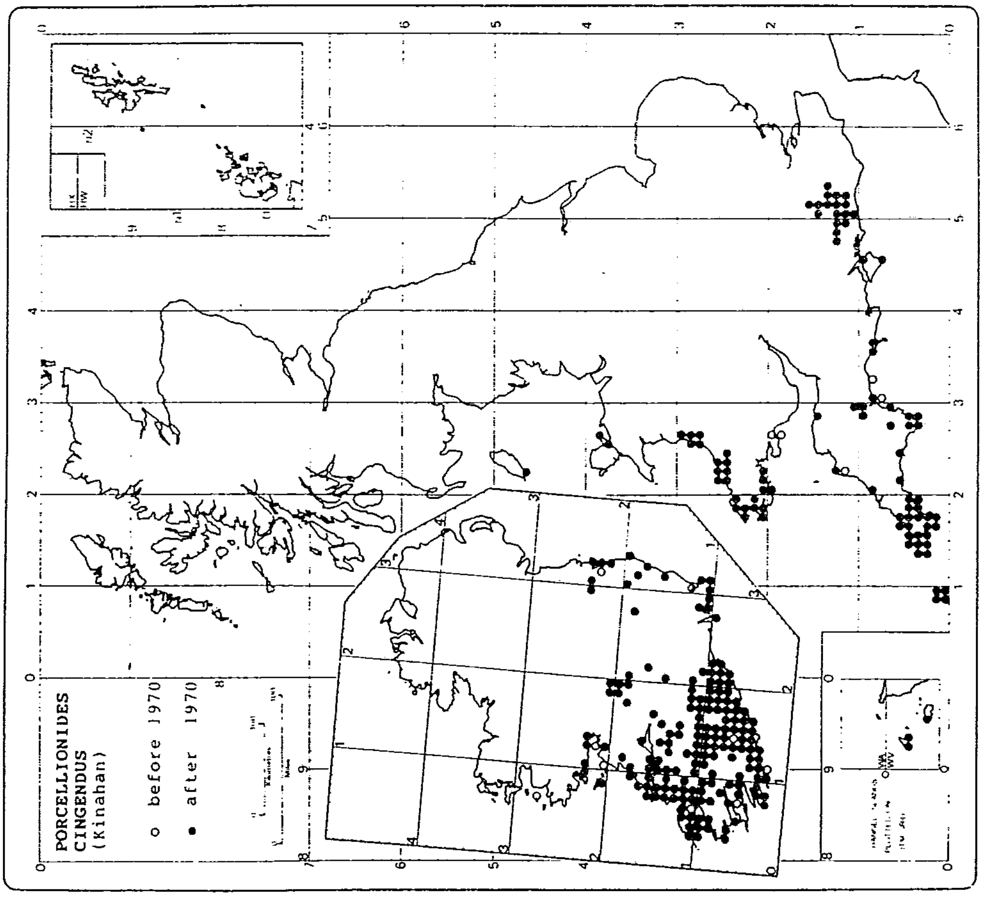

Fig. 11 : *Porcellionides cingendus*
SOUTH-WESTERN (LUSITANIAN)

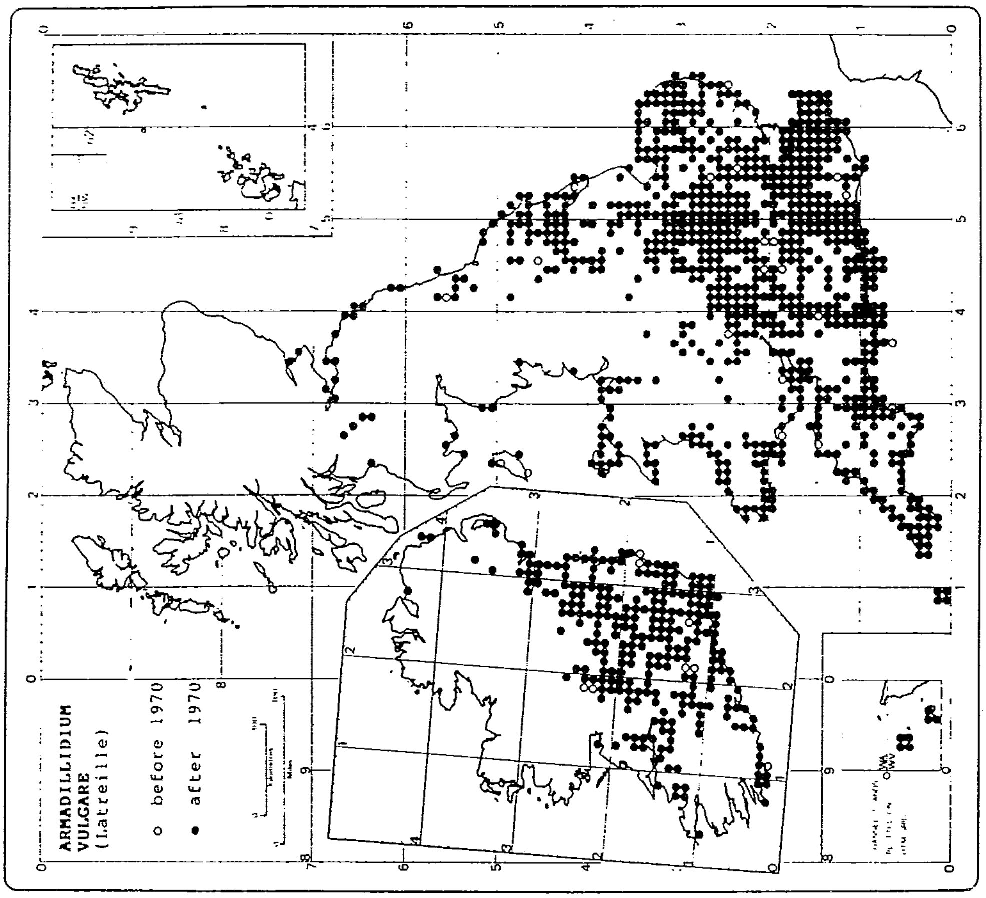

Fig. 13 : Armadillidium vulgare
SOUTHERN/SOUTH-EASTERN

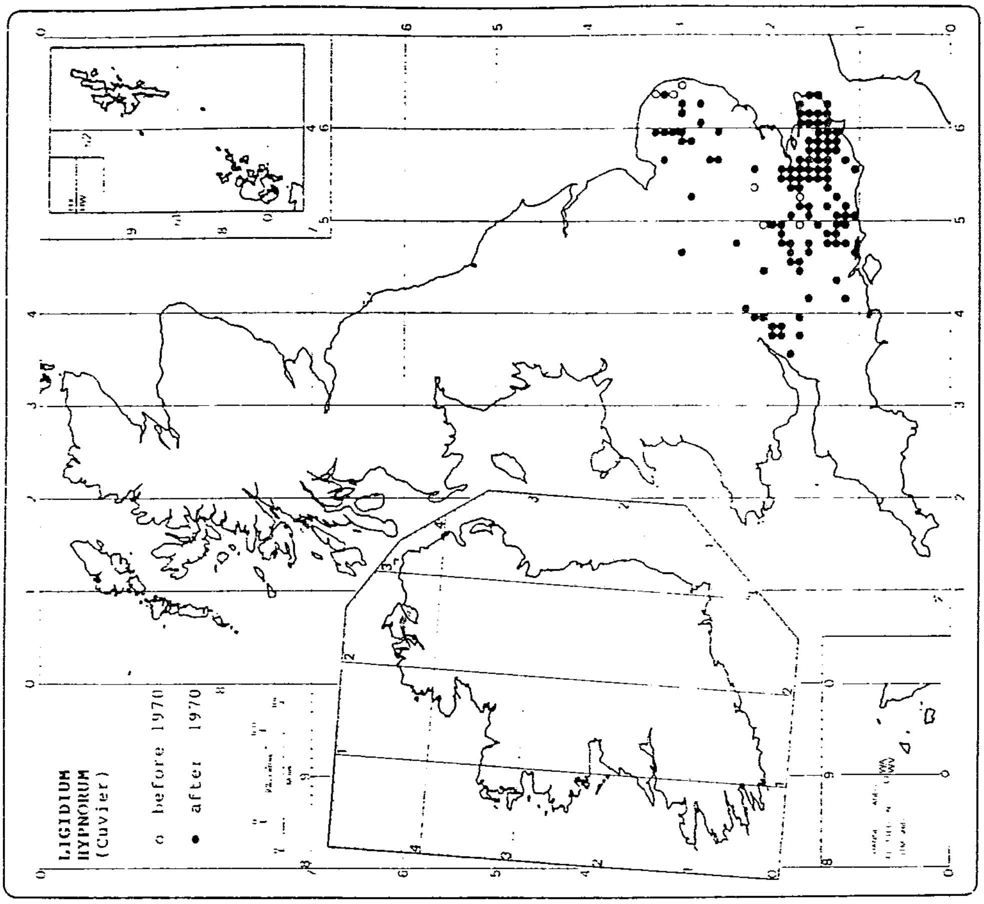

Fig. 14 : Ligidium hypnorum
SOUTHERN/SOUTH-EASTERN

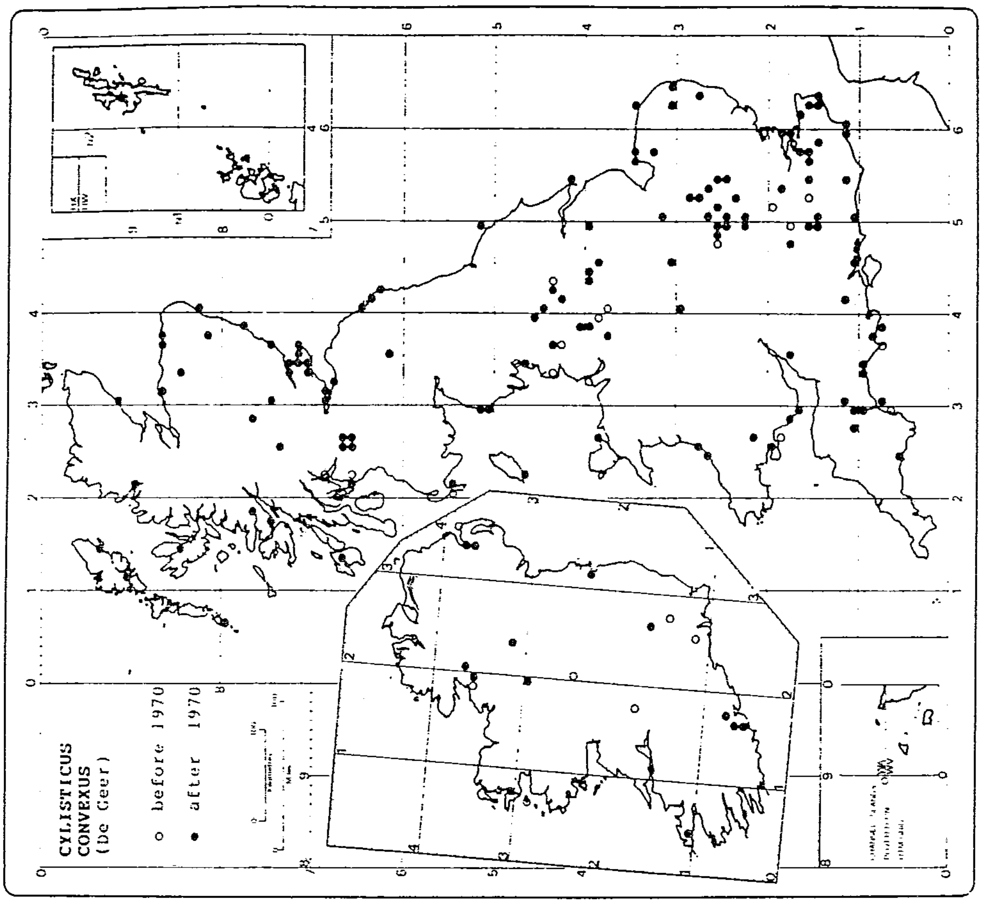

Fig. 16 : *Cylisticus convexus*
WIDESPREAD

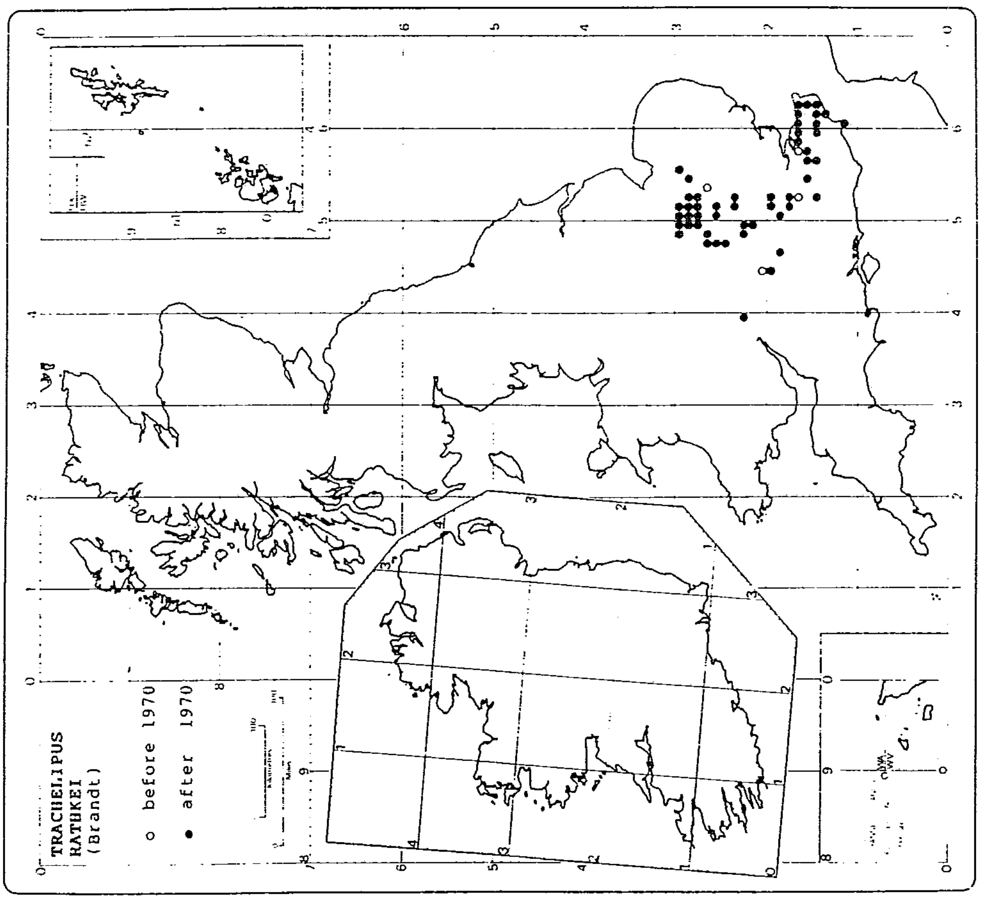

Fig. 15 : *Trachelipus rathkei*
SOUTHERN/SOUTH-EASTERN

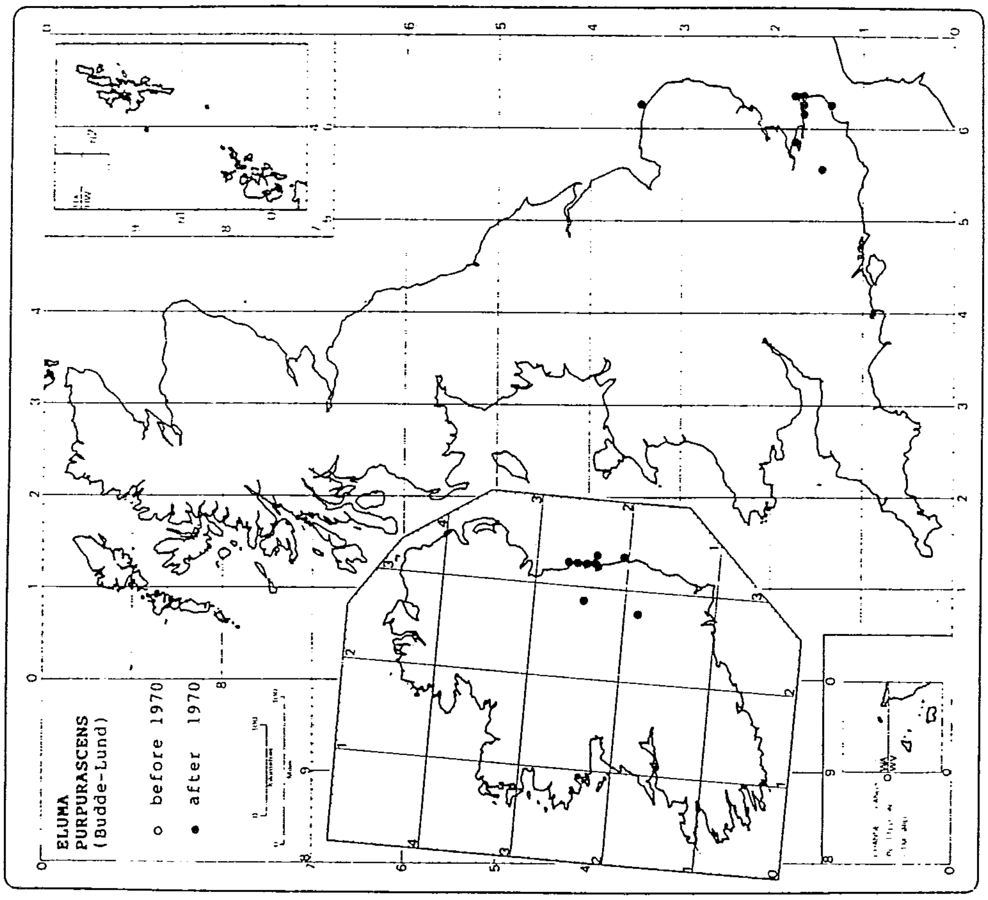

Fig. 17 : *Eluma purpurascens*
INSUFFICIENT RECORDS

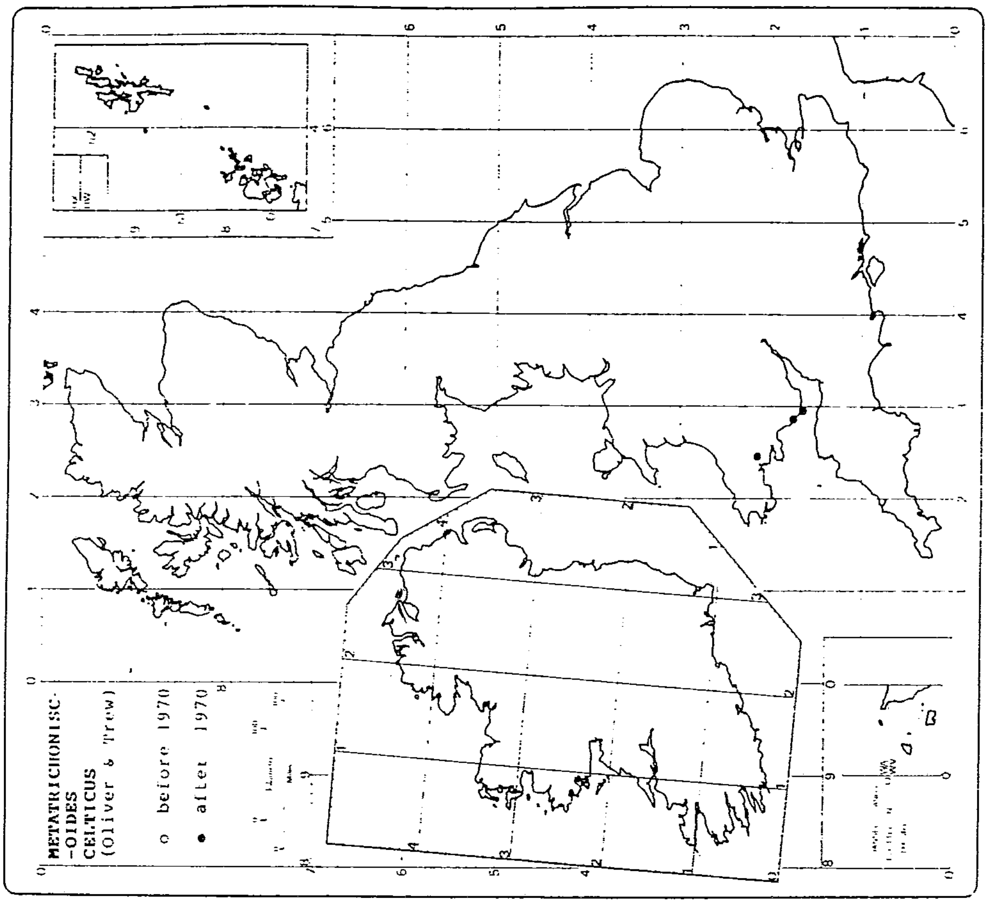

Fig. 18 : *Metatrichoniscoides celticus*
INSUFFICIENT RECORDS

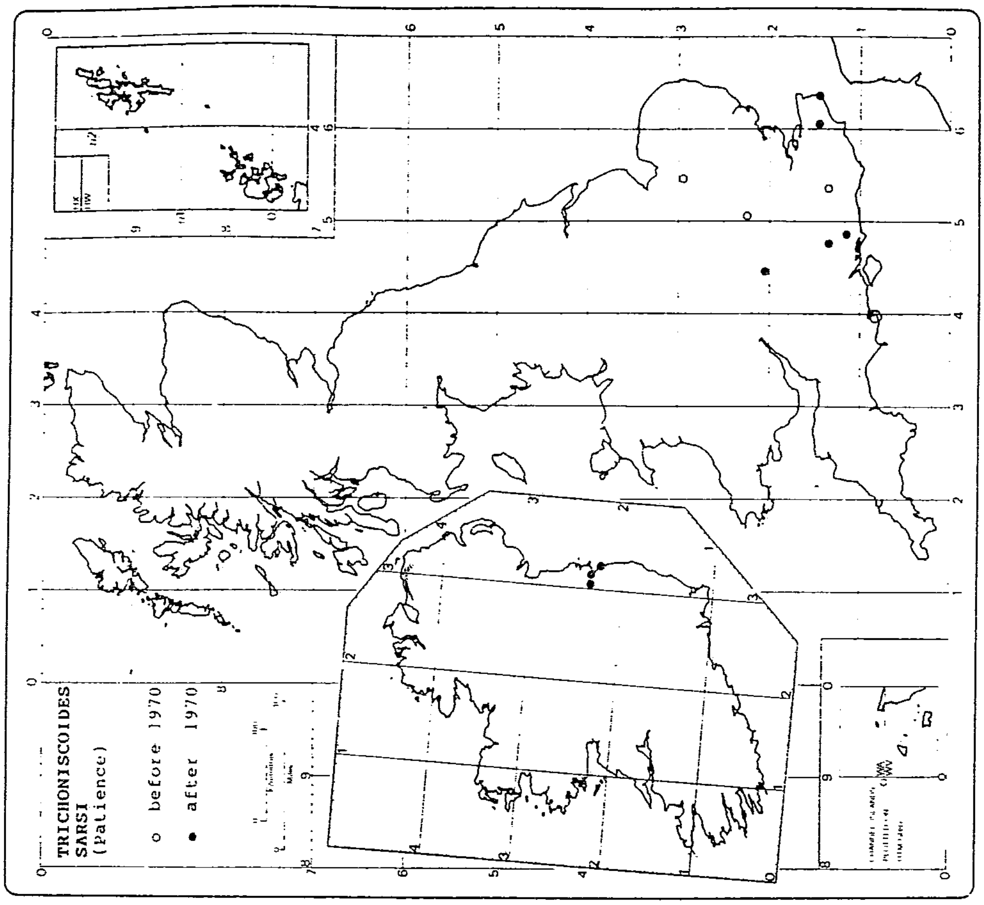

Fig. 18 : *Trichoniscoides sarsi*
INSUFFICIENT RECORDS

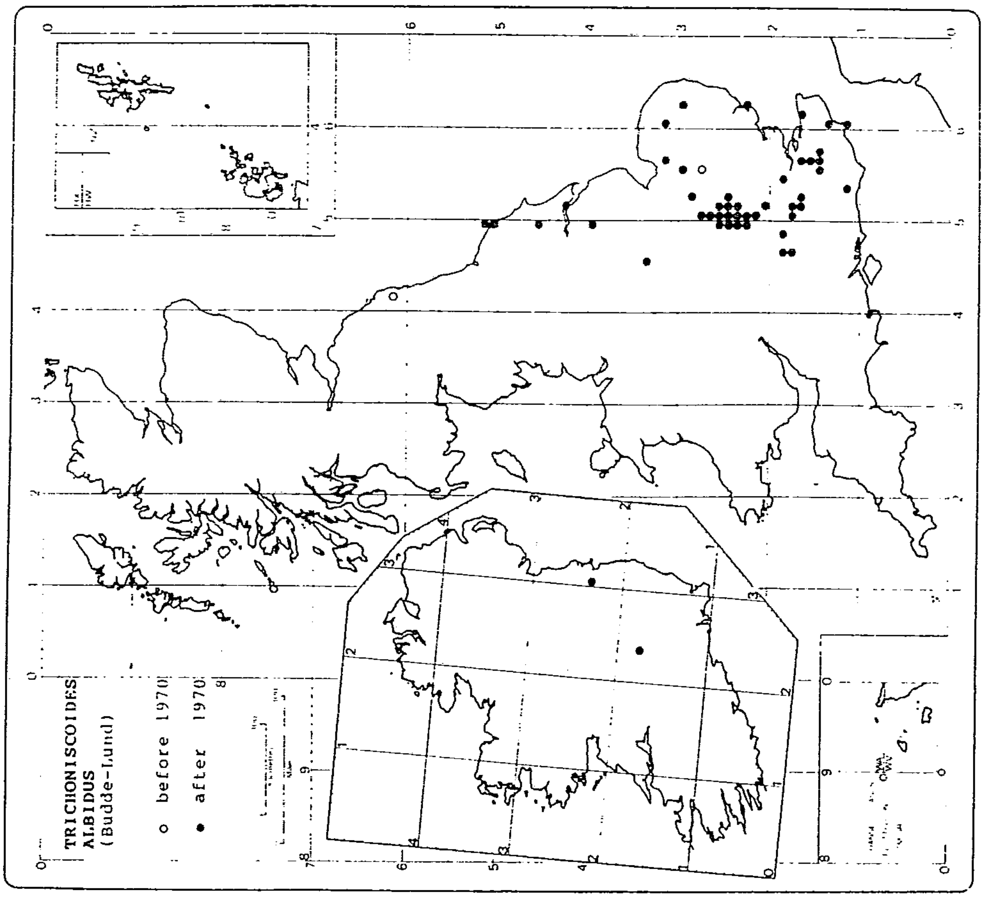

Fig. 19 : *Trichoniscoides albidus*
INSUFFICIENT RECORDS