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Tracing the History of a Genus from its Geographical Range by the Example of *Sitticus* (Arachnida: Araneae: Salticidae) *

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With 15 figures

Abstract: A theoretical model of the evolution of the geographical range of a genus is proposed. The actual distribution of the Palaearctic Salticidae corresponds usually with rudiments of t is model only, presumably due to the post-Pleistocene character of their ranges. The genus *Sitticus* differs from others by a rather complex range. It is supposed that *Sitticus* originated in the Palaearctics during Tertiary and survived Pleistocene. A provisional phyletic tree of 35 species of *Sitticus* is presented.

We may assume that the evolution of the range of a genus follows a certain pattern, consisting of stages shown in a theoretical model in fig. 1. The development of each stage takes time, for speciations and spreadings, and we might speculate on the age of a range by judging its complexity. This may be true in typical cases found in old and stable environments in the tropics, and we may also guess that similar patterns were developed in Tertiary in the Palaearctics as well before they were wipped out by the Pleistocene glaciation.

The majority of the present Salticidae genera in the temperate Eurosiberian zone consists of expansive species apparently postglacial migrants, penetrating from South to North as far as permitted by climate and their ecological valency, afterwards spreading longitudinally, often from the Atlantic to the Pacific. They are

*) Revised version of a paper read at the occasion of the ESRC/ESF workshop on "Taxonomy, Biology and Ecology of Araneae" in Gartow, May 7-12, 1982.

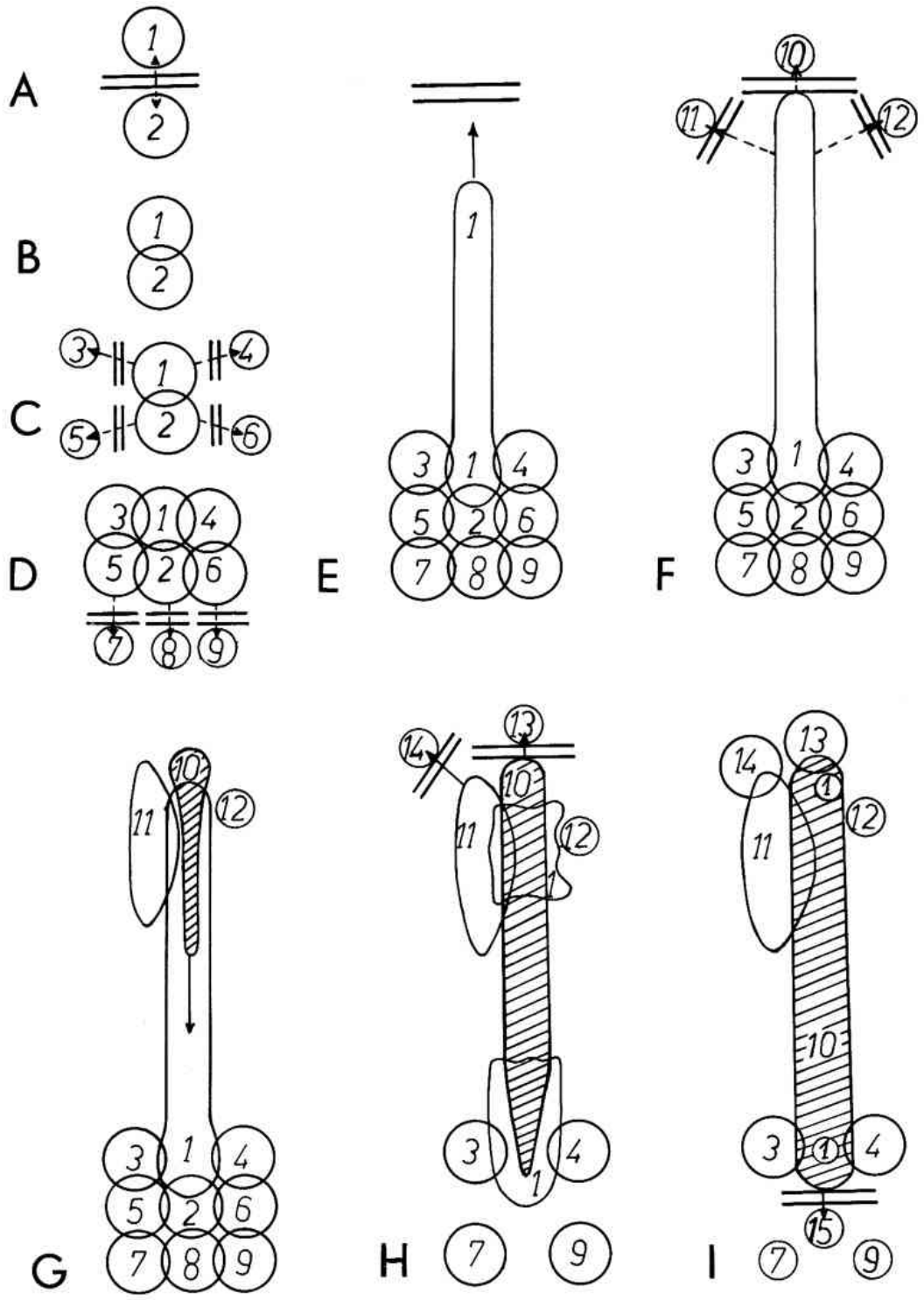


Fig. 1: Theoretical model of the evolution of the geographical range of a genus. — A-D speciation and proliferation of species in a primary speciation area; E spreading of mor expansive species; F speciation and proliferation of species in the secondary speciation area; G spreading of mor expansive species from the secondary speciation area and partial overlapping of areals of older species; H reduction and extinction of some older species (nos. 1,2,5,6); I further spreading of some species (no. 10), further reduction of others (no. 1) and appearance of the youngest generation of species (no. 15) in the area of earliest speciation which makes the whole distribution very complex.

often single representatives of genera distributed mainly in South-East Asia or in Africa, some have local Mediterranean centers. For some genera we do not know yet the areas of the origin and occurrence of closer relatives (figs. 2, 3).

There is, however, the case of the very complex distribution of the genus *Sitticus*, 1901, which is mainly Palaearctic but occurs as well in North America with some species (fig. 4). There are numerous pairs of closely related species replacing themselves geographically, which indicate former speciation processes. Their ranges are sometimes large, sometimes very local. The commonest examples are West-East Palaearctic replacements, presumably young when the species live in formerly glaciated areas and such cases may be connected with the last glaciation (ending some 12 000 to 10 000 yr BP) (boreal and boreo-montane species; figs. 10, 11). Such replacements certainly evolved much earlier when one species of the pair occurs today in the Central Asian Mountains because crossing of grassland - desert zones was connected with stronger climatic changes (such as in the more extensive glaciation earlier during the Pleistocene). Older age suppositions are confirmed by the presence of endemic speciation as this process needs more time (figs. 7-9).

At our present state of knowledge it is impossible to recognize a relict occurrence of *Sitticus* by the distribution characteristics alone. However, the morphology properties of *S. longipes*, *S. albolineatus* and possibly *S. damini* together with their position in the provisional phyletic tree (fig. 4) seem to suggest that their occurrence may be relict (fig. 15).

Another problem is supplied by the Holarctic occurrence of some species and Nearctic only by others. According to informations given in the provisional phyletic tree the Nearctic and Holarctic species form a small minority, randomly dispersed among almost all groups of species. The *floricola* group is the only significant exception comprising 8 species, 3 of which are Nearctic and 4 Holarctic. The Nearctic species however, do not form any separate branch of the tree but each of them is a sister species of the Holarctic species. One of the Holarctic species has an exclusively Palaearctic representative as well (*S. caricis* - *S. rupicola*). Palaeartic ranges of the Holarctic species are also - as far as we know - more extensive. There are reasons to suppose that the present Holarctic species have in fact colonized the Nearctics from their Palaearctic home ranges. In that case the presence of a Nearctic sister species could indicate the time of colonization - long enough for the speciation of a single sister species, too short for the origin of a group of species.

The *terebratus* group reveals the case of a species caught during colonization of North America - *S. fasciger* (fig. 11) was brought incidentally to the area of New York in the time of 1958.

It may be concluded therefore that the American occurrence of *Sitticus* is due to numerous individual colonizations by particular species at various times. The *S. absolutus* - *cursor* branch and the possible relatives which evolved in North America may be exceptions if their relationship to *S. longipes* would be confirmed. In this case the ancestors' arrival to North America may be very old indeed.

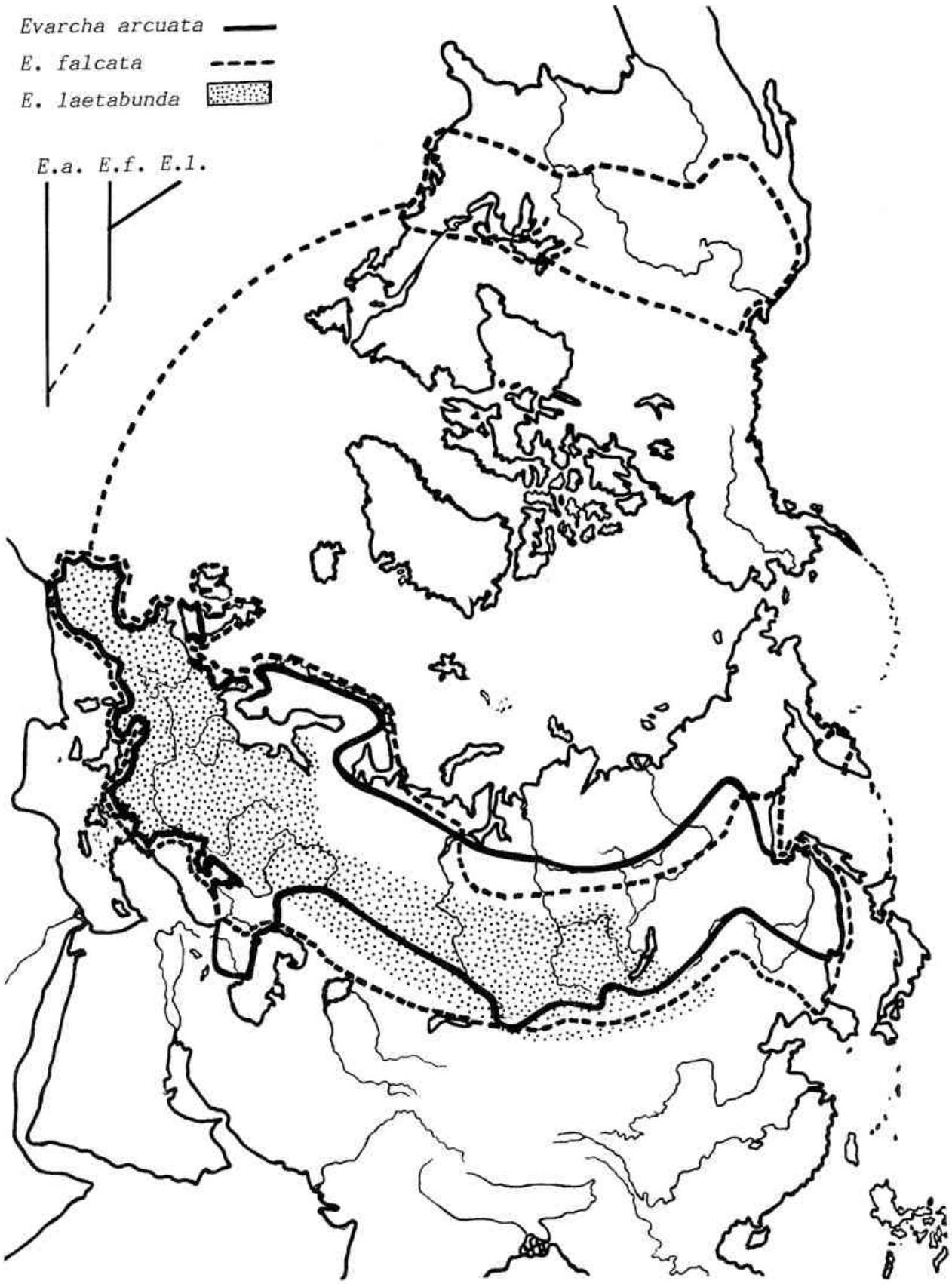


Fig. 2: Typical Eurosibirian distribution of the genus *Evarcha*, consisting of three expansive species. — Note the lack of close relatives with local distribution, the absence of any zone of proliferation of species.

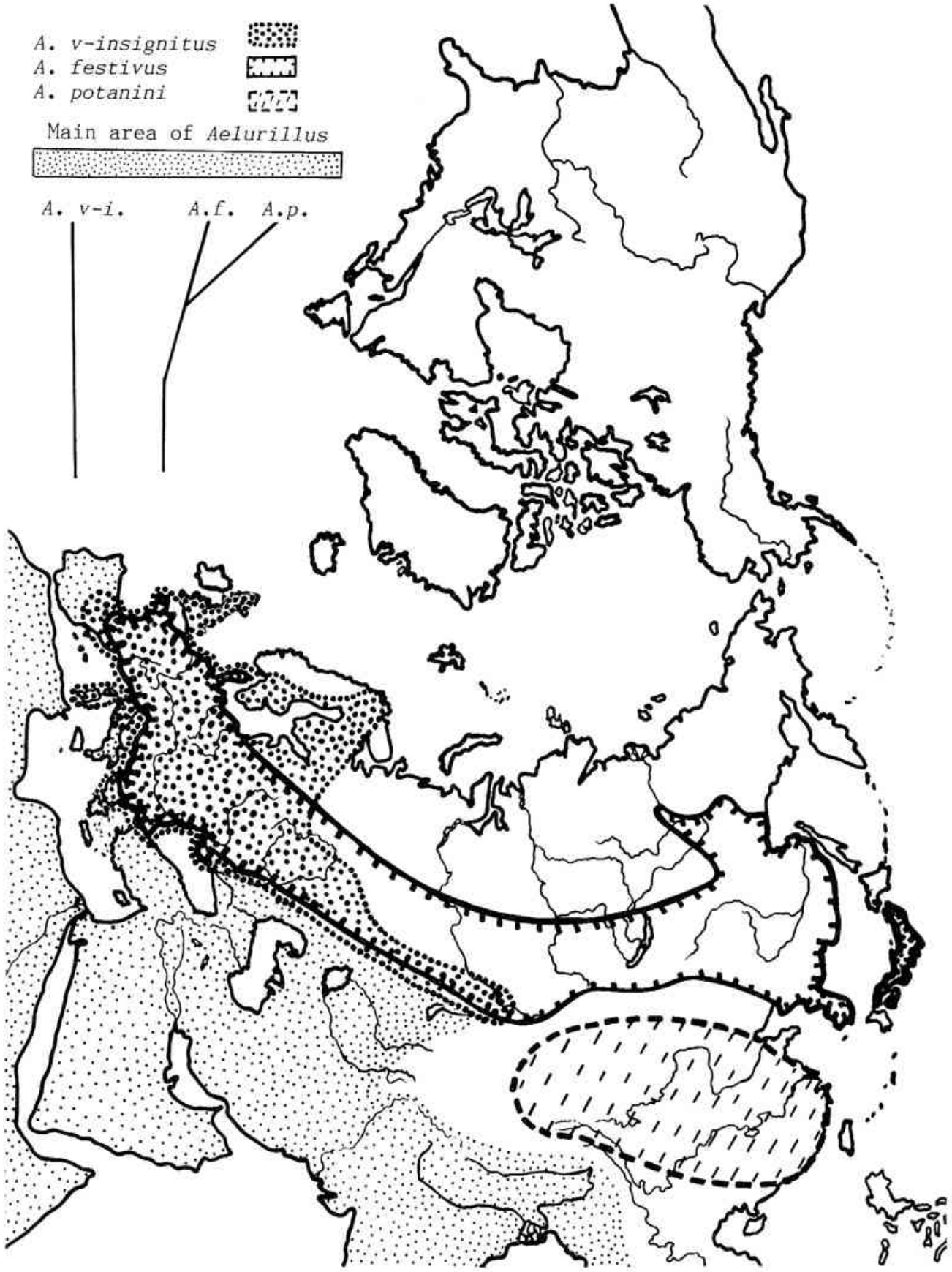


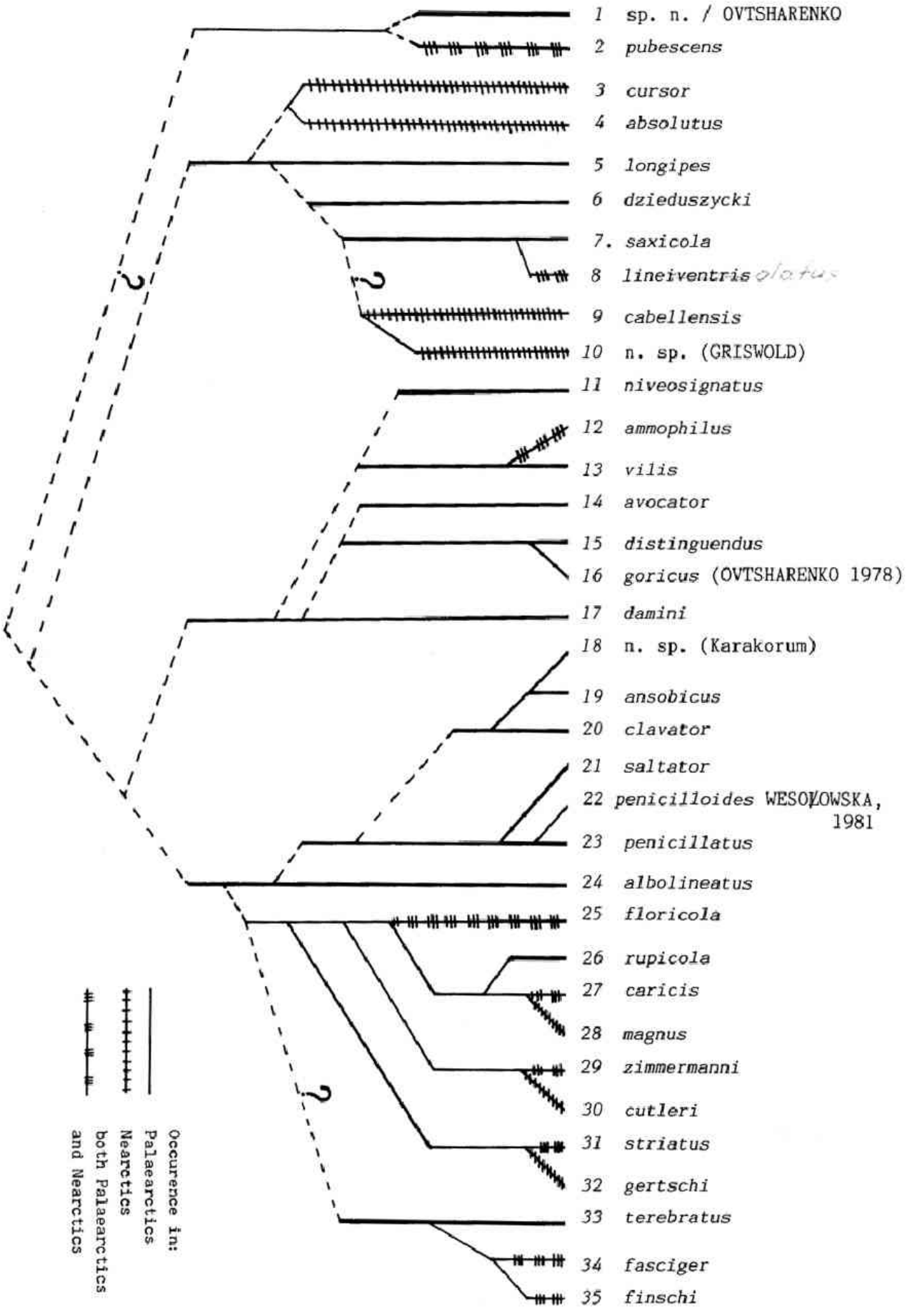
Fig. 3: Another type of Eurosibirian distribution - the genus *Aelurillus*. — The genus spreading to the North from the main areal and colonizing a suitable climatic zone by two species. *A. potanini* is presumably a SE-Palaearctic vicariant species of *A. festivus*.

Summing up what I have shown above I would propose the following conclusions in view of the complexity of the distribution of *Sitticus* and its lack of any geographical origin zone outside the Palaearctics.

The genus *Sitticus* originated and evolved within the Palaearctis, presumably in the Eurosiberian zone during Tertiary and became rather complex at the End of the Pliocene. Its natural range was wipped out during the Ice Age disasters but the species themselves (or part of them) survived in refugional retreats. These species spreaded their ranges from the refugia during interglacials and retreated at the beginning of the following glacials which provided opportunities for species splitting and range changes. So *Sitticus* is a really authochthonous Palaearctic genus, a relict from the Tertiary, preglacial fauna, in contrary to various post-Pleistocene colonists, forming the majority of the present Eurosiberian fauna.

Are there many pre-Pleistocene relicts among the Palaearctic Salticidae? *Euophrys* is the only genus that may be complex enough; in this case further investigations are necessary. However, the possibility of looking back in times older than the Pleistocene seems to be a challenge warranting research.

Fig. 4: Provisional phyletic tree of the genus *Sitticus*, based on recent revisions (PROSZYNSKI 1968, 1972, 1973, 1980, and in prep.). — Note the random distribution among predominantly Palaearctic branches, resulting presumably from multiple incidental colonisation. - Additional information to the species mentioned in the figure: 1 - from Caucasus, 8 - *S. lineiventris (= S. ranieri)*, 11 - *niveosignatus* (or possibly two or more related species), 14 - *S. avocator (= S. viduus)*, 15 - *S. distinguendus (= S. helveolus, histrio, frigidus)*, 18 - n. sp. from Karakorum ('*pubescens*' of DI CAPORIACCO), 27 - *S: caricis* (including *S. sylvestris* EMERTON - unpublished data of W. MADDISON).


1 sp. n. / OVTSHARENKO
2 pubescens
3 cursor
4 absolutus
5 longipes
6 dzieduszycki
7. saxicola
8 lineiventris
9 cabellensis
10 n. sp. (GRISWOLD)
11 niveosignatus
12 ammophilus
13 vilis
14 avocator
15 distinguendus
16 goricus (OVTSHARENKO 1978)
17 damini
18 n. sp. (Karakorum)
19 ansobicus
20 clavator
21 saltator
22 penicilloides WESOŁOWSKA, 1981
23 penicillatus
24 albolineatus
25 floricola
26 rupicola
27 caricis
28 magnus
29 zimmermanni
30 cutleri
31 striatus
32 gertschi
33 terebratus
34 fasciger
35 finschi
Occurence in:
Palaearctics
Nearctics
both Palaearctics and Nearctics

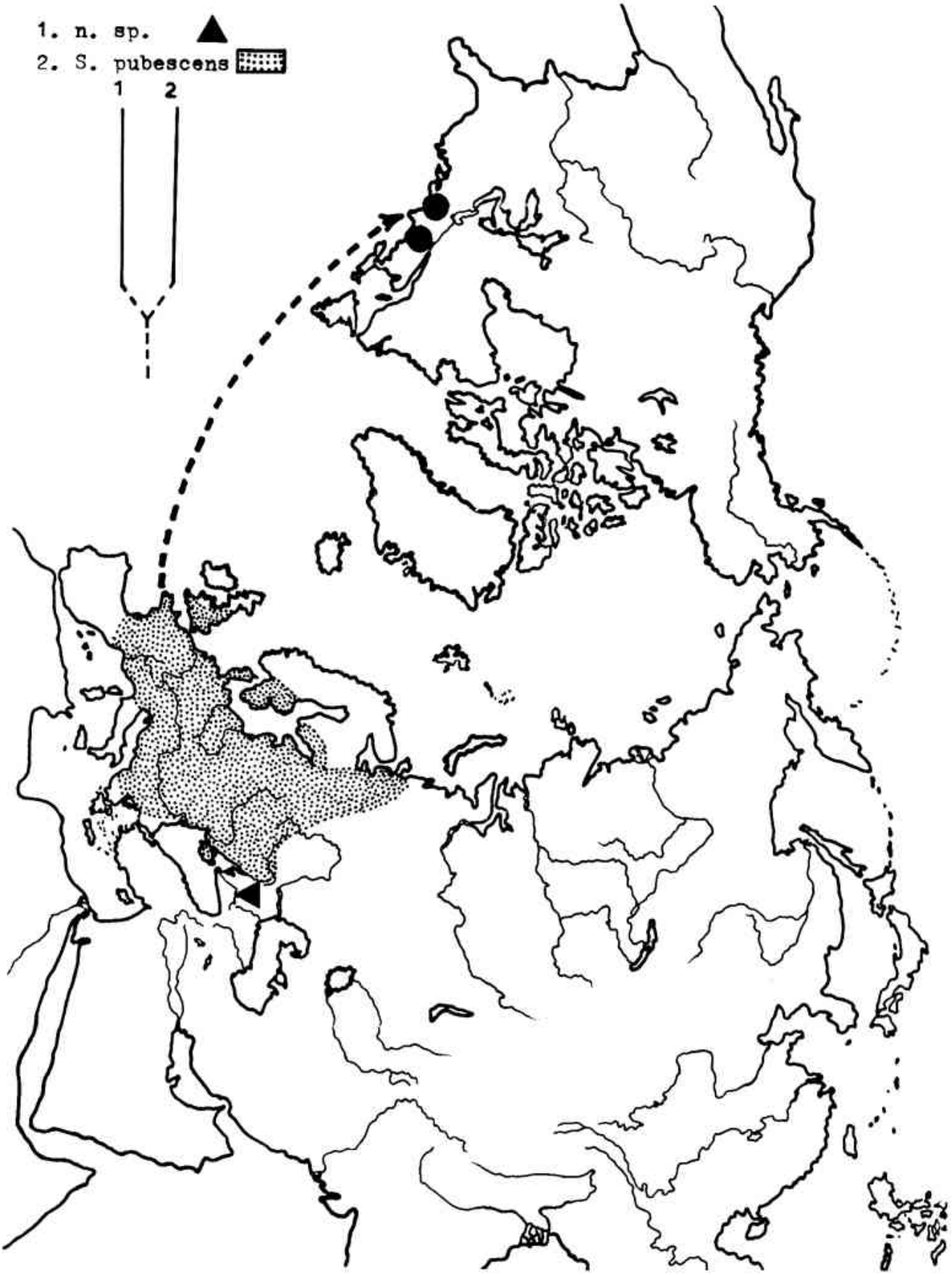


Fig. 5: Recent spreading to the North and the Nearctis. — Discovery of a related new species by OVTSHARENKO in the Caucasus Mountains may indicate the geograpical origin range of this line in *Sitticus*.

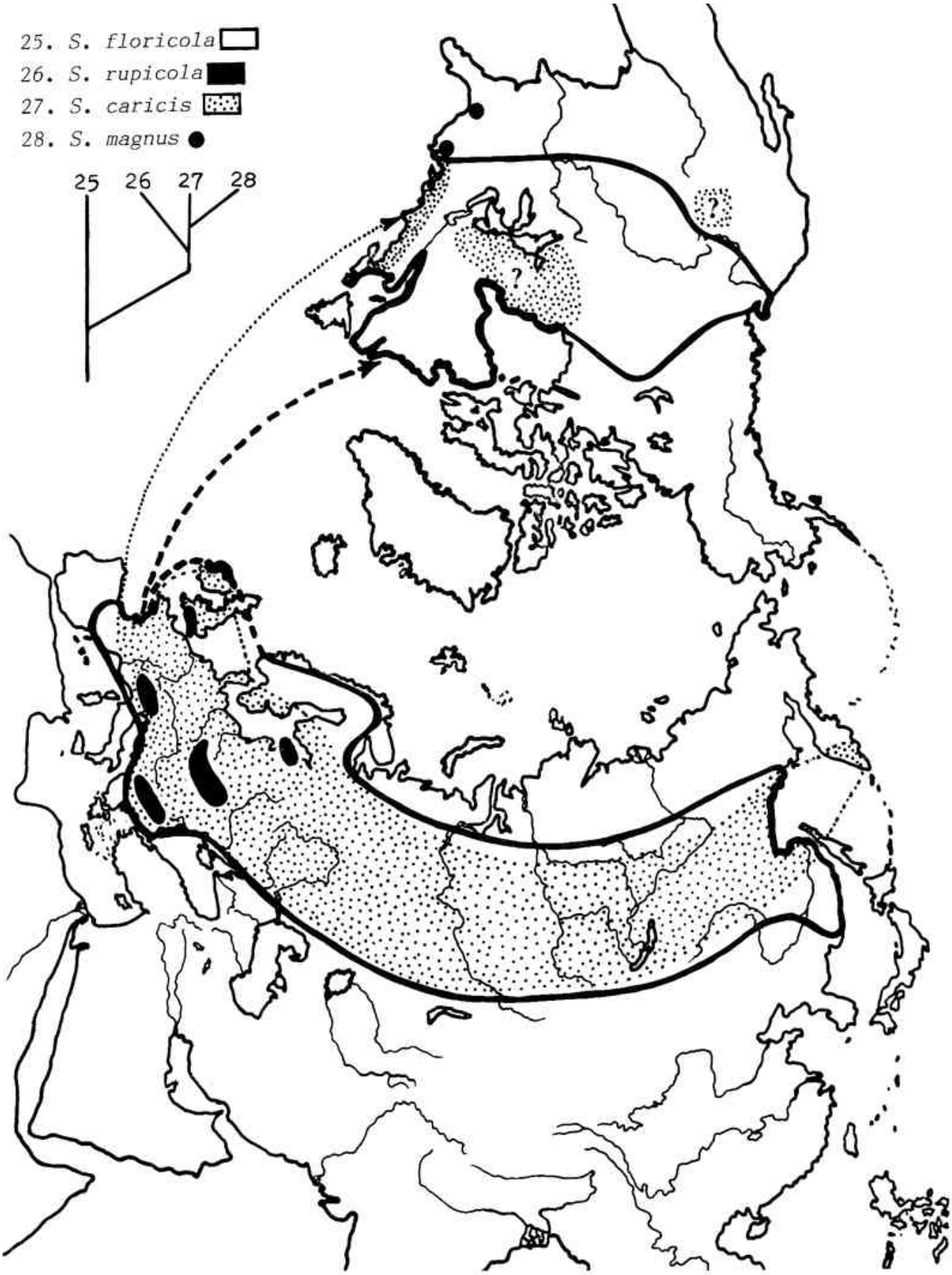


Fig. 6: Postglacial type of distribution of *S. floricola* and *S. caricis*. — The possible local origin of *S. rupicola* suggests an older - interglacial or preglacial (less probable) - existence of *S. caricis* in this areae.

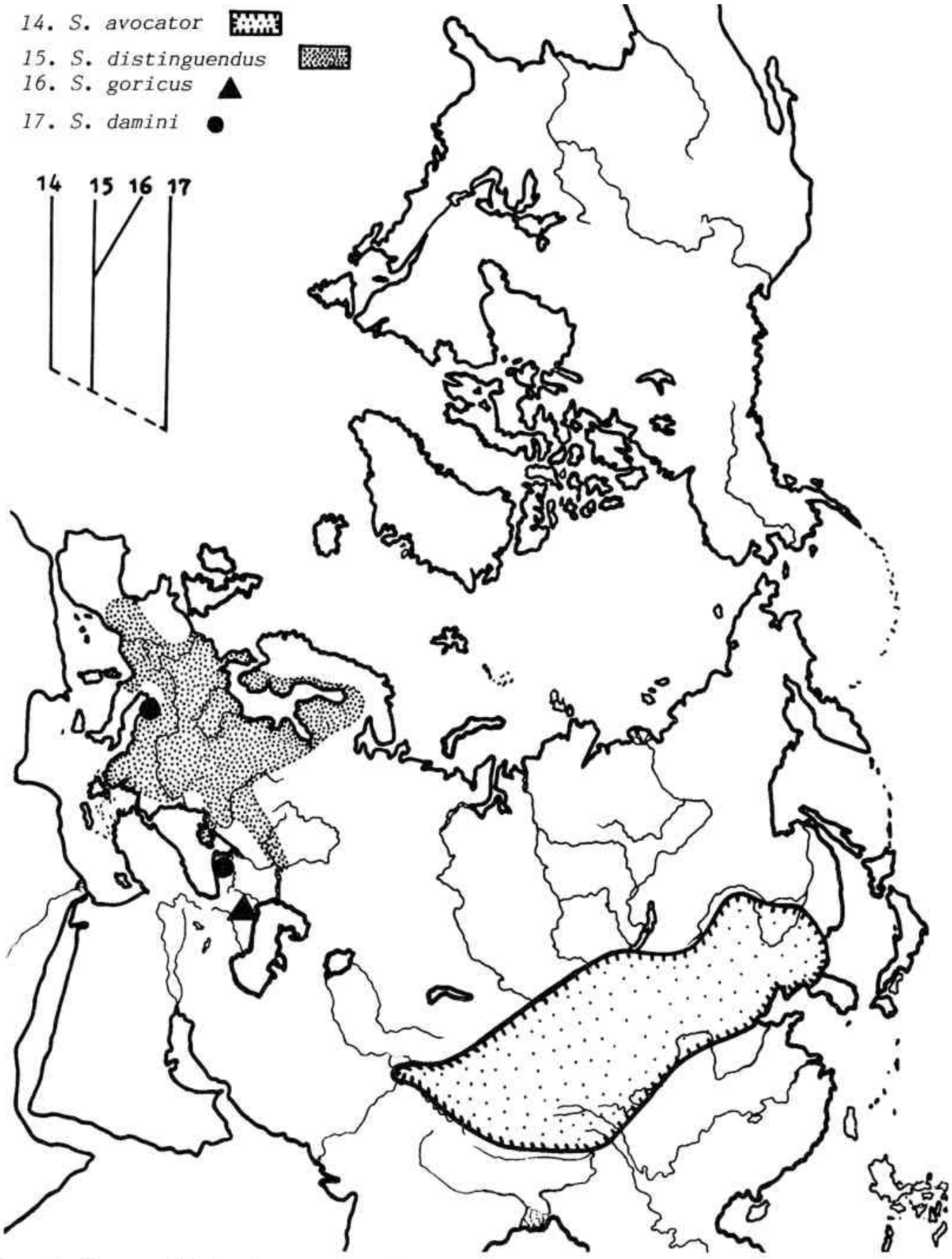


Fig. 7: Geographical vicariants of *S. distinguendus (= frigidus, helveolus, histrio)* and *S. avocator (= S. viduus)* and two locally distributed species.

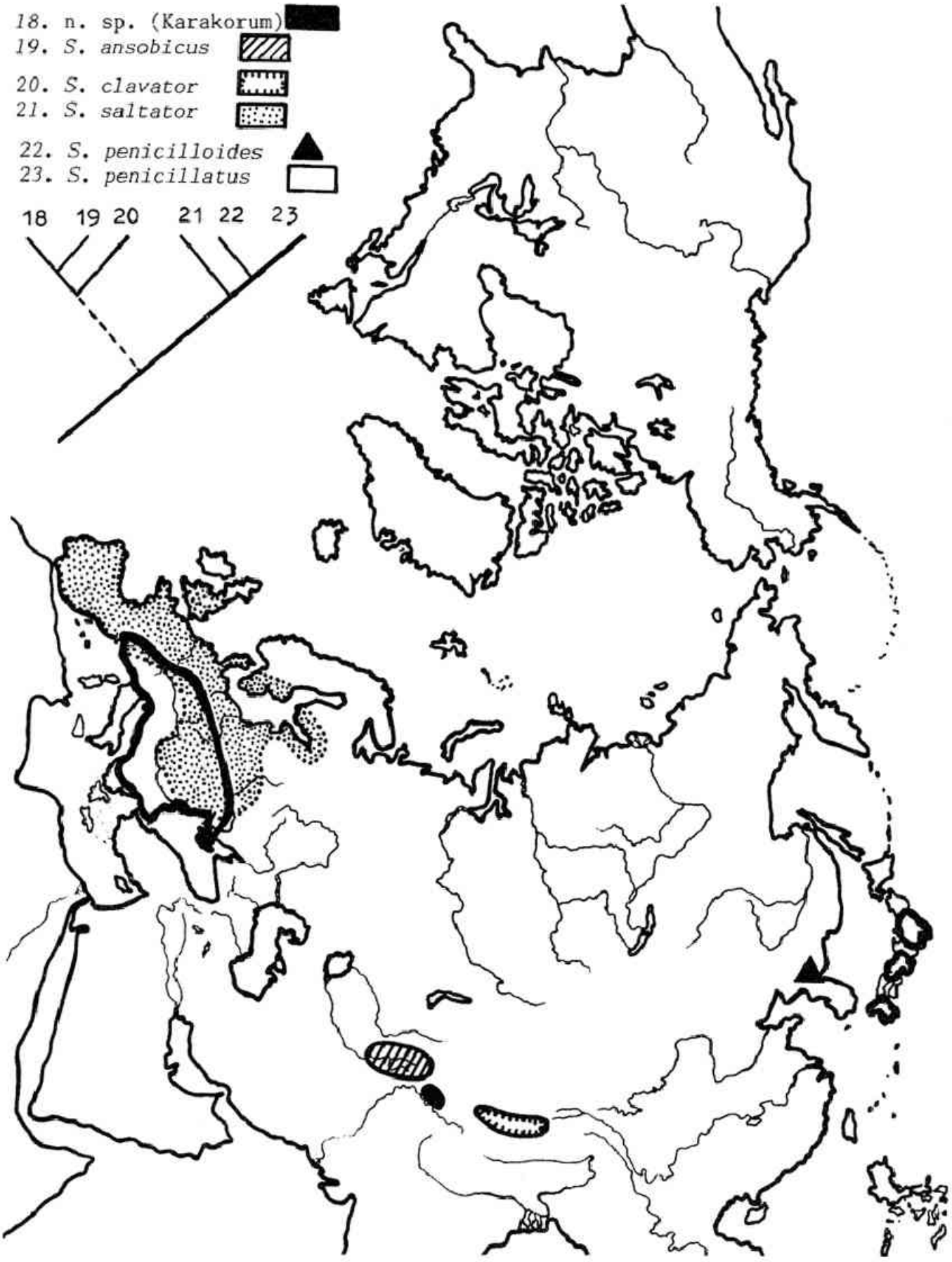


Fig. 8: Partial overlapping of the ranges of *S. penicillatus* and *S. saltator*, and possible proliferation of their relatives in Central Asia.

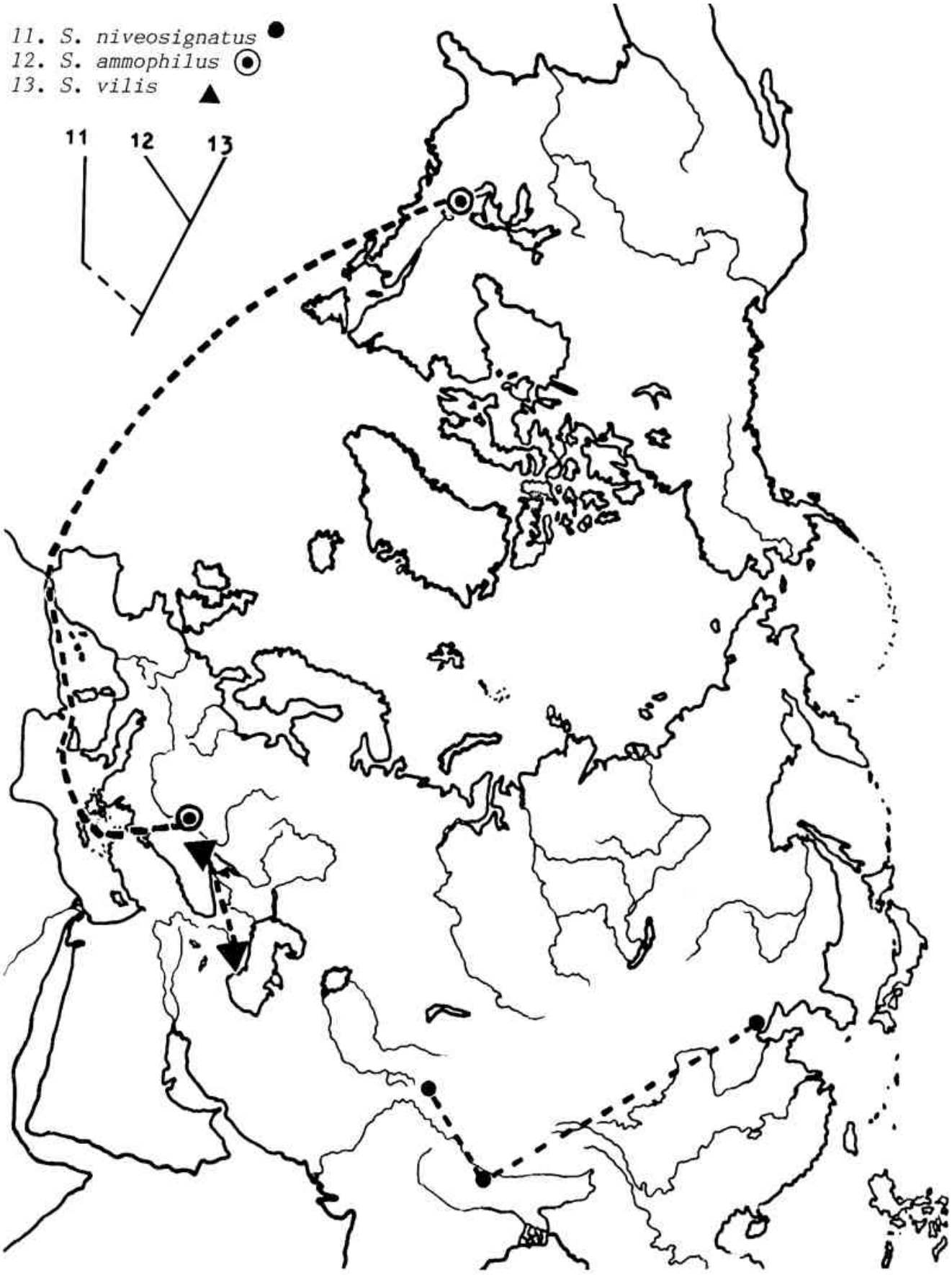


Fig. 9: Poorly known, presumably locally distributed species (*S. niveosignatus* may be a group of proliferating species.

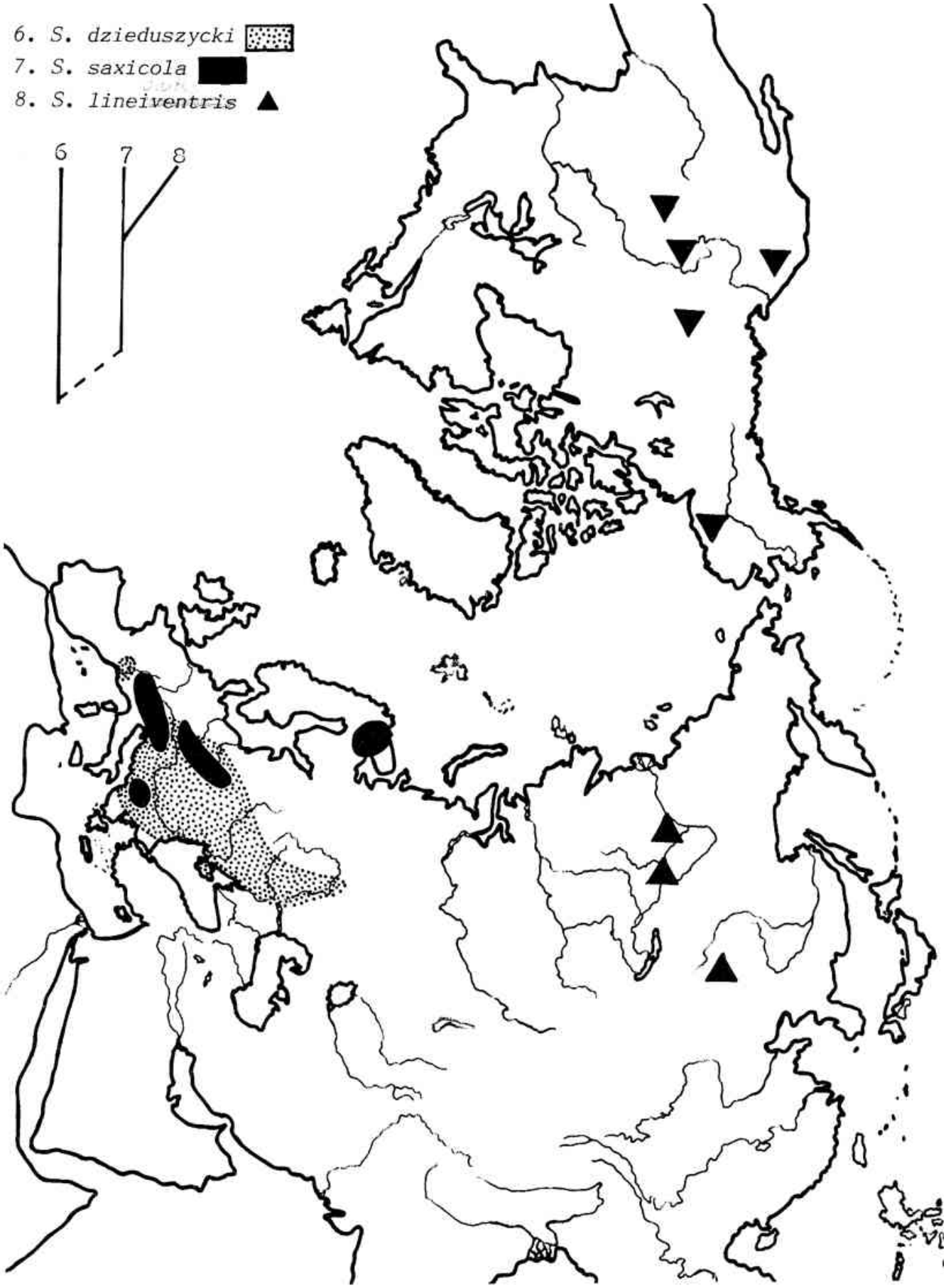


Fig. 10: Geographical vicariants *S. saxicola* - *S. lineolatus (= ranieri)*; *S. dzieduszycki* is a more distant relative.

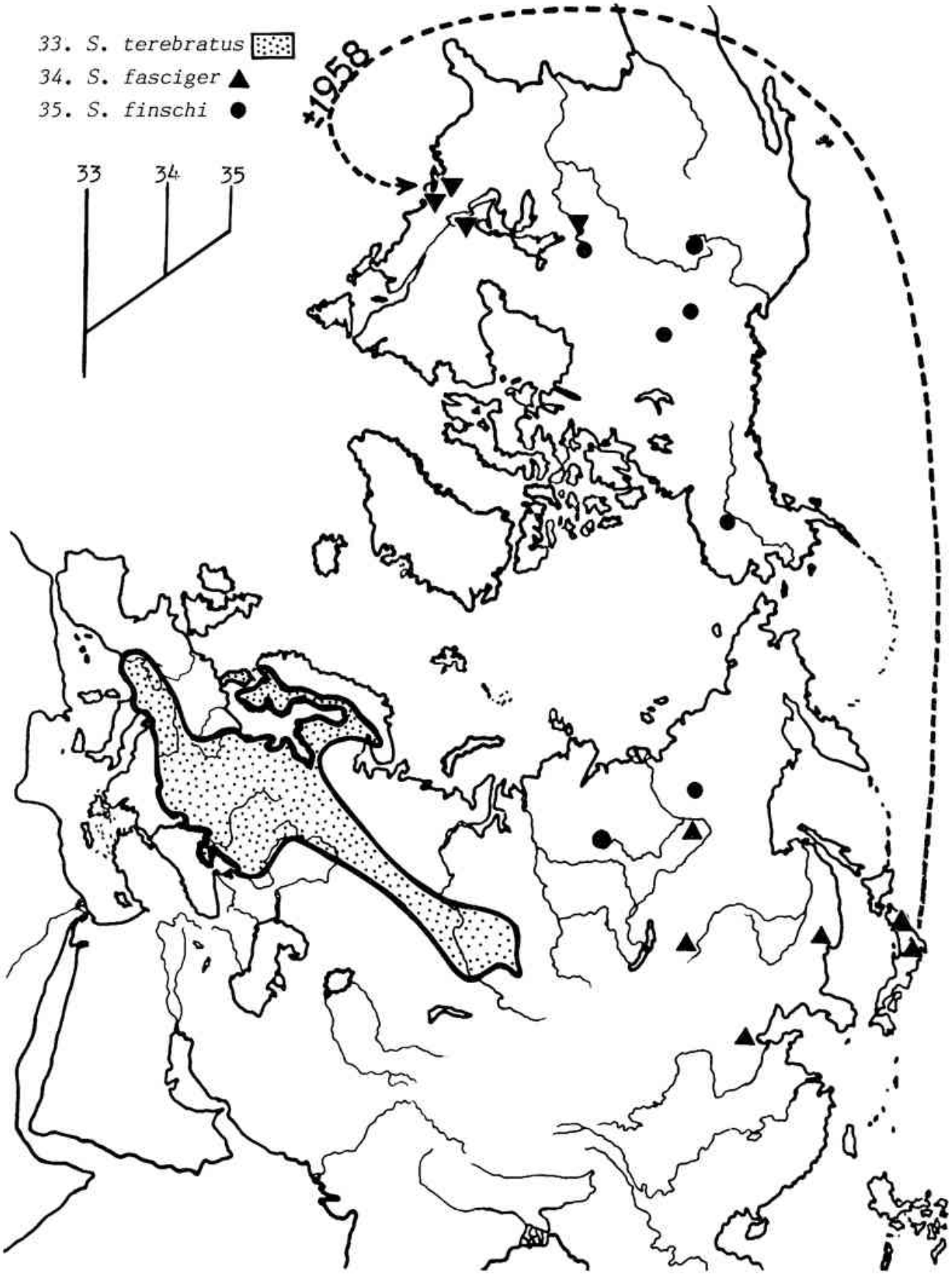


Fig. 11: Separate branches within the genus. Species are related but do not form sister pairs. *Sitticus finschi* is boreo-montane holarctic, *S. fasciger* arrived in North America from Asia as recently as 1958.

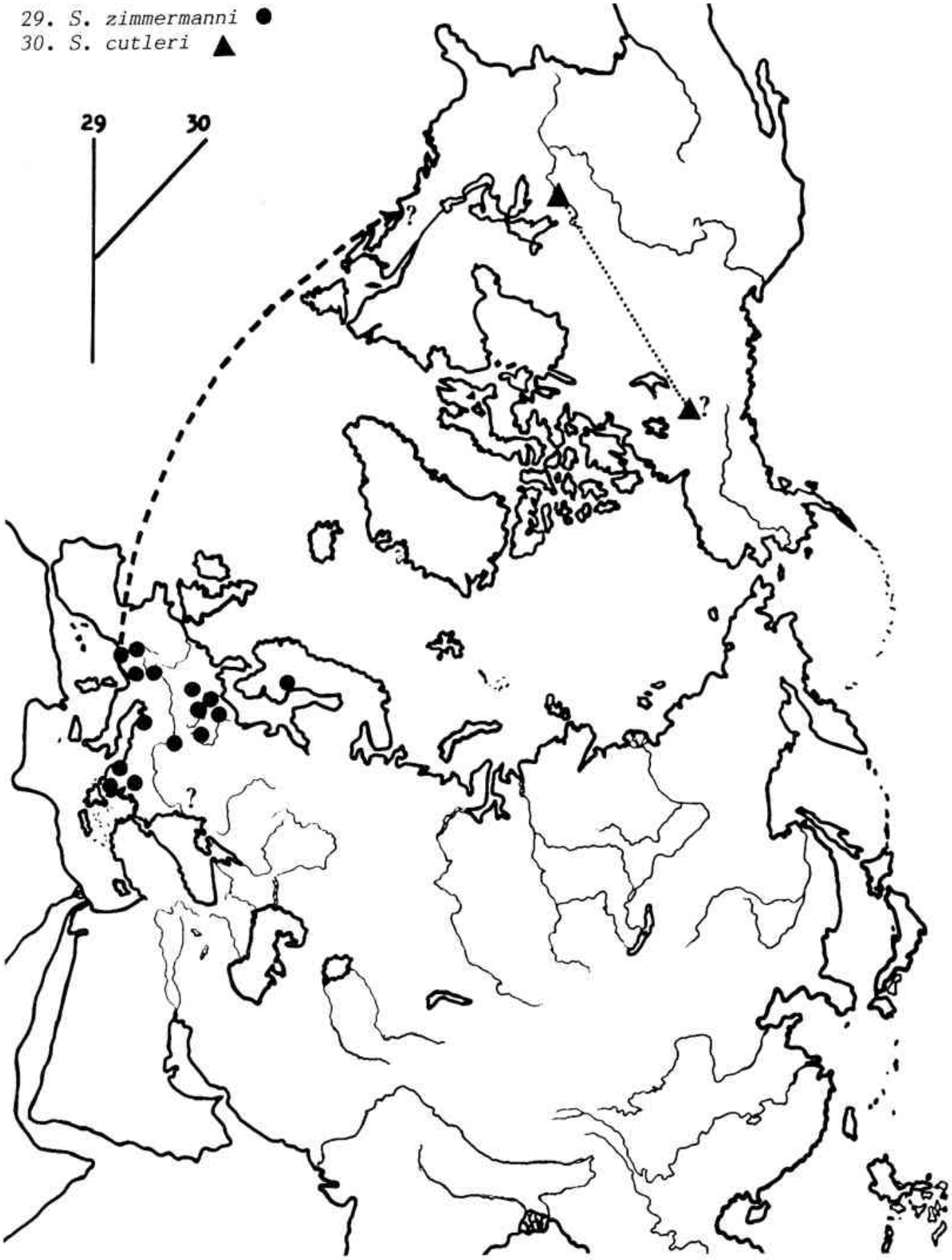


Fig. 12: The uncertain amphi-atlantic occurrence of *S. zimmermanni* is supported by the discovery of its nearest relative *S. cutleri*.

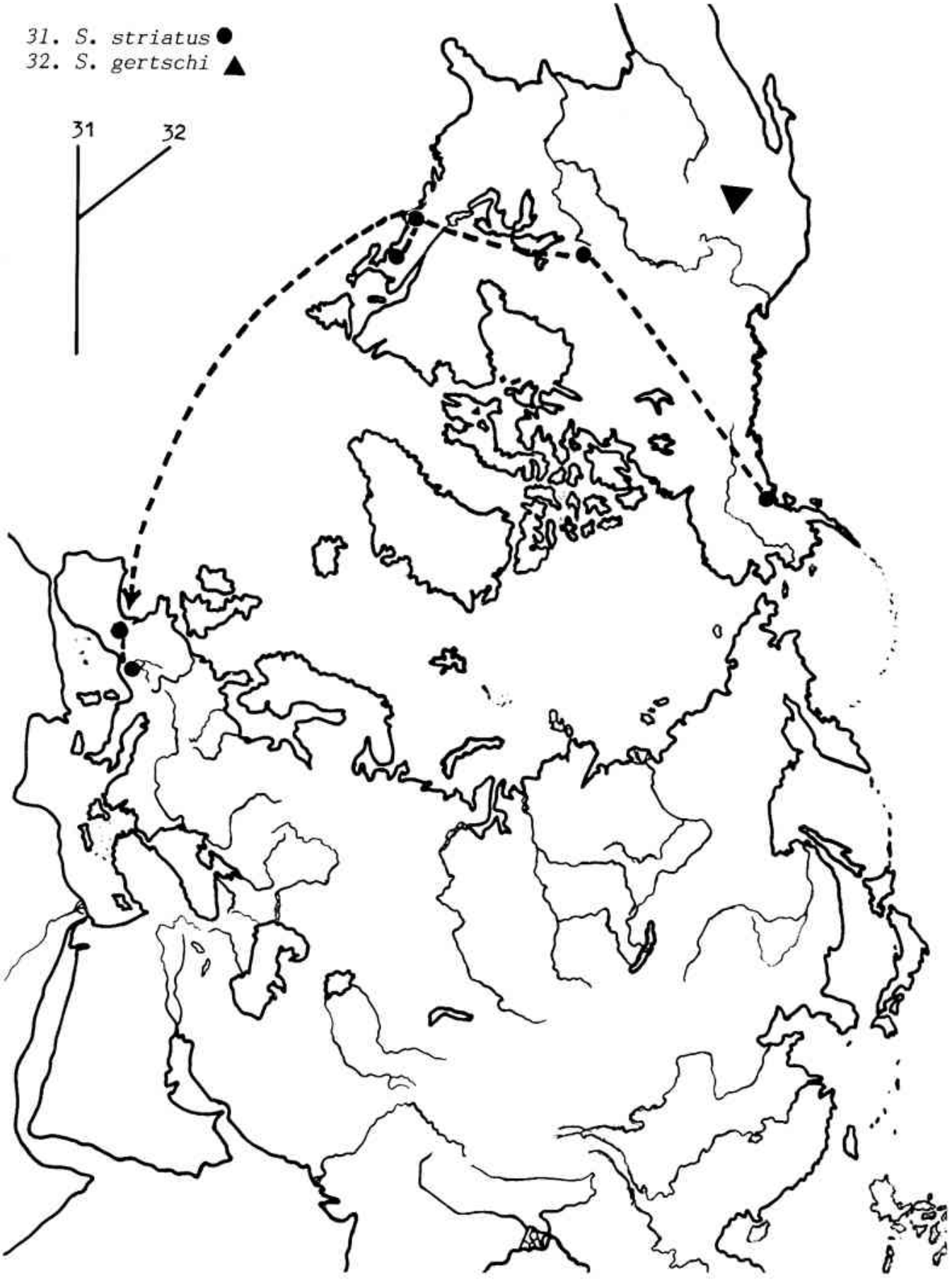


Fig. 13: The amphi-atlantic distribution of *S. striatus*, and the Nearctic occurrence of its nearest relative.

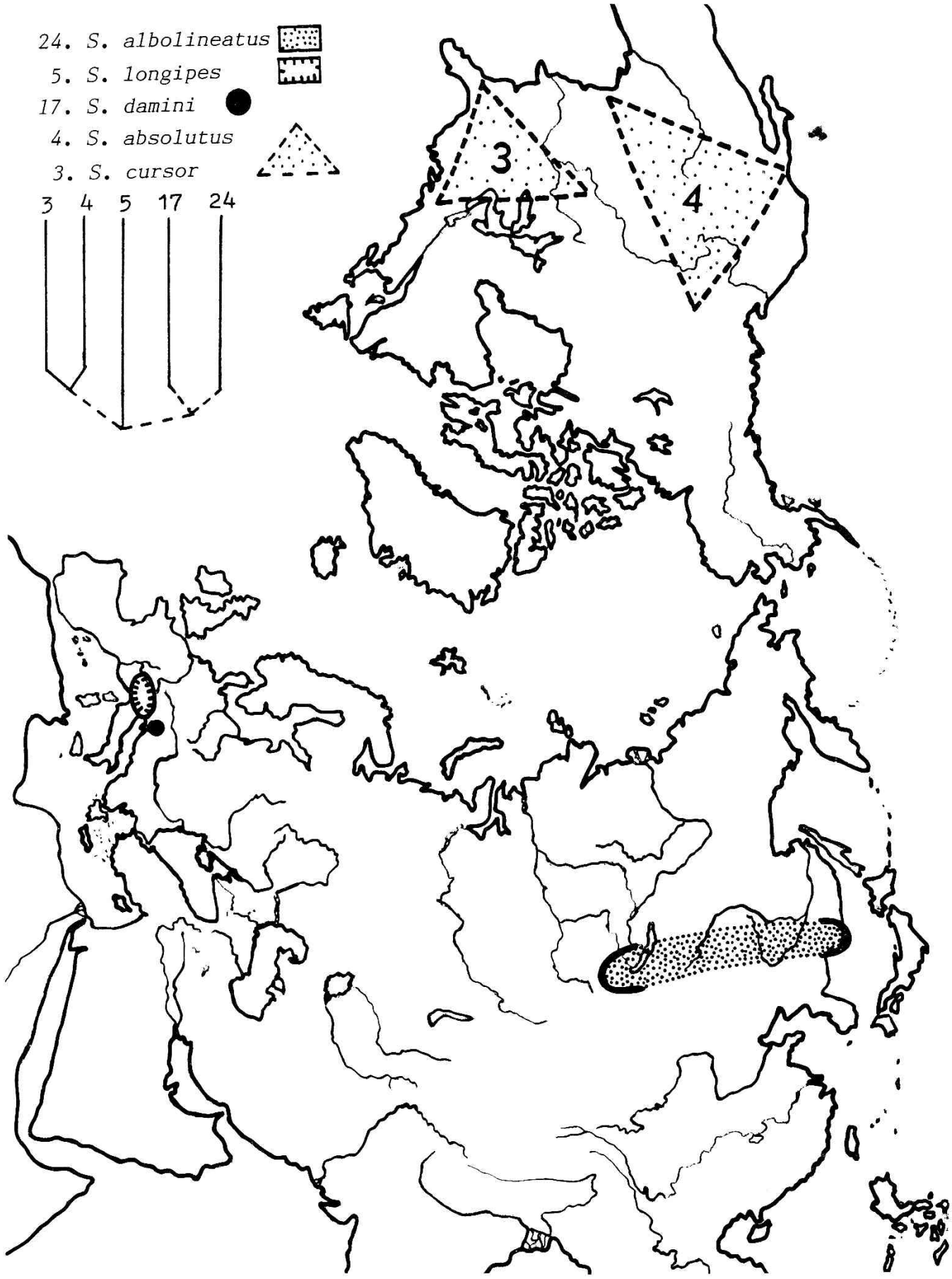


Fig. 15: The presumably oldest, relict species *S. longipes*, *S. albolineatus*, *S. damini*, and their Nearctic distant relatives.

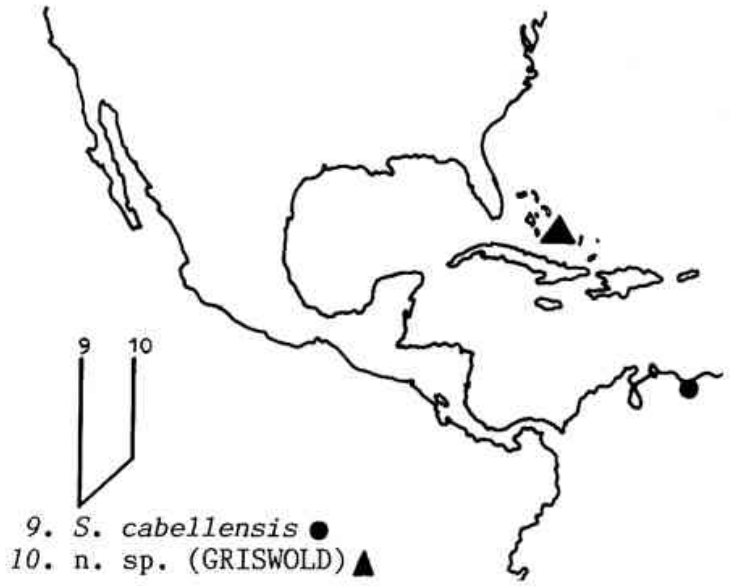


Fig. 14: The Southern distribution of a pair of *Sitticus*-species, unusual for this genus.

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