

Curculionidae Curculioninae: relationships between Mediterranean and southern African species (Coleoptera)

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SUMMARY

Eight tribes of the subfamily Curculioninae (Anthonomini, Cionini, Curculionini, Derelomini, Mecinini, Rhamphini, Storeini and Tychiini) have representatives known from both the Mediterranean and southern African subregions. Six genera (*Cionus* [Clairville], 1798, *Cleopomiarus* Pierce, 1919, *Gymnetron* Schoenherr, 1825, *Pachytichius* Jekel, 1861, *Sibinia* Germar, 1817, *Tychius* Germar, 1817) have a consistent number of taxa in both regions. In these genera the affinities between the two faunas appear very close, since many groups of them are known from both subregions. A true Mediterranean-southern African disjunct distribution occurs only in *Cleopomiarus*, whereas in the other genera some species, although few in number, are present also in eastern central Africa. The distribution of the weevils here considered is usually more restricted than that of their potential host plants and this is probably due to climatic reasons.

INTRODUCTION

In the latest years there was a rising interest in the knowledge of the southern African weevil fauna. By the discovery of many new species it has appeared increasingly clearer that at last in some groups this fauna has close relationship with the Mediterranean one as recently reviewed by Osella et al. (1998). Taking into account primarily the latest taxonomic revisions, we consider the characteristics of these two faunas in Curculionidae Curculioninae in more detail, with a particular emphasis on their host plants. Taxonomy of plants follow here Stevens (2007).

Curculioninae is a speciose subfamily of Curculionidae, whose members are usually found on flowers, leaves and branches of several and various herbaceous plants and trees in nearly all habitat types, from planes up to high mountains, and from deserts to tropical pluvial forests. The biology of Curculioninae varies conspicuously according to tribes and also to genera within a single tribe.

This subfamily is composed of approximately 370 genera and 2700 species (O'Brien & Wibmer, 1978; Thompson, 1992; Alonso-Zarazaga & Lyal, 1999). Presently, 23 tribes are recognized in Curculioninae (Alonso-Zarazaga & Lyal, 1999; Alonso-Zarazaga, 2002; Franz, 2006; Alonso-Zarazaga, pers. com.). Seven tribes (Anthonomini, Curculionini, Derelomini, Rhamphini, Smicronychini, Storeini, Tychiini) are cosmopolitan in distribution. Other tribes are also widely distributed like Cionini, which are absent only in Australia and America. Mecinini are absent only in Australian and Oriental regions. Two tribes (Geochini, Nerthopini) have representatives both in Africa and Australia. Other tribes are limited to the Palaearctic region, whereas some of them are diffused both in the Neotropical and Australian regions, or are exclusive for the Australasian region or for the Americas. One tribe, Ulomascini, appears to be endemic of central Africa, but none of them has representatives only in southern Africa.

Also with regard to the genera of the tribes distributed both in the Palaearctic and Afrotropical regions, several of them are only known to occur respectively in the Mediterranean subregion, Asia, central Africa and Madagascar, whereas only a dozen of genera seem indigenous for southern Africa (Alonso-Zarazaga & Lyal, 1999).

Unfortunately, only few tribes have been submitted to systematic and phylogenetical approaches, a fact mainly due to the high number of taxa of Curculioninae and to their exceedingly high diversity.

Here we treat the eight tribes which presently appear to have representatives both in the Palaearctic and the Afrotropical regions.

Anthonomini

This tribe is composed of numerous genera and species, the systematics and phylogeny of which appear still very intricate (Kojima & Morimoto, 1994; Kojima & Idris, 2004). The morphological features of these weevils are so diverse that transferring of some of them from Anthonomini to other tribes (especially Tychiini Ochyromerina and vice-versa) even happened during the past. The greatest number of the members of this tribe occurs in the New World (Alonso-Zarazaga & Lyal, 1999), whereas in the Palaearctic region only about 100 species are known (Dieckmann, 1968), mainly belonging to the widespread genus *Anthonomus*, so far not reported from Southern Africa.

Only two genera of Anthonomini with few representatives are known to occur in southern Africa: *Assuanensius* Pic, 1916, and *Sphincticraerus* Marseul, 1871, both with species spread in the whole of the African continent. It is notheworthy that a species of *Sphincticraerus* also occurs in a warm spot of southern Spain (Osella & Meregalli, 1986). It is probable that all *Assuanensius* live on *Acacia* (Fabaceae Mimosoideae), a genus distributed in the whole of Africa, since on flowers of this kind of trees the adults are always been collected both in North and South Africa (Hoffmann, 1963; Colonnelli, pers. obs.). Members of *Sphincticraerus* live on *Ziziphus* (Osella & Meregalli, 1986), a rather speciose genus of Rhamnaceae widely distributed in the southern Mediterranean and in northern and eastern Africa from Ethiopia to South Africa, in addition to south-western Asia and Arabian peninsula.

Cionini

This tribe is presently composed of seven genera (Caldara & Korotyaev, 2002). Among these only *Cionus* [Clairville], 1798, which includes over 50 Palaearctic and Oriental species, appears to have representatives both in the Mediterranean subregion and in southern Africa. Whereas the Palaearctic species of *Cionus* have been revised by Wingelmüller (1914), the about 20 presently known southern African species were never treated after their description dating back to the first half of the nineteenth century. The habitus of the South African species is very similar to the Palaearctic ones (Figs. 14 and 15). However, all of the Afrotropical taxa lack the two characteristic black spots on elytral sutural interval present in most of the Palaearctic species, and in addition many of the southern African members of the genus have two small pronotal tubercles (Caldara, unpublished data). After revision, southern African *Cionus* may prove to belong to a lineage different from the Palaearctic one.

In the Palaearctic region members of *Cionus*, as well as those of *Cleopus*, live mainly on Scrophulariaceae in the genera *Scrophularia* and *Verbascum* (Hoffmann, 1958; Caldara & Korotyaev, 2002), but other genera of the tribe (*Stereonychus* Suffrian, 1854 and *Cionellus* Reitter, 1904) live on Oleaceae of the genera *Phyllirea* and *Chionanthus*, and Plantaginaceae of the genus *Globularia* (Hoffmann, 1958; Caldara & Korotyaev, 2002). Larvae of Cionini are ectophagous, living externally on the host plant or hidden between leaves stuck together by them. They eat flowers and leaves and move nimbly, being covered with viscid mucus, which is secreted by a retractile tubular structure placed on the last segment. This substance is also used at the end of their growth in order to form a spherical transparent cocoon, attached to leaves or branches, where the metamorphosis occurs. No biological data were published for South African species, but personal unpublished data due to direct collec-

tion or to the examination of labels of many examined specimens reveal that southern African *Cionus* are frequently collected on *Olea* (Oleaceae) and *Pseudoselago* and *Tetraselago* (Scrophulariaceae) (Colonnelli, pers. rec.).

As well emphasized on the maps, the distribution of *Cionus* in the Palearctic and Afrotropical regions follows almost perfectly that of the Scrophulariaceae (Figs. 1 and 2). However, in northern and north-eastern Africa only very few species of *Cionus* are known.



Fig. 1 - Distribution of *Cionus*. Dark grey: species number > 40; light grey: species number <5.

Curculionini

In this tribe only the worldwide distributed genus *Curculio* Linnaeus, 1758 has representatives both in the Palaearctic and Afrotropical regions, although the southern African species are fewer, and clearly more related to the several members of *Curculio* distributed across all tropical Africa.

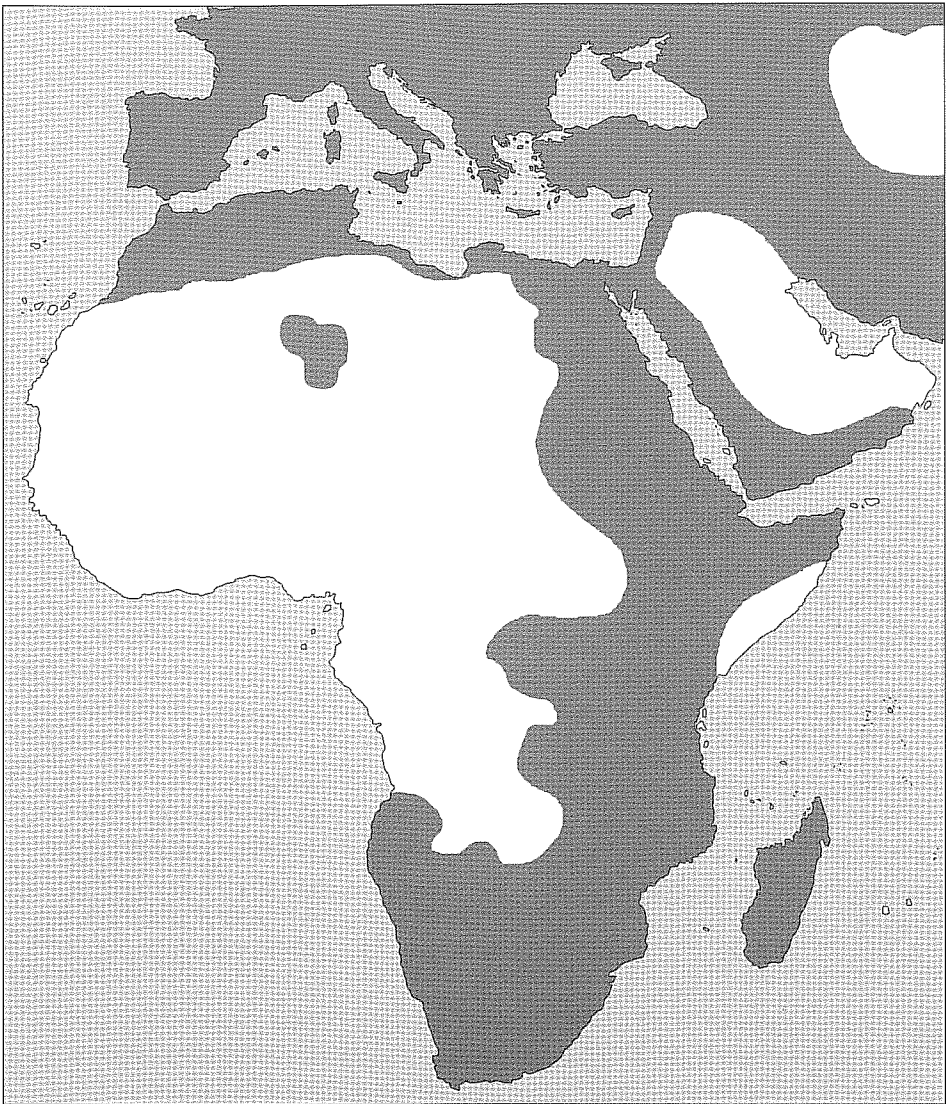


Fig. 2 - Distribution of Scrophulariaceae.

The biology of many species of *Curculio* is well known. Their host plants are usually trees belonging to Fagaceae, Corylaceae, Betulaceae and Salicaceae in the Holarctic (Hoffmann, 1954; Gibson, 1969; Gibson, 1977), whereas in western central Africa many species live on Moraceae (Rasplus et al., 2003) like the majority of the Oriental ones (Colonnelli, pers. obs.). Generally, larvae of several genera complete development in the flower buds or fruits of their host plants, whereas pupation takes place in the soil (Hoffmann, 1954).

Derelomini

Presently, this tribe is divided into three subtribes, Derelomina, Acalyptina and Phyllotrogina (Franz, pers. com.). The species of Derelomini, also known as “palm flower weevils” (Franz, 2006), are primarily associated with reproductive organs of monocotyledons belonging to the families Arecaceae and, only in southern America, Cyclanthaceae (Henderson, 1986; Franz & Valente, 2005).

Only *Derelomus* Schoenherr, 1825 (Derelomina) has both Palaearctic and Afrotropical representatives (Figs. 16 and 17). *Derelomus* is also composed of some species distributed in Brasil, China and Japan. In the Mediterranean subregion three species are presently known: *D. chamaeropsis* (Fabricius, 1798), *D. subcostatus* Boheman, 1844, and *D. schoedli* Rheinheimer, 2005. The first two species live in the western Mediterranean subregion on *Chamaerops humilis* L. (Arecaceae, Coryphoideae) (Hoffmann, 1958), whereas the third species was described from Saudi Arabia, but nothing is known about its biology. In southern Africa adults of *Derelomus* are frequently found feeding on pollen of flowers of Rhamnaceae and Fabaceae of the genus *Acacia* (Colonnelli, pers. rec.), although their exact biology is at the moment unknown.

Mecinini

This tribe is presently composed of six genera (Caldara, 2001), only two of them, *Gymnetron* Schoenherr, 1825 and *Cleopomiarus* Pierce, 1919, having representatives both in the Palaearctic and Afrotropical regions.

Gymnetron is comprised of about 30 taxa from the Palaearctic region, and of 60 species from the Afrotropical region (Fig. 3), 55 of which only recently described primarily from South Africa (Caldara, 2003). Only three undescribed species are known from western Africa (Caldara, unpublished data). The Afrotropical species are currently included into 13 different groups, all of which considered endemic of this region. However, the species of both regions appear very closely related each other and essentially distinguishable only on the basis of few subtle differences (Figs. 18 and 19), so that at the moment it is impossible to assess whether they belong to the same or to two different lineages. All



Fig. 3 - Distribution of *Gymnetron*. Dark grey: species number > 30; light grey: species number < 5.

of the Palearctic species live on the genus *Veronica* currently included in Plantaginaceae, whereas the species from the Afrotropical region, where *Veronica* are poorly represented, appear to live on various Scrophulariaceae, i.e. *Hebenstreitia*, *Sutera*, *Selago*, *Buddleja*, *Diascia*, *Nemesia*, *Hemimeris* (Caldara, 2003) and *Tetraselago* (Colonnelli, pers. rec.), and Stilbaceae, i.e. *Anastrebe* (Caldara, 2003), which is a family closely related to Plantaginaceae (Fig. 4). It is noteworthy that two genera very closely related to *Gymnetron* like *Mecinus*

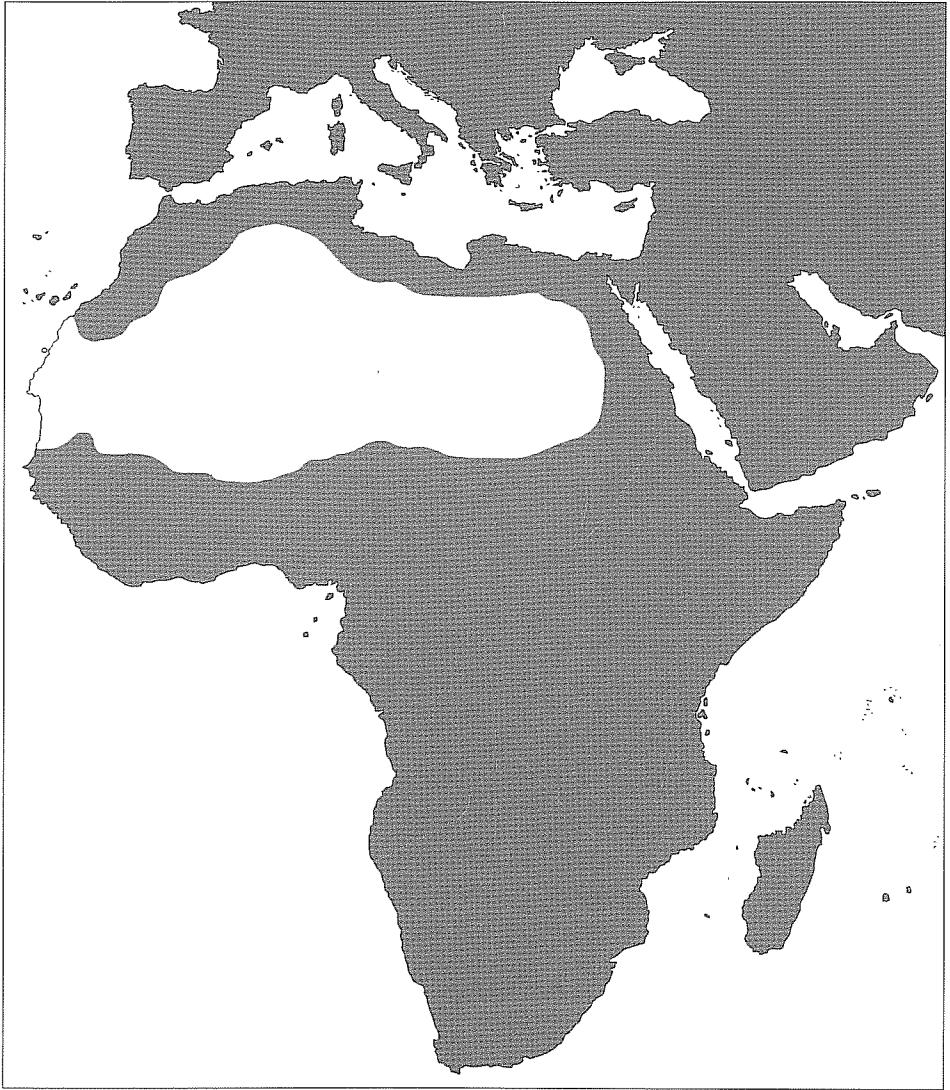


Fig. 4 - Distribution of Plantaginaceae.

German, 1817 and *Rhinusa* Stephens, 1829, both also living on Plantaginaceae and Scrophulariaceae, appear to lack in central and southern Africa. Larvae of *Gymnetron* live and pupate into roots, branches, leaves and ovaries of the host plants, usually causing a swelling of these structures and sometimes true galls (Hoffmann, 1958; Caldara, 2001; Caldara, 2003; Caldara, 2005).

The Afrotropical species of *Cleopomiarus* have been recently revised (Caldara, 2005), whereas the Palearctic ones still are in need of revision (Figs. 20 and

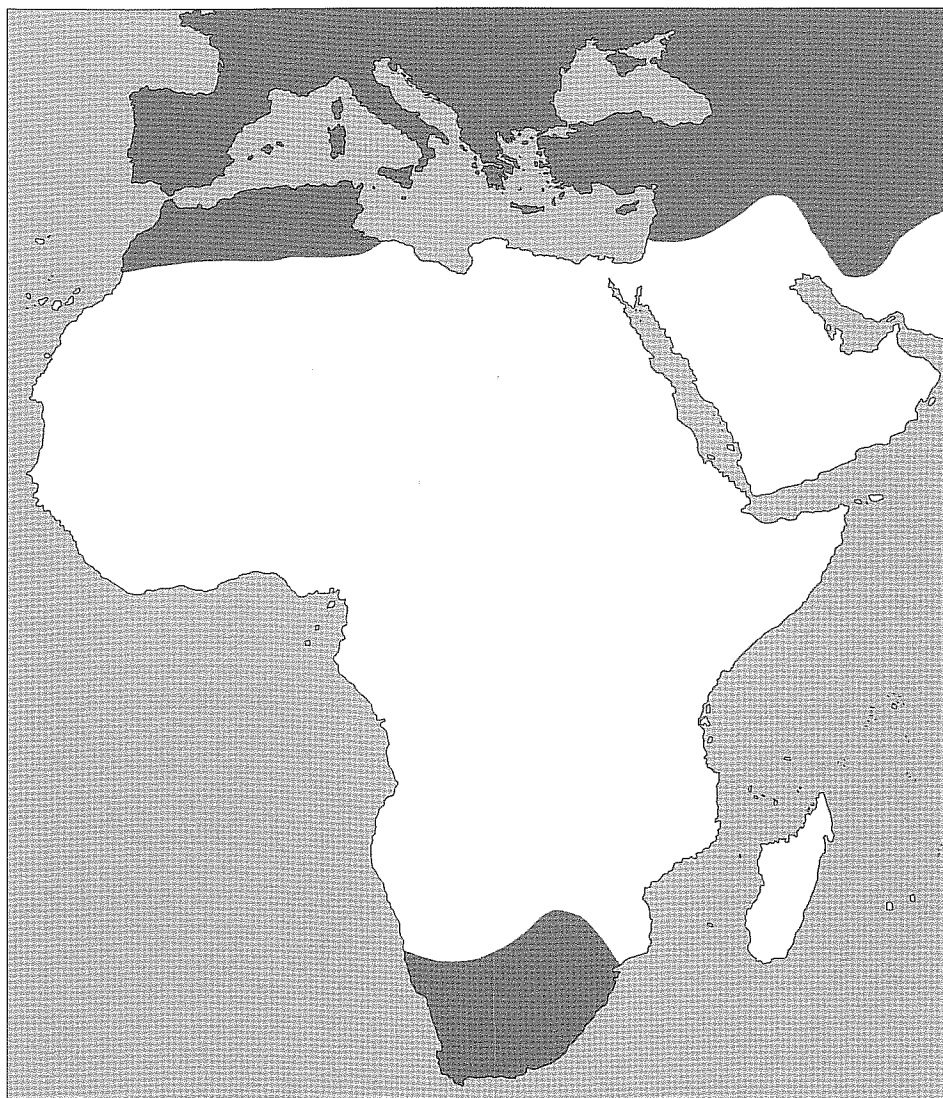


Fig. 5 - Distribution of *Cleopomiarus*.

21). To the six previously known species of the Afrotropical *Cleopomiarus*, 15 new species were added, all from the southern part of Africa (Caldara, 2005). All of them appear to be very closely related each other and have been separated in three groups differing by few characters of the genitalia. However, only one of these groups is endemic for the Afrotropical region, whereas the other two groups include also all the Palearctic species. No species are known from eastern Africa (Fig. 5). Both Palearctic and Afrotropical species live on

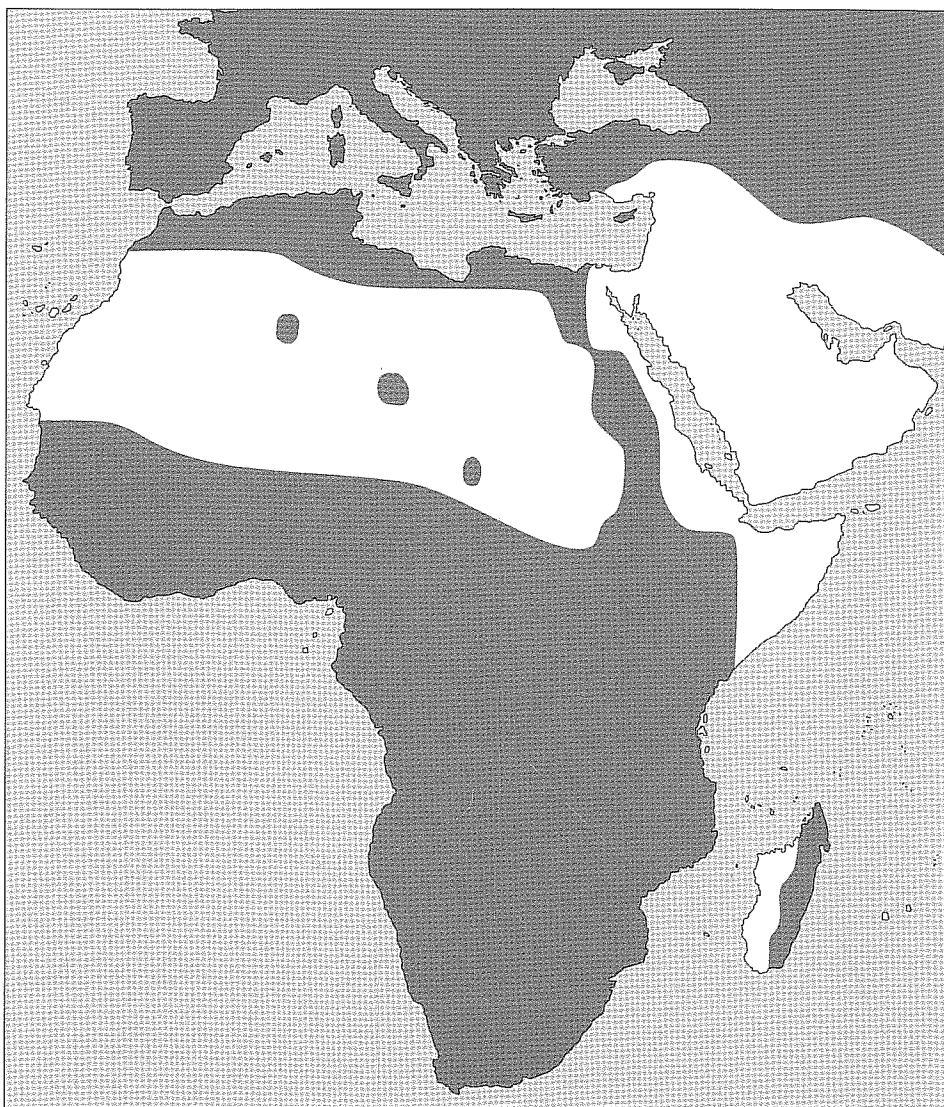


Fig. 6 - Distribution of Campanulaceae Campanuloideae.

Campanulaceae, the first ones on *Campanula*, *Phyteuma* and *Jasione* and the second ones on *Wahlenbergia*, *Roella* and *Lobelia* (Caldara, 2005), all genera belonging to the subfamily Campanuloideae except the last one belonging to Lobelioideae (Figs. 6 and 7). Larvae of *Cleopomiarus* live inside the capsules of the flowers of their host plants, where they pupate and changed into adult, without forming galls or evident deformation.

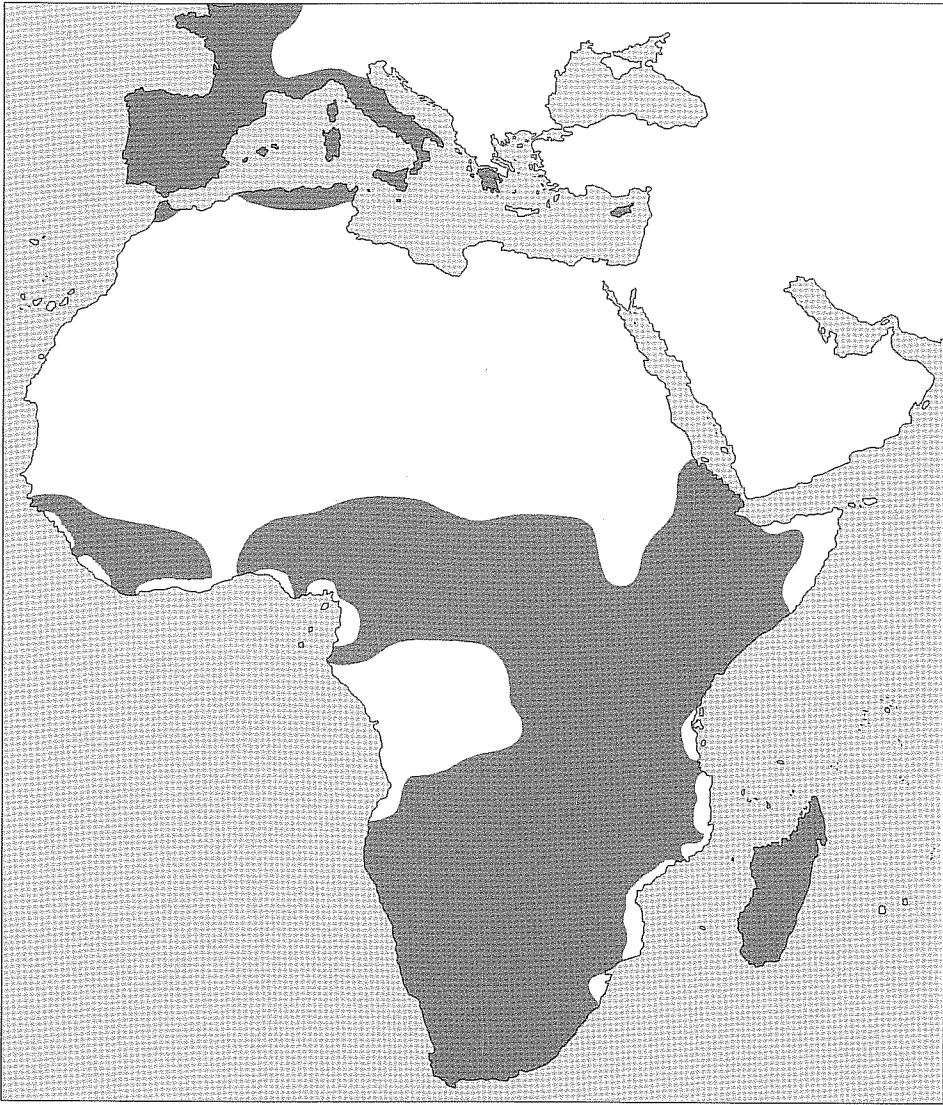


Fig. 7 - Distribution of Campanulaceae Lobelioideae.

Rhamphini

This tribe is divided into four subtribes (Alonso-Zarazaga & Lyal, 1999). Only for some Holarctic and south-eastern Asiatic genera are available some partial revisions. Relationships and true systematic position of the remaining members of this worldwide tribe are poorly known.

It can be reminded that one species of the widespread genus *Rhamphus* [Clairville], 1798 was described from Namibia by Korotyaev (1994), and a number of species were collected on *Acacia* in southern Africa (Colonnelli, pers. rec.). The feeding on these Fabaceae is also known for some Australian species (Lea, 1894; Colonnelli pers. rec.). One species of the primarily Palaearctic genus *Pseudorchestes* Bedel, 1894 was recently described from Namibia (Korotyaev, 1996).

Larvae of Rhamphini usually mine the young leaves of broad-leaving trees belonging to many families (Anacardiaceae, Betulaceae, Caprifoliaceae, Fabaceae, Fagaceae, Myricaceae, Rosaceae, Salicaceae, Ulmaceae), eating its parenchyma, forming winding tunnels, and often causing serious damage by defoliation, but those of *Pseudorchestes* Bedel feed on herbaceous plants belonging to Asteraceae (Hoffmann, 1958; Anderson, 1989; Kojima & Morimoto, 1996).

Storeini

This is a tribe which surely needs a careful revision at generic level. It is composed of about 30 Australian or Australasian, three African and two Palaearctic genera, one of them, *Pachytychius* Jekel, 1861, also including Afrotropical species.

Several of the *Pachytychius* are only occasionally collected probably because of our nearly complete lack of knowledge of their biology. However, many species appear to have a true relict distribution. Of the 55 species thus far described, 40 are Palaearctic, 10 Afrotropical and 5 Indian.

The Afrotropical species belong to three groups, two of which include members also distributed in Europe and Asia and apparently very closely related to each other. Some Palaearctic and Indian species closely allied to the Afrotropical ones live on Fabaceae (Caldara, 1978; Caldara, 1984a; Caldara, 2000). Nothing is known about the host plant of the Afrotropical species (Caldara, 2000).

Tychiini

This tribe is composed of four subtribes, which distinctly differ in their distribution. Only one subtribe, Tychiina, has representatives in both Palaearctic and southern Africa. It is composed of two genera, *Tychius* Germar, 1817 and *Sibinia* Germar, 1817.

Presently about 240 taxa of the genus *Tychius* are considered as valid species. In the Afrotropical region only a dozen of species were known prior to recent revisions, in which about 45 species mainly from South Africa were described as new (Caldara, 1989a; Caldara, 1996). The southern African taxa were arranged into six groups, of which only four appear endemic, whereas two include also several



Fig. 8 - Distribution of *Tychius*. Dark grey: species number >50; light grey: species number <10.

Palaeartic species. However, also the four endemic groups appear very closely related to some Palaeartic ones (Figs. 22 and 23), from which they can be separated only by few characters. Apart from northern and southern Africa, a few species of *Tychius* are also known from eastern and western Africa (Fig. 8).

Both Palaeartic and Afrotropical species, like the American ones, live on the worldwide distributed family Fabaceae (Clark, 1971; Clark, 1977; Clark & Burke 1977; Clark et al., 1978; Caldara, 1989a; Caldara, 1990) (Fig. 9).

However, whereas the Palaearctic species live mainly on Galegae and Trifolieae, the Afrotropical ones appear to live on Lotononideae and Indigofereae. Members of *Tychius* have a relatively homogeneous biology: most species are seed predators, whereas a few of them form galls on leaves, flowers or pods (Clark & Burke, 1977; Korotyaev et al., 2005). Larvae which have fed on the seeds inside the fruit, typically leave the pod and enter the soil to pupate when mature (Clark & Burke, 1977).

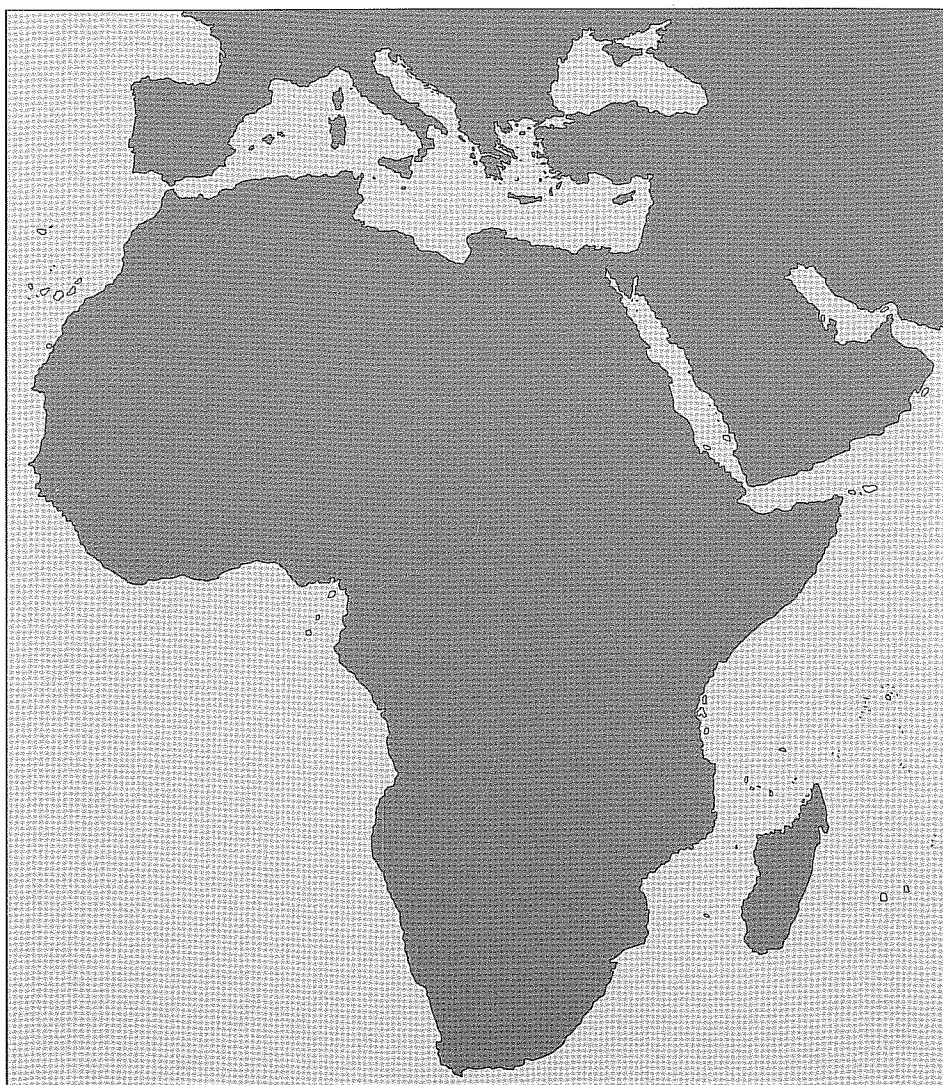


Fig. 9 - Distribution of Fabaceae.

With regard to *Sibinia*, prior to recent revisions about 100 Palearctic taxa were considered as valid species, and only 30 American and 12 Afrotropical taxa were known. On the contrary, now only 50 Palearctic taxa are considered as valid (Caldara, 1979; Caldara, 1984b), whereas the number of American (mainly South American) and Afrotropical (mainly South African) taxa increased to 130 (Clark, 1978) and 60 (Caldara, 1989b; Caldara, 1993) respectively (Fig. 10). Both American and Afrotropical species appear to be



Fig. 10 - Distribution of *Sibinia*. Dark grey: species number >40; light grey: species number <5.

closely related to the Palearctic ones (Figs. 24 and 25), which are presently divided into two subgenera. However, whereas most of the American species were included into a different subgenus, the Afrotropical species are considered for the moment as belonging to the nominotypical subgenus due to their very close relationships with many of the Palearctic ones. The Afrotropical *Sibinia* belong to eight groups, seven of which considered indigenous. The development of the Palearctic ones occurs mainly in seeds of Cariophyllaceae



Fig. 11 - Distribution of Cariophyllaceae.

and Plumbaginaceae Staticoideae (Figs. 11 and 12), and also on Paronychiaceae and Thymeleaceae (Hoffmann, 1958; Caldara, 1979; Caldara, 1984b). Probably the Afrotropical species of *Sibinia* live, at least in part, on Aizoaceae Mesembryanthemoideae (Caldara, 1989b), whereas none of them are recorded from Caryophyllaceae and Plumbaginaceae, although several species of these families occur in southern Africa (Fig. 13). It is noteworthy that Aizoaceae and Caryophyllaceae appear to be closely related. In addition,



Fig. 12 - Distribution of Plumbaginaceae Staticoideae.

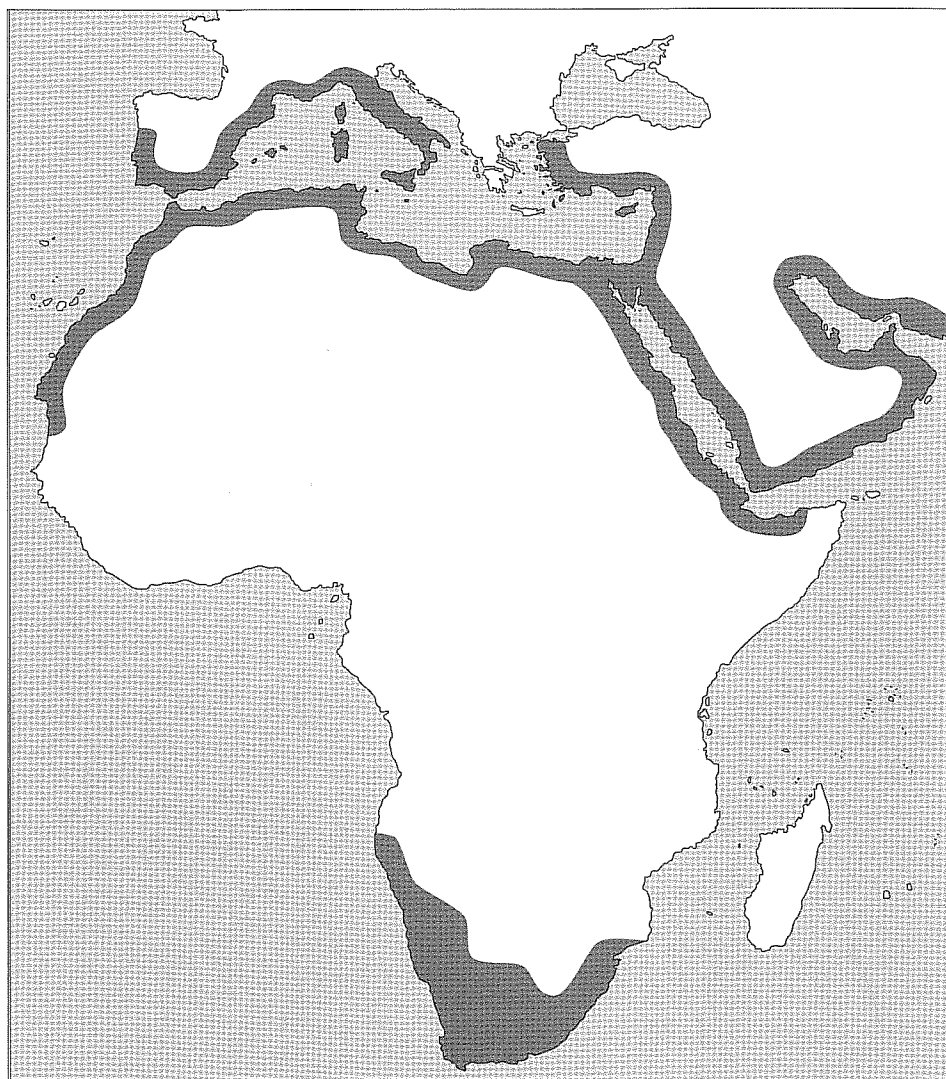
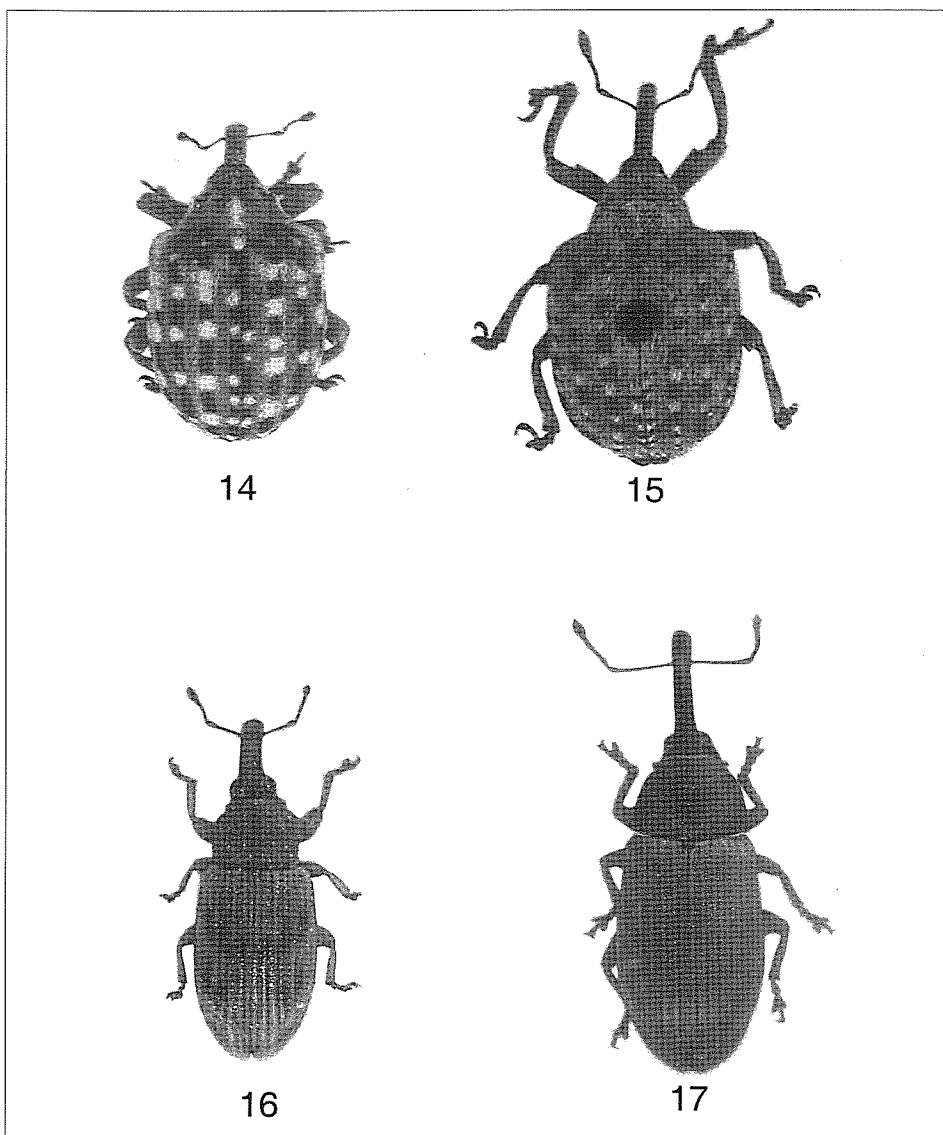


Fig. 13 - Distribution of Aizoaceae Mesembrianthemoideae.

all of the Neotropical species whose biology is known live on Mimosoideae (Clark, 1978), but none of the Afrotropical species has hitherto been reported as living on these plants, although they are well represented in this region.

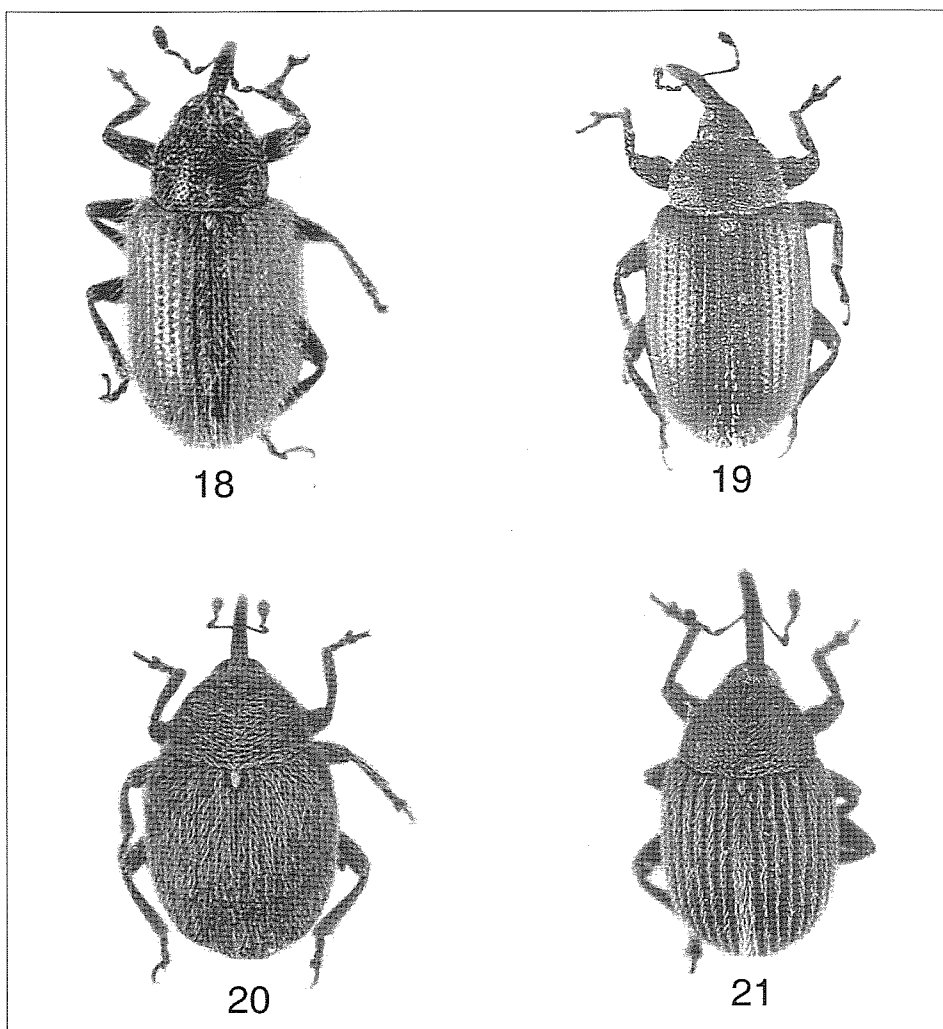
CONCLUSION

About 50 of the 65 genera of the subfamily Curculioninae have Mediterranean representatives. Eleven of them have representatives in both Mediterranean and



Figs. 14-17. Habitus of: 14: *Cionus histrio* Rosenschoeld, 1838 from South Africa; 15: *Cionus hortulanus* (Fourcroy, 1785) from Italy; 16: *Derelomus signatus* Gyllenhal, 1834 from South Africa; *D. chamaecropis* (Fabricius, 1798) from Italy.

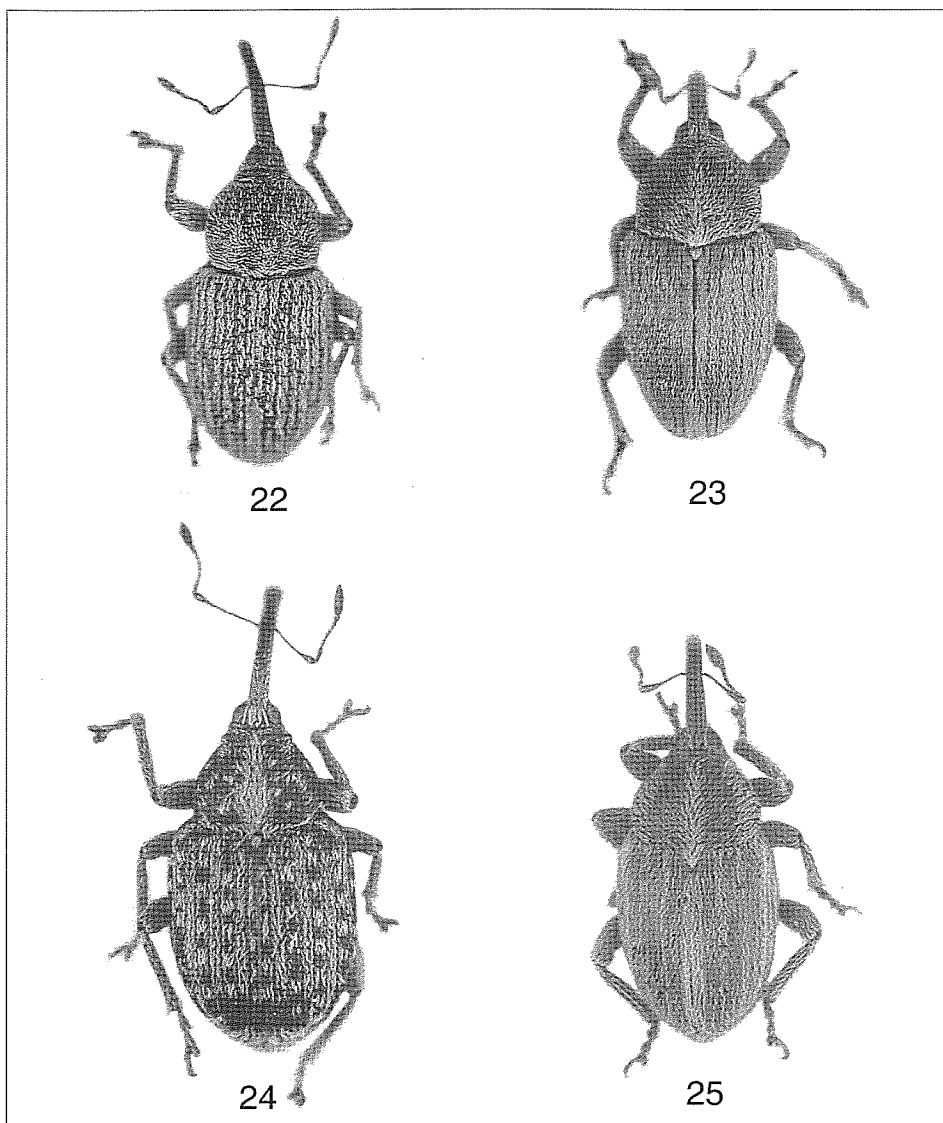
southern African subregions. Considering the total number of species which constitute these genera, presently at least six of them (*Cionus*, *Cleopomiarus*, *Gymnetron*, *Pachytychius*, *Sibinia*, *Tychius*) have a consistent number of taxa in both regions, whereas the others are only marginally represented in southern Africa. It is noteworthy that these genera, except *Cionus*, were recently revised,



Figs. 18-21. Habitus of: 18: *Gymnetron perrinae* Caldara, 2003 from South Africa; 19: *G. vittipenne* Marseul, 1876 from Turkey; 20: *Cleopomiarus plebejus* (Rosenschoeld, 1838) from South Africa; 21: *C. graminis* (Gyllenhal, 1813) from Italy.

with the consequence that the known southern African species increased by ten times. It is therefore possible that the same might occur also for the other five genera not yet revised and that several other Palaearctic genera might actually be present also in southern Africa.

In the Palaearctic and Afrotropical regions, the six genera above mentioned have a similar distribution. They are widely diffused with several members in the whole Palaearctic, North Africa included, are poorly represented or presently unknown (*Cleopomiarus*) in central and eastern Africa and are abundant in



Figs. 22-25. Habitus of: 22: *Tychius aspalathi* Caldara, 1989 from South Africa; 23: *T. trivialis* Boheman, 1843 from Italy; 24: *Sibinia amyloacea* (Thunberg, 1815) from South Africa; 25: *S. attalica* Gyllenhal, 1836 from Italy.

southern Africa. These data appear to be nearly definitive for the Palearctic region and for central Africa, from where probably only few new species still have to be described, but are surely underestimate for southern Africa, from where most likely the number of new taxa might at least double the total of species presently known by appropriate collections on the plants of the fami-

lies which appear to be their hosts. This hypothesis seems to be strengthened by the fact that up to now every expedition in South Africa, also not especially aiming to the collection of weevils, resulted in the finding of some new species of these genera.

The affinities between Palaearctic and southern African species of the weevil genera here considered are undoubtful and very close, and this is the same for the host plants parasitized. Therefore, it might be assumed that among Curculionidae precisely Curculioninae is the group, perhaps followed by Baridinae and Ceutorhynchinae, where the affinities between southern African and Palaearctic species are the highest.

Probably the dispersal route was the Nile river valley. However, presently it is not possible to assess whether the six genera originated in southern Africa or in the Palaearctic region. This for phylogenetic studies on them appear very difficult due to the scanty number of reliable characters and the poor knowledge of the tribes of Curculioninae possibly related to Cionini, Mecinini, Storeini and Tychiini.

In order to improve our knowledge on the relationships about southern African and Palaearctic Curculioninae it will be necessary to continue and potentiate the assembling of material in South Africa, especially with targeted collections, preserving specimens also in alcohol for molecular studies, and to discover the host plants of as many as possible species.

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