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Reconstruction of the Phylogeny of the Rhynchitids and Leaf-rolling Weevils (Coleoptera, Rhynchitidae, Attelabidae) Using the Synap Method: Communication 1

A. A. Legalov

Siberian Zoological Museum, Institute of Animal Systematics and Ecology, Siberian Division of Russian Academy of Sciences, Novosibirsk 630091, Russia

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Abstract—The phylogenetic relationships in the families Rhynchitidae and Attelabidae have been reconstructed. The main synapomorphies have been revealed. The morphologically advanced groups have been distinguished in the families studied. The family Attelabidae forms two large branches. The most advanced is the supertribe Rhynchititae, the representatives of which could adapt not only to development in various parts of a plant, but also to rolling leaf packages. This supertribe consists of eight well-defined tribes forming three groups: (1) Auletini and Minurini; (2) Cesauletini, Eugnamptini and Isotheini; (3) Pterocolini, Rhynchitini and Byctiscini.

The families Rhynchitidae and Attelabidae (leaf-rolling weevils) belong to the most surprising beetles on our planet. Some of them have developed the ability to make leaf packages in which their larvae feed; others put eggs into fruits or vegetative parts of plants in which the larval development proceeds. The both families mostly inhabit forests and are associated with arboreal vegetation; those species that occur in open landscapes develop on herbs. These weevils are widely distributed over the planet, the most of species occur in the subtropical and tropical zones.

These families are poorly investigated despite their wide distribution and a comparatively simple collecting both adults and larvae. The classification used until the present time was elaborated in the first half of the XX century by E. Voss. Unfortunately, when creating it, he used formal characters, therefore the classification is artificial: many closely allied species are placed in different genera, and close genera, in different tribes. Therefore Voss's (1965) concept of the phylogeny of the Rhynchitidae and Attelabidae was largely erroneous. The problem of revealing the phylogenetic relationships in these groups remained unsolved.

In last decades, the cladistic analysis has been widely used in the systematics and phylogeny of insects (Pavlinov, 1989, 1990; Rasnitsyn, 2002). Two authors (Sawada, 1993; Riedel, 2002) have undertaken attempts of the cladistic analysis of the Rhynchitidae and Attelabidae. Sawada (1993) proposed a phylogenetic hypothesis for species of the Rhynchitidae from Japan. He has managed to show that the tribes Eugnamptini and Isotheini, and also Rhynchitini and Byctiscini are sister-groups and form two lineages, both widely separated from the tribe Auletini. Sawada has made a number of mistakes. For example, *Temnocerus japonicus* (Morimoto) (tribe Rhynchitini) was united with species of the tribe Auletini; *Teretriorhynchites amabilis* (Roelofs) and *Involvulus pilosus* (Roelofs) (subtribe Rhynchitina) were grouped together with species of the subtribes Lasiorhynchitina, Temnocerina, and Perrhynchitina. The situation appeared worse with the final phylogenetic tree (Sawada, 1993) constructed on the basis of the method of minimisation of the number of characters (Sawada, 1988). This scheme reflected the traditional Voss's classification where Isotheini are considered the most advanced tribe, and Eugnamptini are placed close to Rhynchitini. The erroneousness of the Sawada's hypothesis may result primarily from including a small number of taxa in the analysis.

Riedel (2002) has carried out a cladistic analysis of species of the tribe Euopsini of the New Guinea fauna (PAUP program). He has investigated representatives of various species-groups now promoted to genera (Legalov, 2003a). It should be noted that other Euopsini from the Oriental, Afrotropical, and Australian biogeographical regions have not been included in the analysis. The genera *Epirhynchites* (family Rhynchitidae), *Attelabus*, *Lamprolabus*, *Euscelophilus* (subfam-

in the course of transition to commensalism in the leaf packages made by the American Attelabinae (tribes Pilolabini and Hybolabini).

The closely allied (IPHR = 16) tribes Rhynchitini and Byctiscini may be conventionally considered the most advanced ones in the Rhynchitidae. They are sister groups and are distinguished from other tribes by the procoxae of males having a fovea and a bunch of setae (synapomorphy). In these tribes males sometimes have anteriorly-directed spines on sides of the prothorax.

Tribe Rhynchitini (IP = 18) is species-richest within the family and has a very complicated taxonomic structure. The genera are characterized by various apomorphies. The species of this tribe develop in both the vegetative (groups 1b, 1c and 2b) and reproductive parts of plants (group 1a). Development in the vegetative parts of plants probably was initial in this tribe, and transition to flowers and fruits is the result of a reversion.

The tribe Byctiscini is a young, compact group mainly distributed in the Oriental Region. Its major apomorphic characters are the narrowed frons, metepisternum not reaching the metacoxa, byctiscoid type of the endophallus armament, and conical head. In the tribe Byctiscini, the transition from development inside fruits (group 1a1) to rolling leaves into packages (group 2a) is observed. This tribe includes the primitive Svetlanaebyctiscina (IP = 11) characterized by the larval development in fruit and also the more advanced Byctiscina (IP = 14) and Listrobyctiscina (IP = 16).

Calculations have revealed that there were 56 phylogenetic events in the evolution of leaf-rolling weevils, of which 29 were unique, 23 were parallelisms, and 4, reversions.

The family Rhynchitidae forms two large branches. The most apotypical is the supertribe Rhynchititae. Its genera have adapted to development in various parts of plants and to rolling tubes. This supertribe consists of 8 distinctive tribes, which form three groups according to their IP: (1) Auletini and Minurini; (2) Cesauletini, Eugnamptini, and Isotheini; (3) Pterocolini, Rhynchitini, and Byctiscini.

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