

## Cladistic analysis of the Meenoplidae-Kinnaridae genera: the Kinnaridae, a paraphyletic family (Hemiptera, Fulgoromorpha)

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Using the principle of parsimony a cladistic analysis of meenoplid and kinnarid genera has been performed with PAUP (v. 3.0s, Swofford<sup>14</sup>), MacClade (v. 3.0, Maddison *et al.*<sup>9</sup>) and Hennig 86 (v. 1.5, Farris<sup>5</sup>; with SoftAT v. 2.52) on a Macintosh LC (68030). Two outgroups have been included in the analysis: *Cixius* (Cixiidae) and *Plectoderes* (Achilidae). When possible, the type species was selected for coding characters. A set of about 130 characters has been retained from the study of head capsules, female abdominal sclerotized plates, tegumentary glands and wax gland areas, female genitalia and wing venation. Only 79 were selected to infer the phylogeny, others being non informative, equivocal or homology not clearly established. The consensus tree of the 20 most parsimonial trees (CI=0.47; RI=0.75) is given in Fig. 1.

**The Meenoplidae-Kinnaridae monophyly.** Metcalf<sup>10</sup> ranges meenoplids and kinnarids in the Cixioidea super-family with the Cixiidae, the Derbidae, the Achilixiidae and the Achilidae. Five characters are listed but they are symplesiomorphies and/or not precise enough to allow a real phylogenetic discussion. According to Fennah<sup>7</sup> Meenoplidae and Kinnaridae share with Achilidae and Achi-lixiidae 7 fundamental characters. In agreement with Wilson<sup>15</sup>, none of these characters can be considered as an indication of a close relationship between those four families.

For Emeljanov<sup>3</sup>, the external morphology and the genitalic structures in both sexes indicate a closer relationship between kinnarids and meenoplids than with any other family. He elaborated this point of view in a more recent paper<sup>4</sup> listing two autapomorphic characters for the monophyly of these two families : "a reduced gathering-mixing ovipositor" and "wax areas (wax-bearing plates) on abdominal tergites VI-VIII". On the base of the character "annular rectal mycetome in female", he defines their sister group as including the [Dirbidae + Achilidae<sup>+</sup>](1). The Cixiidae form the sister-group of the whole : [(Kinnaridae + Meenoplidae) + Derbidae<sup>+</sup>].

Asche<sup>1</sup> also considers that kinnarids + meenoplids form a monophyletic group on the base of the character "presence of the vertical wax-producing fields on the caudal parts of the tergites VI-VIII". However, Fennah<sup>9</sup>, dividing kinnarids into two subfamilies : Kinnarinae and Prosotropinae, specified that the possession of wax secreting plates on the terga of the sixth, seventh and eighth abdominal segments was not a family character, as Prosotropinae includes forms which them reduced on the sixth tergite, obsolete on the seventh and absent from the eighth.

In the cladogram proposed the monophyly of this taxa is strongly supported by 21 synapomorphies. Most significant are : "Sc+R and Cu forking close to the nodal line", "first subapical cell closed at the same level as the second", "wax-producing of the tergites VI-VIII" (secondarily absent in some prosotropines), stigmatic sclerite

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1. The conventional notation of De Souza Amorim (1982) is used : Group A + [B + (C + D)] = A<sup>+</sup>, Group B + (C + D) = B<sup>+</sup>... (the sup-port name of the group being the supposed more primitive).

VI and VII absent", tergites VI, VII and VIII in two hemitergites" (secondarily fused in prosotropines), "gonoplae reduced", "gonapophyses VIII lobiform"...

**The monophyly of the Meenoplidae.** In 1925, Muir stated that Meenoplidae "forms a homogeneous and, evidently, a monophyletic group". He pointed out the type of female genitalia and the form of the male genitalia without more precision, the long apical segment of the labium and the presence of a median ocellus (two plesiomorphic characters), the arrangement and the granulation of the tegmina venation<sup>11,12</sup>. Only this last character should be considered as apomorphic and it was also proposed by Asche<sup>1</sup>. This character occurs also in some Derbidae and Flatidae<sup>15</sup>, but probably convergently evolved. Emeljanov<sup>4</sup> has added "base of weakened costa connected to Sc+R stem on forewing".

The monophyly of the Meenoplidae is here well supported by 7 synapomorphies: "sensory pits present in A1 and Sc+R, and in lateral parts of the front", "labium 3-segmented"... Within meenoplids, the monophyly of Meenoplineae is also well supported, in opposition to the Kermesiinae that should be paraphyletic: only one synapomorphy was found: "claval veins fused distally".

**The monophyly of the Kinnaridae.** Describing Kinnaridae, Muir<sup>11</sup> has mentioned several characters and he selected as characteristic the form of the male genitalia and also mentioned the presence of wax producing areas on abdominal tergite VI to VIII, along with the Meenoplidae and in the young stages of some Cixiidae<sup>12</sup>. Synave<sup>13</sup> describing *Nesomicrixia*, has listed several characters and among them "the long common stalk of R+M in the tegmina", "Cu non bifurcated before the apex of the clavus" and "the unarmed metatibia". An important contribution was given by Emeljanov<sup>3</sup> dividing the subfamily Kinnarinae into three tribes Propleromini (= Emeljanopleromini<sup>8</sup>), Adolendini and Kinnarini, but no precise information was given on the monophyly of the family in either paper<sup>3,4</sup>. Asche<sup>1</sup> concluded that no significant autapomorphy could be found for Kinnaridae except perhaps in the comparatively broad costal field in the tegmen.

Our study shows that the Kinnaridae forms a paraphyletic group including the Meenoplidae and 3 main clades are isolated: 1) the Kinnarini sensu Emeljanov<sup>3</sup>, sister group of 2) the (Kinnocia + Kinnacana) + (Nesomicrixia + Prosotropinae) and of 3) the other kinnarids + Meenoplineae.

In conclusion, the past use of symplesiomorphic characters as group criteria has caused a misinterpretation of the Meenoplidae-Kinnaridae relationships. The paraphyletic Kinnaridae family have to be reevaluated at lower taxonomic levels and falls into the Meenoplidae (taxonomic priority rule). Some taxa appear in unusual positions: *Paramicrixia*, *Emeljanopleroma*, *Southia*, but it seems too early to discuss this cladogram more precisely for different reasons: 1) several genera are probably not monophyletic: *Adolenda*, *Suva*, *Nisia*, *Eponisia*, *Anigurs*, *Kermesia*, *Oeclidius*, 2) several new genera are known in the Prosotropinae, in the Kinnarini, and in the Kermesiinae (unpublished data), 3) some taxa were only available from the literature: *Eponisiella*, *Eponisia*, *Suva*, *Dineparymene*, *Emeljanopleroma* and/or females have never been collected: *Dineparymene*, *Microissus*, *A. decolorata*, *Micrixia*. This first phylogenetical hypothesis is then a preliminary result and only an outline of the cladogram is discussed here. More basic taxonomical studies of the monophyly of each genera and comparative morphology of other sets of characters would have to be done first.

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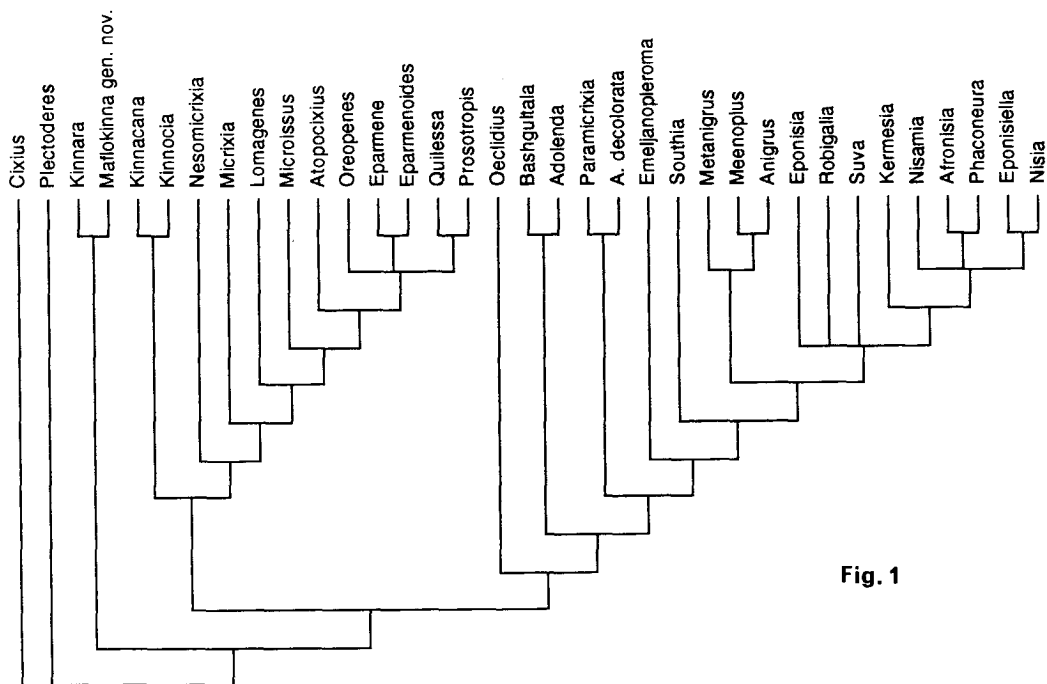


Fig. 1