

# New Neuroptera from Crato Formation, Lower Cretaceous, Araripe Basin, Northeast Brazil

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## ABSTRACT

The family Nymphidae Brauer (Neuroptera) is recorded for the first time to the laminated limestone from Nova Olinda Member, lowermost unit of the Crato Formation, Araripe Basin, Lower Cretaceous, Northeast Brazil. The following new taxa are proposed: *Olyndanympbes makarkini* n. gen. et n. sp. and *Santananympbes ponomarenkoi* n. gen. et n. sp. and additionally, new material of *Cratoneura dividens* Martins-Neto (Araripeneuridae) is figured. The relationship between the new taxa and the other known neuropterans from Crato Formation are discussed.

**Key words:** fossil insects, Neuroptera, Nymphidae, Araripeneuridae, Lower Cretaceous, Brazil

## RESUMO

A família Nymphidae Brauer é registrada pela primeira vez para os calcários laminados do Membro Nova Olinda, unidade inferior da Formação Crato, Bacia do Araripe, Cretáceo Inferior do nordeste do Brasil. Os seguintes taxa novos são propostos: *Olyndanympbes makarkini* n. gen. et n. sp. e *Santananympbes ponomarenkoi* n. gen. et n. sp. e, adicionalmente, é ilustrado um novo material de *Cratoneura dividens* Martins-Neto (Araripeneuridae). A relação filogenética entre os novos taxa propostos e outras formas de neuropteros já conhecidos para a Formação Crato é discutida.

**Palavras-chave:** insetos fósseis, Neuroptera, Nymphidae, Araripeneuridae, Cretáceo Inferior, Brasil.

## INTRODUCTION

Nymphidae Rambur 1842 is recorded for the first time from the Crato Formation, Lower Cretaceous (Upper Aptian) of Brazil. To Mesozoic the family have been known from Jurassic of Germany (Carpenter, 1929), Lower Cretaceous of Transbaikalia (Ponomarenko, 1992), and from the Upper Cretaceous of northeastern Siberia (Makarkin, 1990).

The fossils were collected at Mina Pedra Branca, Santana do Cariri road, 4 km far from the district of Nova Olinda. The geological aspects of the Araripe Basin were extensively focused in previous papers (Martins-Neto, 1996, 2002). The terminology is the same adopted in Martins-Neto (2000).

## SYSTEMATIC PALEONTOLOGY

Order NEUROPTERA Linnaeus, 1758  
Family NYMPHIDAE Rambur, 1842

### *Olyndanympbes* n. gen..

**Type species.** *Olyndanympbes makarkini* n. sp.

**Etymology.** From Nova Olinda municipality (Ceará State, Brazil), provenance of the fossil material, and *nymphes*, common suffix for Nymphoidea. Gender: feminine.

**Diagnosis.** Fore wing with narrow costal area and wide apical area. *ScP* and *RA* distally fused. Hipostigmal cell present. *M* branched in *MA* and *MP*. At least twelve cross-veins connecting *RP* to *MA* and six connecting *CuA* to *CuP*.

**Etymology.** In honour to Dr. Vladimir N. Makarkin (Russian Academy of Sciences, Vladivostok) by the great contribution to the neuropterology.

**Holotype.** MPFT-I-030, Sociedade Brasileira de Paleoartropodologia, Ribeirão Preto, SP, Brazil.

**Type locality.** Pedra Branca Mine, Nova Olinda- Santana do Cariri road, 4 Km far from Nova Olinda municipality, Ceará

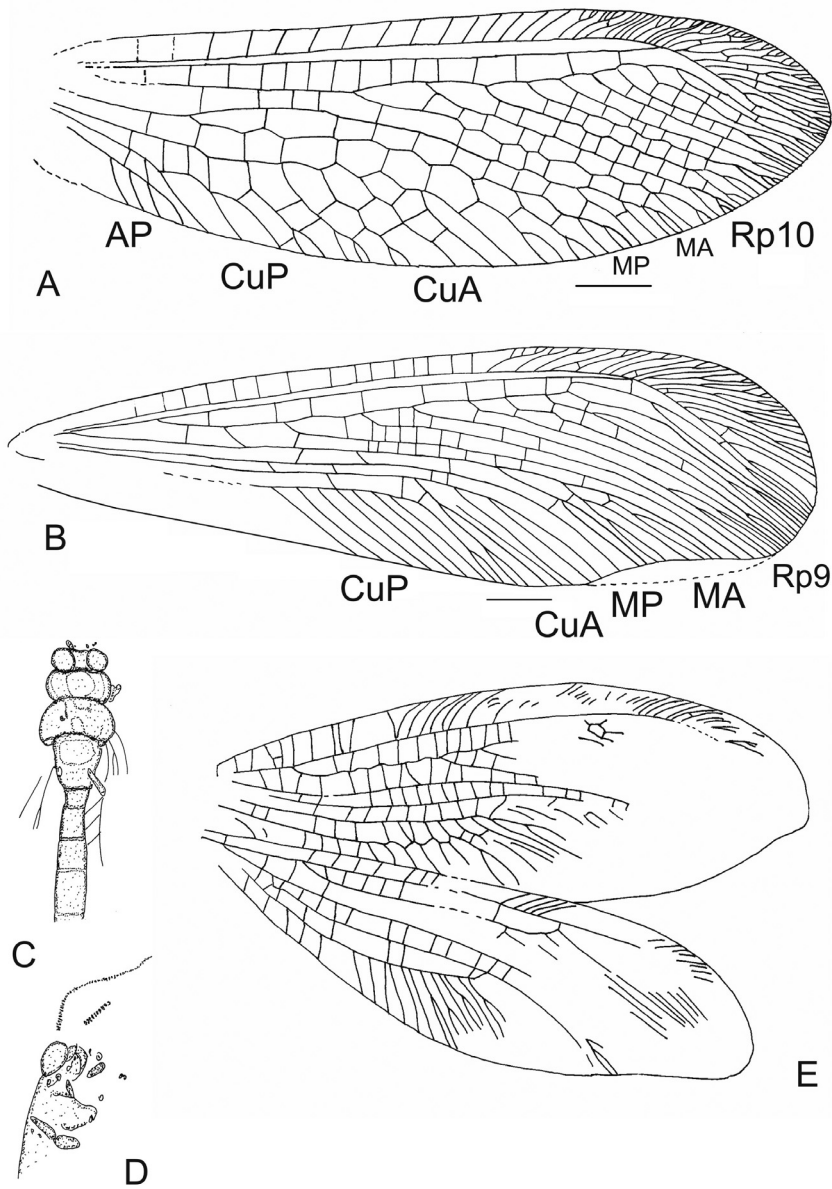
State, Northeast Brazil.

**Type stratum.** Laminated limestone level, Crato Formation, Nova Olinda Member, Araripe Basin.

**Age.** Upper Aptian, Lower Cretaceous.

**Diagnosis.** As for the genus. Fore wing circa 20 mm long and 7 mm wide. *CuA* zigzag-like. *AP* with at least four secondary branches.

**Description.** (Holotype MPFT-I-030, Figure 1A and 1D, Figure 3A). Fore wing 21 mm long and 6.8 mm wide (Figure 1A), as preserved. Trichosors are absent. Costal area relatively narrows at the wing base, notably widening toward the apex, filled by pectinated cross-veins, longer and dichotomous at the apical area. The *RP* origin is very close to wing base and at least fourteen radial cells visible. Hipostigmal cell long and narrow with basal margin preceding *ScP* and *RA* fusion, and distal one close to boundary of apical/anal margin. Ten branches of *RP*, all with marginal dichotomies. *RP10* originates slightly before the mid length of



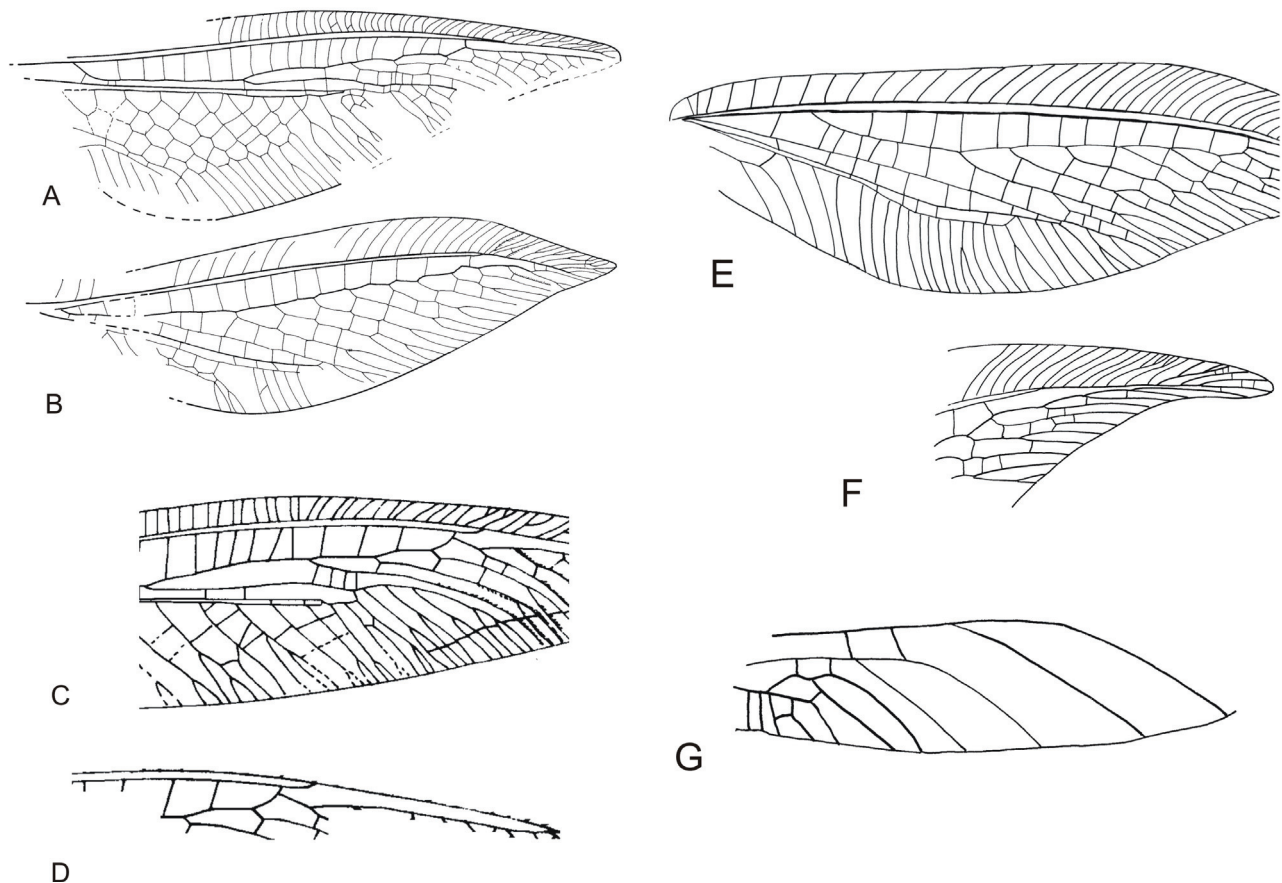
**Figure 1.** A and D. *Olindanymphe makarkini* n. sp., holotype MPFT-I-030, fore wing (A), body detail (D), respectively; B and C. *Santananymphe ponomarenkoi* n. sp., holotype MPFT-I-031. E. Nymphidae gen. et sp. n., drawn from a private collection material. Terminology: AP, posterior anal; CuA, CuP, anterior and posterior cubitus, respectively; MA, MP, anterior and posterior Media, respectively; RP, posterior radius. Scale bar 2 mm.

wing and are zigzag-like. The intraradial cell (*ir*) is relatively small, with similar size of the subsequent cell. At least four cross-veins present before *RP10* origin. The *M* vein forking in *MA* and *MP* circa 1/5 of wing base. Long, slightly curved, distally trichotomous *MA*. Twelve cross-veins connecting *RP* to *MA*. *CuA* and *MP* zigzag-like, *MP* with three secondary branches, all they distally dichotomous

and *CuA* with six secondary branches, the basal ones with distal dichotomies. At least seven cross-veins connecting *MP* to *CuA*. *CuP* reaching obliquely the anal margin, straight, a little after the 1/5 of wing base with three long secondary branches. At least four cross-veins connecting *CuA* to *CuP*. *AP* restricted to wing base with, at least four secondary branches. At least two cross-veins connecting *CuP*

to *AP*. Body (Figure 1D) circa 20 mm long. Head two times wider than long with great and protuberant eyes. Antenna long and narrow, narrower distally, whip-like, with at least sixty preserved segments.

**Discussion.** The status of the family Nymphitidae Handlirsch was discussed by Makarkin and Archibald (1993) and apart the type genus *Nymphites* with three species, just *Sialium* and *Baissoleon* (maybe also a Triassic genus described by Hong, 1980) are accepted as belonging to it, although restrictions. Other two genera initially considered as Nymphitidae (*Chrysoleonites* Martynov, 1925 and *Sogjuta* Martynova, 1958) were removed for the family Mesochrysopidae Handlirsch (Panfilov, 1980) and for an osmylid group (Lambkin, 1988), respectively. *Baissoleon*, *Chrysoleonites*, *Sogjuta*, Chrysopidae (e. g. *Cratochrysa* Martins-Neto and Vulcano), and Allopteridae Zhang (e. g. *Karenina* Martins-Neto) shares a single basal cross-vein connecting the basal part of *R* to *MA*, a synapomorphic character not present in *Olindanymphe* n. gen., as well as in Nymphidae, e. g. *Cretonymphes* Ponomarenko (1992) and *Mesonymphes* Carpenter (1929), but not in *Dactylomyrus* Makarkin (1990). Another distinctive character is the *RP* branches sigmoid, present in Chrysopidae, Allopteridae, and *Baissoleon*, excluding of this group *Sogjuta* Martynova, *Olindanymphe* n. gen. and Nymphidae. *Olindanymphe* n. gen. is excluded of Nymphitidae + Mesochrysopidae + Allopteridae + Chrysopidae group by having a wider distal costal space (apomorphic condition), several cross-veins connecting the basal part of *R* to *MA* (plesiomorphic condition), and *RP* branches not sigmoid (plesiomorphic condition). Nymphitidae (judging by *Baissoleon*, the best known described genus) could be a sister group of Mesochrysopidae + Chrysopidae + Allopteridae, having a family status. Within of Nymphidae, *Olindanymphe* n. gen. differs of *Mesonymphes* Carpenter, with species described from the Jurassic of Germany (Carpenter, 1929), Jurassic of Karatau (Panfilov, 1980), Lower Cretaceous of Transbaikalia (Ponomarenko, 1992), and *Cretonymphes* Ponomarenko,



**Figure 2.** A, B, E-G. *Cratoneura dividens* Martins-Neto 1994, fore (A) and hind wing (B), reproduced from Martins-Neto (2002, fig. 3 sequence I, A, B), hind wing (E), apical area of same hind wing (F), and fore wing anal area detail (G), all drawn of supplementary material MPFT-I-032, respectively. C-D. *Cratoneura longissima* Martins-Neto 1992 fore wing detail, reproduced from Martins-Neto (2002, fig. 3. Sequence II, A, B).

from Lower Cretaceous of Transbaikalia (Ponomarenko, 1992), by having a wider costal distal space, a minor number of radial cells and *RP* secondary branches as well as a greater hipostigmal cell.

*Santananympbes* n. gen.

**Type species.** *Santananympbes ponomarenkoi* n. sp.

**Etymology.** From the stratigraphic unit, Santana Group, and *nymphes*, common suffix for Nymphoidea. Gender feminine.

**Diagnosis.** Fore wing with *ScP* and *RA* distally fused. Hipostigmal cell relatively long and narrow. Ten radial cells with the basal one smaller than subsequent. *RP* origin close to wing base. *M* branched in *MA* and *MP*, both originating very close to the wing base. *CuP* long, reaching the

anal margin after mid length of wing with several long and pectinated secondary branches.

**Discussion.** Similar to *Olindanympbes* n. gen. by having a wide distal costal space and long hipostigmal cell, differing however by having the *M* fork very close to the wing base and a notably longer *CuP* with long and numerous pectinated secondary branches.

**Etymology.** In honour to Dr. Alexander G. Ponomarenko (Russian Academy of Sciences, Moscow) by the great contribution to neuropterology.

**Holotype.** MPFT-I-031, Sociedade Brasileira de Paleoartropodologia, Ribeirão Preto, SP, Brazil.

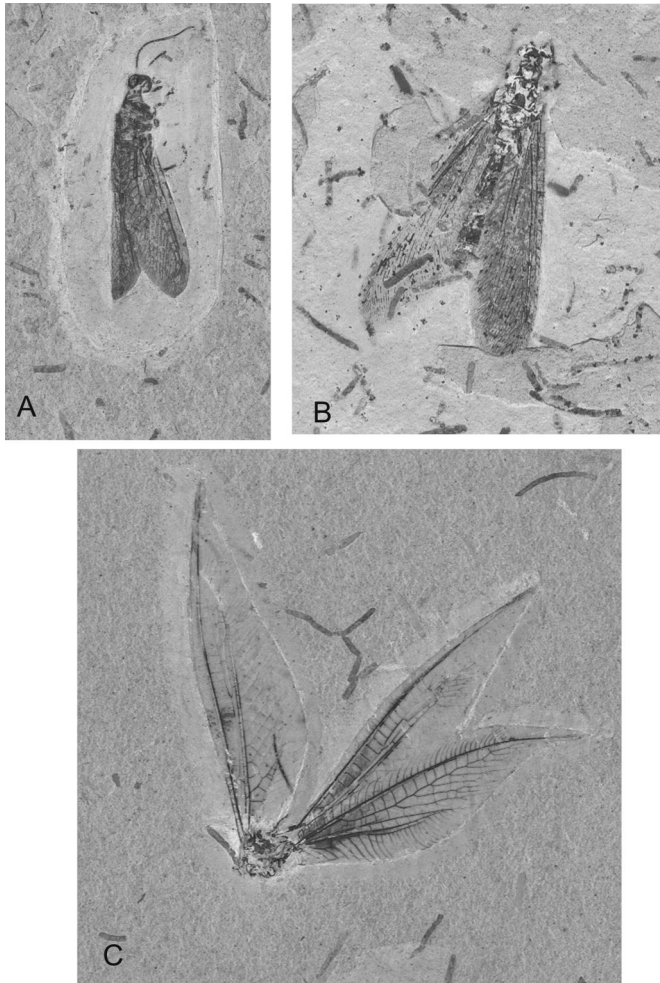
**Type locality, type stratum and age.** As for *Olindanympbes makarkini* n. sp.

**Diagnosis.** As for the genus. Fore wing

circa 28 mm long.

**Description.** (Holotype MPFT-I-031, Figures 1B, 1C). Fore wing 27.5 mm long and 7.0 mm wide (Figure 1B), as preserved. Trichosors absent. Costal space narrow, with subcostal veinlets short, unforked proximally (ca. 2/3 of wing length), and long, oblique and forked distally. Costal space strongly expanded distal to fusing of *ScP* and *RA*. *RP* origin close to wing base. Ten relatively small radial cells, with the basal one smaller than the subsequent. Hipostigmal cell relatively short and notably narrow, with basal margin at *ScP* and *RA* fusion and the distal one close to wing apex. Nine *RP* branches, most of them dichotomously branched distally. *MA* origin close to wing base, at R. Intraradial cell (*cir*) short and narrow.





**Figure 3.** A. *Olindanympbes makarkini* n. sp., holotype MPFT-I-030; B. *Santananympbes ponomarenkoi* n. sp., holotype MPFT-I-031; C. *Cratoneura dividens* Martins-Neto 1994, supplementary material MPFT-I-032.

*MP* long, slightly curved, distally with four dichotomic secondary branches. *MA* parallel and very close to *MP*. *MP* origin close to wing base, at R, distally unbranched and undichotomous. *CuA* parallel and very close to *MP*, with four secondary branches, the proximal one trichotomous. Two long cross-vein before of the most proximal branch of *CuA*. *CuP* slightly curved, reaching obliquely to anal margin a little after mid length of wing base, with at least eight long pectinated secondary branches. Body (Figure 1C) with a relatively small head, two times wider than long and great and prominent eyes. Pronotum wider and longer than head, with

rounded lateral margins. Mesonotum trapezoidal, with rounded lateral margins, wider and longer than pronotum. Metanotum trapezoidal, longer than wide, with anterior margin wider than posterior, and lateral margins oblique. Abdomen long and narrow.

**Remarks.** A third form (probably representing a new genus) recorded from Crato Formation (Figure 1E), differs from both above described species. Unfortunately this specimen is property of a private collector (M. A Vulcano) and the type locality is unknown as well as the actual repository. For ethical proposes this material, although new for science, cannot be formally described and remain unnamed. The fur-

nished draft was made by the proper author in 1988 visiting this collection, and until now none, although several fieldtrips have been made, similar material was revealed.

This draft demonstrates that nymphids are present in the Araripe neuropterofauna with at least three distinct species.

Superfamily MYRMELEONTOIDEA  
 Burmeister, 1839  
 Family ARARIPENEURIDAE *sensu*  
 Martins-Neto, 2002  
 Subfamily ARARIPENEURINAE *sensu*  
 Martins-Neto, 2002  
 Tribu CRATOALLONEURINI  
 Martins-Neto, 2002  
 Genus *Cratoneura* Martins-Neto, 1992

**Type species.** *Cratoneura longissima* Martins-Neto, 1992, by original designation.

**Supplementary material.** MPFT-I-032, Sociedade Brasileira de Paleoartropodologia, Ribeirão Preto, SP, Brazil.

**Type locality, type stratum and age.**

As for *Olindanympbes makarkini* n. sp.

**Remarks.** In addition to the species knowledge a nearly complete *Cratoneura dividens* Martins-Neto specimen was recently collected. A new hind wing drawn is furnished (Figure 2E, F) as well as a better detail of the fore wing anal area (Figure 2G), all from the same specimen. Additionally the specimen figured in Martins-Neto (2002, Figure 3A, B) as *Cratoalloneura acuminata* Martins-Neto and Vulcano, 1989 is reproduced here to prevent further confusion (Figure 2A, B), because the true legend is *Cratoneura dividens* and not as printed.

## PHYLOGENETICAL APPROACH ON THE ARARIPE NEUROPTEROFAUNA: COMPLEMENTS

The matrix of data (published in Martins-Neto, 2002), added by the taxa *Olindanympbes* and *Santananympbes* here described, *Baissoleon* representing Nymphitidae, *Chrysoleonites* representing

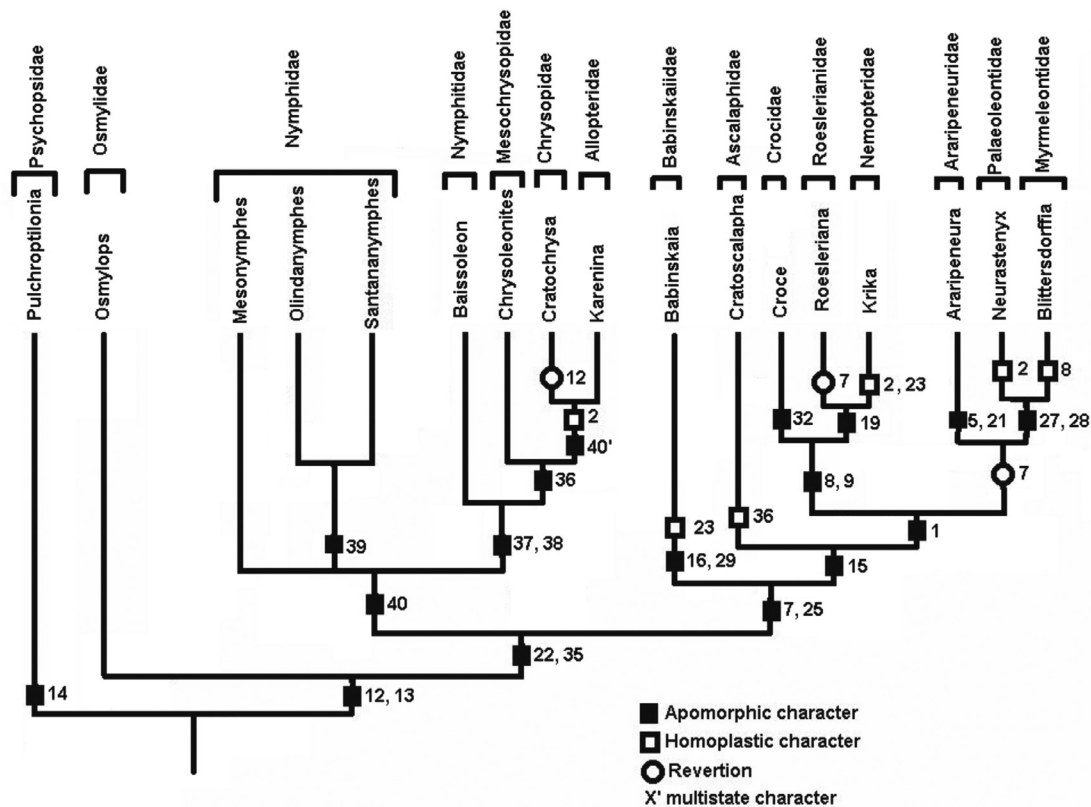


Figure 4. Simplified phylogeny of the Araripe Neuropterofauna (including *Olindanymphe* n. gen. and *Santananymphe* n. gen. and related genera), modified from Martins-Neto (2002, fig. 3).

Mesochrysoptidae, *Cratochrysa* representing Chrysoptidae, *Karenina* representing Allopteridae, and more six added characters presented below, was submitted to the program Hennig 86, option mhenning\*; bb\* (Farris, 1989) interface for Windows (Microsoft) Tree Gardner 2.2, resulting in a single tree, length 26, ci 80 and r1 91, not ordered and not weighted (Figure 4). The present result, apart the new taxa included, is identical of the previously published one (Martins-Neto, 2002). Using the same discussed characters, Nymphidae (including *Olindanymphe* n. gen. and *Santananymphe* n. gen.) can be considered as sister group of Nymphitidae (a valid family, judging by *Baissoleon*) + Mesochrysoptidae + Chrysoptidae + Allopteridae, a monophyletic group, supported by two synapomorphies (characters 37 and 38). *Chrysoleonites* can be considered as sister group of Chrysoptidae + Allopteridae.

The following characters are added: 35. Fore wing proximal costal space: enlarged (0), narrow (1)

The enlarging of proximal costal space is plesiomorphic for Neuroptera groups as Psychopsidae and Osmyloids. Costal space homogeneously narrow is synapomorphic for Myrmeleontoidea, Nymphidae, chrysoptid-like group (Nymphitidae, Mesochrysoptidae and Allopteridae), occurring a reversion of this character in Chrysoptidae.

36. Fore wing *pseudomedia*: absent (0), present (1).

The presence of a conspicuous *pseudomedia* is synapomorphic for Mesochrysoptidae + Chrysoptidae (except *Limaiinae*) + Allopteridae, and excludes of this group Nymphitidae.

37. Fore wing space between R and MA: filled by several cross-veins (0); only one basal (1).

The presence of only one basal cross-vein connecting R to MA is a

synapomorphic character shared by Nymphitidae + Mesochrysoptidae + Chrysoptidae + Allopteridae and excludes Nymphidae for this group.

38. Fore wing RP branches: straight (0), sigmoids (1).

Sigmoids RP branches is a synapomorphic condition for Nymphitidae + Mesochrysoptidae + Chrysoptidae + Allopteridae.

39. Fore wing distal costal space: narrow (0), wide (1).

The whole Neuroptera group have a rather narrow distal costal space. The enlargement of this space is common in Araripeneuridae, Roeslerianidae and some Myrmeleontidae, as well as in *Olyndanymphe* and *Santananymphe* (Nymphidae).

40. Fore wing MP: branched (0); unbranched (1)

The Neuroptera groups as Osmyloids has MP two-branched and MA unbranched. In Babinskaiidae +

Ascalaphoidea + Nemopteroidea + Myrmeleontoidea *MP2* + *CuA1* is partially fused. In Nymphidae + Nymphitidae + Mesochrysopidae + Chrysopidae + Allopteridae *M* forks basally in *MA* and *MP*, both unbranched and rather long, reaching the anal margin close to wing apex (synapomorphic condition). The character is multistate, occurring a shortening of these veins just in Chrysopidae.

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