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CLADISTIC ANALYSIS OF THE GENERA OF AGRYPNINAE CANDÈZE, 1857 (COLEOPTERA: ELATERIDAE) FROM PAKISTAN

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ABSTRACT

Ten genera of the subfamily Agrypninae have been analyzed cladistically on the basis of their apomorphies and a cladogram has been constructed. The relationship of these genera has been discussed in the light of apomorphies found in the ten genera included in the present study of the subfamily Agrypninae. A key to the genera of the subfamily Agrypninae has also been given.

Keywords: Cladistic analysis; apomorphy; Agrypninae; Elateridae; Coleoptera; genera; Pakistan.

INTRODUCTION

In the early classification of Coleoptera, the Elateridae had been considered first as a tribe (Latreille 1804, 1825) and then Lacordaire (1857) named it as a family. The subfamilies of elaterid beetles were described on adult characteristics (Lacordaire, 1857; Candèze, 1857, 1863, 1874; Schwarz, 1906, 1907; Fleutiaux, 1947), but the larval taxonomy was first made useful by Hyslop (1917, 1923).

The phylogenetic relationships among the families of Elateriformia have been analyzed on the basis of both larval and adult characters by Lawrence (1988) and Beutel (1995).

The classification of Elateridae has pointed out many difficulties since the early times of the systematic and taxonomical studies of click beetles, even at the time of Lacordaire (1857), to date many of the taxa are still in unstable condition (Costa *et al*., 2003; Casari, 2008).

Many taxonomists of Elaterids have put forward their efforts on the cladistic analysis and phylogeny of this group. Calder *et al*. (1993) had analyzed the nine elaterid subfamilies cladistically including Agrypninae.

Elateridae has been considered as a paraphyletic group with Throscidae as a derived, within the elaterid clad (Muona, 1995). Later, Lawrence *et al.* (1995) had established a relationship between Elateridae and Eucnemidae in an analysis of 34 genera of Elateriformia.

The morphological, molecular and phylogenetic analysis of 77 elaterid species in 57 genera based on partial sequence of nuclear 28S ribosomal DNA have been conducted by Oba (2007), Lawrence *et al.* (2007) and Sagegami-Oba *et al*. (2007), they found four distinct clades: Elaterinae (including Melanotini) basal to the remaining members of the family, Agrypninae, basal to (Negastriinae + Cardiophorinae) + Denticollinae (including Hypnoidini, *Campsosternus* and *Pectocera* Hope) (Costa and Roza, 2011).

Casari (2008) has conducted cladistic analysis of the tribe Hemirhipini (Subfamily Agrypninae) and resulted the 6 genera excluded from Hemirhipini and kept in Agrypninae (formerly Pyrophorinae) (Casari-Chen, 1993).

The intention to the present work was to understand the elaterid fauna in the region and to find out some new facts to contribute in the existing knowledge about the phylogenetic relationship of the click-beetles. The key to identification of the ten genera has been given.

MATERIALS AND METHODS

The click-beetles were collected by hand picking, light traps, sweeping, beating the bushes, foliage and herbs, lifting the bark by butcher knife. The beetles were killed by exposing vapor of ethyl acetate and by 70% ethyl alcohol. The material was preserved in dry condition, were pinned directly in metathorax for facilitating examination of the specimen from both dorsal and ventral aspects.

After identification, they were labeled with complete scientific name with name of author and determination year. The genital apparatus was dissected the specimen and placed overnight in 10% KOH, then passed through the grades of absolute alcohol in 30%, 50%, 70% and 90% keeping the specimens for 2 to 10 minutes in each grade of alcohol for dehydration and then fixed the body parts of the specimen using water soluble transparent glue on the pin-tag strip.

The taxonomical characters of genera of subfamily Agrypninae have been derived from the adults morphology. The multi-states of each character have also made, based on the morphology. According to the characters present in the genera of Agrypninae, the cladogram (Fig. 1) has been constructed.

RESULT

Key to the genera of the subfamily Agrypninae Candèze, 1857

1. Setae or scales not forming any patches……..…2
-. Setae or scales forming irregular or regular patches……9

2. Frontal carina absent or rarely incomplete……..3
-. Frontal carina complete across front of frons……...…6

3. Propleurae or metasternum without grooves for accommodating of anterior or middle tarsi……..…*Lanelater* Arnett
-. Propleurae or metasternum with grooves for accommodating of anterior or middles tarsi….…4

4. Scutellum with longitudinal carina at middle……..….*Meristhus* Candèze
-. Scutellum without longitudinal carina at middle……..…5

5. Antennal grove extending at least 2/3 of the length of prosternopleural sutures…… ……*Agrypnus* Eschscholtz
-. Antennal grove extending at least half of the length of prosternopleural sutures…….. …. ……...….*Lacon* Castelnau

6. Pronotum with two basal rounded impressions……...….*Aeoloides* Schwarz
-. Pronotum without basal impressions……7

7. Combined length of 2nd and 3rd segments of antennae always shorter than 4th segment…… ……..….*Heteroderes* Latreille
-. Combined length of 2nd and 3rd segments of antennae not shorter than 4th segment……8

8. 4th segment of tarsi expanded……*Aeoloderma* Fleutiaux
-. 4th segment of tarsi hairy beneath……..….*Drasterius* Eschscholtz

9. Hind angles of pronotum carinate and free margin of metacoxal plate straight…*Calais* Laporte
-. Hind angles of pronotum not carinate and Free margin of metacoxal plate with small lobe…… .....……*Cryptalaus* Ohira

Cladistic analysis of the genera of the subfamily Agrypninae Candèze, 1857

a_o Setae or scales absent.
a_1 Setae or scales not forming any patches (*Agrypnus, Lacon, Lanelater, Meristhus, Aeoloderma, Aeoloides, Drasterius, Heteroderes*)
a_2 Setae or scales forming irregular or regular patches (*Calais, Cryptalaus*)

b_o Frontal carina in reduced form.
b_1 Frontal carina absent or rarely incomplete (*Agrypnus, Lacon, Lanelater, Meristhus*)
b_2 Frontal carina complete across front of frons (*Aeoloderma, Aeoloides, Drasterius, Heteroderes*)

c_o Head more or less flat.
c_1 Head more or less concave (*Agrypnus, Lacon, Lanelater, Meristhus*)
c_2 Head more or less convex (*Aeoloderma, Aeoloides, Drasterius, Heteroderes*)

d_o Propleurae or metasternum with grooves for accommodating of anterior or middle tarsi as impression.
d_1 Propleurae or metasternum without grooves for accommodating of anterior or middle tarsi (*Lanelater*)

d_2 Propleurae or metasternum with grooves for accommodating of anterior or middles tarsi (*Agrypnus, Lacon, Meristhus*)

e_o Scutellum with carina reduced.
e_1 Scutellum with longitudinal carina at middle (*Meristhus*)
e_2 Scutellum without longitudinal carina at middle (*Agrypnus, Lacon*)

f_o Antannal groove extending at least ¼ of the length of prosternopleural sutures.
f_1 Antennal grove extending at least 2/3 of the length of prosternopleural sutures (*Agrypnus*)
f_2 Antennal grove extending at least half of the length of prosternopleural sutures (*Lacon*)
g_o Pronotum with one basal rounded impression.
g_1 Pronotum with two basal rounded impressions (*Aeoloides*)
g_2 Pronotum without basal impressions (*Heteroderes, Drasterius, Aeoloderma*)

h_o Combined length of 2nd and 3rd segments of antennae equal to 4th segment.
h_1 Combined length of 2nd and 3rd segments of antennae always shorter than 4th segment (*Heteroderes*)
h_2 Combined length of 2nd and 3rd segments of antennae not shorter than 4th segment (*Aeoloderma, Drasterius*)

i_o 4th segment of tarsi simple.
i_1 4th segment of tarsi expanded (*Aeoloderma*)
i_2 4th segment of tarsi hairy beneath (*Drasterius*)

j_o Hind angles of pronotum with reduced carina.
j_1 Hind angles of pronotum carinate (*Calais*)
j_2 Hind angles of pronotum not carinate (*Cryptalaus*)

k_o Free margin of metacoxal plate divergent.
k_1 Free margin of metacoxal plate straight (*Calais*)
k_2 Free margin of metacoxal plate with small lobe (*Cryptalaus*)

Character and characterstates of the genera of the subfamily Agrypninae Candèze, 1857

Patterns of setae (a):

In *Agrypnus, Lacon, Lanelater, Meristhus, Aeoloderma, Aeoloides, Drasterius* and *Heteroderes* setae not forming any patches show their synapomorphic condition (a_1) while setae forming irregular or regular patches in *Calais* and *Cryptalaus* show their derived synapomorphic condition (a_2).

Frontal carina (b):

In *Agrypnus, Lacon, Lanelater* and *Meristhus* frontal carina absent or rarely incomplete show their synapomorphic condition (b_1) while frontal carina complete across front of frons in *Aeoloderma, Aeoloides, Drasterius* and *Heteroderes* show their derived synapomorphic condition (b_2).

Head shape (c):

In *Agrypnus, Lacon, Lanelater* and *Meristhus* head more or less concave shows their synapomorphic condition (c_1) while head more or less convex in *Aeoloderma, Aeoloides, Drasterius* and *Heteroderes* show their derived synapomorphic condition (c_2).

Grooves on propleurae or metasternum (d):

In *Lanelater* propleurae or metasternum without grooves for accommodating of anterior or middle tarsi shows its autapomorphic condition (d_1) while propleurae or metasternum with grooves for accommodating of anterior or middles tarsi in *Agrypnus, Lacon, Meristhus* show their synapomorphic condition (d_2).

Carina on scutellum (e):

In *Meristhus* scutellum with longitudinal carina at middle shows its autapomorphic condition (e_1) while scutellum without longitudinal carina at middle in *Agrypnus* and *Lacon* show their synapomorphic condition (e_2).

Length of antennal grooves (f):

In *Agrypnus* antennal grove extending at least 2/3 of the length of prosternopleural sutures shows its autapomorphic condition (f_1) while antennal grove extending at least half of the length of prosternopleural sutures in *Lacon* shows its derived autapomorphic condition (f_2).

Impressions on pronotum (g):

In *Aeoloides* pronotum with two basal rounded impressions shows its autapomorphic condition (g_1) while pronotum without basal impressions in *Heteroderes*, *Drasterius* and *Aeoloderma* show their synapomorphic condition (g_2).

Combined length of antennal segments 2nd and 3rd (h):

In *Heteroderes* combined length of 2nd and 3rd segments of antennae always shorter than 4th segment shows its autapomorphic condition (h_1) while combined length of 2nd and 3rd segments of antennae not shorter than 4th segment in *Aeoloderma* and *Drasterius* show their synapomorphic condition (h_2).

Shape of tarsal segment four (i):

In *Aeoloderma* 4th segment of tarsi expanded shows its autapomorphic condition (i_1) while 4th segment of tarsi hairy beneath in *Drasterius* shows its derived autapomorphic condition (i_2).

Carina on Hind angles of pronotum (j):

In *Calais* hind angles of pronotum carinate shows its autapomorphic condition (j_1) while hind angles of pronotum not carinate in *Cryptalaus* show its derived autapomorphic condition (j_2).

Margin of metacoxal plate (k):

In *Calais* free margin of metacoxal plate straight shows its autapomorphic condition (k_1) while free margin of metacoxal plate with small lobe in *Cryptalaus* show its derived autapomorphic condition (k_2).

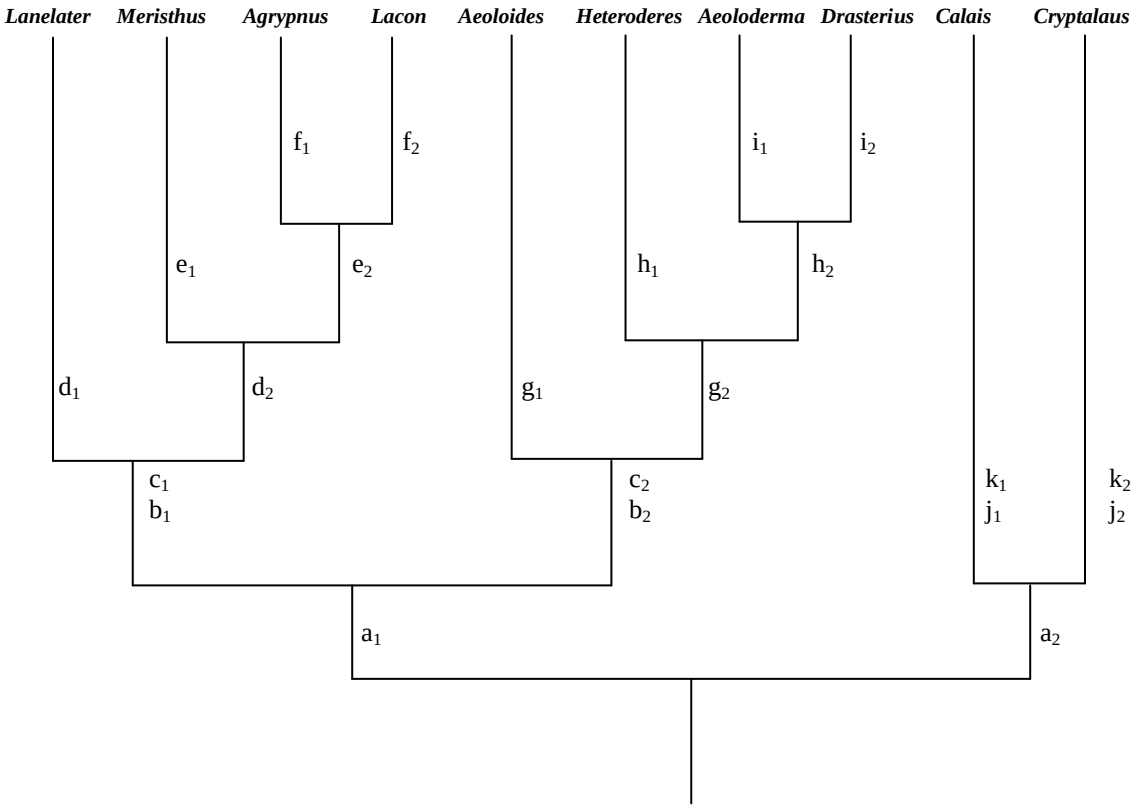

Fig. 1: Cladogram of the genera of subfamily Agrypninae (Coleoptera: Elateridae).

DISCUSSION ON CLADOGRAM OF THE GENERA OF THE SUBFAMILY AGRYPNINAE CANDÈZE, 1857:

The subfamily Agrypninae Candèze presently included ten genera *viz*. *Agrypnus* Eschscholtz, *Lacon* Castelnau, *Lanelater* Arnett, *Meristhus* Candèze, *Aeoloderma* Fleutiaux, *Aeoloides* Schwarz, *Drasterius* Eschscholtz, *Heteroderes* Latereille, *Calais* Laporte and *Cryptalaus* Ohira appear to fall into two groups (Fig. **1**).

Group I includes *Calais* Laporte and *Cryptalaus* Ohira, play out group relationship with other Agrypninae in having autapomorphy of setae forming irregular or regular patches (a_2). They also play sister group relationship with each other, in which *Calais* shares the derived apomorphies of hind angles of pronotum carinate (j_1) and free margin of metacoxal plate straight (k_1), whereas *Cryptalaus* shares the derived apomorphies of hind angles of pronotum not carinate (j_2) and free margin of metacoxal plate with small lobe (k_2).

Group II comprises rest of above eight genera representing the subfamily Agrypninae further consists of two subgroups. Subgroup I comprises of *Aeoloides* Schwarz, *Heteroderes* Latreille, *Aeoloderma* Fleutiaux and *Drasterius* Eschscholtz, of which *Aeoloides* play out group relationship with rest of the three genera in having the apomorphy of pronotum with two basal rounded impressions (g_1). Among the other three genera, of this subgroup *Heteroderes* plays out group relationship with the other two genera, *Aeoloderma* and *Drasterius* on the basis of the apomorphy of combined length of 2nd and 3rd segments of antennae always shorter than 4th segment (h_1). The genera *Aeoloderma* and *Drasterius* play sister group relationship with each other in having the apomorphy of combined length of 2nd and 3rd tarsal segments of antennae not shorter than 4th segment (h_2).

The subgroup II comprises four genera *Lanelater* Arnett, *Meristhus* Candèze, *Agrypnus* Eschscholtz and *Lacon* Castelnau, in which *Lanelater* plays out group relationship with the other three genera in having the apomorphy of propleurae or metasternum without grooves for accommodating of anterior or middle tarsi (d_1). Among the other three genera, of this subgroup *Meristhus* plays out group relationship with the other two genera, *Agrypnus* and *Lacon* on the basis of the apomorphy of scutellum with longitudinal carina at middle (e_1). The genera *Agrypnus* and *Lacon* play sister group relationship with each other in having the apomorphy of Scutellum without longitudinal carina at middle (e_2).

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