CLADISTIC ANALYSIS OF GENERA OF THE SUB-FAMILY GRYLLINAE (ORTHOPTERA: GRYLLIDAE) FROM PAKISTAN

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خلاصہ

ذیلی خاندان گریلائنی کے چودہ اجناس کا تقابلی جائزہ بدر شکلی خصوصیات کو مدّ نظر رکھتے ہوئے جو انکے بیرونیخصوصیاتِ نر اور مادہ تناسلی اعضاء کے حوالہ سے پیش کیا گیا ہے۔ نیز انکے مل شکلی اور خود شکلی کے حوالے سے ایک کلیڈوگرام بھی بنایا گیا ہے۔

Abstract

A cladistic analysis of the fourteen genera of sub-family Grylline is attempted using apomorphic characters which was selected from their external morphological characters, male and female genital components. A cladogram is also made and discussed their synapomorphies and autapomorphies.

Introduction

Gryllids are regarded as important agricultural and domestic pests throughout the world, more particularly in Pakistan. The morphotaxonomic work on the Gryllids attempted by Hinton and Corbel(1949), Alexander and Thomas (1959), Chen *et al.*, (1967) and Furukawa (1970). Wagner trees are one possible generalization of the most parsimonious trees of deducing branching sequencing phylogeny evolution (Camin and Sokal, 1965). The ground plan –analysis method for estimating evolutionary trees has been employed in Zoological evolutionary taxonomy (Kluge and Farris 1969). Farris (1970) discussed some methods for computing Wagner tree. This article derived some properties of Wagner tree and network and described computational procedures for prime networks with the help of algorithms. The ground-plan divergence method of constructing phylogenetic trees was created during 1950s for illustrating systematic principles, the method attempts to deduce pathways of genetic change on the basis of phonetic evidences (Wagner, 1980,Gorokhov 1981, Gross *et al.*, 1989, and Yasuhiro 1990). But the cladistic analysis of this group was not attempted till now. Recently a cladistic analysis of the Nemobine crickets is attempted including 14- species of 5- genera from Pakistan, (Kamaluddin and Khan, 2012)

Kamaluddin *et al.*, (2001) discussed the external morphology of *Gryllus bimaculatus*(DeGeer) and compared with the representative of sub-family Nemobiinae and also described the apomorphic characters to build a background for their cladistic. Kamaluddin and Khan (2005) described three new species of Genus *Pteronemobius*of the Sub-family Nemobiinae from Pakistan with a key and their cladistic relationship. Khan and Kamaluddin (2006) studied the external morphology of head, thorax and abdomen and their appendages of *Pteronemobiusindicus (*Walker) and compared with those of other crickets in the literature and tribal apomorphies are established with their phylogeny. Khan and Kamaluddin (2009) described two new species of Genus *Scottiola*Uvarove of Nemobiinae from Pakistan in detail with special reference to their genital components and also presented a key of Pakistani genera with their cladistic relationship. Kai Li and Xianwel (2010) described four new species of Nemobiinae from China.

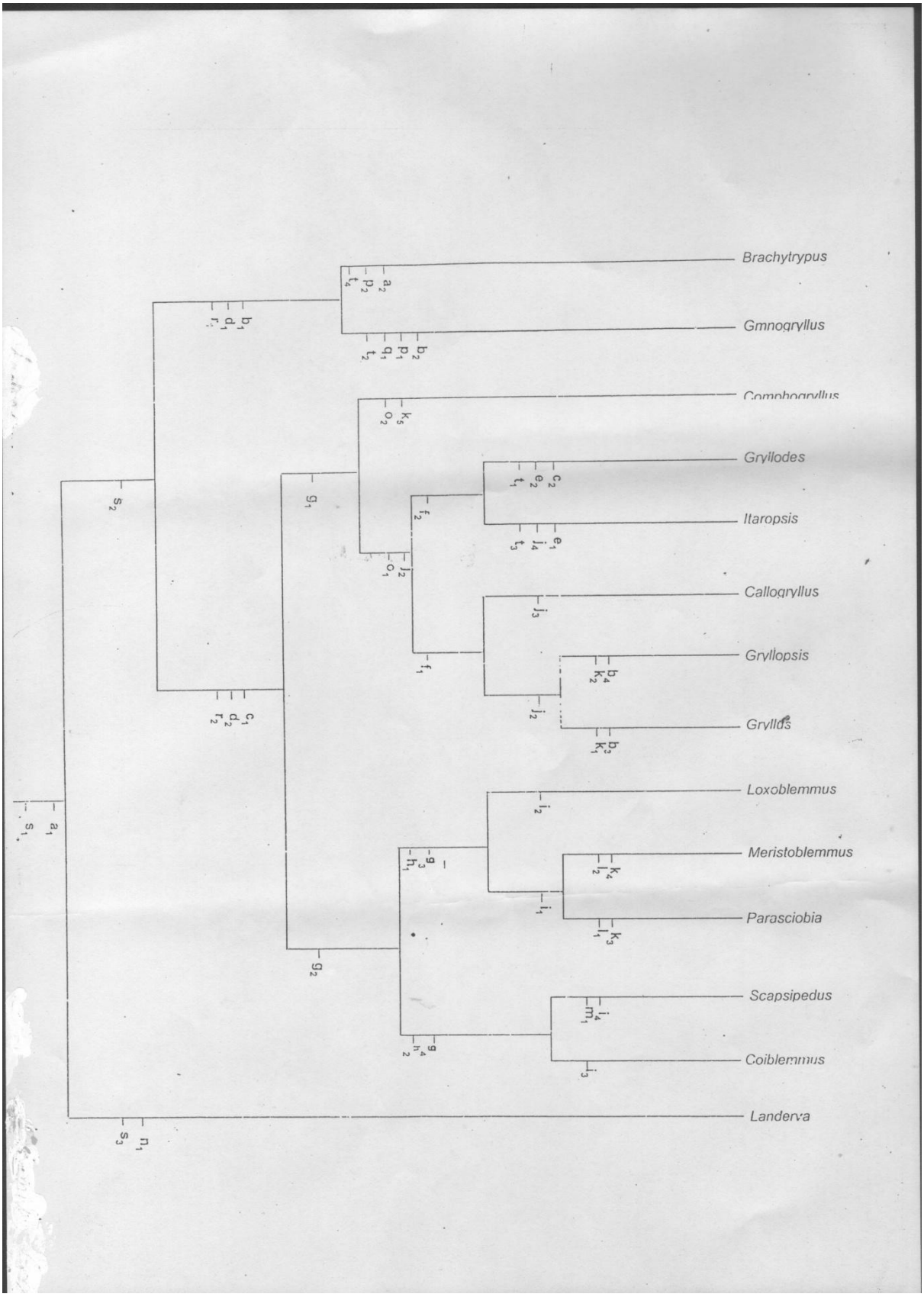
Materials and Methods

The characters of included taxa were coined from all body structures including head thorax, abdomen and ovipositors and also from available literature. These characters were coded as a, b, c and so on. The numbers 1, 2, 3, etc represent derived, more derived and further more derived states, whereas zero shows the plesiomorphic state which is not included in discussion. On the basis of these characters a cladogram is constructed which shows the relationship of included taxa.

Result

Character codes

a_0	Moderate sized species
a_1	Large species (A11)
a_2	Very large species (*Brachytrypus*)
b_0.	Body shape normal
b_1	Body almost globular (*Brachytrypus*and *Gymnogryllus*).
b_2	Body less stout (*Gymnogryllus*)
b_3	Body slightly convex (*Gryllus*)
b_4	Body very convex (*Gryllopsis*)
c_0	Body without pubescent.
c_1	Body usually more or less pubescent (*Comphogryllus* to *Coiblemmus*)
c_2	Body pubescent (*Gryllodes*)
d_0	Ocelli present
d_1	Ocelli disposed in straight line(*Brachytrypus*and *Gymnogryllus*).
d_2	Ocelli disposed as a triangular (*Comphogryllus* to *Coiblemmus*).
e_0	Head convex above.
e_1	Head small and rounded (*Itaropsis*).
e_2	Head somewhat flattened above (*Gryllodes*).
f_0	Head with rounded frontal rostrum.
f_1	Head with wide frontal rostrum (*Callogryllus*, *Gryllopsis* and *Gryllus*).
f_2	Head with narrow frontal rostrum (*Gryllodes*and *Itaropsis*).
g_0	Face highly convex.
g_1	Face convex in both male and female species.(*Comphogryllus*to *Gryllus*).
g_2	Face more or less flattened in males (*Loxoblemmus* to *Coiblemmus*).
g_3	Males with strongly flattened face (*Loxoblemmus*to*Parasciobia*).
g_4	Males with flattened or somewhat concave face (*Scapsipedus* and *Coiblemmus*).
h_0	Forehead normal.
h_1	Forehead with more or less strongly prolonged (*Loxoblemmus*to*Parasciobia*).
h_2	Forehead small (*Scapsipedus* and *Coiblemmus*).
i_0	Front of the rostrum smooth.
i_1	Front of rostrum strongly projecting in males, corneous or presenting a membranous process (*Meristoblemmus* and *Parasciobia*).
i_2	Front of the rostrum of male projecting but simply angular (*Loxoblemmus*).
i_3	Front of rostrum subangulate in male (*Coiblemmus*).
j_0	Elytra well developed in both sexes.
j_1	Elytra well developed at least in males (*Gryllodes* to *Gryllus*).
j_2	Elytra of males with well-developed mirror (*Gryllopsis* and *Gryllus*).
j_3	Elytra of males with indistinct or small mirror displacement towards the apex (*Callogryllus*).
j_4	Elytra very simple in males (*Itaropsis*).
k_0	Females with highly developed elytra.
k_1	Females with more or less perfectly developed elytra (*Gryllus*).
k_2	Females with short lateral elytra (*Gryllopsis*).
k_3	Females with very short elytra (*Parasciobia*).
k_4	Females with highly reduced elytra (*Meristoblemmus*).
l_0	Membranous process smooth.
l_1	Membranous process non-divided unilobed (*Parasciobia*).
l_2	Membranous process divided into two large lobes (*Meristoblemmus*).
m_0	Mandibles of the male normal.
m_1	Mandibles of the males very strong and lengthened (*Scapsipedus*).
n_0	Tympanum absent.
n_1	Tympanum on the internal face (*Landreva*).
o_2	Anterior tibiae smooth.
o_1	Anterior tibiae perforated with one or two foramina (*Gryllodes* to *Gryllus*).
o_2	Anterior tibiae non-perforated (*Comphogryllus*).
p_0	Anterior metatarsi very long.
p_1	Anterior metatarsi moderately long (*Gymnogryllus*).
p_2	Anterior metatarsi very short (*Brachytrypus*).


Brachytrypus
Gmnogryllus
Gryllodes
Itaropsis
Callogryllus
Gryllopsis
Loxoblemmus
Meristoblemmus
Parasciobia
Scapsipedus
Coiblemmus
Landerva

q_0	Anterior and middle tibiae smooth.
q_1	Anterior and middle tibiae beset with long hairs (*Gymnogryllus*).
r_0	Posterior femora very long.
r_1	Posterior femora long, usually as long as tibiae and tarsi together (*Brachytrypus* and *Gymnogryllus*).
r_2	Posterior femora shorter than tibiae and tarsi together (*Comphogryllus*to *Coiblemmus*).
s_0	Posterior tibiae entirely smooth.
s_1	Spines of the posterior tibiae immoveable (All Grylline).
s_2	Posterior tibiae smooth at base (*Brachytrypus*to*Coiblemmus*).
s_3	Posterior tibiae serrated at base, proximal with insertion of the spines (*Lendreva*).
t_0	Ovipositors of moderate size.
t_1	Ovipositors very long (*Gryllodes*).
t_2	Ovipositors usually long (*Gymnogryllus*).
t_3	Ovipositors abortive (*Itaropsis*).
t_4	Ovipositors usually short (*Brachytrypus*).

Characterstates:

Body size (a);Body usually large sized in all the representatives of the sub-family Gryllinae show their synapomorphic condition (a_1). In *Brachytrypus*body very large sized shows its autapomorphic conditions (a_2).

Body shape (b): Body almost globular in *Brachytrypus*and *Gymnogryllus* shows their synapomorphic condition (b_1). Body less stout in *Gymnogryllus* shows its autapomorphic condition (b_2). In *Gryllus* body slightly convex shows its derived autapomorphic condition (b_3). Body highly convex in *Gryllopsis* shows its more derived autapomorphic state (b_4).

Body structures (c): Body usually more or less pubescent in *Comphogryllus*, *Gryllodes*, *Itaropsis*, *Callogryllus*, *Gryllopsis*, *Gryllus*, *Loxoblemmus*, *Meristoblemmus*, *Parasciobia*, *Scapsipedus*, and *Coiblemmus* show their synapomorphic condition (c_1). In *Gryllodes* body pubescent shows its autapomorphic condition (c_3).

Ocelli (d): Ocelli disposed in a straight line in *Brachytrypus*and *Gymnogryllus*show synapomorphic condition (d_1). In *Comphogryllus*, *Gryllodes*,*Itaropsis*, *Callogryllus*, *Gryllopsis*, *Gryllus*, *Loxoblemmus*, *Meristoblemmus*, *Parasciobia*, *Scapsipedus*, and *Coiblemmus* the ocelli disposed as a triangular shape show their derived synapomorphic condition (d_2).

Head shape (e): Head small and rounded in *Itaropsis* shows its autapomorphic condition (e_1). In *Gryllodes*the head somewhat flattened above shows its derived autapomorphic condition (e_2).

Suture on head(f): Head with wide frontal rostrum in *Callogryllus*, *Gryllopsis*, and *Gryllus*, show their synapomorphic condition (f_1). In *Gryllodes* and *Itaropsis* head with narrow frontal rostrumshow their derived synapomorphic state (f_2).

Shape of the face (g): Face convex in both male and female specimens in *Comphogryllus*, *Gryllodes*, *Itaropsis*, *Callogryllus*, *Gryllopsis*, and *Gryllus* show their synapomorphic condition (g_1). In *Loxoblemmus*, *Meristoblemmus*, *Parasciobia*, *Scapsipedus*, and *Coiblemmus*the face more or less flattened in males show their derived synapomorphic condition (g_2). Face strongly flattened in males in *Loxoblemmus*, *Parasciobia*and *Scapsipedus* show their more derived synapomorphiccondition(g_3). In *Scapsipedus* and *Coiblemmus*theface flattened or somewhat concave in males show their further more derived synapomorphiccondition (g_4).

Fore head (h): Fore head with more or less strongly prolonged in *Loxoblemmus*, *Meristoblemmus*and*Parasciobia*, show their synapomorphiccondition (h_1). In *Scapsipedus*, and *Coiblemmus*foreheadsmall show their derived synapomorphic state (h_2).

Front of rostrum (i): Front of rostrum strongly projecting in males, corneas or presenting a membranous process in *Meristoblemmus* and *Parasciobia* show their synapomorphic condition (i_1). In *Loxoblemmus*front of the rostrum of male projecting but simply angular shows its autapomorphic condition(i_2). Front of the rostrum subangulate in males in *Coiblemmus* shows its derived autapomorphic condition (i_3). In *Scapsipedus* front of the rostrum convex shows its more derived autapomorphic state (i_4).

Elytra (j): Elytra well developed at least in males in *Gryllodes, Itaropsis*, *Callogryllus, Gryllopsis,* and *Gryllus* show their synapomorphic condition (j_1). In *Gryllopsis*and *Gryllus* elytra of male with well developed mirror show their derived synapomorphic condition (j_2). Elytra of male with indistinct or small mirror displacement towards the apex in *Callogryllus* shows its autapomorphic condition (j_3). In *Itaropsis* the elytra very ample in males shows its derived autapomorphic state (j_4).

Position of wings (k): Females with more or less perfectly developed elytra in *Gryllus*shows its autapomorphic condition (k_1). In *Gryllopsis* females with short lateral elytra shows its derived autapomorphic condition (k_2). In females elytra very short in *Parasciobia* shows its more derived autapomorphic condition (k3). In females elytra very much reduced in *Meristoblemmus* shows its further more derived autapomorphic condition (k_4). Both males and females are apterous form in *Comphogryllus* shows its specially derived autapomorphic condition (k_5).

Membranaceous process (l): Membranaceous process unilobed in *Parasciobia*shows its autapomorphic condition (l_1). In *Meristoblemmus*thememembranaceousprocess deeply divided into large lobes shows its derived autapomorphic condition (l_2).

Mendibles (m): Mandibles of males very strong and lengthened in *Scapsipedus* shows its autapomorphic condition (m_1).

Tympanum (n): Tympanum is present on the internal face in *Landreva* shows its derived autapomorphic condition (n_1).

Anterior tibiae (o): Anterior tibiae perforated with one or two foramina in *Gryllodes,* Itaropsis, *Callogryllus*, *Gryllopsis*, and *Gryllus* show their synapomorphic condition (o_1). In *Comphogryllus*the anterior tibiae smooth and non-perforated shows its autapomorphic state (o_2).

Anterior metatarsi (p): Anterior metatarsi moderately long in *Gymnogryllus* shows its autapomorphic state (p1). In *Brachytrypus* the anterior metatarsi very short shows its derived autapomorphic condition (p_2).

Anterior and middle tibiae (q): Anterior and middle tibiae beset with long hairs in *Gymnogryllus* shows its autapomorphic condition (q1).

Posterior femora (r): Posterior femora long, usually as long as tibiae and tarsi together in *Brachytrypus* and *Gymnogryllus* show their synapomorphic condition (r_1). In *Comphogryllus, Gryllodes*, *Itaropsis, Callogryllus, Gryllopsis, Gryllus, Loxoblemmus, Meristoblemmus, Parasciobia, Scapsipedus,* and *Coiblemmus*the femora shorter than tibiae and tarsus together show their synapomorphic condition (r_2).

Posterior tibiae (s): Spines of the posterior tibiae immovable in all the representatives of the sub-family Gryllinae show their synapomorphic condition (s_1). In *Brachytrypus,Gymnogryllus,Comphogryllus, Gryllodes*, *Itaropsis, Callogryllus, Gryllopsis, Gryllus, Loxoblemmus, Meristoblemmus, Parasciobia, Scapsipedus,* and *Coiblemmus* the posterior tibiae smooth at base show their derived synapomorphic condition (s_2). In *Landerva*the posterior tibiae serrated at base and proximally with insertion of the spines shows its autapomorphic state (s_3).

Ovipositors (t): Ovipositors very long in *Gryllodes* shows its autapomorphic condition (t_1). In *Gymnogryllus* ovipositorsare usually long shows its derived autapomorphic condition (t_2). Ovipositors abortive in *Itaropsis* shows its more derived autapomorphic condition (t_3). In *Brachytrypus* ovipositors usually short shows its further more derived autapomorphic condition (t_4).

Discussion

Kamaluddin and Khan (2012) have been studied the apomorphic character of Nemobine crickets of the family Gryllidae using autapomorphic and Synapomorphic characters.

The present cladogram represents the cladistic analysis of fourteen genera of the Sub-family Gryllinae. The members of the sub-family appear to be their out group from the sub-family Nemobiinae in having large or rather larger sized body (a_1) and spines of the posterior tibiae immovable (s_1).

Among Gryllinae the genus *Landreva* appears to exhibit sister group relationship with other genera. Among these *Brachytrypus* and *Gymnogryllus* appears to be sister group with those of others out group genera viz. *Comphogryllus, Gryllodes, Itaropsis, Callogryllus, Gryllopsis, Gryllus, Loxoblemmus, Meristoblemmus, Parasciobia, Scapsipedus,* and *Coiblemmus.* All these genera divided into two sub-groups.

The first group includes *Comphogryllus, Gryllodes, Itaropsis*, *Callogryllus*, *Gryllopsis* and *Gryllus.* The *Comphogryllus* plays out group relationships with sister group relationships of the other five genera. Among these *Gryllodes*and *Itaropsis*play sister group relationships to each other and out group relationships with *Callogryllus, Gryllopsis* and *Gryllus.* The *Gryllopsis* and *Gryllus* plays sister group relationships to each other and out group relationships with *Callogryllus.*

The second group includes *Loxoblemmus, Meristoblemmus, Parasciobia, Scapsipedus,* and *Coiblemmus.* Among these the *Scapsipedus* and *Coiblemmus* plays sister group relationships to each other and out group relationships with other genera. *Meristoblemmus*and*Parasciobia* play sister group relationships to each other and out group relationships with *Loxoblemmus.*

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