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CLADISTIC ANALYSIS OF THE SUB- FAMILY NOCTUINAE (LEPIDOPTERA: NOCTUIDAE)FROM PAKISTAN

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Abstract

The cladistic analysis of 24- species of the representatives of five genera of the sub-family Noctuinae attempted from Pakistan. A cladogram is constructed using the apomorphies and are discussed of the included texa with their sistergoup and outgroup relationship.

Introduction

The cladistic analysis on different families of the Lepidoptera were attemted by various authers Viz. Peigler (1993), Choi(2006), Ylla *et al*.(2005), Emerson *et al*. (1997), Kamaluddin *et al*. (1997, 1999 and 2000) Willmott (2003), Brower (2000) and De Camargo *et al.* (2009).

Kamaluddin *et al.* (1997) attempted a review and Lym cladistic analysis af ntriidgenera from Pakistan and adjoining areas. They also formulated a key of 23- genera of the family Peigler (1993) attempted hypothetical phylogenies of the ten genera of Neotropical saturmid sub-family Arsenurinae using cladistic methodology to analyze morphological characters of adult and Lymandridae and discussed their apomorphies on venations of both wings and external morphological charactersied the cladistic analysis Sphingidae from Pakistan. They also formulate of 28- genera of five sub- families of Hawk . larvae. Kamaluddin *et al*. (1999) stud moths family d a key of above genera and discussed sister and out-group relationship on the basis of apomorphies. In (2000) Kamaluddin *et al*. also attempted cladistic analysis of the 33- genera of the sub- family Trifinae of the family Noctuidae and discussed their relationships using apomorphies

Brower (2000) gave the phylogenetic relationships of 103- species of the family Nymphalidae and performed the cladistic analysis on a 378 bp region of the wingless gene. Ylla *et al*.(2005) attempted cladistic analysis of 16- moon moths using their morphological molecules and behavioral pattern comprising 93- characters De Camargo *et al*.(2009) studied the cladistic analysis about 1528 - species of 162- genera of the sub- family Arsenurinae of family Saturnidae with reference to their adult morphology.

Materials and methods: The external morphological and genital characters of the both male and females were studied and selected from included taxa and are compared with those characters which are found in outgroup within the sub- family Noctuinae. A cladogram is constructed showing relationship of the included taxa .The code a_0 ,b_0 ,c_0 etc indicate plesiomorphy which are not discussed where as the states 1, 2, 3 and so on in ascending order reflect derived, more derived and specialy more derived states.

Results

Cladistic analysis of the sub-family Noctuinae:

Charactesrs:

a_0 Body usually slim.
a_1 Body usually cylindrical *(Diarsia, Abagrotis, Xestia)*
a_2 Body usually robust *(Euxoa to Agrotis)*

b_o Vertex smooth and depressed.
b_1 Vertex raised (*Diarsia to Agrotis*)
b_2 Vertex comb- like and convex (Heliothinae)
b_3 Vertex slightaly raised or smooth (*Euxoa munis to Euxoa messoria*)
b_4 Vertex convex (*Xestia isolata*)
b_5 Vertex highly raised (*Euxoa detersa*)
b_6 Vertex bulging out (*Xestia dolosa*)

c_0 Frons highly produced.
c_1 Frons smooth (*Agrotis segetum to Agrotis clavis*)
c_2 Frons straight (*Agrotis exclemationis*)
c_3 Frons anteriorly sub-rounded (*Agrotis venerabilis*)
c_4 Frons roundly produced (*Xestia triangulum*)

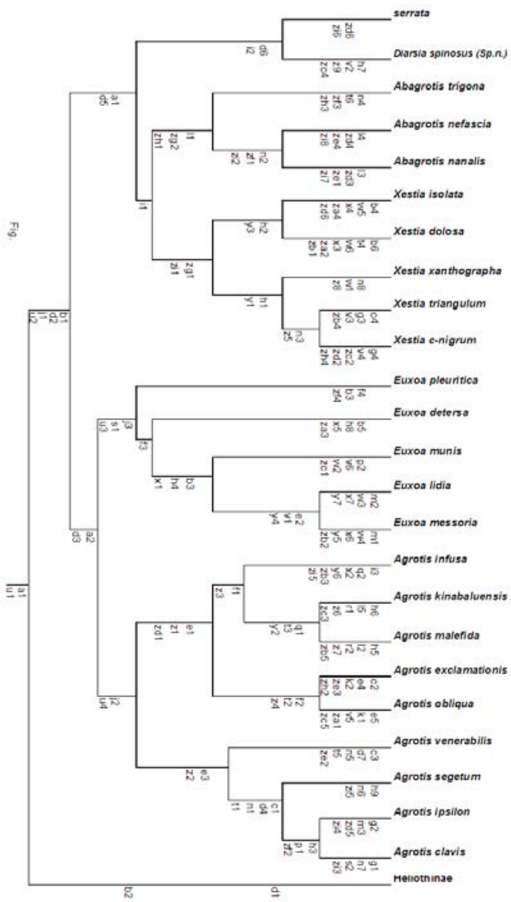

Fig. 1. Cladogram showing cladistic analysis of Nouctuine taxa

d_0 Palpi simple reduced.
d_1 Palpi compresed and short (Heliothinae)
d_2 Palpi well developed usually upturned (*Diarsia* to *Agrotis*)
d_3 Palpi usually short or moderate (*Euxoa to Agrotis*)
d_4 Palpi upwardly or latterly directed (*Agrotis segetum* to *Agrotis clavis*)
d_5 Palpi usually long *Diarsia* to *Xestia C-nigrum*
d_6 Palpi usually anterio- laterally directed (*Diarsia serrata* and *Diarsia spinosus* sp.n.)
d_7 Palpi anteriorly directed (*Agrotis venerabilis*)

e_0 palpi with basal segment equal to second segment.
e_1 Palpi with basal segment longer or equal to 2^{nd} segment (*Agrotis infusa to Agrotis obliqua*)
e_2 Palpi with basal segment shorter than 2^{nd} segment (*Euxoa lidia and Euxoa messoria*)
e_3 Palpi with basal segment much shorter than 2^{nd} segment (*Agrotis venerabilis* to *Agrotis clavis*)
e_4 Palpi with basal segment about equal to 2^{nd} segment (*Agrotis exclamationis*)
e_5 Palpi with basal segment longer than 2^{nd} sgment (*Agrotis obliqua*)

f_0 palpi with basal segment equal to 3^{rd} segment .
f_1 Palpi with basal segment less than 3X the length of 3^{rd} segment (*Agrotis kinabaluensis* to *Agrotis obliqua*)
f_2 Palpi with basal segment more than 6X the 3^{rd} segment (*Agrotis excalmationis* and *Agrotis obliqua*)
f_3 Palpi with basal segment more than 2.5X the 3^{rd} segment (*Euxoa detersa to Euxoa messoria*)
f_4 Palpi with basal segment 1.5X the 3^{rd} segment (*Euxoa pleuritica*)

g_0 Palpus with second segment normal.
g_1 Palpi with 2nd segment cylindrical (*Agrotis clavis*)
g_2 Palpi with 2nd segment thick (*Agrotis ipsilon*)
g_3 Palpi with 2nd segment distally narrowed (*Xestia triangulum*)
g_4 Palpi with 2nd segment distally broad (*Xestia c-nigrum*)

h_o Palpi with 2nd segment about equal to 3rd segment.
h_1 Palpi with 2nd segment less than 2.5X the 3rd segment (*Xestia xanthographa Xestia c-nigrum*)
h_2 Palpi with 2nd segment 2.5X the 3rd segment (*Xestia isolata and Xestia dolosa*)
h_3 Palpi with 2nd segment not more than 3X the 3rd segment (*Agrotis ipsilon* and *Agrotis clavis*)
h_4 Palpi with 2nd segment less than 4X the 3rd segment (*Euxoa munis to Euxoa messoria*)
h_5 Palpi with 2nd segment 2X the 3rd segment (*Agrotis malefida*)
h_6 Palpi with 2nd segment 3X the 3rd (*Agrotis kinabaluensis*)
h_7 Palpi with 2nd segment about 4X the 3rd segment (*Diarsia spinosus sp.n*)
h_8 Palpi with 2nd segment more than 4X the 3rd (*Euxoa deters*)
h_9 Palpi with 2nd segment 5X the 3rd segment (*Agrotis Segetum*)

i_0 Palpi with 3rd segment large.
i_1 Palpi with 3rd segment moderate more than 1/3rd the length of 2nd segment (*Abagrotis trigona to Xestia c-nigrum*)
i_2 Palpi with 3rd segment short less than 1/3rd the length of 2nd segment (*Diarsia serrata and Diarsia spinosus sp.n*)
i_3 Palpi with 3rd segment apically truncated (*Agrotis infusa*)

j_0 Fore wings with unicolours.
j_1 Fore wings with costal margin have two small lobes (*Diarsia serrata to Agrotis clavis*)
j_2 Fore wings with costal margin light colour lobe (*Agrotis infusa* to *Agrotis clavis*)
j_3 Fore wings with transverse dark wrinkled lining (*Exuoa pleuritica to Euxoa messoria*)

k_0 Anterior margin of fore wing straight.
k_1 Anterior margin of fore wings convex (*Agrotis obliqua*)
k_2 Anterior margin of fore wings sinuated *Agrotis exclamationis*
l_0 Apical angle of fore wing smooth.
l_1 Fore wings with apical angle upwardly directed (*Abagrotis trigona to Abagrotis nanalis*)
l_2 Apical angle of fore wings broad (*Agrotis malefida*)
l_3 Apical angle of fore wings sub-rounded (*Abagrotis nanalis*)
l_4 Apical angle of fore wings sub-acute (*Abagrotis nefascia*)
l_5 Apical angle of fore wings narrowed (*Agrotis kinabaluensis*

m_0 Fore wings with veins R_2 and R_3 anastomosing .
m_1 Fore wings with veins R_2 and R_3 wideapart (*Euxoa messoria*)
m_2 Fore wings with veins R_2 and R_3 stalked (*Euxoa lidia*)
m_3 Fore wings with veins R_2 and R_3 stalked further stalked with R_4 and originating from cell (*Agrotis ipsilon*)

n_0 Fore wings with veins R_3, R_4 and R_5 wide apart .
n_1 Fore wings with veins R_3 and R_4 not or stalked and anastomosing with R_5 (*Agrotis segetum to Agrotis clavis*)
n_2 Fore wings with veins R_3 and R_4 stalked later anastomoising with R_5 and originating from cell (*Abagrotis nefascia and Abagrotis nanalis*)
n_3 Fore wings with veins R_3 and R_4 stalked further anastomosing with R_5 and originating from upper angle of cell (*Xestia triangulum* and *Xestia c nigrum)*
n_4 Fore wings with veins R_3 and R_4 stalked and originating from cell (*Abagrotis trigona*)
n_5 Fore wings with veins R_3 and R_4 stalked and originating from upper angle of cell (*Agrotis venerabilis*)
n_6 Fore wings with veins R_3 and R_4 stalked anastomosing and originating from upper angle of cell (*Agrotis segetum*)
n_7 Fore wings with veins R_3 and R_4 stalked later anastomosing with R_5 and originating from cell (*Agrotis clavis*)
n_8 Fore wings with veins R_3 and R_4 stalked further stalked with R_5 (*Xestia xanthographa*)

o_0 Hind wings entire, without spot
o_1 Hind wings with discal spot (Heliothinae to Noctuinae)
p_0 Hind wings with three anal veins.
p_1 Hind wings with two anal veins (*Agrotis ipsilon* and *Agrotis clavis*)
p_2 Hind wings with only one anal vein (*Euxoa munis*)

q_0 Anterior margin of hind wings straight.
q_1 Anterior margin of hind wings convex (*Agrotis kinabaluensis* and *Agrotis malefida*)
q_2 Anterior margin of hind wings sinuated (*Agrotis infusa*)

r_0 Hind wings with veins $Sc+R_1$, Rs and M_1 separated.
r_1 Hind wings with veins $Sc+R_1$ fused with Rs near base, Rs and M_1 anastomosing (*Agrotis kinabaluensis*)
r_2 Hind wings with veins $Sc+R_1$ wide apart Rs and M_1 stalked (*Agrotis malefida*)

s_0 Hind wings with veins Rs and M_1 wideapart.
s_1 Hind wings with veins Rs and M_1 anastomosing and originating from upper angle of cell (*Euxoa detersa to Euxoa messoria*)
s_2 Hind wings with veins Rs and M_1 shortly stalked (*Agrotis clavis*)
s_3 Hind wings with veins Rs and M_1 stalked and originating from upper angle of cell (*Exuoa pleuritica*)
s_4 Hind wings with Rs originating just above upper angle of cell, M_1 originates from upper angle of cell (*Diarsia spinosus* sp.n.)
t_0 Hind wings with M_2 and M_3 shortly stalked.
t_1 Hind wings with veins M_2 and M_3 wide apart (*Agrotis segetum* to *Agrotis clavis*)
t_2 Hind wings with veins M_2 and M_3 anastomosing (*Agrotis exclamationis* and *Agrotis obliqua*)
t_3 Hind wings with veins M_2 and M_3 wide apart M_2 originates from lower angel of cell (*Agrotis kinabaluensis* to *Agrotis malefida*)
t_4 Hind wings with veins M_2 originates from lower angle of cell (*Xestia dolosa*)
t_5 Hind wings with veins M_2 and M_3 stalked (*Agrotis venerabilis*)
t_6 Hind wings with veins M_2 and M_3 anastomosing and originating from lower angle of cell (*Abagrotis trigona*)

u_0 Tibae without spine .
u_1 Fore tibae with apical setae (*Diarsia to* Heliohinae)
u_2 Fore and hind tibiae usually and mid tibiae with spine like-setae (*Diarsia serrata* to *Agrotis clavis*)
u_3 Tibiae normally spined (*Euxoa pleuritica* to *Euxoa messoria*)
u_4 Tibiae very strongly spined (*Agrotis infusa* to *Agrotis clavis*)

v_0 Uncus simple, straight.
v_1 Uncus moderate lateraly curved (*Euxoa lidia* and *Euxoa messoria*)
v_2 Uncus shorter than gnathos (*Diarsia spinosus* sp.n.)
v_3 Uncus with apex pointed, lateraly directed (*Xestia triangulum*)
v_4 Uncus with apex sharply pointed inwardly directed (*Xestia c-nigrum*)
v_5 Apex of uncus incurved thorn-like (*Agrotis obliqua)*
v_6 Uncus very large curved inwardly (*Euxoa munis*)

w_0 Gnathos moderate and simple.
w_1 Gnathos well developed (*Xestia xanthographa*)
w_2 Gnathos reduced (*Exuoa munis*)
w_3 Gnathos membranous(*Euxoa lidia*)
w_4 Gnathos scleretoized (*Euxoa messoria*)
w_5 Apex of gnathos truncated (*Xestia isolata*)
w_6 Apex of gnathos club-shaped (*Xestia dolosa*)

x_0 Saccus simple large.
x_1 Saccus anteriorly blunt (*Euxoa munis* to *Euxoa messoria*)
x_2 Saccus broad (*Agrotis infusa*)

x_3 Saccus anteriorly broadly rounded (*Xestia dolosa*)
x_4 Saccus anteriorly narrowed (*Xestia isolata*)
x_5 Saccus anteriorly sharply produced (*Euxoa detersa*)
x_6 Saccus U-shaped (*Euxoa messoria*)
x_7 Saccus V-shaped (*Euxoa lidia*)

y_0 Apex of paramere broad.
y_1 Apex of paramere unilobed with aprocess at sub-apical outer margin (*Xestia xanthographa* to *Xestia c-nigrum*)
y_2 Apex of paramere sub-rounded (*Agrotis kinabaluensis* and *Agrotis malefida*)
y_3 Apex of paramere bilobed with convex sub-apical outer margin convex (*Xestia isolata* and *Xestia dolosa*)
y_4 Apex of paramere with a small outgrowth (*Euxoa lidia* and *Euxoa messoria*)
y_5 Apex of paramere acute (*Euxoa messoria*)
y_6 Apex of paramere tooth (*Agrotis infusa*)
y_7 Apex of paramere truncated (*Euxoa lidia*)

z_0 Paramere simple without process.
z_1 Paramere with pointed process at inner median margin (*Agrotis infusa* to *Agrotis obliqua*)
z_2 Paramere with blunt process at inner median margin (*Agrotis venerabilis* to *Agrotis clavis*)
z_3 Inner margin of paramere with a short thorn-like process (*Agrotis infusa* to *Agrotis malefida*)
z_4 Inner margin of paramere with a large pointed process (*Agrotis exclamationis* and *Agrotis obliqua*)
z_5 Paramere with outer process large inner process Axe-shaped (*Xestia triangulum* and *Xestia c-nigrum*)
z_6 A small blunt process at inner margin of paramere (*Agrotis kinabaluensis*)
z_7 A sickle-shaped process at inner margin of paramere (*Agrotis malefida)*
z_8 Outer process of paramere short with inner process tooth-like (*Xestia xanthographa*)
z_9 Paramere very large apically broad with a large curved thorn-like process inner median surface (*Diarsia spinosus* sp.n.)
za_0 Theca at simple, tubular.
za_1 Theca with distal inner margin irregular (*Agrotis obliqua*)
za_2 Theca with pointed thecal appendage (*Xestia dolosa*)
za_3 Theca with thorn-like thecal appendage (*Euxoa detersa*)
za_4 Theca with truncated thecal appendage (*Xestia isolate*

zb_0 Apex of membranous conjunctival lobe simple .
zb_1 Membranous conjunctival lobe distally pointed (*Xestia dolosa*)
zb_2 Apex of membranous conjunctival lobe with spinous appendage (*Euxoa messoria*)
zb_3 Apex of conjunctival lobe with thorn-like appendage (*Agrotis infusa*)
zb_4 Membranous conjunctival lobe with distally five leaf-like cornuti (*Xestia triangulum*)
zb_5 Membranous conjunctival lobe with a series of leaf-like structure at apex (*Agrotis malefida*)
zb_6 Membranous conjunctival lobe distally recemose (*Xestia isolata*)

zc_0 Membranous conjunctival lobe entire .
zc_1 Membranous conjunctival lobed multilobe (*Euxoa munis*)
zc_2 Membranous conjunctiva distally bilobed medially with spine-like cornuti (*Xestia c-nigrum*)
zc_3 Membranous conjunctival lobe with row of small spine-like cornuti (*Agrotis kinabaluensis*)
zc_4 Membranous conjunctival lobe besets with cluster of large and small cornuti (*Diarsia spinosus*)
zc_5 Membranous conjunctival lobe with a small sickle-shaped spine, with a group of small spine at its base and small circular plate at inner media n surface (*Agrotis obliqua*)

zd_0 Papillae anales simple quadrangular-shaped
zd_1 Papillae anales bean-shaped (*Xestia c-nigrum*)
zd_2 Papillae anales posteriorly concave (*Abagrotis nanalis*)
zd_3 Papillae anales posteriorly deeply notched (*Abagrotis nefascia*)
zd_4 Papillae anales moderate kidney-shaped (*Agrotis ipsilon*)
zd_5 Papillae anales very large kidney-shaped (*Diarsia serrata*)

ze_0 Apophyses anteriors and posteriors simple and moderate.
ze_1 Apophyses anteriors straight with apex blunt (*Abagrotis nanalis*)
ze_2 Apophyses anteriors with apex truncated (*Agrotis venerabilis*)
ze_3 Apophysis posteriors dilated at base longer than apophyses anteriors (*Agrotis exclamationis*)
ze_4 Apophyses posteriors twisted with apex pointed (*Abagrotis nefascia*)

zf_0 Apophyses posteriors shorter than anteriors .
zf_1 Apophyses posterior much longer than anterior (*Abagrotis nefascia* and *Abagrotis nanalis*)
zf_2 Apophyses posterior 2X the apophyses anterior (*Agrotis ipsilon* and *Agrotis clavis*)
zf_3 Apophyses posterior equal to anterior (*Abagrotis trigona*)
zf_4 Apophyses posterior more than 2X the length apophyses anteriors (*Euxoa pleuritica*)
zf_5 Apophyses posterior very long about 3X the apophyses anteriors and apex of both pointed (*Agrotis segetum*)

zg_0 Ductus bursae moderate .
zg_1 Ductus bursae very long (*Xestia isolata* to *Xestia c-nigrum*)
zg_2 Ductus bursae short (*Abagrotis trigona* to *Abagrotis nanalis*)

zh_0 Corpus bursae smooth oval-shaped .
zh_1 Corpus bursae irregular-shaped (*Abagrotis trigona* to *Abagrotis nanalis*)
zh_2 Corpus bursae very large balloon-shaped (*Agrotis exclamationis*)
zh_3 Corpus bursae with distal lobe large balloon-shaped (*Abagrotis trigona*)
zh_4 Corpus bursae irregular bag-like with wrinkled cornuti (*Xestia c-nigrum*)

zi_0 Corpus bursae simple unilobed.
zi_1 Corpus bursae smoothly bilobed (*Xestia isolata* to *Xestia c-nigrum*)
zi_2 Corpus bursae with distal lobe small oval-shaped (*Abagrotis nefascia* and *Abagrotis nanalis*)
zi_3 Corpus bursae bilobed dorsal lobe small oval-shaped (*Agrotis clavis*)
zi_4 Corpus bursae bilobed dorsal lobe large pear-shaped (*Agrotis ipsilon*)
zi_5 Corpus bursae bilobed both lobes large balloon-shaped (*Agrotis infusa*)
zi_6 Corpus bursae large irregularly bilobed (*Diarsia serrata*)
zi_7 Corpus bursae with apex of one lobe balloon-shaped (*Abagrotis nanalis*)
zi_8 Corpus bursae with apex of one lobe beak-shaped (*Abagrotis nefascia*)

Characters: Body shape (a): The body usually cylindrical in the representatives of the genera *Diarsia, Abagrotis* and *Xestia* shows their synapomorphic condition (a_1). In the representatives of the genera *Euxoa*, and *Agrotis* the body is usually robust shows their derived synapomorphic condition (a_2).

Vertex (b): Vertex raised in all the representatives of the genera *Diarsia*, *Abagrotis*, *Xestia*, *Euxoa* and *Agrotis* shows their synapomorphic condition (b_1). In all the reprentatives of the sub-family Heliothinae the vertex convex and comb-like shows their derived synapomorphic condition (b_2). Vertex slightly raised or smooth in *Euxoa munis, Euxao lidia* and *Euxoa messoria* shows their more derived synapomorphic condition (b_3). In *Xestia isolata* the vertex is convex shows its autapomorphic condition (b_4). The vertex is highly raised in *Euxoa detersa* shows its derived autapomorphic condition (b_5). In *Xestia dolosa* the vertex bulging out shows its more derived autapomorphic condition (b_6).

Frons (c):Frons smooth in *Agrotis segetum*, *A. ipsilon* and *A. clavis* shows their synapomorphic condition (c_1). In *Agrotis exclamationis* the frons is straight shows its autapomorphic condition (c_2). The frons is anteriorly sub-rounded in *Agrotis venerabilis* shows its derived autapomorphic codition (c_3). In *Xestia triangulum* frons roundly produced shows its more derived autapomorphic condition (c_4).

Palpi (d):Palpi compressed short in the representatives of the Heliotheinae shows their synapomorphic condition (d_1). The palpi well developed usually upturned in the representatives of the genera *Diarsia, Abagrotis, Xestia*, *Euxoa and Agrotis* palpi usually short and modrate shows their more derived synapomorphic condition (d_2). In the representatives of the genera *Euxoa* and *Agrotis* palpi usually short and moderate shows their more derived synapomorphic condition (d_3). The palpi upwardly or laterally directed in *Agrotis segetum, A. ipsilon* and *A. clavis* shows their specially synapomorphic condition (d_4). In the representatives of the genera *Diarsia* and *Xestia* the palpi usually long shows their specially derived synapomorphic condition (d_5). The palpi antero-lateraly directed in *Diarsia serrata* and *Diarsia spinosus* shows their specially more derived synapomorphic condition (d_6). In *Agrotis venerabilis* the palpi anteriorly directed shows its autapomorphic condition (d_7).

Basal and 2^{nd} palpus segment (e):Palpi with basal segment longer or equal to second segment in *Agrotis infusa, A. kinabaluensis, A. malefida, A. exclamationis* and *A. obliqua* shows their synapomorphic condition (e_1). In *Euxoa lidia* and *E. messoria* the basal segment of palpi shorter than second segment shows their derived synapomorphic condition (e_2). The basal segment of palpi much shorter than second segment in *Agrotis venerabilis, A. segetum, A. ipsilon* and *A. clavis* shows their more derived synapomorphic condition (e_3). In *Agrotis exclamationis* the palpi with basal segment about equal to 2^{nd} segment shows its autapomorphic condition (e_4). The basal segment of palpi longer than second segment in *Agrotis obliqua* shows its derived autapomorphic condition (e_5).

Basal and third palpus segment (f):Basal segment of palpi less than 3X the length of third segment in *Agrotis infusa, A. kinabaluensis* and *A. malefida* shows their synapomorphic condition (f_1). In *A. exclamationis* and *A. obliqua* the basal segment of palpi more than 6X the length of 3^{rd} segment shows their derived synapomorphic condition (f_2). Basal segment of palpi more than 2.5X the length of 3^{rd} segment in *Euxoa detersa, E' munis, E. lidia* and *E. messoria* shows their more derived synapomorphic condtion (f_3). In *E. pleuritica* the basal segment of palpi 1.5X the length 3^{rd} segment shows it autapomorphic condition (f_4).

Shape of 2^{nd} palpus segment (g):Palpus with second segment cylindrical in *Agrotis clavis* shows its autapomorphic condition (g_1). In *Agrotis ipsilon* the second segment of palpi thick shows its derived autapomorphic condition (g_2). The second segment of palpi distinctly narrowed in *Xestia triangulum* shows its more derived autapomorphic condition (g_3). In *Xestia c-nigrum* second segment of palpi distinctly broad shows its specially derived autapomorphic condition (g_4).

Palpi with 2^{nd} and 3^{rd} segment (h):Second segment of palpi less than 2.5X the length of 3^{rd} segment in *Xestia xanthographa, X. triangulum* and *X. c-nigrum* shows their synapomorphic condition (h_1). In *X. isolata* and *X. dolosa* the second segment of palpi 2.5X the length of 3^{rd} segment shows their derived synapomorphic condition (h_2). The second segment of palpi not more than 3x the 3^{rd} segment in *Agrotis ipsilon* and *A. clavis* shows their more derived synapomorphic condition (h_3). In *Euxoa munis, E. lidia* and *E. messoria* the second segment of palpi less than 4X the length of 3^{rd} shows their specially derived synapomorphic condition (h_4).The second segment of palpi 2X the third segment in *Agrotis malefida* shows its autapomorphic condition (h_5). In *A. kinabaluensis* the second segment of palpi 3X the length of 3^{rd} segment shows their derived autapomorphic condition (h_6). The second segment of palpi about 4x the length of 3^{rd} segment in *Diarsia spinosus* shows its more derived autapomorphic condition (h_7). In *Euxao detersa* the second segment of palpi more than 4X the length of third segment shows its specially derived autapomorphic condition (h_8). The second segment of palpi 5X the length of 3^{rd} segment in *Agrotis segetum* shows its specially more derived autapmorphic condition (h_9).

Third segment of Palpi (i):Palpi with 3^{rd} segment moderate more than $1/3^{rd}$ the length of second segment in *Abagrotis trigona* and all the species of the genus *Xestia* shows their synapomorphic condition (i_1). In *Diarsia serrata* and *D. spinosus* the third segment of palpi short less than $1/3^{rd}$ the length of second segment shows their derived synapomorphic condition (i_2). The third segment of palpi apically truncated in *Agrotis infusa* shows its autapomorphic condition (i_3).

Fore wings (j):Fore wings with costal margin with two small lobes in all the representative of the Noctuinae shows its synapomorphic condition(j_1). In all the species of the genus *Agrotis* fore wings with costal margin light colour lobe shows their derived synapomorphic condition (j_2). Fore wings with transverse dark wrinkled linings in *Euxoa pleuritica, E. detersa, E. munis, E. lidia* and *E. messoria* shows their more derived synapomorphic condition (j_3).

Anterior margin of fore wings (k):Anterior margin of fore wings convex in *Agrotis obliqua* shows its autapomorphic condition (k_1). In *Agrotis exclamationis* the anterior margin of fore wings sinuated shows its derived autapomorphic condition (k_2).

Apical angle of fore wings (l):Fore wings with apical angle upwardly directed in *Abagrotis trigona, A. nefascia, A. nanalis* shows their synapomorphic condition (l_1). In *Agrotis malefida* the apical angle of fore wings broad shows their autapomorphic condition (l_2). The apical angle of fore wings sub-rounded in *Abagrotis nanalis* shows its derived autapomorphic condition (l_3). In *Abagrotis nefascia* the apical angle of fore wings sub-acute shows its more derived autapomorphic condition (l_4). The apical angle of fore wing narrowed in *Agrotis kinabaluensis* shows its specially derived autapomorphic condition (h_5).

Fore wings with veins R_2 and R_3 (m): Fore wings with veins R_2 and R_3 wide apart in *Euxoa messoria* shows its autpomorphic condition (m_1). In *Euxoa lidia* the fore wings with veins R_2 and R_3 stalked shows its derived autapomorphic condition (m_2). The fore wings with R_2 and R_3 stalked, further stalked with R_4 and originating from cell in *Agrotis ipsilon* shows its more derived autapomorphic condition (m_3).

Fore wings with veins R_3, R_4 and R_5 (n):Fore wings with veins R_3 and R_4 not or stalked and anastomosing with R_5 in *Agrotis segetum, A. ipsilon* and *A. clavis* shows their synapomorphic condition (n_1). In *Abagrotis nefascia* and *A. nanalis* the fore wings with veins R_3 and R_4 stalked later anastomosing with R_5 and originating from cell shows their derived synapomorphic condition (n_2). The fore wings with veins R_3 and R_4 stalked further anastomosing with R_5 and originating from upper angle of cell in *Xestia triangulum* and *Xestia c-nigrum* shows their more derived synapomorphic condition (n_3). In *Abagrotis trigona* the fore wings with veins R_3 and R_4 stalked and originating from cell shows its autapomorphic condition (n_4). The fore wings with R_3 and R_4 stalked and originating from upper angle of cell in *Agrotis venerabilis* shows its derived autapomorphic condition (n_5). In *Agrotis segetum* the fore wings with veins R_3 and R_4 anastomosing and originating from upper angle of cell shows its more derived autapomorphic condition (n_6). The fore wings with veins R_3 and R_4 stalked later anastomosing with R_5 and originating from cell in *Agrotis clavis* shows its specially derived autapomorphic condition (n_7). In *Xestia xanthographa* the fore wings with veins R_3 and R_4 stalked, further stalked with R_5 shows its especially more derived autapomorphic condition (n_8).

Hind wings with spot (O):Hind wings with discal spot in all the representatives of the sub-family Heliothinae and Noctuinae shows their synapomorphic condition (O_1).

Anal veins on hind wings (p):Hind wings with two anal veins in *Agrotis ipsilon* and *A. clavis* shows their synapomorphic condition (p_1). In *Euxoa munis* the hind wings with one anal vein shows its autapomorphic condition (p_2).

Anterior margin of hind wings (q):Anterior margin of hind wings convex in *Agrotis kinabaluensis* and *A. malefida* shows their synapomorphic condition (q_1). In *A. infusa* the anterior margin of hind wings sinuated shows its autapomorphic condition (q_2).

Hind wings with veins Sc+R_1, Rs and M_1 (r): Hind wings with veins Sc+R_1 fused with Rs near base, Rs and M_1 anastomosing in *Agrotis kinabaluensis* shows its autapomorphic condition (r_1). In *A. malefida* the hind wings with veins Sc+R_1 wide apart, Rs and M_1 stalked shows its derived autapomorphic condition (r_2).

Hind wings with veins Rs and M_1 (s):Hind wings with veins Rs and M_1 anastomosing and originating from upper angle of cell in *Euxoa detersa, E. munis, E. lidia* and *E. messoria* shows their synapomorphic condition (s_1). In *Agrotis clavis* the hind wings with veins Rs and M_1 shortly stalked shows its autapomorphic condition (s_2). The hind wings with veins Rs and M_1 stalked and originating from upper angle of cell in *Euxoa pleuritica* shows its derived autapomorphic condition (s_3). In hind wings with vein Rs originates just above upper angle cell and M_1 originates from upper angle of cell shows its more derived autapomorphic condition (s_4).

Hind wings with veins M_2 and M_3 (t):Hind wings with veins M_2 and M_3 wide apart in *Agrotis segetum, A. ipsilon* and *A. clavis* shows their synapomorphic condition (t_1). In *Agrotis exclamationis* and *A. obliqua* hind wings with veins M_2 and M_3 anastomosing shows their derived synapomorphic condition (t_2). Hind wings with vein M_2 originates from lower angle of cell in *Agrotis kinabaluensis* and *A. malefida* shows their more derived synapomorphic condition (t_3). In *Xestia dolosa* the hind wings with veins M_2 originates from lower angle of cell shows its autapomorphic condition (t_4). The hind wings with veins M_2 and M_3 stalked in *Agrotis venerabilus* shows its derived autapomorphic condition (t_5). In *Abagrotis trigona* the hind wings with veins M_2 and M_3 anastomosing and originating from lower angle of cell shows its more derived autapomorphic condition (t_6).

Tibiae (u): Fore tibiae with apical setae in all the representatives of the sub-family Noctuinae and Heliothinae shows their synapomorphic condition (u_1). In the representatives of the genera *Diarsia, Abagrotis, Xestia, Euxoa* and *Agrotis* fore and hind tibiae usually and mid tibiae with spin-like shows their derived synapomorphic condition (u_2).The tibia are normally spined In *Euxoa pleuritica, E. detersa, E. munis, E. lidia* and *E. messoria* shows their more derived synapomorphic condition (u_3).In all the species of the genus *Agrotis* tibiae very strongly spined shows their specially derived synapomorphic condition (u_4).

Uncus (v):The uncus is modrate laterally curved in *Euxoa lidia, E. messoria* shows their synapomorphic condition (v_1). In *Diarsia spinosus* uncus shorter than gnathos shows its autapomorphic condition (v_2). The uncus with apex pointed, laterally directed in *Xestia triangulum* shows its derived autapomorphic condition (v_3). In *Xestia c-nigrum* the uncus with apex sharply pointed inwardly directed shows its more derived autapomorphic condition (v_4). The apex of uncus incurved thorn-like in *Agrotis obliqua* shows its specially derived autapomorphic condition (v_5). In *Euxoa munis* the uncus very large, inwardly curved shows its specially more derived autapomorphic condition (v_6).

Gnathos (w):Gnathos well developed in *Xestia xanthographa* shows its autapomorphic condition (w_1). In *Euxoa munis* the gnathos reduced shows its derived autapomorphic condition (w_2) . The gnathos is membranous in *Euxoa lidia* shows its more derived autapomorphic condition (w_3). In *Euxoa messoria* the gnathos is sclerotized shows its specialized autapomorphic condition (w_4). The apex of gnathos truncated in *Xestia isolata* shows its specially derived autapomorphic condition (w_5). In *Xestia dolodsa* apex of gnathos club-shaped shows its specially more derived autapomorphic condition (w_6).

Saccus (x): Saccus anteriorly blunt in *Euxoa munis, E. lidia* and *E. messoria* shows their synapomorphic condition (x_1). In *Agrotis infusa* the saccus is broad shows its autapomorphic condition (x_2). The saccus is anteriorly broadly rounded in *Xestia dolosa* shows its derived autapomorphic condition (x_3). In *Xestia isolata* the saccus is anteriorly narrowed shows its more derived autapomorphic condition (x_4). Saccus anteriorly sharply produced in *Euxoa detersa* shows its specialzed autapomorphic condition (x_5). In *Euxoa messoria* the saccus is U-shaped shows its specially derived autapomorphic condition (x_6). The saccus is V-shaped in *Euxoa lidia* shows its specially more derived autapomorphic condition (x_7).

Apex of Paramere (y):Apex of paramere unilobed with a process at sub-apical outer margin in *Xestia xanthographa, X. triangulum and X. c-nigrum* shows their synapomorphic condition (y_1). In *Agrotis kinabaluensis* and *A. malefida* the apex of paramere sub-rounded shows its derived synapomorphic condition (y_2). The apex of paramere bilobed with sub-apical outer margin convex in *Xestia isolata* and *X. dolosa* shows their more derived synapomorphic condition (y_3). In *Euxoa lidia* and *E. messoria* the apex of paramere with small outgrowth shows their specialized synapomorphic condition (y_4). Apex of paramere acute in *Euxoa messoria* shows its autapomorphic condition (y_5). In *Agrotis infusa* the apex of paramere toothed shows its derived autapomorphic condition (y_6). The apex of paramere truncated in *Euxoa lidia* shows its more derived autapomorphic condition (y_7).

Process at Paramere (z):Paramere with a pointed process at inner median margin in *Agrotis infusa, Agrotis kinabalensis, Agrotis malefida, Agrotis exclamationis* and *Agrotis obliqua* shows their synapomorphic condition (z_1). In *Agrotis venerabilis, Agrotis segetum, Agrotis ipsilon and Agrotis clavis* the paramere with blunt process at inner median margin shows their derived synapomorphic condition (z_2). Inner margin of paramere with short thorn-like process in *Agrotis infusa, Agrotis kinabaleunsis and Agrotis malefida* shows their more derived synapomorphic condition (z_3). In *Agrotis exclamationis* and Agrotis obliqua the inner margin of paramere with a large pointed process shows their specially derived synapomorphic condition (z_4). Paramere with outer process large and inner process Axe-shaped in *Xestia triangulum* and *Xestia c-nigrum* shows their specially more derived synapomorphic condition (z_5).

A small blunt process at inner margin of paramere in *Agrotis kinabaluensis* shows its autapomorphic condition (z_6). In *Agrotis melafida* a sickle-shaped process at inner margin of paramere shows its derived autapomorphic condition (z_7). The paramere with outer process short and inner process tooth-like in *Xestia xanthographa* shows its more derived autapomorphic condition (z_8). In *Diarsia spinosus* the paramere very large apically broad with a large curved thorn-like process at inner median surface shows its specially derived autapomorphic condition (z_9).

Aedeagus (z_a):Theca with distal inner margin irregular in *Agrotis obliqua* shows its autapomorphic condition (za_1). In *Xestia dolosa* the theca with pointed thecal appendage shows its derived autapomorphic condition (za_2). The theca with thorn-like thecal appendage in *Euxoa detersa* shows its more derived autapomorphic condition (za_3). In *Xestia isolata* the theca with truncated thecal appendage shows its specially derived autapomorphic condition (za_4).

Apex of membranous conjunctival lobe (zb):Membranous conjunctival lobe distally pointed in *Xestia dolosa* shows its autapomorphic condition (zb_1). In *Euxoa messoria* the apex of membranous conjunctival lobe with spinous appendage shows its derived autapomorphic condition (zb_2). The apex of membranous conjunctival lobe with a thorn-like appendage in *Agrotis infusa* shows it's more derived autapomorphic condition (zb_3). In *Xestia triangulum* the apex of membranous conjunctival lobe with leaf-like cornuti shows its specialized autapomorphic condition (zb_4). Apex of membranous conjunctival lobe with a series of leaf-like structure in *Agrotis malefida* shows its specially derived autapomorphic condition (zb_5). In *Xestia isolata* the apex of membranous conjunctiaval lobe with recomose structure shows its specialized more derived autapomorphic condition (zb_6).

Structure of membranous conjunctival lobe (zc):Membranous conjunctival lobe multilobated in *Euxoa munis* shows its autapomorphic condition (zc_1). In *Xestia c-nigrum* the membranous conjunctival lobe distally bilobed and medially with a spine-like cornuti shows its derived autapomorphic condition (zc_2).The membranous conjunctival lobe with a row of small spine-like cornuti in Agrotis kinabaleunsis (zc_3). In *Diarsia spinosus* the membranous conjunctival lobe besets with cluster of large and small cornuti shows its specially derived autapomorphic condition (zc_4). The membranous conjunctival lobe with a small sickle-shaped with a group of small spine at base and a small circular plate at inner median surface in *Agrotis obliqua* shows its specialized more derived autapomorphic condition (zc_5).

Papillae anales (zd):Papillae anales rectangular shaped in *Agrotis infusa, Agrotis kinabaluensis, Agrotis malefida, Agrotis exclamationiss* and *Agrotis obliqua* shows their synapomorphic condition (zd_1). In *Xestia c-nigrum* the papillae anales bean-shaped shows its autapomorphic condition (zd_2). The papillae anales posteriorly concave in *Abagrotis nanalis* shows its more derived autapomorphic condition (zd_3). In *Abagrotis nefascia* the papillae anales posteriorly deeply notched shows its more derived autapomorphic condition (zd_4). The papillae anales moderate kidney-shaped in *Agrotis ipsilon* shows its specialized autapomorphic condition (zd_5). In *Diarsia serrata* the papillae anales very large kidney-shaped shows its specially derived autapomorphic condition (zd_6).

Shape and structure of apophysesse (ze):Apophyses anteriors straight with apex blunt in *Abagrotis nanalis* shows its autapomorphic condition (ze_1). In *Agrotis venerabilis* the apophyses anteriors with apex truncated shows its derived autapomorphic condition (ze_2). Apophysis posteriors dilated at base and longer than apophyses anteriors in *Agrotis exclamationis* shows its more derived autapomorphic condition (ze_3). In *Abagrotis nefascia* the apophyses posteriors twisted with apex pointed shows its specialized autapomorphic condition (ze_4).

Size of apophysesses (zf):Apophyses posteriors much longer than anteriors in *Abagrotis nefascia* and *Abagrotis nanalis* shows their synapomorphic condition (zf_1). In *Agrotis ipsilon* and *Agrotis clavis* the apophysis posteriors 2X the length apophyses anteriors shows their derived synapomorphic condition (zf_2). The apophysis posteriors equal to apophysis anteriors in *Abagrotis trigona* shows its autapomorphis condition (zf_3). In *Euxoa pleuritica* apophyses posteriors more than 2X the length of apophyses anteriors shows its derived autapomorphic condition (zf_4). The apophyses posteriors very long about 3X the apophyses anteriors and apex of both are pointed in *Agrotis segetum* shows its more derived autapomorphic condition (zf_5).

Ductus bursae (zg): The ductus bursae very long in *Xestia isolata, X. dolosa, X. xanthographa, X. triangulum* and *X. c-nigrum* shows their synapmorphic condition (zg_1). In *Abagrotis trigona, A. nefescia* and *A. nanalis* the ductus bursae short shows their derived synapomorphic condition (zg_2).

Shape of corpus bursae (zh):Corpus bursae irregular shaped in *Abagrotis trigona*, *A. nefescia and A. nanalis* shows their synapomorphic condition (zh_1). In *Agrotis exclamationis* the corpus bursae very large-shaped shows its autapomorphic condition (zh_2). The corpus bursae with distal lobe large balloon-shaped in *Abagrotis trigona* shows its derived autapomorphic condition (zh_3). In *Xestia c-nigrum* the corpus bursae irregular bag-like with wrinkled cornuti shows its more derived autapomorphic condition (zh_4).

Lobe in corpus bursae (zi):Corpus bursae smoothly bilobed in *Xestia isolata, X. dolosa, X. xanthographa, X. triangulum* and *X. c-nigrum* shows their synapomorphic condition (zi_1). In *Abagroits nefescia*, and *A. nanalis* the corpus bursae with distal lobe small oval-shaped shows their derived synapomorphic condition (zi_2). Corpus bursae bilobed with dorsal lobe small oval-shaped in *Agrotis clavis* shows its autapomorphic condition (zi_3). In *Agrotis ipsilon* the corpus bursae bilobed with dorsal lobe large pear-shaped shows its derived autapomorphic condition (zi_4). The corpus bursae bilobed, both lobe large balloon-shaped in *Agrotis infusa* shows more derived autapomorphic condition (zi_5). In *Diarsia serrata* the corpus bursae large irregular bilobed shows its specialized autapomorphic condition (zi_6). The corpus bursae with apex of one lobe balloon-shaped in *Abagrotis nanalis* shows its specially derived autapomorphic condition (zi_7). In *Abagrotis nefascia* the corpus bursae with apex of one lobe beak-shaped shows its specially more derived autapomorphic condition (zi_8).

Discussion on cladogram (Fig.1): In the present studies the sub-family Noctuinae comprises five genera and 24-species from Pakistan plays sister group relationship to each other by their synapomorphies like vertex raised (b_1), the palpi well developed and usually upturned (d_2), fore wings with costal margin having two small lobes (j_1) and fore and hind tibiae usually and mid tibiae with spines (u_2) and outgroup relationship with Heliothinae by their synapomorphies like vertex convex and comb-like (b_2) and palpi compressed and short (d_1).

The representatives of the sub-family Noctuinae falls into two groups. The first group comprises three genera and ten species which plays sister group relationships to each other by their synapomorphies like body usually cylindrical (a_1) and palpi usually long (d_2) and out group relationship with second group which comprises two genera and 14-species by their synapomorphies like the body is usually robust (a_2) and palpi usually short and modrate (d_3).

Among first group the representatives of the genera *Abagrotis* and *Xestia* plays sister group relationships to each other by their synapomorphic condition like palpi with 3rd segment modrate, more than 1/3rd the length of second segment (i_1) and outgroup relationship with *Diarsia serrata* and *Diarsia* spinosus by their synapomorhies like the palpi antero-laterally directed (d_6) and the 3rd segment of palpi short less than 1/3rd the length of second segment (i_2). The representatives of the genera *Xestia* plays sister group relationships to each other by their synapomorphies like, the ductus bursae very large (zg_1) and corpus bursae smoothly bilobed (zi_1) and out group relationship with *Abagrotis trigona, A. nefascia* and *A. nanalis* by their synapomorphies like fore wings with apical angle upwardly directed (l_1), ductus bursae short (zg_2) and corpus bursae irregular shaped (zh_1). In the representatives of the genus *Abagrotis* the species *A. nefascia* and *A. nanalis* plays sister group relationship with each other by their synapomorphies like the fore wings with veins R_3 and R_4 stalked later anastomosing with R_5 and originating from cell (n_2), apophyses posteriors much longer than apophyses anteriors (zf_1) and the corpus bursae with distal lobe small oval-shaped (zi_2) and out group relationships with *Abagrotis trigona* by its autapomorphies like fore wings with veins R_3 and R_4 stalked and originating from cell (n_4), hind wings with veins M_2 and M_3 anastomosing and originating from lower angle of cell (t_6), apophyses posteriors equal to apophyses anteriors (zf_3) and the corpus bursae with distal lobe large balloon-shaped (zh_3).

Among the representatives of the genus *Xestia* three species viz. *xanthographa, triangulum* and *c-nigrum* plays sister group relationships with each other by their synapomorphies like second segment of palpi less than 2.5X the length of 3rd segment (h_1) and apex of paramere unilobed with a process at sub-apical outer margin and outgroup relationships with *Xestia isolata* and *X. dolosa* by their synapomorphic like, the second segment of palpi 2.5X the length of 3rd segment (h_2) and the apex of paramere bilobed with sub-apical outer margin convex (y_3).

In former three species the *Xestia triangulum* and *Xestia c-nigrum* plays sister group relationships to each other by their synapomorphies like the fore wings with vines R_3 and R_4 stalked and further anastomosing with R_5 and originating from upper angle of cell (n_3) and paramere with outer process large and inner process Axe-shape (z_5) and out group relationships with *Xestia xanthographa* by its autapomorphies like the fore wings with veins R_3 and R_4stalked further stalked with R_5 (n_8), gnathos well developed (w_1) and the paramere with outer process short and inner process tooth-like (z_8).

The second group, which comprises two genera and fourteen species, are further divided into two sub-groups. The first sub-group contains five species of the genus *Euxoa*, in which *Euxoa detersa, E, munis, E. lidia* and *E. messoria* plays sistergroup to each other by their synapomorphic characters like basal segment of palpi more than 2.5X the length of third segment (f_3) and and outgroup relationships with *Euxoa pleuritica* by its autapomorphies like the basal segment of palpi 1.5X the length of 3^{rd} segment (f_4), the hind wings with veins Rs and M_1 stalked and originating from upper angle of cell (s_3) and the apophyses posteriors more than 2X the length of apophyses anteriors (zf_4). In rest of the species the *Euxoa munis*, *E. lidia* and *E. messoria* play sistergroup relationships with each other by their synapomorphies like vertex slightly raised or smooth (b_3) the second segment of palpi less than 4X the length of 3^{rd} (h_4) and saccus anteriorly blunt (x_1) and out group relationships with *Euxoa detersa* by its autapomorphies like the vertex is lightly raised (b_5), the second segment of palpi more than 4X, the length of third segment (h_8), saccus anteriorly sharply produced (x_5) and the theca with thorn-like thecal appendage (za_3). Among rest of the three species the *Euxoa lidia* and *E. messoria* plays sistergroup relationships with each other by their synapomorphies like basal segment of palpi shorter than second segment (e_2), uncus is modrate and laterally curved (v_1) and the apex of paramere with small outgrowth (y_4) and out group relationships with *Euxoa munis* by its autapomorphies like the hind wings with only one anal vein (p_2), the uncus is very large and inwardly curved (v_6), the gnathos reduced (w_2) and membranous conjunctival lobe multilobed (zc_1).

The second sub-group contains nine species of the genus *Agrotis* further divided into two groups, the first group contains five species viz. *Agrotis infusa, A. kinabaluensis, A. malefida, A. exclamationis* and *Agrotis obliqua* which plays sister group relationships to each other by their synapomorphies like palpi with basal segment longer or equal to second segment (e_1), paramere with a pointed process at inner median margin (z_1) and papillae anales rectangular shaped (zd_1) and out group relationships with second group which contains four species *Agrotis venerabilis, A. segetum, A. ipsilon* and *A. clavis* which plays out group relationships by their synapomorphies like the basal segment of palpi much shorter than second segment (e_3) and the paramere with blunt process at inner median margin (z_2).

Among first group the *Agrotis infusa, A. kinabaluensis* and *A. malefida* plays sistergroup relationships with each other by their synapomorphies like basal segment of palpi less than 3X the length of 3^{rd} segment (f_1) and inner margin of paramere with short thorn-like process (z_3) and outgroup relationships with *A. exclamationis* and *A. obliqua* by their synapomorphies like the basal segment of palpi more than 6X the length of 3^{rd} segment (f_2), hind wings with veins M_2 and M_3 anastomosing (t_2) and the inner margin of paramere with a large pointed process (z_4). In the former three species the *Agrotis kinabaluensis* and *A. malefida* plays sister group relationships to each other by their synapomorphies like anterior margin of hind wings convex (q_1), hind wings with veins M_2 and M_3 wide apart and M_2 originates from lower angle of cell (t_3) and the apex of paramere sub-rounded (y_2) and outgroup relationships with *Agrotis infusa* by its autapomorphies like the third palpus segment apically truncated (i_3), the anterior margin of hind wings sinuated (q_2), the saccus is broad (x_2), the apex of paramere with a tooth (y_6), the apex of membranous conjunctival lobe with a thorn-like appendage (zb_3) and the corpus bursae bilobed, both lobes large balloon-shaped (zi_5). In second group the *Agrotis segetum, A. ipsilon* and *A. clavis* plays sister group relationships to each other by their synapomorphies like frons smooth (c_1), palpi upwardly and laterally directed (d_4), fore wings with veins R_3 and R_4 not or stalked and anastomosing with R_5 (n_1) and hind wings with veins M_2 and M_3 wide apart (t_1) and outgroup relationships with *Agrotis venerabilis* by its autapomorphies like the frons is anteriorly sub-rounded (c_3), the palpi anteriorly directed (d_7), the fore wings with veins R_3 and R_4 stalked and originating from upper angle of cell (n_5), the hind wings with veins M_2 and M_3 stalked (t_5) and the apophyses anteriors with apex truncated (ze_2). In former species of this group the *Agrotis ipsilon* and *A. clavis* plays sister group relationships with each other by their synapomorphies like the second segment of palpi not more than 3X the third segment (h_3), hind wings with two anal veins (p_1) and the apophyses posteriors 2X the length of the apophyses anteriors (zf_2) and outgroup relationships with *Agrotis segetum* by its autapomorphies like the second segment of palpi 5X the length of 3^{rd} segment (h_9), the fore wings with veins R_3 and R_4 anastomosing and originating from upper angle of cell (n_6) and the apophyses posteriors very long about 3X the apophyses anteriors and apex of both are pointed (zf_5).

Reference

Brower, A. V. Z. (2000). Phylogenetic relationship among the Nympalidae (Lepidoptera) inferred from Partial sequences of the wingless gene . *Proc. R . soc. Lon. B* : 1201-1211.

Choi, S .W. (2006). Cladistic analysis of the tribe Xanthorhoini (Lepidoptera : Geometridae) in the Holarctic region *Spixiana* 29(3): 201-202.

De Camargo, A.J.A., Mielke, O.H.H. and Casogrande, M.M. (2009). Cladistic analysis of the sub-family Arsenurinae (Lepidoptera : Saturniidae) based on adult morphology *Zootaxa* 2218: 1-34.

Emerson, B.C., Wallis, G.P. and Patrick, B.H. (1997). Biogeographic area relationship in Southern Newzealand : A cladistic analysis of Lepidoptera distribution. *Journal of Biogeography* 24: 89-99.

Kamaluddin , S., Ahmed, I. and Ahmed, S. (1997). A review and cladistic analysis of Lymantriid genera (Lepidoptera:Noctuidae) from Pakistan and adjoining area. *Proc. Pakistan Cong. Zool.* 17: 271-279.

Kamaluddin, S., Ahmed, I. and Haq, E. (1999). Cadistic analysis, key to the genera and distribushonal ranges of Sphingidae of Pakistan *proc*. *Pakistan*. c*ongr*s. *Zool*. 19: 159-172.

Kamaluddin, S., Fatima, G. and Ahmed, I. (2000). Cladistic analysis of the sub-family Trifinae (Lepidoptera: Noctuidae) from Indo-Pakistan Sub-Continent. *proc*. *Pakistan*. *Cong*. *Zool.* 20: 181-192.

Peigler, R.S. (1993). Cladistic analysis of the genera of the sub- family Arsenurinae (Saturniidae). *Journal of the Lepidopterists Society* 47(3): 211-228.

Willmott, K. R. (2003). Cladistic analysis of the Neotropical butterfly genus *Adelpha* (Lepidoptera: Nymphalidae) with comments on the Subtribal classification of Limenitidini: *Systematic Entomology* 28: 279-322.

Ylla, I., Peigler, R.S. and Kawahara, A.Y. (2005). Cladistic analysis of Moon moths using morphology, molecules and behavior : *Actias* Leach, Grote, 1896; *Argema* Wallergren, 1858 ; *Graellsia* Grote, 1896 (Lepidoptera : Saturniidae). *SHILAP Revista de Leidopterologia* 33(131): 299-317.