GENERAL CONCLUSIONS AND SCOPE FOR FURTHER RESEARCH

A lot of workers have contributed on the taxonomy of family Noctuidae such as Guenee, Walker, Moore, Butler, Swinhoe and Hampson. Hampson’s contribution however, serves as a fundamental reference piece of work for future studies though it requires updating through additional collections besides the improvement in terms of recharacterization of taxonomic status of quite a good no of taxa. The works of Hampson and other earlier workers are no doubt still considered as reference and pioneer works. However, new attributes like genitalia were studied by various workers and they revised taxonomy of family Noctuidae on the basis of external male and female genitalic features. Such taxonomic revisions are must and going on in various groups. In view of this, the present research work was undertaken with an aim to achieve varied objectives. For the fulfillment of this aim, as many as ten major collection cum survey tours were conducted in seven different North-Eastern states covering more than 30 remote and far-flung localities of this mega-biodiverse country for collection of adult moths of family Noctuidae. These tours yielded a rich harvest of as many as 250 adult representatives of 101 species referable to 76 genera of above said family. A total number 19 type species of different genera have been studied in this work. The external genitalic attributes of all the species included here have been studied in detail for incorporating these structures in the diagnosis of various taxa.

- SUBFAMILY ACONTIINAE

In present work single species of genus *Pseudeustrotia* Warren of subfamily Acontiinae has been studied. Forewing without tufts of raised scales in the cell and retinaculum of male bar shaped. Male genitalia with uncus long, slender and beak shaped at tip; valve long and narrow; tegumen inverted V-shaped; aedeagus small with large vesica bearing a long spine. Female genitalia with corpus bursae oblong and ductus bursae small; posterior and anterior apophysis small.
General Conclusions and Scope for Further Research

• **SUBFAMILY ACRONICTINAE**
A total number of three species belonging to three genera have been studied in this subfamily. This group is mainly characterized by fully developed proboscis and naked eyes. Forewing is cryptic and elongate in all the three species included in this manuscript. Male genitalia with uncus curved with hooked apex, sickle shaped to cygnae shape in various genera; tegumen mostly inverted and U-shaped whereas, vinculum V-shaped; juxta highly variable; valve broad and round towards tip in all genera except in genus *Diphtherocome* Warren; aedeagus with vesica bearing cornuti. Female genitalia with corpus bursae usually large but comparatively small in *Acronicta nigromaculata* Warren; ductus bursae usually small but long in genus *Acronicta* Ochsenheimer and sclerotized only in genus *Diphtherocome* Warren; posterior apophysis long in all the studied species. External genitalic attributes of type species of two genera viz., *Diphtherocome* Warren and *Nacna* Fletcher have been studied and photographed in considerable details.

• **SUBFAMILY AGARISTINAE**
A total number of six species pertaining to two genera have been studied in present work. This group is characterized by eyes without cilia and fore tibia without multiple claws. Male genitalia with uncus long, curved and slender; tegumen inverted V-shaped; valve long and narrow at base; harpe present in genus *Sarbanissa* Walker; vinculum U-shaped; aedeagus with Vesica without long cornuti, except in *Sarbanissa subalba* (Leech) and *Sarbanissa interposita* (Hampson). Corpus bursae varies from species to species in shape; signum wanting and posterior apophysis longer.

• **SUBFAMILY CALPINAE**
A total number 36 species referable to 30 genera have been studied in this subfamily. This group of moths have mainly fully developed and hooked proboscis, tibial spines absent on mesothoracic legs. Male genitalia with uncus simple, long, spined in most of the studied genera but some special modifications were also observed in some genera i.e. bulbous in *Sphingomorpha* Guenee, like snake head in genus *Bamra* Moore, woodpecker

**SUBFAMILY CATOCALINAE**

As many as 11 species pertaining to seven genera have been examined and studied. This subfamily is mainly characterized by fully developed eyes without overhanging cilia and spinose middle tibiae. The moths of this group are generally of large size and strongly built. This group is mainly
characterized by different types of uncus in male genitalia. It varies from beak like, cygnate shaped and curved in various genera studied here; uncus spined almost in all studied genera except *Arytrurides* Hampson. Tegumen inverted and V-shaped; vinculum U-shaped; saccus well developed in all studied genera; valve round and broad at tip in most of the genera included here but narrow towards tip in *Ischyja hagenii* (Snellen); juxta highly variable; aedeagus mostly long with vesica bearing cornuti in all observed species. Female genitalia with corpus bursae varies in shape in different taxa; ductus bursae mostly small but comparatively long in *Artena rubida* (Walker) and sclerotized in *Anua* Walker and *Ophisma* Guenee; posterior apophysis highly variable. External genitalic attributes of the type species of genus *Imaharela* Moore, have been studied and photographed in considerable details.

- **SUBFAMILY EUSTROTIINAE**
  In present work single species of genus *Amyna* Guenee of subfamily Eustrotiinae has been studied. Wing venation of hind wing with vein M2 week and a row spines on hind tibia. Male genitalia with uncus simple and slender; tegumen inverted U-shaped; valve long and narrow; aedeagus with vesica membranous. Female genitalia with corpus bursae long and membranous, signum absent; posterior and anterior apophysis long.

- **SUBFAMILY HADEFINAE**
  As many as 12 species belonging to nine genera of this subfamily have been studied. The moths of this group have hairy eyes and fore tibia without multiple claws. Male genitalia with variable shape of uncus in different species studied here. For instance, broad at tip and beak like in *Callopistria* Hubner, *Craniophora* Snellen and *Prospalta* Walker and like hood of cobra in *Phlogophora costalis* (Moore), tegumen usually inverted V shaped, saccus almost wanting in some species, valve also highly variable, aedeagus mostly tube like, having vesica membranous and cornuti absent in presently studied species except *Callyna semivitta* Moore, *Craniophora fasciata* (Moore), *Pseudomudaria leprosa* sp. nov. and *Tycracona obliqua* Moore. Female genitalia with ductus ejaculatorius entering subapically in most of the genera included in the present studies, corpus bursae highly variable in shape, larger
in size and signum wanting, ductus bursae short and membranous in all studied genera but sclerotized in *Callyna semivitta* Moore, *Tycracona obliqua* Moore and *Euplexia chlorogrammata* Hampson. This group is also characterized by longer anterior apophysis and shorter posterior apophysis in female genitalia. External genitalic attributes of type species of two genera viz., *Callopistria* Hubner and *Tycracona* Moore have been studied and photographed in considerable details.

- **SUBFAMILY HERMANINAE**
  Two species of genus *Simplicia* Guenee have been studied in this group. The subfamily is characterized by prominent palpi and counter-tympanal hood prespiracular. Antennae of males with a central swelling. Fore tibia produced into a sheath and with an elongate first tarsal segment. Male genitalia with uncus linguiform and valve narrow towards tip; aedeagus with vesica membranous and without cornuti. Female genitalia with ductus bursae and corpus bursae elongated, later decorated with numerous small granules.

- **SUBFAMILY HYPENINAE**
  A total number of four species belonging to three genera have been studied under this group. This subfamily has mainly well developed snout and labial palpi. Male genitalia with uncus simple, slender and spined in all taxa studied here except *Bertula hisbonalis* Walker, valve small and round in general but long and narrow in *Bertula hisbonalis* Walker, vinculum U-shaped, aedeagus with vesica membranous and sclerotized in some genera. Female genitalia with corpus bursae usually long and ductus bursae small in all taxa included in the present manuscript.

- **SUBFAMILY NOCTUINAE**
  A total number of two species referable to two genera of subfamily Noctuinae have been studied in the present work. The diagnostic characteristic of this group is the absence of spines on the middle tibiae, fore tibia with multiple claws and rows of spines on the hind tibia. Male genitalia with uncus long and curved in both the species included in this thesis, juxta highly variable in this group, length of tegumen almost equal to uncus in all taxa studied here, harpe
well developed in all species included here, valve spined at tip in Anaplectoides virens (Butler), aedeagus tubular, vesica membranous, bearing cornuti. Female genitalia with large corpus bursae and signum absent, ductus bursae usually short and highly sclerotized in Ochropleura leucogaster (Freyer).

- **SUBFAMILY NOLINAE**
  
  A total number of 14 species referable to nine genera of subfamily Nolinae were identified and studied in detail. This subfamily is mainly characterized by eyes without cilia, secondary tympanal hood wanting. Shape of uncus varies from sickle-shaped, curved with hooked apex, bifid etc. In male genitalia, uncus usually long in all taxa studied here except genus Ariola Walker and Tyana Walker, uncus simple and curved in all genera but bifid in genus Earias Hubner, tegumen longer than uncus in all studied genera and length of vinculum varies, gnathos present only in genus Ariola Walker and Tyana Walker, valve highly developed and very long and narrow in genus Ariola Walker as compared to other genera of this subfamily included in the present work, juxta of variable shape in almost all genera studied in this group, aedeagus strongly built with vesica membranous and armed with cornuti in some genera, cornuti very long in genus Ariola Walker and Asinduma Walker. However, these are small in genus Blenina Walker and Tyana Walker. This group of moths is also characterized by oblong corpus bursae of female genitalia, signum wanting in all studied species except Asinduma exscripta Walker, ductus bursae almost short in all taxa except genus clethrophora Hampson, posterior apophysis shows variation in different genera. External genitalic attributes of type species of three genera viz., Ariola Walker, Asinduma Walker and Tyana Walker have been studied and photographed in considerable details.

- **SUBFAMILY PANTHEINAE**
  
  As many as four species referable to four genera have been studied in present work. Moths of this group have hairy eyes and quadrifine hindwing venation. Male genitalia with uncus small, broad and spined at tip in most of the genera but like head of cobra in Trisuloides Butler, valve long and narrow, harpe
present in *Trisuloides* Butler and *Antitisuloides* Holloway, vinculum V-shaped, aedeagus long, vesica membranous with scobination. Female genitalia with corpus bursae large and round, ductus bursae small and sclerotized in *Trisuloides* Butler and *Antitisuloides* Holloway, papilla analis highly sclerotized.

**SUBFAMILY PLUSINAE**

Four species referable to three genera of this group are included in the present work. The forewing usually adorned with metallic spots or blotches in this subfamily. Prothorax and dorsum strongly tufted. Subfamily Plusiinae is characterized by a well-developed uncus, usually long, spined and sickle shaped, length of tegumen also variable, vinculum longer than tegumen in most of the genera presently studied, saccus well developed and juxta with variable structures, valve simple, long narrow in all taxa but saccular margin bearing robust setae in genus *Ctenoplusia* Dufay, aedeagus strongly built with vesica either scobinated or membranous but bearing cornuti in *Ctenoplusia* Dufay and *Yerongponga* Lucas, however with a serrate band in genus *Macdunnoughia* Kostrowicki. Female genitalia with corpus bursae large, oblong and membranous in this group, ductus bursae almost long and anterior and posterior apophysis of same length in various taxa studied during the present research work. External genitalic attributes of type species of single genus *Yerongponga* Lucas has been studied and photographed in considerable details.

**SUBFAMILY STICTOPTERINAE**

In present work single species of genus *Lophoptera* Guenee of subfamily Stictopterinae has been examined and studied in detail. This group is distinguished by the single frenulum in female and raised scales. Male genitalia with uncus very long, slender and bifid, tegumen and valve long, latter narrow also, vinculum U-shaped, aedeagus long and vesica without cornuti.
SCOPE FOR FURTHER RESEARCH

As far as the scope for further research on taxonomy of Indian Noctuidae is concerned, it is tremendous because very little has been done on taxonomic revision of this group of moths in India. Very few workers have taken up taxonomic research on these economically important insects in India, so far. Taxonomic revision of family Noctuidae becomes much more important in the light of a recent research paper by Zahiri et. al. (2011) who gave a new classification of this group on the basis of molecular systematics. Intensive and extensive collection-cum-surveys are warranted from different parts of the country in order to collect large number of Noctuid species. Species specific attributes i.e. male and female genitalia have to be studied in detail in order to revise and update the status of various taxa of this group. Taxonomic revision of this group is an immediate need of the hour and a coordinated effort should be made in different parts of the country by a group of dedicated workers.