

Phylogeny of the Major Basal Groups of Lepidoptera

Synapomorphies of the **Lepidoptera**

Adult:

Head apomorphies:

- 1–Median ocellus lost
- 2–Corporotentorium with posteromedian process
- 3–Presence of an intercalary sclerite laterally in the membrane between the antennal scape and pedicel
- 4–Maxillary palp with points of flexion between segment 1/2 and 3/4; segment 4 longest segment of palp; no antagonistic muscles inserted on the base of any palp segment
- 5–Presence of a slender craniostipital muscle running close to the craniocardinal muscle
- 6–Postlabium an arched sclerite with long piliform scales (Eltringham's organ)
- 7–Terminal segment of labial palp with a group of chemoreceptors located in a depression (von Rath's organ)
- 8–Salivarium devoid of longitudinal dorsal muscle
- 9–Labral nerve and frontal ganglion connective separate from their origin on the tritocerebrum
- 10–Recurrent nerve running within cephalic aorta until reaching retrocerebral complex

Thorax apomorphies:

- 11–Laterocervical sclerite with "hair plate" close to the anterior apex
- 12–Prothoracic endoskeleton with a prominent free arm arising from the bridge between the sternum and the lower posterior corner of the pleuron
- 13–Mesothorax with a "tergopleural apodeme", issued from the upper part of the pleural suture and accommodating the insertion of a tergopleural muscle
- 14–Metathorax with a "prescutal arm"
- 15–Fore tibia on inner surface with a "epiphysis"
- 16–**Wings with dense covering of broad scales**
- 17–Metathoracic spiracle with a single, anteriorly situated, external lip

Abdomen apomorphies

- 18–Tergum I extensively desclerotized and external layer of "short" dorsolongitudinal VII muscles therefore lost
- 19–Tergum I with paired lateral lobes extending downwards/backwards and articulating with the anterior corners of sternum II
- 20–Male gonopod ("valve") primarily undivided
- 21–Protractor muscle of the male phallus originating within the gonopods
- 22–Cerci lacking in both sexes

Visceral anatomy apomorphies:

- 23–Abdominal nerve cord with at most five ganglionic masses and with unpaired connectives
- 24–Mesothoracic aorta curving upwards to dorsum

Larva:

Head apomorphies:

- 25–Pleurostome elongated, craniocardinal articulation far behind mandibular base
- 26–Maxillary palp with less than five segments

Synapomorphies of the **Zeugloptera**

- 27–Presence of antennal "ascoids" [trichoid sensillum -mechanoreceptor- with 2 or more palmate branches]
- 28–Labrum extensively desclerotized
- 29–**Mandibles asymmetrical**, incisor cusps present only apically on left mandible
- 34–Larval thoracic legs with at most four segments, the subterminal one being presumably a tibiotarsus

Synapomorphies of the **Aglossata+Heterobathmiina+Glossata**

- 53–Paraglossae lost
- 56–Pupal mandible hypertrophied, angularly bent
- 59–Larva with only one maxillary endite lobe (probably the galea)
- 60–Larva with metathoracic spiracle non-functional

Synapomorphies of the **Heterobathmiina+Glossata**

- 72–Antennae with sensilla auricillica
- 73–Crossvein sc-r lost
- 74–Pupal mandibles with coarse apical teeth
- 75–Larval head with adfrontal ridges

Synapomorphies of the **Glossata**

- 78–Mandible non-functional after pupa/adult ecdysis, with genuine articulation basally (and often strongly reduced)
- 79–Maxilla devoid of sclerotized lacinia
- 80–**Maxillary galeae forming a proboscis, spirally coiled in repose**
- 84–Larva with articulated "spinneret" on the apex of the prelabio-hypopharyngeal lobe

Synapomorphies of the **Myoglossata**

- 85–Proboscis with an intrinsic musculature
- 86–Presence of "normal type" wing surface scales

Synapomorphies of the **Neolepidoptera**

- 94–Pupa **adecticious** [pupa with immobile mandibles]
- 95–Pupa **obtect** [wings and appendages are appressed to the body and most abdominal segments are immovable]
- 96–Larva with muscled, **crochet-bearing prolegs** on abdominal segments III-VI & X

Synapomorphies of the **Exporia**

- 97–Female genitalia exoporian, without colleterial glands [accessory glands secreting a substance to fasten eggs to a substrate]
- 98–Dicondyloous articulation of antennal base
- 99–Scales on more or less extensive wing areas with secondary ridges

Synapomorphies of the **Heteroneura**

- 103–Venation **heteroneurous** due to simplification of hindwing venation (Sc and R fused and Rs unbranched)
- 104–Wing coupling **retinaculo-frenate** and jugum reduced in males

exoporian - Two reproductive chambers and openings - one for copulation (vagina) the other for egg deposition (bursa copulatrix). In Hepialoidea and Mnesarchaeoidea the vagina and ductus bursa open separately and are connected by an external groove along which spermatozoa pass.

ditrysian - opening of vagina and bursa copulatrix are widely separate.

monotrysian - single opening for copulation and oviposition (in Zeugloptera a cloaca occurs, common opening of vagina and anus)

Reference:

Kristensen, N.P. 1984. Studies on the morphology and systematics of primitive Lepidoptera. *Steenstrupia* 10(5): 141-191. (see also references cited therein)

Synopsis of Non-Heteroneuran Moths

Micropterygidae—ca. 90 described species from all zoogeographical realms. Small, about 1 cm, generally diurnal moths with metallic-colored wings. Adults eat pollen, some feed on fern spores. Larvae feed on bryophytes or lower parts of grasses, other flowering plants, or decaying material.

Agathiphagidae—one genus, *Agathiphaga* with 2 species, from southwest Pacific region. Adults nocturnal, small to medium sized, and superficially very similar to caddisflies. Mandibles are large, but it is unknown if they are functional. Larvae are apodous miners in seeds of kauri pines, *Agathis* (Araucariaceae). Common name "kauri moths".

Heterobathmiidae—Recently discovered genus *Heterobathmia* of southern South America with only 10 species. Small, diurnal moths resembling Eriocraniidae. Found on flowering *Nothofagus* where adults eat pollen. Larvae are leaf miners in *Nothofagus*.

Eriocraniidae, Lophocoronidae, Acanthopteroctetidae

(Dacnonypha)—**Eriocraniidae**: Exclusively Holarctic family of about 20 described species. Small, diurnal moths with iridescent wing patterns. Do not visit flowers, but use short proboscis for drinking water. Mandibles are present, but nonfunctional. Larvae are apodous leaf miners, almost exclusively of trees in order Fagales. **Lophocoronidae**: Small Australian genus *Lophocorona*. Small, nocturnal moths. Females and immatures unknown. **Acanthopteroctetidae**: Small western Nearctic genus *Acanthopteroctetes* with 4 species. Predominantly diurnal moths. Known larvae are leaf miners.

Neopseustidae (Neopseustina)—About 12 described species from southern Asia and South America. Medium-sized, generally nocturnal moths. Immature stages remain unknown.

Mnesarchaeidae—Single genus *Mnesarchaea* with less than 10 described species from New Zealand. Small, diurnal moths with well developed proboscis used to drink water, but have not been observed at flowers. Larvae are ground dwelling.

Hepialoidea:—**Palaeosetidae** (Australian/Oriental/S. America), **Neotheoridae** (S. American), **Anomosetidae** (Australian), **Prototheoridae** (S. African), **Hepialidae** (cosmopolitan) – Ghost moths and relatives. Primarily restricted to southern continents. Larvae tunnel in woody tissue above and below ground or feed on roots externally. Polyphagous.