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# Are moths as old as dinos?

The larvae of moths have eight pairs of legs. The moth family Geometridae is specific in that their larvae have five pairs of legs and move by looping: “looper moths”. One of geometrid subfamilies, Geometrinae, has green wings. This subfamily is divided into twelve groups of genera, tribes. The delimitation of one of these, the Nemoriini tribe, and changes traced back in their morphology across the genera are discussed below. Moths from the IZBE insect collection, housed at the Estonian University of Life Sciences, are used.

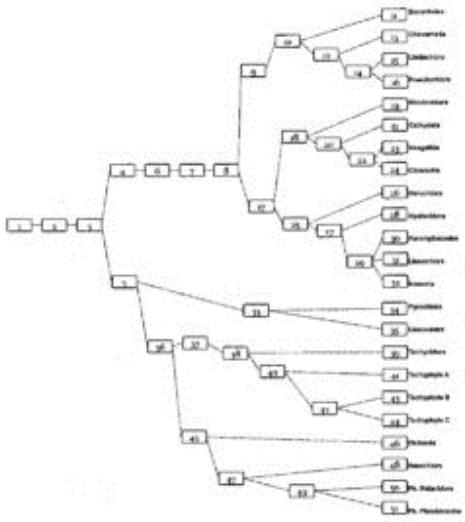

Fig. 1. The study of morphological features across the bright green colored looper moths yielded twenty genera sharing the nemoriine characters. The structure of the tribe is depicted in Fig. 1. The bilobate shape of the uncus of male genitalia and multicolored blotches on wings are shared by the Indo-Australia genus *Eucyclodes* and three Neotropical genera (*Chavarriella* a.o.). Such combinations of characters seem to be missing in Afrotropical genera. Other Neotropical nemoriine genera studied exhibit two main character sets: 1) the presence of ornamentation of the valva in the male genitalia and the modification of male hind shank structure associated with reduction of hind paw; and 2) some trends for modification of the hind shank which is shorter than the paw both in males and females, accompanied by gradual fusion of genitalic sclerites of the valva, and by a weakening of the dorsal part of the genital capsule. These are the *Nemoria* lineage including nine genera and the *Phrudocentra* lineage with its seven genera, respectively.

When constructing a key or searching for taxonomic relationships, one must look for characters. There are hundreds of differentiating traits between different taxa (species, genera). Authors use the easiest observable characters (of the wings and body) when constructing identification keys. Here, characters of the male genital capsule (its dorsal processes, the uncus and paired socii, and lateral parts, the valvae) are used. Shared characters are then traced back along the key to understand the evolutionary history of the keyed taxa.

The coexistence or association of some character states is used to delimit the Nemoriini tribe within the Geometrinae subfamily: the bright green pigment on wings, the broader tip or rod shape of the uncus in the

male genitalia, the longitudinal and distal sclerotization of the last sternite of the male abdomen (characters 1, 2, 3 in Fig. 1), and the body shape of caterpillars with flat dilations (chalazae) of abdominal segments.

The bright green color is widely distributed over the Geometrinae tribes and is diagnosed as such by authors for Comibaenini, Lophochoristini, Nemoriini, Dichordophorini, and Synchlorini. These moths occur in the southern hemisphere. In contrast, the green pigment may be olive, dark, or greyish green as in moths of the Hemitheini tribe which inhabit the northern hemisphere.

The male genital capsule of a moth has a dorsal process, the uncus, to fix the position of a female during the pairing. The geometrine uncus is often hooked, strong, and accompanied by rigid or semi-membraneous lobes (socii). Alternatively, the uncus is reduced and accompanied by strongly sclerotized, rigid socii as in the tribe Lophochoristini. The genera of Comibaenini and Dichordophorini have both an uncus and socii modified as pairs of short strong hooks. A rod-shaped uncus, broader at the tip and supported by semi-membranous socii, is a trait of the Nemoriini tribe.

The male moths of the genera of Nemoriini have a unique feature: the last (eighth) sclerite of the male's belly has a sclerotization along its middle, a midrib reaching the bilobed anal edge of the piece.

A typical geometrine larva has a two-tipped, flat head and a cylindrical body; their usual resting posture is stick-like. Larvae of some tribes, such as Geometrini and Synchlorini, have fleshy, conical processes or projections on their bodies, while in Nemoriini and Comibaenini such processes are flat. Larvae of Comibaenini and Synchloriini use detritus and leaf fragments to attach to chalazae but not the nemoriine larvae.

Summarily, the rod-shaped and broader-tipped uncus of the male genitalia, the specific shape of the eighth sternite of the male abdomen, and larvae with unclothed chalazae characterize the Nemoriini tribe.

There are two or three subordinated trends in the first lineage. The spatulate type of the uncus is associated with multicolor wing markings of moths both in the Old World tropics and in the New World. A simpler rod-shaped uncus, which is often slightly bulbed to its tip, is found in genera having their wing markings reduced to white lines on a plain green ground color.

The geographical pattern of the Nemoriini tribe indicates that its ancestors possibly existed on the ancient supercontinent named Gondwana before its breakup. The adult moths have differentiated after the splitting event, but an essential environmental event has caused the extinction of nemoriines from Africa and restructuring the fauna of South America. If the splitting of Gondwana antedates the Cretaceous-Tertiary event and extinction of the dinosaur fauna, then are the moth tribes as old as dinosaurs? Moths have changed but their larvae have remained the same.

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## Publication

A morphology based key to the genera of the tribe Nemoriini (Lepidoptera: Geometridae, Geometrinae).
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