

A new Turkish *Scopula* species, synthesis of morphological and molecular data

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The genus *Scopula* Schrank, 1802 (Lepidoptera: Geometridae) is, with more than 700 species worldwide, one of the most species-rich genera in the subfamily Sterrhinae. In Europe, the genus includes 42 species in 8 species-groups. Identification and taxonomy of several species is difficult based of their morphology only. We analysed, in an integrative, morphological-molecular approach the five Turkish species of the taxonomically difficult *ornata* species-group, i.e. *S. ornata* (Scopoli, 1763), *S. orientalis* (Alpheraky, 1876), *S. decorata* (Denis & Schiffermüller, 1775), *S. submutata* (Treitschke, 1828) and a new, unnamed

Scopula species sampled from various regions in Turkey. Furthermore, the extraterritorial *S. vigilata* (Wagner, 1926) and *S. honestata* (Mabille, 1869) were included in the analysis. Mitochondrial DNA sequences (COI 5', barcoding fragment; 658 bp) and morphological characters were used to reveal relationships among and within species. mtDNA data confirmed the existence of two different species in the *S. decorata* complex and helped to clear up some unresolved, conflicting character sets from the morphological analysis. The description of the new species is on the way of publication.

Molecular phylogeny of Geometridae and the evolution of winter moths

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Geometridae is one of the most diverse families within the Lepidoptera, comprising nine subfamilies. Winter moths, which have a unique life history, are found in three subfamilies. To examine the phylogeny of the Geometridae at the subfamily level and determine the evolutionary history of winter moths, we constructed phylogenetic trees for all nine geometrid subfamilies using two mitochondrial and two nuclear gene sequences. Specimens of all subfamilies were sampled from Japan. Simultaneous analyses of the combined data from all genes revealed that the Geometridae comprised two major clades: one with subfamilies Larentiinae and Sterrhinae, and the other with the remaining seven subfamilies. The second clade included the largest subfamily,

Ennominae, and the subfamily Archiearinae, which is traditionally considered to be an ancestral lineage of the Geometridae. The Larentiinae + Sterrhinae clade contained one winter moth lineage, and the second major clade consisted of three winter moth lineages, including Alsophilinae, which contains winter moths exclusively. Using a Bayesian inference of divergence times, we estimated that geometrids began to diverge 54 Ma (62-48 Ma), whereas winter moth lineages differentiated from non-winter moth lineages 34-12 Ma, during the global cooling events in the Oligocene and the early Miocene. The adaptation to cool climates may have been a preadaptation that facilitated the winter moth life cycle.