Moth and butterfly vulnerability to habitat fragmentation

The fragmentation of habitats is a growing concern for nature conservation. Butterflies and moths are particularly sensitive and new research has shed light on what makes some species more vulnerable than others. Those that are less mobile with more specialist diets and less reproductive potential appear to be more affected by habitat fragmentation.

Fragmented habitats are those that were once continuous and have been disrupted, primarily by human disturbances, such as land clearing and changes of crops. This often has negative effects on the species living there and survival can depend on "life-history traits", which are those that affect the life cycle, particularly survival and reproduction. Survival in the face of habitat fragmentation depends on likelihood of local extinction and ability to colonise either the fragmented habitats or other habitats elsewhere. This means the most influential life-history traits are mobility (dispersal capacity), the restriction on what or where they can eat (feeding niches) and their ability to reproduce.

Few studies have explicitly investigated whether species with different traits are affected in different ways by habitat fragmentation. The research, conducted under EU COCONUT project1, collated data on responses of butterflies and moths to habitat fragmentation. 24 independent data sets were analysed containing 1485 species and covering a range of landscapes in Europe and North America. The study investigated the responses of species to changes in habitat area and connectivity and the influence of mobility (measured by wing span), the feeding niche of larvae and reproductive potential (measured by number of eggs produced).

On the whole, results demonstrated that the greater the habitat area and connectivity between habitats, the greater the number of butterfly and moth species. It also demonstrated that life-history traits modified the response. Butterflies that are less mobile and with low reproduction rates, such as Aphantopus hyperantus (the ringlet), Pieris brassicae (the large white) or Maniola jurtina (the meadow brown), are more sensitive to habitat loss and fragmentation than those who are more mobile and have high reproductive rates, for example, Cupido minimus (the small blue), Lycaena helle (the violet copper) and Spialia Sertorius (the red underwing skipper).

Species whose larvae can only feed on one type of plant are more affected by habitat loss than those whose larvae can feed on a wider range of plants but, to some extent, this can be compensated for by greater reproduction.

Overall species richness increased with connectivity between habitats, except for the case of nocturnal moths whose richness decreased. However, in the five studies of nocturnal moths it appeared that isolated habitat patches had more species because these patches were larger. Another methodological issue was that wing-span does not only reflect mobility but is also related to other life-history traits such as energy needs. Lastly species with different traits could also differ in their ability to be detected, which would potentially skew the results.

The research indicated that, although there are some general patterns in responses of species to habitat loss and fragmentation, these depend on life history traits. The results suggest that the communities that survive in highly fragmented landscapes will be mainly mobile species that are able to feed off a range of plants. This could have serious consequences for the functioning of ecosystems. Identifying which species are most vulnerable could provide useful information for mitigation and adaptation measures to habitat fragmentation.

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