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Nanda Devi Biosphere Reserve.

Mothing in the Himalaya: No mountain too high

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The Himalayas never cease to enthrall us with their beauty, vastness and endemicity. The Western Himalaya covers the Kumaon-Garhwal, North-West Kashmir and North Pakistan. Biogeographically it lies in the transition zone between the Palearctic and Indo-Malayan realms, so species from both the zones overlap. The geological, climatic and altitudinal variations as well as physical structural complexity contribute to the biological diversity of the region. These mountains range from 500m asl (above sea level) to more than 8000m asl giving a range of ecosystems within only a couple of hundred kilometers.

Large parts of this unique ecosystem are under threat due to human impacts. The habitats for many species have a patchy distribution due to human encroachment. The increasing population in the region has led to extensive deforestation and the clearing of grasslands for cultivation. There is a large-scale conversion of lands for agriculture and settlements.

Atlas moth

Erebus sp. (Photo Abesh Sanyal)

Western Himalayan Landscape, Garhwal.

We studied the diversity patterns of moths in Nanda Devi Biosphere Reserve, a Western Himalayan protected area and a World Heritage Site. The area has the typical attributes of the larger Western Himalayan range and promised to provide us with stunning insights into the existing patterns of biodiversity. Our research on the altitudinal distribution of moths took us to many villages within the area of my study. The local tribe is the *Bhotiya* who are mainly agro-pastoralists. There are about 19 villages within the protected area. We stayed with them, spoke with them, and learnt their ways and practically lived their lives. Their hospitality and simplicity was beyond our imagination.

Moths as bio-indicators:

Moths have always lagged behind butterflies, being nocturnal, less attractive and thus less studied. We have very little idea as to how many species are endangered or even how many exist. Moths are important ecologically as pollinators, herbivores, and prey for birds, but most recently as environmental indicators. Many studies have established this group as potent bio-indicators (Summerville et al. 2003, Kitching et al. 2000).

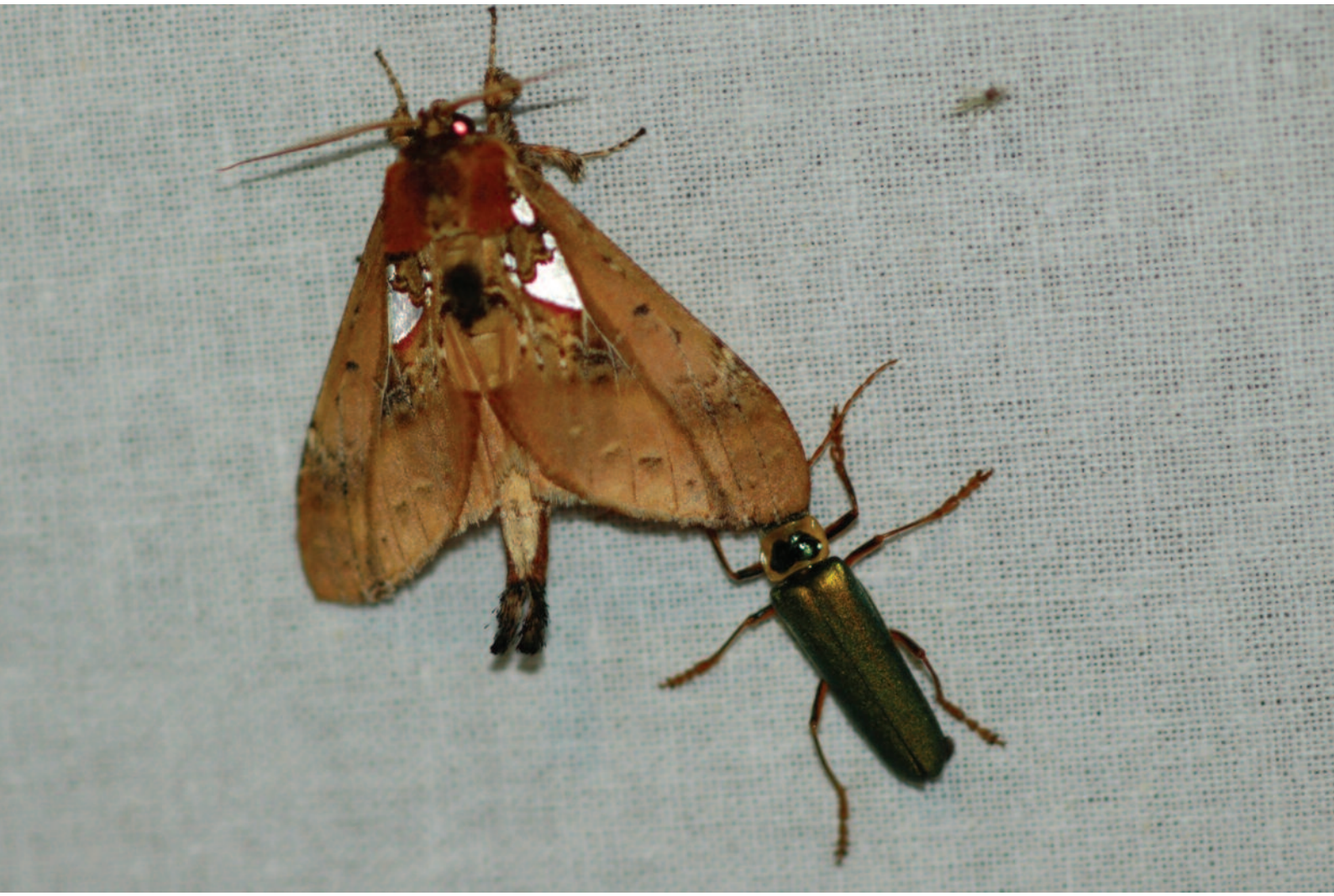
Reading about these less-explored taxa, we were curious to know how they would respond to rapid changes in environmental gradients and human impacts. The Western Himalaya landscape with its uniqueness gave us an array of conditions to study these patterns in moth diversity. I particularly chose one family of moths, the Geometridae family. This family along with Erebidae is the most speciose among the moths. Geometrid moths have shown interesting patterns in other high altitude areas and are more abundant in high altitudes. The study area has four broad divisions of forest types *viz*. Temperate forests (2,000–2,800m), Subalpine forests (2,800–3,500m), Alpine scrublands (3800–4500m), Alpine meadows and moraines (>4,500m) (Champion and Seth 1968).

The study area attracts many tourists as it is home to the highest gurudwara in India, the Hemkund Sahib (4,500m), Valley of Flowers National Park, and the Badrinath shrine. So thousands of pilgrims and general tourists come to Joshimath (the most populated town within the protected area). The area surrounding Joshimath is highly modified by human activities, generated by the economic benefits of tourism but at higher altitudes other villages are just hamlets nested within forests. This generates a dramatic gradient of anthropogenic pressures within the region, which gives us an opportunity to study and understand the response of moths as a group sensitive to environmental and anthropomorphic change.

Our research:

Studying moths along the altitude was a challenge as working at night in the mountains is not as easy or adventurous as it might seem. As we stayed in the villages with the local people, they failed to understand why we would want to venture out at night in the forest to study some insect! They would stop us; warn us of evil spirits in the forest as well as the Himalayan Black Bear (*Ursus thibetanus*) which might attack. But nothing stopped us from completing the work and finally our determination impressed them, and few of the villagers even volunteered to come along with us at night to help us out!

Eumelea sp. (Photo Abesh Sanyal)



Ginshachia sp. (Photo Abesh Sanyal)

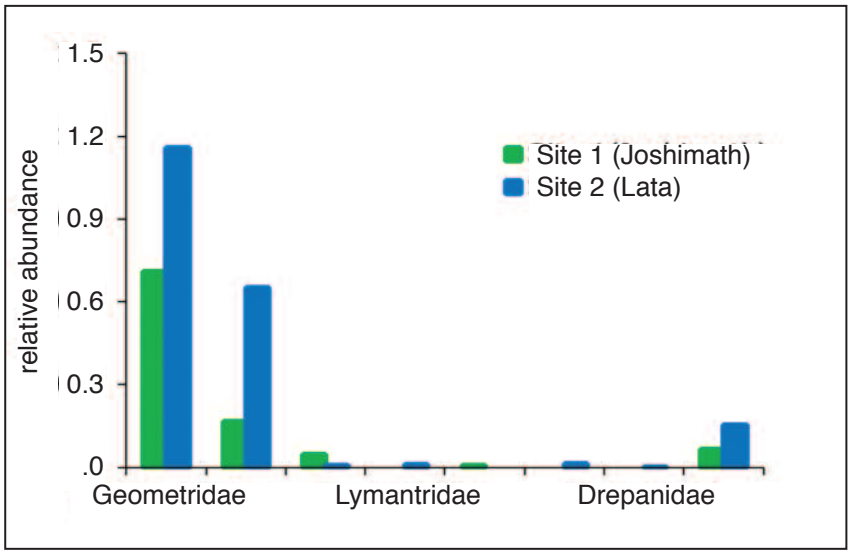


Fig 1: The family Geometridae showed high abundance in both the study sites.

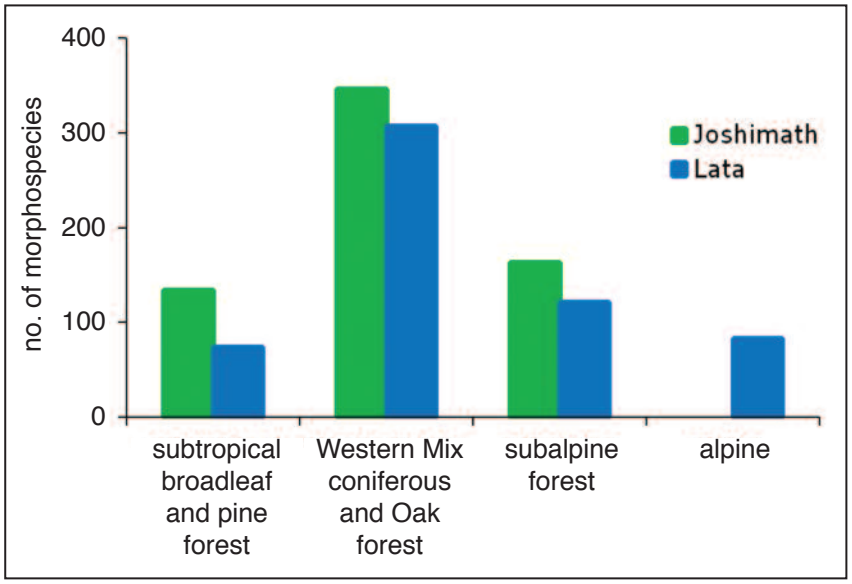


Fig. 2. The western mix coniferous forest showed highest species richness.

We studied two gradients of human disturbance and forest types (Joshimath and Lata) to investigate the relationship between the moths, the environment and the human activity. We sampled moths in the forests at dusk by setting light traps which were operated for 3-4 hours; the moths were collected manually and documented with photographs. We recorded the microhabitat and other variables which might influence the presences or absents of the moths. We sampled across the available forest types at different altitudes in order to determine any patterns in diversity and species composition.

Moths belonging to the five most diverse families (Noctuidae, Geometridae, Arctiidae, Crambidae, Lymantriidae) were identified into morphospecies. The family Geometridae was the most abundant (Fig.1) at all the sites with over 700 individuals recorded. The subfamily Ennominae was most abundant at the lower altitudes while the higher altitudes were dominated by the species belonging to the subfamily Larentiinae. The Western Mixed coniferous forest (sub forest type under temperate forests) showed the maximum species richness (Fig.2). The number of morphospecies and individuals at each of the trap sites were negatively correlated with elevation and temperature. The species diversity (alpha diversity) showed a differential response to vegetation structure on the two mountain slopes with a mid-elevation peak (2,300-3,000m) in the more disturbed gradient in Joshimath. Interestingly, the forest types had a greater effect on diversity on the more disturbed mountain slopes.

Family Geometridae with such high abundance can be studied for long-term as indicative of environmental changes.

Our results indicate that resource diversity plays an important role in maintaining species diversity. These results predict negative impacts for any ongoing extraction of forest resources on moth diversity and the ecosystem services they deliver. It also highlights the role that moths can play in monitoring climatic and anthropomorphic changes in forest structure.

The study on moths in high altitude landscapes can provide a much-needed insight into their endemic diversity. Monitoring insect populations is often a difficult task for the managers of protected areas. So we hope this study will make the these managers more aware of the importance of moth species and also hope it will play a role in shaping future management programs for the conservation of the habitats of the rare species by controlled grazing and limiting resource extraction by local people.

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Website

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