

# FINAL REPORT

## PROJECT TITLE: HOSTPLANTS AND EARLY STAGES OF LEPIDOPTERA IN THE KUMAON HIMALAYA, INDIA

**PROJECT DURATION:** June 17th 2008 to June 17th 2009.

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### INTRODUCTION

The main aim of the project was to discover the larval host plants of as many butterflies and moths as possible in order to obtain enough data to understand why the population of moths differs according to elevation in Himalayan Oak forests.

### METHODOLOGY

In order to obtain as many different eggs and larvae as possible, adult female Lepidoptera were collected and put in boxes, where many of them laid eggs. When the larvae emerged, different potential food plants were offered. In a few cases, the larvae accepted the food plant and proceeded with their life-cycle. In many cases, though, none of the plants offered were accepted.

Caterpillars in a communal web were discovered on a small oak tree (*Quercus leucotrichophora*) near Gagar in October 2008. They fed through the winter, necessitating frequent trips to Gagar (2400 m) for fresh leaves. They simply refused to accept leaves from the same species of oak from Bhimtal (1500 m). I have sought assistance in the identification of this moth.

Since the method above met with limited success and the results thus obtained are classified as captive rearing, we relied heavily on discovering larvae feeding on their host plants in the wild, or else observing female Lepidoptera laying eggs on their host plants.

The drawbacks in the former case is that more often than not, the larva is parasitized, which is why it is too lazy to hide and escape observation. The fact that it is parasitized only emerges much later, sometimes in the later instars of the larva but most often after

the pupa has been formed and one is expecting the moth or butterfly to emerge: instead, a tiny wasp(s) emerges. Since one does not know the identity of the larva in the first place, it is not even possible to use the information, since all it amounts to is, "this parasite emerged from a larva belonging to an unknown species of Lepidoptera."

In the case of observing females laying eggs and then discovering and breeding the eggs, this led to the best successes. However, most moths lay their eggs in darkness, a fact which considerably hindered our work. Also, it is very slow work, for one is extremely lucky to obtain eggs of one species a day during the season.

A number of moth species was added to the known fauna of Gagar. Most of the new records of this project, however, are still unidentified, despite my best efforts.

The rains failed during the winter of 2008-2009. This had several negative effects: first, many of the pupae that were overwintering in individual plastic boxes covered with gauze dried out and did not emerge. I did not water them for fear of fungal attack and depended on atmospheric humidity which, apparently, fell below critical levels.

Secondly, the effect of the failed winter rains was so severe that it resulted in an officially declared state wide drought in the summer of 2009. Compared with other years, fewer insects emerged from their pupae in the wild. Some species which I was looking forward to breeding, such as *Delias sanaca*, *Gonepteryx mahaguru* and *Delias belladonna* (Pieridae), *Neptis narayana* and *Neptis ananta* (Nymphalidae), *Euaspa ziha*, *Chrysozephyrus syla*, *Tajuria illurgis* and *Tajuria illurgioides*, etc (Lycaenidae) were not to be found, although the first three mentioned are very common in normal years. Presumably, the same thing that happened to the pupae we had reared happened to the pupae of these and other Lepidoptera in the wild.

Thirdly, due to the dry spring and early summer, there were a large number of uncontrollable forest fires in April and May 2009. Not only pine forest, which is normally prone to such fires, but even oak forest burnt this year. The broadleaf forest around Gagar burnt, except in the immediate vicinity of water courses.

We therefore shifted our main focus to a forest 40 km away, which had not burnt. Thus, we managed to obtain a fair number of larvae this season. Some are still feeding, some are in the pupal stage and there are even some eggs that we are hoping will hatch.

The results of the trip to Ladakh in July 2008 are still coming in: the last moth emerged in April 2009 from a pupa that had overwintered. Presumably it was used to desert conditions, so it did not dry out! It will now be possible to describe the early stages of those two hawkmoth species in detail.

This breeding experiment also resolved a long standing problem with the distribution of the hawkmoth, *Hyles nicaea lathyris*: its easternmost limit was reported to be Nainital.

However, I had never seen this moth in the Nainital area. Breeding it in Ladakh clarified that it is xerophytic and will probably not breed in a heavy rainfall area like Nainital. Hence the Nainital record(s) was of a straggler(s), perhaps from the trans-Himalayan area.

Besides the trip to the Forest Research Institute, Dehra Dun in January mentioned in my interim report, I was invited to give a talk at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore on "Lepidoptera as bio-indicators" in March 2009. This talk was also presented at the Agricultural University (GKVK) and at the Project Directorate for Biological Control, Indian Council for Agricultural Research, Bangalore around the same time. It was a pleasure presenting the results of the previous Rufford Small Grant Foundation project at these fora, in addition to other data.

## **RESULTS**

Overall, the data obtained so far points to a sort of middle-of-the-way result: some Lepidoptera are restricted to the zone occupied by their larval host plants; some are regularly found at lower elevation than their food plant: these are, strictly speaking, stragglers, although their regularity of appearance and numbers had not suggested this status earlier. Some are restricted by factors other than their larval host plants, so that, like the Pyralid that fed through the winter on oak leaves, they refuse to feed on leaves of the same plant from a different area: needless to say, this Pyralid moth has not been recorded from lower elevation, although oak plants occur there. Several similar examples have been discovered.

Statistical analysis of the total number of Lepidoptera species belonging to these three groupings will help in arriving at a conclusion concerning the validity of discerning areas to be conserved exclusively on the basis of "keystone species" or plant communities. Figures for this analysis will emerge after Lepidoptera currently in their pupal, larval or egg stage have emerged and been identified. However, I am reasonably certain from results obtained so far that data generated from this and the previous project will provide at least a preliminary basis to urge the need to include insect communities in conservation planning, especially biodiversity conservation.

Results will be published in scientific journals. There are already 7 scientific notes and papers in press or under editor's consideration from results obtained partly or wholly under this and the previous Rufford Small Grant Foundation project. I am working on several more.

A number of identified moths will be donated to the National Forest Insect Collection at the Forest Research Institute, Dehra Dun, especially those not represented in that collection.

## **CONCLUSIONS**

The main aims of the present project were to breed as many Lepidoptera as possible in the broadleaf forests above 1800 m elevation, to distinguish as many larval host plants as possible in order to ascertain whether the different insect communities in Bhimtal (1500 m) and Gagar (2400 m) were the result of difference in plant distribution or insect preferences independent of plant distribution.

Preliminary assessment suggests that food plants for above 100 species will be added to the literature.

Results of this project will be presented in at least two major papers, one on larval host plants and the second dealing with a statistical analysis of the preferences of various groups and species whose larval food plants are known. It is almost certain at this point that sufficient data has been generated to validate the need to take insect communities into consideration while planning biodiversity conservation strategies.

Besides the main thrust of using this and existing data to ascertain the reason for the different moth communities at different elevation in the same forest type in this area, it is likely that two species will have to be synonymised, once we have enough data from several generations. The population dynamics of a group of conspicuous butterflies also proved to be very interesting once their larval host plants in this area were discovered in the course of this project. This will be the subject matter for another paper.