

Paul Cannon, Norbert Maczey : CABI Bioscience UK Centre, Bakeham Lane, Egham, Surrey TW20 9TY, UK. Email: p.cannon@cabi.org
 Nigel Hywel-Jones : BIOTEC (National Center for Genetic Engineering & Biotechnology), Thailand
 Tshitila, Lungten Norbu : Council of Renewable Natural Resources Research (CORRB), Ministry of Agriculture, Bhutan

Introduction

Cordyceps sinensis is an entomopathogenic fungus that infects root feeding larvae of Hepialid moths belonging to the genus *Thitarodes*. The fungus is highly prized in Chinese medicine, and is almost literally worth its weight in gold; prices have recently reached US\$4000-7000/kg. Many beneficial effects are reported, especially in promoting energy.



Figure 1 : Field site at Namna, Jigme Dorji National Park (left) and a days harvest of *Cordyceps sinensis* (right).

In Bhutan *C. sinensis* grows in the northern parts of the country near the border with Tibet on high montane pastures (between about 4000m and 5000m altitude). The Bhutanese Agriculture Ministry estimated exports of 6000 kg in 2003 – with fruit bodies weighing only a gramme or so – supplying around 10% of the global market.

The Nature Conservation Division (NCD) and Council of Renewable Natural Resources Research of Bhutan (CORRB) have been concerned for several years about the sustainability of *Cordyceps* harvest. An initial prohibition policy led to extensive cross-border poaching from Tibet, and the ban was subsequently modified to allow regulated collection by Bhutanese citizens. There is however little information on what level of exploitation would be sustainable. Harvest involves large numbers of people scouring fragile montane grasslands, and impact is also unknown on the flora, or of grazing by the endangered bharal and by yaks.



Figure 2 : Location of the two main study sites in Jigme Dorji National park in 2005.

Objectives

Main project activities include:

- Surveys of current population levels of *C. sinensis* and current harvest, using participatory techniques involving the local population
- Establishment of long-term monitoring/impact studies on the fungus and its natural habitat, complementary to GEF/UNDP-sponsored integrated management plans
- Promulgation of best practice for harvest by local people
- Improvement of regulation, including measures to achieve public support
- Research to elucidate host life cycle and food preference
- Cultivation of food plants for the moth larvae, along with existing experimental medicinal plant gardens
- Establishment of cultures of host larvae and experimental inoculation with *Cordyceps*
- Review and modification if needed of a Government-regulated trading scheme



Figure 3 : Fruiting body of *Cordyceps sinensis* (top left); with excavated caterpillar remains (top right); selection of adult *Thitarodes* specimens at the Natural History Museum, London (bottom).

Initial field activities

Activities were divided between survey work for the fungi themselves, investigation of their insect host, initial studies on food plants, and socioeconomic work interviewing yak herders to tap their knowledge on *Cordyceps*. We also attempted to establish the level of poaching across the border with Tibet and its impact on harvest by legitimate collectors in Bhutan.

There were numerous concerns expressed that Tibetan poachers had extracted many *Cordyceps* before legal collecting in Bhutan began at the beginning of June. However, the season was poorly advanced and we believe that there is likely to be considerable fluctuations in population from year to year.

One of the primary obstacles to farming *Cordyceps* is lack of knowledge of the insect host. We still have problems to identify the caterpillars unequivocally, but we were able to make initial assessments of population levels with 4-5 caterpillars being gathered per m².



Figure 4 : Some of the likely host plants of the *Thitarodes* caterpillars: *Bistorta macrophylla* (left), *Potentilla microphylla* (middle), *Astragalus donianus* (right).

The intention is to establish the food plants in gardens inside Bhutan, allowing food preference experiments to take place. Some of the sampled caterpillars were carried down to CORRB's experimental base at Yusipang (2700m altitude), but the mortality rate was high. Subsequent observations suggested that the caterpillars will eat generic foodstuffs such as carrot, which could make cultivation of *Cordyceps* much more practical.

Capture of adult moths was also attempted using light traps and sweep nets, but no hepialid species were captured. We are unsure as to whether this was because the season was incorrect, or that the moths are genuinely rare following a population crash in recent years.

CORRB staff carried out further surveys to look into the frequency of *Cordyceps* fruit bodies late in the season. It was established that there were significant numbers of *Cordyceps* fruit bodies remaining in early August. This suggests either that the fruiting season is longer than we originally expected, or that sufficient numbers are missed by collectors to ensure harvest in future years.

Acknowledgements

This project is funded by DEFRA through the UK Government's Darwin Initiative