Ethnobotany Nepal Himalaya Project

परम्परागत हिमाली वनस्पति

परियोजना नेपाल, २०६५

Final Report

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The project logo
The logo integrates the two major disciplines involved with the team's research: botany and anthropology. *Meconopsis horridula* is depicted against the backdrop of the Langtang Himal of Rasuwa district. The remote high mountain districts of Nepal are home to a number of ethnic groups in which a vibrant Buddhist tradition is alive today. To represent this element of the study, a 'mandala' style frame encircles the logo. The colours are those of Tibetan prayer flags: blue, white, red, green and yellow. Prayer flags are a common sight in both the cities and high mountains of Nepal and throughout the Himalayan region.

1 Project Overview

1.1 Summary

The Ethnobotany Nepal Himalaya Project was a multi-disciplinary research study led by a team of postgraduate and undergraduate students of the University of Aberdeen, UK, in collaboration with Tribhuvan University, Nepal. Elements of both botanical and anthropological fields of investigation were drawn together for purpose of the study, under the banner of ethnobotany.

Fieldwork was conducted between early July and mid September 2008, after which time lab work, data analyses and the write-up of field notes has been ongoing. Progress during this time has been relatively constant. In addition to the extensive notes and many datasheets recorded from the field, over 25 hours of raw film footage, 8GB of photography and 10 hours of audio recordings were made. Along with a final report, various other outputs have been generated, and are detailed below in section 7. This has included several written articles (both scientific and informal), collection of herbarium specimens, photography and various other forms of multimedia. Dissemination of findings has also been by means of several talks presented during the course of the year, and through the expedition website, which is currently under redevelopment.

Ever since the conception of the project in early 2007, and throughout the development and elaboration of our goals, we have considered the impact that both our presence and research could make out in Nepal. The conservational and social relevance of the project was meticulously weighed, precautions taken regarding our environmental and cultural impact, and an ethical framework adopted for the process of anthropological research. For moral reasons and otherwise, collaboration with a national institution in Nepal was highly favoured, and subsequently proved an extremely enriching experience for all involved; before, during and after the period of fieldwork. During the wind-up of the project in Nepal the team also had the privilege of donating a considerable amount of equipment, materials and remaining food supplies to various causes deemed appropriate. These included a local primary school in Dhunche, Rasuwa district, and the Botanical Student Society of Tribhuvan University.

Concerning some of what we feel are the major findings and achievements resulting from the research, a significant contribution has been made to the ethnobotanical and cultural documentation of the Tamang people of northern central Nepal. Various biological attributes of the threatened alpine genus *Meconopsis* have also been extensively investigated, with several novel findings made. Some particularly outstanding news in this regard has been the discovery of an entirely new species of *Meconopsis* during the course of fieldwork, further information on which is provided in section 5.3.5. Also included in the report is a commentary on the logistics of the project in the field, listed under section 3. As we took a less orthodox, largely independent approach to organisation of logistics, we hope that this section may aid those organising similar ventures in the future. The team have been generally very satisfied with how the expedition progressed, and have felt the experience a truly positively challenging one.

1.2 Research Background

Ethnobotanical research targeted several Tamang communities of northern Nepal, particularly individuals involved in the harvest, preparation and administration of plant-based medicines. In addition, the effects of migration on community dynamics were also investigated.

Botanical research focused on the endangered Himalayan Poppy (*Meconopsis)* genus. The aims of the botanic study were to examine the morphology and conservation threats faced by species in the wild, and to further develop ecological descriptions of several *Meconopsis* native to central Nepal. Samples of the medicinal species of the genus, which are renowned in Tibetan medicine, were collected for phytochemical analysis.

Figure 1 illustrates the location of research sites, throughout Rasuwa district, central Nepal. Botanic research was generally carried out at elevations ranging from 3500–5000m, while anthropological and ethnobotanical information was collected throughout several villages of the region.

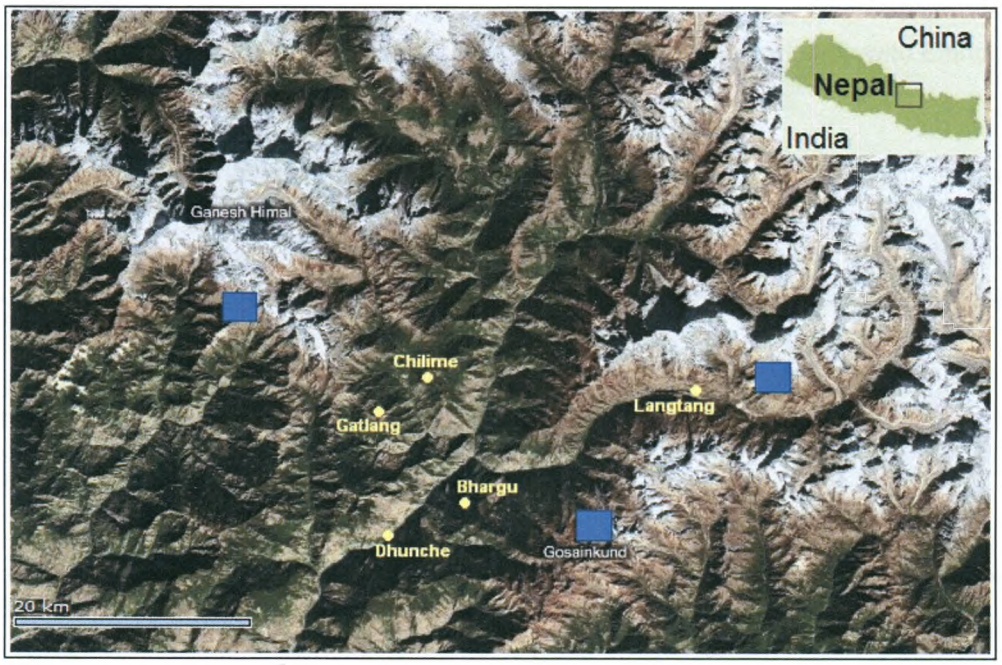

Figure 1 Project research location in northern central Nepal. Botanic study sites (blue) from east to west are namely upper Langtang valley, Gosainkund and Ganesh Himal. Villages in which anthropological / ethnobotanical investigations were conducted are indicated in yellow.

2 The Team

- **Carol-Ann Cunningham**
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  Education:
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- **Paul Egan**
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3 Itinerary & Logistics

3.1 Itinerary

July 6th – 18th
Research preparation in Kathmandu (permits, supplies etc.). Planning workshop with Ethnobotanical Society of Nepal (ESON) and Tribhuvan University staff.

July 18th – August 1st
First research period in Langtang National Park. Anthropological research in Dhunche & Bhargu, botanic research in the vicinity of Gosainkund.

August 1st – 5th
Return to Kathmandu. Restock of supplies and consumable materials. Extension of visas. Deposit of collected herbarium specimens.

August 6th – September 1st
Second research period in the Ganesh Himal and upper Langtang valley. Anthropoligcal research in villages of Gatlang, Chilime and Langtang. Botanic research in the vicinity of Paldor peak (Ganesh Himal) and Kyanjin Gompa (upper Langtang valley).

September 1st – 10th
Project wind-up in Kathmandu; evaluation and presentations, research visit to National Herbarium, departure Nepal.

3.2 Logistics

Nepal has for a long time been a popular trekking destination, and as such, is well suited to the needs of trekking parties. A great many specialist agencies in Kathmandu are willing to organise all logistics concerned with trekking, including transport, route, porters, and food. However, such convenience has its associated expense, and our team instead opted for the alternative of organising all logistics by ourselves. There have of course been both obvious advantages and disadvantages to this approach. Not having to worry about a full-scale trekking crew, we were therefore afforded a great deal of flexibility regarding schedule while in the field, and spared significant expense.

We utilized trekking lodges for accommodation on an ad hoc basis when these were available and if needed, mostly within the Langtang region. Otherwise we came prepared for full self-sufficiency, which was necessary for research in the vicinity of the much more remote Ganesh Himal. A significant amount of food supplies, fuel and consumables were purchased by us in Kathmandu for consumption in the field. However, as we lacked a professional trekking crew, the duty of food preparation and local sourcing of porters was our own concern. Due to relatively large amounts of equipment, hire of porters was essential. We made precaution as to only request reasonable loads to be carried, and in return paid what we knew to be good rates.

On the other hand, relatively long stays were required in local villages for purpose of the anthropological study. 'Home-stays' were a much more preferred and relevant alternative to occupying any tourist orientated accommodation available in the villages visited. This allowed a greater connection to be made with local people beyond those directly involved with tourism, and provided a much more effective means of access to the community as a whole. A 'social moralizer' was without too much difficulty sourced and employed in most villages as a translator.

In general, the advantages of independent organisation of field research were significant, and ultimately very rewarding, as opposed to going through a trekking agency. However, we must emphasize that our Nepali co-member of the team was highly instrumental in this operation. Accordingly, it would be very difficult to recommend such an approach to logistics in the absence of prior partnership. Moreover, it is highly unlikely that research would have progressed as a whole in Nepal without such meaningful collaboration due to the particularly complex situation surrounding research permits, mostly concerning the Department of National Park & Wildlife Conservation.

4 Anthropological study: Ethnobotanical & cultural documentation of the Tamang ethnic group

4.1 Introduction

The Tamang are a Tibetan-related people native of northern central Nepal (Fig 2). This area of the country is a renowned hotspot of biodiversity and a rich source of medicinal plants, which are exported from here onto national and international markets. Due to a mix of geographical, economic and cultural factors, the Tamang rely on traditional plant-based medicine as a predominant source of primary healthcare. It was therefore an aim of the project to investigate in these communities the ethnobotany surrounding a number of selected medicinal plant species. Medicinal plants collected in the region form an important element of the local economy, and so particular attention was paid to the aspect of trade.

Figure 2 The village of Gatlang, Rasuwa district; a remote Tamang community remarkably well connected to both medicinal plant and international labour markets

As part of a secondary research interest which developed, we also collected information on the experiences and attitudes of residents to working abroad. The northern communities in which research took place are major providers of labour for the needs of foreign countries, particularly those of the Gulf States and Malaysia. Thus many people are wrapped up in the concerns that arise from their relationship with global labour markets, reliance on remittances and the work of parents and older siblings.

4.2 Methods

4.2.1 Ethnobotanical methodology

A number of methods were used in the collection of ethnobotanic data as similar to anthropological methods listed in the following section. For several medicinal plant species information was obtained on collection, trade, preparation and use of the plants. A series of 'Medicinal plant profiles' are here presented based on this information, and are a culmination of information assembled from multiple sources and locations in the region (see Fig 1), as well as from Kathmandu. A diverse array of medicinal plant 'user-groups' contributed information, which included traditional healers, medicinal plant collectors, secondary traders, herders and knowledgeable persons.

In addition to sharing knowledge surrounding plant-use, we also invited interviewees to contribute some thoughts surrounding their livelihood as a whole, as they see it. The information collected as a result of this dialogue has informed the discussion presented in section 4.3.3, entitled 'Cultural and economic perspectives surrounding medicinal plants'. Based on collected information, we have also attempted to form an overview highlighting a number of different viewpoints and clashes of interest on the collection, use and trade of medicinal plants. In conclusion, prospective solutions to a number of the perceived problems are discussed.

4.2.2 Anthropological methodology

Our methods for obtaining information were heavily influenced by various texts (including ethical guidelines prepared by various anthropological associations) and their discussions on the ethical dimensions of carrying out research and on textualising encounters with people. We felt (as does Laine in Fieldwork, Practice and Preparation) that the best way to conduct ourselves appropriately was to be prepared and to do some research prior to departure on ethical literature and to take note of what others have done previously.

The researchers were not well versed in Nepali script and only had a rudimentary understanding of the native language Tamang. Interviews were conducted with the help of the interpreter; a man in all

three cases, who arranged the interviews, asked the questions, and received the answers and translated them. Audio and video recordings were taken in several interviews; though interviews were predominately written down or else notes were made upon leaving the interview space. When this occurred there was only a short period of time before writing up a report on the interview that took place. Interviews were conducted with men and women of various ages in order that the research aim could be met i.e. giving a broad account of the experiences and differences in experience between people.

4.3 Ethnobotanical research

Two main research themes were undertaken as part of the ethnobotanical study, and included:

1. To investigate the trade and qualitative ethnobotany of a number of medicinal plant species
2. An analysis of the cultural and economic importance of medicinal plant use, and associated problems, in a number of Tamang communities

Instead of a broad 'sweep' of species, the team resounded to focus extensively on a small number of highly-traded, yet seemingly understudied medicinal plant species native to Rasuwa district, central Nepal. These species, and their respective families included:

Aconitum spicatum (Ranunculaceae)
Meconopsis napaulensis (Papaveraceae)
Meconopsis horridula (Papaveraceae)
Meconopsis paniculata (Papaveraceae)
Nardostachys grandiflora (Valerianaceae)
Neopicrrohiza scriphulariifolia (Scrophulariaceae)
Rheum australe (Polygonaceae)
Rhododendron arboreum (Ericaceae)
Swertia chirayita (Gentianaceae)

4.3.1 Use-categories of the selected medicinal & aromatic plants

From our research on the above 9 selected MAPs we found 4 main categories of plant use, divided into 21 sub-classes, based on classification by Cook (1995). These use-categories and their sub-classes are as follows:

Medicine (M)
- Blood System Disorders (blo)
- Circulatory System Disorders (cir)
- Digestive System Disorders (dig)
- Endocrine System Disorders (end)
- Genitourinary System Disorders (gen)
- Infections/Infestations (inf)
- Inflammation (ifm)
- Injuries (inj)
- Mental Disorders (men)
- Metabolic System Disorders (met)
- Muscular-Skeletal System Disorders (mu
- Nutritional Disorders (nut)
- Pain (pai)
- Respiratory System Disorders (res)

Food (F)
- Exudates (exu)
- Leaves (lea)
- Root (roo)
- Stem (ste)

Food Additives (A)
- Stems (ste)

Social (S)
- 'Religious' Uses (rel)
- Miscellaneous Social Uses (mis)

The type and amount of medicinal uses per species is illustrated in Table 1 below. It can be observed that some common ailments, such as pain and digestive problems, possess several methods of treatment, while more complex and uncommon ailments, such as mental or metabolic disorders, possess few. It can also be seen that the 9 selected species have a differential number of medicinal uses. The number of uses assigned to a plant by locals can perhaps be related to how ecologically rare or common a species is, in addition to the intrinsic chemical character of the plant. Food and social uses have been excluded from the table, focusing on medicinal uses only.

Table 1 Species use-catagories; type and number of medicinal uses (excluding food & social categories)

Species/Use	blo	cir	dig	end	gen	inf	ifm	inj	men	met	mus	nut	pai	res	Total
A. spicatum						•	•				•		•		4
M. napaulensis			•								•				2
M. horridula			•								•				2
M. paniculata			•												1
N. grandiflora		•													1
N. scriphulariifolia			•			•								•	4
R. australe								•	•			•	•		4
R. campanulatum	•		•	•	•					•					5
S. chirayita			•			•							•	•	4
Total	1	1	6	1	1	3	1	1	1	1	3	1	3	2	

4.3.2 Medicinal Plant Profiles

Note:

- All trading prices presented in Nepali Rupees (1GBP = 123.6RPS)
- Weight presented as dry weight, unless otherwise stated
- For local plant names 'Tm' indicates Tamang, and 'Tb' Tibetan
- Plant photography is accredited to the team
- All data and descriptions presented below are original, based on primary research alone, and have not been cross-referenced elsewhere for their accuracy

Aconitum spicatum (Ranunculaceae)
Part(s) used: Whole plant, root.
Collection: No particular regard for sustainable harvest was expressed by those involved in collection of the species. Hands are washed after harvest, as plant perceived as highly poisonous. For use of the root, plant is best collected when above-ground parts are dead.
Preparation & use: Used in rheumatism, joint problems, in wounds to stop bleeding and as an antibacterial. Also used as a painkiller. The root is first boiled for over one hour, or cooked in oil, before use in order to detoxify poisons, after which the material is dried for ~20 days. Storage is in cloth bags in order to expose the roots to air. Use of the plant is limited to those only with expert knowledge, owing to its toxicity and strength. Commercial companies manufacture pesticide with Aconitum as an ingredient.
Use category: Minf, Mifm, Mmus, Mpai
Trade: Primary collectors receive around 120RPS per kg. Secondary traders sell the plant for 225RPS per kg, with 7RPS government tax applied to trade.
Ethnoecology & other notes: Collectors highly conscious of flowering time of the plant, which is reported as from July onwards. Several species of the Aconitum genus are used interchangeably, as most local collectors/users can not taxonomically distinguish between these. Several species of Aconitum are sometimes mixed together for sale by secondary traders.

Figure Harvest of *A. spicatum* by medicinal plant collector

Figure Flower of *A. spicatum*

Meconopsis napaulensis (Papaveraceae)
Part(s) used: Whole plant, including seeds
Collection: Plant is collected when young for use as a vegetable
Preparation & use: Used to treat diarrhea of yak and dog. *M. napaulensis* is usually a minor ingredient in a medicine mixture involving *Meconopsis horridula* (see below). Root and young stem shoot eaten as vegetable, best collected in late winter. Taste of *M. napaulensis* reportedly bitterer than that of *M. paniculata*. Use of only younger stems is preferable for culinary purposes.
Use category: Froo, Mdig, Mmus
Trade: 1kg = ~150RPS for primary collectors, and less if only a small amount of material. If a bulk of 200kg is collected then price per kg rises to 225RPS. New stock generally appears for sale in markets annually in early winter.

Figure Traditional healer with a collected *M. napaulensis*

Ethnoecology & other notes: Due to seemingly close morphology, most collectors/traders cannot taxonomically distinguish between *Meconopsis napaulensis* and *Meconopsis paniculata*, and commonly use these interchangeably where they are found in close proximity. The same seemingly applies with other yellow-flowered species of the genus. Locals observe that the growth of the young stem is very fast, around May/June.

Meconopsis horridula (Papaveraceae)
Local name: Uppal ping (Tm), Uppal mumpu (Tb)
Part(s) used: Whole plant, including seeds, or whole plant excluding stem material.
Collection: No criteria given to plant size, and all sizes are harvested.
Preparation & use: Used singularly or in a preparation with *Meconopsis napaulensis* to treat swelling and gastric disorders. Plant is dried and ground, and 2 spoonfuls of powdered material dissolved in a glass of water and administered as such. Plant material is dried for 3 days in good sun, and then stored in sacks.
Use category: Mdig, Mmus
Trade: 1kg = ~350RPS for primary collectors, and less if only a small amount of material. If a bulk of 500kg is collected then price per kg rises to 225RPS. Market price is highly marked-up by secondary traders and vendors. New stock generally appears for sale in markets yearly in early winter.
Ethnoecology & other notes: Although potential sources of material, a number of collectors claim to avoid harvest of juvenile plants in order to maintain a viable population for future years.

Figure Collection of *M. horridula* by a medicinal plant collector in the plants typical rocky habitat at high altitude

Meconopsis paniculata (Papaveraceae)
Local name: Uppal urr (Tm), Uppal sherpu (Tb)
Part(s) used:
Collection: Between 40-100kgs of plant material have been collected from certain locations yearly.
Preparation & use: Root and young stem shoot used as vegetable, best collected in late winter. Taste of *M. paniculata* reportedly more sweet than that of *M. napaulensis*. Use of only younger stems is preferable for culinary purposes. For medicinal use, plant material is dried for 3 days in good sun, and then stored in sacks.
Use category: Froo, Mdig
Trade: 1kg = ~150RPS for primary collectors, and less if only a small amount of material. If a bulk of 200kg is collected then price per kg rises to 225RPS. New stock generally appears for sale in markets annually in early winter.
Ethnoecology & other notes: No cultivation of the species is currently in progress, though local perception is this may be a worthwhile pursuit due to the relative ease of seed collection. (For further information see notes of '*Meconopsis napaulensis*' above)

Figure (Left) Root of *M. paniculata*, which is sometimes used as a vegetable. **(Right)** A patch of wild *M. paniculata*

Nardostachys grandiflora (Valerianaceae)
Local name: Poi (Tm)
Part(s) used: Rhizome
Collection: Mature plants are dug up and rhizomes are separated. Vegetative parts are discarded.
Preparation & use: Primary collectors prepare rhizome by sun-drying for between 2-6 days after collection. Main use of the rhizome is for extraction of aromatic essential oils, and in the manufacture of incense, both commercially and locally. For local medicinal use, the plant is used in the treatment of heart problems.
Use category: Smis, Srel, Mcir

Figure (Left) Incense manufacturer with *N. grandiflora* based incense **(Right)** The species growing in the wild

Trade: Nardostachys is sold to secondary traders for 100RPS per kg, who in turn commonly receive up to 200RPS (excluding 15 RPS government tax) as a selling price to industrial companies throughout the Indian sub-continent. On local scale markets 20 sticks of incense sell for 8RPS.
Ethnoecology & other notes: Due to the species economic importance, collectors are expressing concern for the threatened nature of the plant. Because of this concern, a high market demand and good price potential, local people are planning future cultivation of the species. A number of collectors make sure to collect only plants that have set seed, for conservational purposes.

Neopicrrohiza scriphulariifolia (Scrophulariaceae)
Local name: Kutki (Tm), Tikta (Tb)
Part(s) used: Stem
Collection: Above ground parts of mature plants are collected in October/November after flowering, and root, leaf and flowers separated from the stem.
Preparation & use: Collected material is sun-dried for 2-6 days, after which there is a 50% decrease in weight. For medicinal use, 50g of stem is placed in half a litre of water for 2 hours, with the resulting preparation yellow in colour and bitter in taste. This is taken hot up to 8 times daily, along with sleep, to relieve fever, coughing and treat typhoid.
Use category: Mdig, Minf, Mres
Trade: Primary collectors receive ~140-160RPS per kg, while secondary traders can receive upwards of 200RPS for this. If plants have not been prepared by removal of leaves and roots from stem, then price per kg is decreased by one third. 10RPS per kg tax is applied to secondary traders.
Ethnoecology & other notes: Due to the creeping rhizotomous habit of the plant, small attached plantlets are often pulled up mistakenly during harvest of mature plants, despite collectors aiming to minimize this for conservational purposes. Commonly collected by traditional healers and knowledgeable persons for local use, as well as by medicinal plant collectors for trade.


Figure A creeping patch of *N. scrphulariifolia*, with dark flowers

Rheum australe (Polygonaceae)
Local name: Chungwarin (Tm), Churcha (Tb)
Part(s) used: Leaves, rhizome and stem
Collection: Plant is collected at all times after flowering.
Preparation & use: Plant material is used as a vegetable, with young leaves dried before eating, and the stems prepared into a pickle. Stem and peeled rhizome material is dried and powdered and added to Tibetan tea in a preparation to relieve both physical or mental fatigue and pain. A similar preparation made with water is given to domestic animals in need of weight gain. A paste made from the rhizome is also used in bandages applied to injured animals.
Use category: Smis, Aste, Fste, Flea, Minj, Mmen, Mnut, Mpai
Trade: No commercial trade of *Rheum australe* is reported, though pickle is supplied as food for sale throughout lodges of the region. The powdered stem and rhizome material is commonly given as gifts to relatives and monasteries.
Ethnoecology & other notes: Collection of the plant is made by women, and is commonly found growing for a long period during the summer months. The plant is available dried and pickled for use throughout the year.


Figure Himalayan rhubarb – *Rheum australe*

Rhododendron campanulatum (Ericaceae)
Part(s) used: Petals
Collection: Collection of plant material is during March/April/May while plant is in flower. Flower is collected and stigma and style removed.
Preparation & use: Petals are washed with hot water to clean, and then ground a maximum of one day after collection has taken place in order to ensure a high output of petal juice. 5kg of flowers are used to produce 3 liters of juice. Both wine (3-4% alcohol content) and juice are prepared from the pressed petal juice. The beverage is served by adding 40ml of water to 20ml of the concentrated juice, and is taken either hot or cold as a general tonic, or as an aid for liver disease, ulcers and diabetes. The juice is a renowned source of vitamins.


Figure The end product of a small-scale production of Rhododendron juice

Use category: Fexu, Mblo, Mdig, Mend, Mgen, Mmet
Trade: Primary collectors receive ~10RPs per kg. The juice is produced only on a local scale, with an end selling price of 80RPs. 2RPs per kg raw material is applied as tax.
Ethnoecology & other notes: Locals are aware of the need to restrict harvest, and so a maximum of only 60% of flowers are harvested from every individual, with the remaining flowers left to seed. Stigmas and styles are removed from flowers, as this decolorizes the resulting juice, and problems are faced due to solidified material during filtering.

Swertia chirayita (Gentianaceae)
Local name: Timga (Tm), Dhoitikta (Tb)
Part(s) used: Whole plant
Collection: Plant is collected when in seed from both cultivated and wild stock. Roughly 20kg of plant material is produced locally per village due to cultivation.
Preparation & use: Seed is separated from other plant material. The plant is commonly used locally as well as traded. It is prepared by placing one whole dried plant (~40cm) in half a litre of cold water for 2 hours, which is then drank 3 times daily. The preparation is used to suppress colds, headache, fever, gastric complaints and sore throat.
Use category: Mdig, Minf, Mpai, Mres

Figure Seeds of *S. chirayita* collected from wild and cultivated sources

Trade: Primary collectors/cultivators receive around 100RPS per kg of *Swertia chirayita*. Secondary traders sell plant material for 140-150RPS per kg, after 20 RPS government tax is applied per kilo. Herbal companies in Kathmandu are common end points for collected material. It is reported that secondary traders only make ~2-3RPS profit per kg if trade has gone through official channels.
Ethnoecology & other notes: The species is cultivated by locals due to popularity of the plant for trade and local medicinal use. 2-3kg of seed is harvested per village per year for future cultivation, and supplemented with seed collected from the wild. In the past local reliance on the plant as a source of primary medicine has been heavy.

Figure *Swertia sp.* pictured growing in the wild

4.3.3 Cultural & economic perspectives surrounding MAPs

User-groups of medicinal plants
A varied number of user-groups are involved in the collection, trade and use of MAPs locally in Rasuwa district. Plant-based medicines still form an essential part of local health care, and most members of the community were observed to possess, at the very least, a rudimentary knowledge of collection and use of medicinal plants.

Most knowledgeable persons are not involved with collection of medicinal plants on a large scale, but for personal use in their immediate communities. Usually, when a minor sickness is encountered in a family, plant-based medicine is administered by family members, the medicinal plants either sought and prepared fresh from the wild, or prepared from a pre-dried source. If the ailment is perceived as more serious or persistent, or the family possess an inadequate level of knowledge surrounding medicinal plant use, then the patient may be taken to a traditional healer.

Although the role of traditional healer is revered amongst the northern societies of Nepal, most traditional healers are involved in other professions. Commonly no payment is sought for treatment due to what traditional healers see as community or religious obligation, and any income generated in this sense is usually negligible. This voluntary subsistence has implications for the continuity of the profession, as it was observed there is a decreasing will by younger generations to learn such traditions from their elders, ahead of what is

Figure 3 Sun-drying of leaves of *Rhododendron setosum* for use in a family home as incense

seen as more worthwhile economic pursuits. Traditional healers form what they perceive to be an intricate relationship with medicinal plants, as when preparing medicine most refuse to purchase plants and insist on only directly collecting plants from the wild. This relationship is also apparent in how, of all user-groups involved in collection of MAPs, traditional healers were deemed as most conscious of both the need and actual practice of conservation of natural resources. During collection of MAPs, care is taken to minimise all but essential damage to the plant population, and seed is collected and actively planted in the vicinity of the wild plants; a type of wild gardening. Most interaction that traditional healers have with medicinal plants involve intimate ritualistic practises attributed to spiritual belief. It is believed that such practices must be carefully sustained in order to maintain the effectiveness of the medicine. The specifics of ritual can include the time of year/day that a certain plant is to be collected, the manner in which it is to be collected, the anatomical parts to be used and their ceremonial method of preparation and administration. It is clear that in many cases such ritual would also hold sound reasoning from a scientific perspective, particularly in relation to variance in phytochemical content of plants due to environmental, temporal or preparational influences.

In the region, medicinal plants are harvested on both commercial and casual scales. Primary collectors of medicinal plants are involved with harvest in a more serious and long-term sense, and rely relatively heavily on income generated from this source. For most of the year commercial plant collectors are involved in other main sources of employment, as collection of MAPs usually only forms an intense seasonal occupation, following the annual phenology of plants. On the other end of the scale are those involved in the casual collection of MAPs. These collectors are usually herders of domestic animals, such as goats or yaks, who during the summer months spend large amounts of time herding at high altitude throughout species rich alpine pastures. Collection of medicinal plants by herders is mostly on a sporadic/opportunistic basis, but none-the-less provides an effective means to supplement primary income. Local women and porters also harvest MAPs on such a basis for personal use (Fig 3), and only to a minor extent for trade.

Figure 4 MAP secondary trader displaying a store of medicinal plants to be traded

The harvests of MAPs by primary and casual collectors then passes up the chain to a number of regional MAP secondary traders, who are connected to national and international markets. Secondary traders accumulate medicinal plants into large sacks for transport out of the region (Fig 4); a process which may take months depending on how much material is offered. Collectors generally expressed dissatisfaction at the prices offered by secondary traders for their harvest, but nevertheless endure this due to a self-perceived lack of market knowledge. Secondary traders appeared to be extensively more educated and experienced as to the markets, profit margins, laws and taxes surrounding MAP trade, and are often within a legal capacity required to deal with such formalities. Most of those involved in secondary trade do so as a primary occupation.

Prospective solutions; trade, cultivation & conservation of MAPs

All stake-holders involved in the collection and trade of medicinal plants expressed at least some level of concern and frustration related to their occupation. Depending on the specific user-group, this can be due to difficulty in physical accusation of material, variability in quantity and quality of harvest, over-exploitation of wild resources, low prices for harvest, and an extensive system of taxation and bureaucracy.

In gathering information throughout the region from the various stake-holders it was apparent that an overhaul of the current system of MAP taxation is called for, as it was suggested that this has mostly served to promote illicit trade. A number of plant collectors and secondary traders described their preference and/or need for smuggling harvests over the nearby Tibetan border. In their view, this has allowed for greater profit to be made due to evasion of taxation, as well as strong market demand in

Tibet/China for particular MAP species. At custom points, secondary traders are also known to declare much less than the actual value of produce they carry, in order to avoid associated taxation. In some instances profit margins made by secondary traders going through purely legal channels can be as low as ~3RPS for produce with an actual market value of 150RPS. Hence a stimulus to avoid or minimise additional expense incurred by means of fully legitimate trade. It is proposed that lowering the current level of taxation may work to remove incentive for such illegal cross-border untaxed trade, and on the contrary potentially increase revenue generated through taxation, as compared to that of current levels.

Figure 5 Chilme VDC, Rasuwa district, a well known market centre for MAP trade. Both collection from the wild and a limited amount of cultivation of MAPs occurs in the VDC

Other illegal activities come in the form of collection of MAPs from within protected area boundaries, and in collection and trade of species protected by CITES legislation. In 1976, Langtang National Park was established in Rasuwa district. Since this time all collection of natural resources within the protected area of 1710 km² was to be halted, with the exception of bufferzones. However, as with many protected areas, illegal collection of MAPs for local use and commercial trade has continued to this day. Similarly, collection of CITIES protected species and other endangered or highly threatened plant species has continued despite local awareness of laws prohibiting this. A number of collectors and traders still involve in illegal trade in CITES protected species in Rasuwa, with the high market prices fetched for these species possibly associated with their rarity. To confound the problem further, plant collectors usually return to the same location year after year to harvest plants form the wild, which focuses overwhelming pressure on specific populations, whether these species have official threatened status or not.

A common complaint from both primary collectors and secondary traders of MAPs is the restricted profit margin involved in trade along the network. Plant collectors generally feel exploited by traders, who place a large mark-up on their selling price, but who in turn feel that the large herbal companies in Kathmandu and beyond conspire in fixing artificially low prices in unity with each other. Examples illustrating this can be seen throughout the 'trade' data presented in section 4.3.2 above.

A prospective solution to the above presented problems comes in the form of cultivation of key medicinal plant species. Cultivation of MAPs serves a number of advantages to both the people involved and for the conservation of threatened plant species, as: (I) Acquisition of MAPs from cultivated sources can be a more energy efficient process given the right management, and allows for much greater control over both quality and quantity of produce year in year out, (II) Profit is more evenly distributed along the trade network between producers, traders and industry, and (III) Pressure is removed from wild populations of medicinal plant species, and the incentive for illegal trade and violation of protected areas is decreased.

Already the limited cultivation of MAPs that is taking place in Rasuwa, which is centred around Chilime VDC, show results to this effect. Local appraisal is positive, and most people feel that living standards have been raised as a result. Once suitable land is available, cultivation of key MAPs can serve as cash crops with a high potential to supplement subsistence agriculture and to greatly contribute to plant conservation.

4.4 Anthropological research

4.4.1 Research process

When we arrived in Rasuwa district we spoke to local practitioners of plant medicine, filmed plant species, and recorded collection, preparation and distribution methods for these plants as medicines (as our primary topic of investigation). However, as I began to be more involved in the lives of my interpreter and his family and friends, I saw they had particular concerns revolving around the issue of migration for the purpose of foreign work, which drew my attention. At opportunities when we were not conducting research to fit with the other established plans, this line of conversation often prevailed.

4.4.2 Discussion of findings

Some people do better out of migration than others; in the light of the overwhelming writings and discussions on migratory processes associated with labour markets, it generally seems that workers draw the shorter straws. Even if the story does not play out the same with every reading the majority follow that host countries and elites benefit more from the exchange. Experiences that I recounted share common themes such as deception and mistreatment, of long days enduring great exhaustion and poor conditions once the work day was over. This was followed by a resignation that it would not change, and without dismissing the idea of going abroad again, they certainly did not feel keen on going to that particular place again. They would look toward another country that they said treated people with more respect, where it would be easier and less hardship. Accounts like these help pave the way for community members to travel to other places. Many spoke of not wishing to go to Saudi Arabia because they could expect greater problems than in Kuwait and U.A.E, which have now become more popular through word of mouth.

Female migrants have increased in numbers worldwide and of the female migrants in villages I visited many are settled into domestic work most often in the Gulf States. They are cleaning the home, attending to meals (which require being taught new foods and ways of cooking) as well as going to the market for household necessities or in some cases collecting children from school. The work is most often seven days a week and they see no one but the family they tend to and work for. The treatment of the migrants depends on the family they live with. In the majority of cases those spoken to report that they were treated well, paid regularly and without incident. Few saw other Nepalese people or anyone who did not have business at the home. The family were their source of human interaction. When asked what their employers were like the answers were absent of much details. This suggests either a disinclination to speak on the matter to me or else minimal in-depth interactions. This can be partly explained by the language barrier (few, if any, have Arabic when first leaving Nepal) and by what is considered an acceptable relationship for domestic servants and employers.

The men working abroad in the Gulf States were sent to factories. Their accounts establish that they are not being told the nature of the work before travelling, only that the pay and the work would be good. If figures or jobs were discussed they inevitably were false and people would be told of the readjustments to their pay or jobs once they arrive. Conditions tend to be crowded and in many cases facilities and utilities are not properly maintained. The men are in camps with other men and share cooking and cleaning duties on a rota system. The age range was anything from teenage years to men of perhaps sixty or sixty-five years of age. The work was physically tough and the men complained of high temperatures due to factory substances and poor ventilation.

Pay was discussed and from their accounts it seems many had to pay employers for accommodation and food. This was not part of the package of work. I would predict a lot of the money earned could be sent home as remittances after these expenses were paid. However the picture would be incomplete without consideration of gambling. It did seem to be a popular pastime amongst a wide base of Tamang men in the Tamang villages. For all the talk sometimes of having difficulties of making ends meet quite a lot of money was passing hands and I postulate that similar practices went on away from home too.

Much of the benefit derived from going abroad comes from the influence of money and training on one's identity. Many in the community when leaving to work abroad have not a secure financial base; the draw of working abroad is the financial security that it could bring. There is a hope that future plans can more easily materialise and that one's prospects are more attractive to the families of potential husbands and wives (and potential husbands and wives themselves). To have few prospects or reserves of value is not very satisfactory to families when marrying away of their sons and daughters so going abroad could improve chances of agreement. However, there were people who left communities only to return shortly after hence the reservation of better status until a full term abroad and return to home. The stay abroad needs to be fairly substantial because the financing of their travels comes from loans, received from members of their own village or ones further away.

Figure Dance at the village centre of Gatlang as part of a festival celebration

5 Botanical study: Investigation into the biology and conservation of *Meconopsis* of central Nepal

5.1 Introduction

The Himalayan Poppy (*Meconopsis*) genus falls under the family Papaveraceae, and with one European exception, is endemic to the Himalayan region. The genus contains some 50 species distributed throughout mountainous sub-alpine and alpine areas of south central Asia. Recent taxonomic reclassifications and discoveries of new species (Grey-Wilson 2006) are continuously pushing the number of known species up. As presented in table 2, 18 species of *Meconopsis* are native to Nepal, 9 of which are endemic. The current study focused on 6 species of the genus, samples of which have been collected throughout central Nepal.

As a whole, the genus is considered endangered (Sulaiman & Hasnain 1996). Like other regions throughout the Himalayas, the conservational status of the *Meconopsis* species native to Nepal is in great need of identification, and currently is largely unknown. This study aimed to supply data for such a purpose, from an important area of genus' distribution in the central Nepal Himalaya.

The *Meconopsis* genus is also notorious for the high number of medicinal species it contains (that are still readily utilised in traditional medicine throughout the Himalayan region, China, and the Indian subcontinent. Our study also aimed to contribute to the limited research that has been conducted into the phytochemistry of the genus, and especially to that of *M. horridula* (Fig 6), to date.

The genus *Meconopsis* is also renowned as a taxonomically controversial one, and much reshuffling of subgeneric taxa has occurred for nearly two centuries. In many cases the interspecies boundary is ill-defined, due in part to the high level of polymorphism found in the genus. It was therefore an aim of the study to contribute quantitative morphological data for such a purpose.

Figure 6 The thorny blue poppy *Meconopsis horridula*, a species renowned in Tibetan medicine (Photo credit: P.A. Egan)

Table 2 The *Meconopsis* of Nepal and their altitudinal range. The 6 highlighted species were the focus of the study. Endemic and medicinal species are indicated (data assembled from multiple sources)

Species	End.	Altitude	Medicinal
M. bella		3500-5200m	
M. chankheliensis	×	3200–4575m	Δ
M. dhwojii	×	3500-5600m	Δ
M. discigera		3300-4900m	Δ
N. ganeshensis	×	3658–4040m	Δ
M. gracilipes	×	3500-4900m	
M. grandis		3000-5200m	Δ
M. horridula		3000-5800m	Δ
M. lyrata		3000-4800m	
M. napaulensis	×	2700-5200m	Δ
M. paniculata		3000-4500m	Δ
M. pinnatifolia			
M. regia	×	3500-4600m	
M. robusta			Δ
M. simikotensis	×		
M. simplicifolia		3300-5300m	Δ
M. sinuata		2700-4300m	
M. staintonii	×	2590-3810m	Δ
M. taylorii	×	3600-4500m	
M. wallichi		2440-3810m	Δ
Meconopsis sp.			

5.2 Aims

5.2.1 Recap of established objectives

The four main aims of the botanical study as set out in the expedition proposal were as follows:

- Assess conservational status of *Meconopsis* of C Nepal
- Ecological investigation of the species
- Phytochemical investigation of medicinal *Meconopsis* species
- Examine morpho-geographical variance

Originally it was anticipated that analysis of genetic diversity by the RAPD technique would be most apt for assessment of threat in relation to conservational concerns. However, following a detailed analysis of both morphological and phytochemical diversity, it is envisioned that such data may also serve a similar function, and that RAPD analysis would therefore not be needed for such purposes.

5.2.2 Additional objective

Following the discovery of a new species of *Meconopsis* in the field, a full taxonomic description of the species has been undertaken for publication. The species is to be named *Meconopsis autumnalis*, but for the meantime is referred to here as 'Mec. sp.'.

5.3 Results & discussion

5.3.1 Summary

Table 3 below summarizes the study site characteristics, presenting the number of regions that were studied (in reference to figure 1), the maximum and minimum distances between populations which were examined, and the total number of quadrats and individuals sampled per species. For each of the 123 individuals sampled in the field, 5 ecological variables were recorded, if possible, along with measurement of 17 quantitative morphological characters.

Table 3 Study site characteristics

Species	No. of regions studied	Max pop. distance	Min pop. distance	No. quadrats completed	No. individuals sampled
Mec. sp.	1	7.1km	1.80km	4	18
M. horridula	3	41.4km	0.89km	10	47
M. napaulensis	2	22.8km	0.65km	7	27
M. paniculata	3	35.5km	0.69km	8	25
M. simplicifolia	1	0.5km	0.51km	2	6
Total				31	123

5.3.2 Ecology & conservation

Table 4 below summarizes some parameters measured in the field on the abiotic aspects of the species ecology. From the presented data it can be seen that the species studied exhibited a varied range of habitat preference and quite broad ecological niches, and can therefore be classed as 'generalists'. *M. horridula*, however, is confined to a much narrower ecological niche, and is aptly designated a 'specialist'. The biggest contrast exists between *M. horridula* and *M. simplicifolia*, the former an inhabitant of high rocky cliff ledges, the latter found in fertile soil on quite flat ground at much lower altitude. The greatest amount of similarity is between *M. paniculata* and Mec. sp., which display a predominantly overlapping abiotic niche. An account of the biotic ecology of each species, and degree of pressure faced by populations as assessed in the field is presented in Table 5.

Little research has been conducted in the wild on *Meconopsis* ecology, and a lot of what is presently known can be attributed to the keen interest of horticulturalists through their knowledge of germination, propagation etc. However, much remains to be studied in the field, especially on the population dynamics of *Meconopsis*, so important for conservational purposes. Currently, only two

species are classified by the IUCN: *Meconopsis aculeata* (endangered), and *Meconopsis latifolia* (vulnerable). However, the conservational status of the majority of the species remains largely unknown, and it is likely that many more *Meconopsis* warrant an IUCN designation.

Table 4 Abiotic ecology of sampled species of *Meconopsis*

Species	Ecological characteristic	Average	Minumum	Maximum	*n*
M. horridula	Altitude	4748m	4512m	4854m	47
	Slope	60°	40°	85°	47
	Soil pH	7.03	6.56	7.43	32
M. napaulensis	Altitude	4039m	3737m	4433m	27
	Slope	28°	5°	60°	27
	Soil pH	5.91	4.77	6.85	15
M. paniculata	Altitude	3769m	3338m	4147m	37
	Slope	20°	1°	45°	37
	Soil pH	6.22	4.79	7.22	23
M. simplicifolia	Altitude	3736m	3708m	3763m	6
	Slope	16°	12°	20°	6
	Soil pH	5.34	5.17	5.53	6
Mec. sp.	Altitude	3570m	3338m	4081m	18
	Slope	21°	3°	30°	18
	Soil pH	6.90	6.62	6.86	18

It was quite unexpected to find such a wide range of pH values tolerated by *Meconopsis* in the wild. *M. simplicifolia* revealed the strongest preference for acidic soils, while the pH range of *M. horridula* stretched from just below neutral, into truly alkaline soils. The majority of *M. horridula* which we encountered were found growing on steep screes and almost vertical cliff ledges, which perhaps goes to explain the extreme pH of the very thin soil layer in these cracks and crevices. Strict confinement to such difficult to reach habitat may imply that the species' local distribution has been pushed back from lower more open spaces to increasingly isolated positions less grazed and visited by medicinal plant collectors. Despite this, the majority of populations of *M. horridula* encountered were deemed quite healthy, in consideration of age structure and seedling recruitment.

Table 5 Summary of the ecological segregation of the species encountered

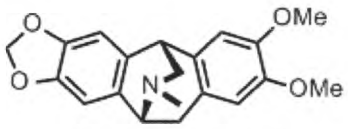
	Bio-climatic zone	Vegetation type	Disturbance
M. horridula	Upper alpine	Scree	Low - Med
M. napaulensis	Upper sub-alpine – Lower alpine	Alpine meadow	Med - High
M. paniculata	Lower sub-alpine – Lower alpine	Alpine pasture	Med - High
M. simplicifolia	Upper sub-alpine	Scrubland	Low - Med
Meconopsis sp.	Lower sub-alpine – Lower alpine	Alpine pasture	Med - High

M. simplicifolia showed a similar situation to *M. horridula* in the fact that its local distribution has most likely been pushed back to within a very small proportion of its potential. The only populations we encountered were located deep into thick sub-alpine scrubland dominated by thorny *Berberis*, thus allowing refuge from grazing pressures (an ecological phenomenon known as 'facilitation'). In several instances we also found thick patches of *Berberis* harbouring healthy *M. napaulensis*, in contrast to individuals of open habitat which were frequently in severely damaged condition. Trampling by grazing livestock is likely to hold a drastic impact on *M. simplicifolia* in particular, considering the ease of which its 1 or 2 long slender pedicels (which bear a solitary flower) are prone to damage. Although *M. paniculata* appeared to grow to a mature state quite happily in heavily grazed areas, seedling

recruitment was commonly very low. Despite its reputation as one of the most widespread of the genus, *M. paniculata* was evaluated as rare, and very much locally aggregated in the Gosainkunda region, though populations were found to overlap on several occasions with those of the more common *M. napaulensis*, and elsewhere with *Meconopsis* sp.

5.3.3 Phytochemistry

Plant samples have been dried in the field using a silica gel technique. Considering the complexity and time consuming process associated with analysis of plant chemical constituents, this aspect of the research is still currently ongoing in the Lab. An optimal methodology and solvent system has now been devised after considerable effort and initial screening by thin-layer chromatography (TLC). The specific focus of the investigation is on alkaloids of the collected species, for which plant samples have undergone grinding in liquid nitrogen, freeze drying, solvent extraction and purification via acid-base type separation. Currently a vast amount of metabolomics data has been generated following subsequent analysis of prepared samples by nuclear magnetic resonance (NMR) spectroscopy, with preliminary analyses looking promising. Alkaloids will also now shortly be quantified by high performance liquid chromatography (HPLC). Sample numbers are in the range of 100-150. Multivariate statistics will be used for the analysis of data, through principal components analysis and other such related methods as relevant.



(+) Amurensinine

Figure 7 Chemical structure of amurensinine, an isopavine type isoquinoline alkaloid typically present in *Meconopsis* species of the series Aculeatae

No previous phytochemical research has been conducted on several of these species of *Meconopsis*, with this study set to represent the first. Previous estimates of the number of species of the genus used medicinally stood at about 14. However, from our subsequent review of the fragmented and often obscure literature existing on this topic, the number can be increased to 25; which now approaches half the genus. Our field study was able to provide the first confirmation of the ethnobotanical use of *Meconopsis napaulensis* in traditional medicine.

The qualitative and quantitative presence of secondary metabolites, especially alkaloids, can reveal important taxonomic information. With such data in hand, it may be possible to contribute valuable taxonomic information on closely related species of the genus, and such chemical data is also ethnobotanically significant. The main class of secondary metabolites present in *Meconopsis* are the structurally diverse isoquinoline alkaloids (Fig 7), for which the genus appears as a rich source. In addition, the relationship between the main alkaloid composites of the sampled species and several measured ecological parameters (including pH, altitude etc.) will be modelled. By this means, it may be possible to deduce the extent (if any) to which expression of secondary metabolites are adaptive to environmental conditions, and whether such expression can also be differentiated geographically.

5.3.4 Morphology

For every individual sampled in the field 17 different morphological measurements were taken, which allowed detection of the degree of morphological variation within and between populations. This data may prove taxonomically useful, as the extent of polymorphism in the majority of Meconopsis species has not been sufficiently established.

In addition to quantitative measurements, variances in some qualitative traits were also noted, in particular that of flower colour. This was found to be more consistent than other morphological traits in most species, except for *Meconopsis horridula*, which exhibited a multitude of petal colours, ranging between pale purple, lilac and sky blue (Fig 8). Many flowers were multi-toned, and displayed a combination of these shades. The colour varieties of *M. horridula* were not isolated geographically, but were typically apparent in a number of individuals within most populations encountered.

Figure 8 The shades of *M. horridula*. **(Left)** lilac and light blue multi-toned petals **(Middle)** A pale purple flowered individual **(Right)** The most typical characteristically sky blue form

Other polymorphic features of *M. horridula* include the presence or absence of dark bases on leaf bristles, and stigma colour. Whether dark bristle bases were present or not differed between individuals *within* populations, though dark bases were observed as most common. However, stigma colour was found to differ *between* populations of *M. horridula*. The stigma in several populations were seen to be a very dull grey-purple colour, while in most populations, the characteristic bright

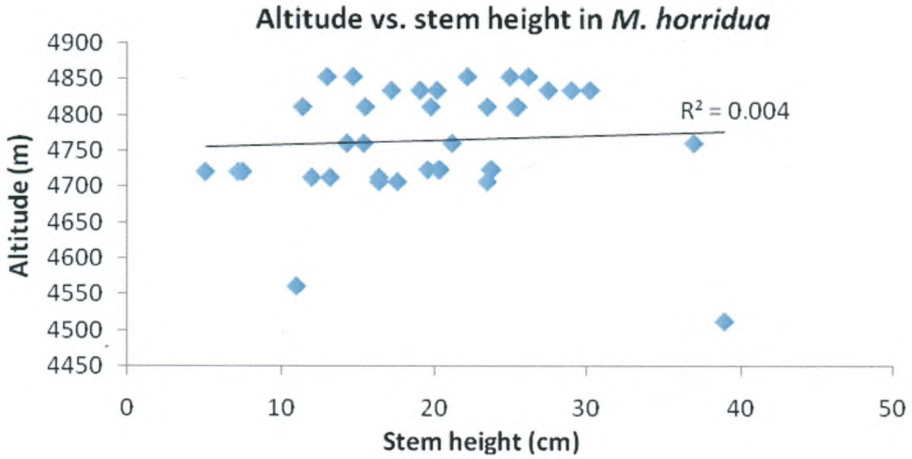


Figure 8 Correlation between stem height and altitude for *M. horridula* was highly insignificant over the sample range, with populations frequently containing both small scapose individuals interspersed with taller racemose plants

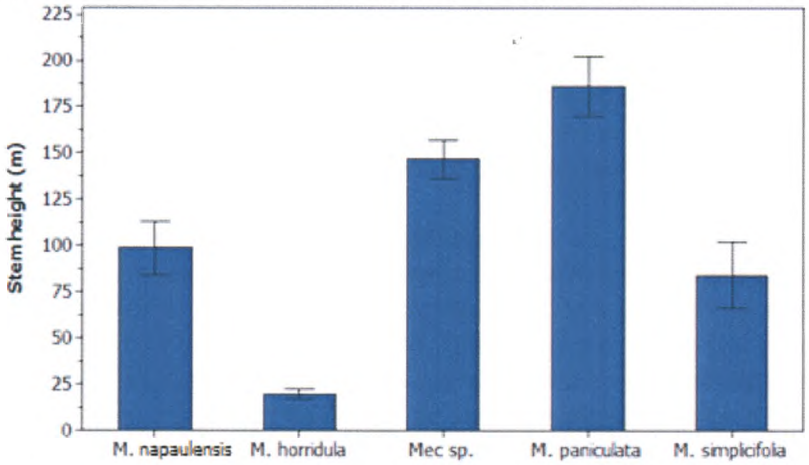


Figure 9 Stem heights of the 5 species of *Meconopsis*, with mean values. 95% confidence interval for the mean

yellow usually associated with the species was evident. Additionally, an insignificant correlation revealed no relationship found between altitude and plant height (Fig 8), despite the commonly held supposition that plant size varies over an altitudinal gradient. Both scapose and racemose forms of *M. horridula* were frequently found within the same population, which has lead to such variance in plant height even throughout a constant altitude. Due to such high intrapopulational polymorphism inherit in the species, it appears that any future attempt at classification of forms or varieties of *M. horridula* based on stem form or flower and bristle colour would appear unfavourable, and thus cannot be recommended.

Of the 5 species of Meconopsis studied, *M. paniculata* was clearly found to be the tallest, with an average height of 186 cm, though mature individuals were found as small as 88 cm, and as tall as 265 cm. Stem height was also found to be quite a varied trait for the other 4 species of Meconopsis studied. The average values for species stem heights are presented in figure 9, which upon analysis have proved statistically different from each other (p =<0.001). The exception to this is in the difference of stem height between *M. napaulensis* and *M.* simplicifolia, which was not found to be statistically different. *Meconopsis napaulensis* was also found to possess a high degree of polymorphism (Fig 10), the extent of which has not been previously noted in the species' taxonomy. The most apparent features which were found to differ between individuals of the same population included stem height (which in fully mature plants ranged from 47cm to 165cm), and capsule dimensions (which ranged from 0.9cm – 3.3cm in length, and from 1.8cm – 4.3cm in circumference).

Figure 10 (Left) Intrapopulational variance in the capsule dimensions of two individuals of *M. napaulensis*, left and right of the measuring tape. Taller capsules were generally found at the tops of plants, and smaller ones from the bottom. Style length seems to remain quite independent of capsule dimensions **(Right)** Three mature individuals of significantly different stature collected from within the same population of *M. napaulensis*

In regard to the as of yet unidentified species of Meconopsis that was studied, figure 11 below reveals that there is a clear distinction in stem height, and to a lesser degree in flower width, in the individuals of 'Mec. sp.' and *M. paniculata* that were measured. Looking at the clustered pattern apparent in the graph, the two species can clearly be segregated based on these two morphological measurements.

Figure 12 reveals a clear segregation of the three species, 'Mec. sp.', *M. paniculata* and *M. napaulensis*, based on the morphological characteristics of stem height and stigma length. It can be seen from the graph that 'Mec sp.' holds a distinct clustering, and can be separated from the other two species most evidently by its large stigma length. The typical size of the plant seems to be in between both that of *M. paniculata* and *M. napaulensis*, which are predominantly taller and smaller respectively. The above data are further evidence that the unidentified species of *Meconopsis* which has been observed in the field holds a unique identity, and has not arisen due to hybridization with other yellow flowered *Meconopsis* of C Nepal.

A species previously said to be found in the upper Langtang valley was *Meconopsis longipetiolata*, but from collected morphological data it was clear to us that the species has indeed been justifiably reduced to synonymy with *M. napaulensis*. It is interesting to note that local botanists, National Park authorities and also WWF have in fact for a long time referred to what we now know as the 'true' yellow-flowered *Meconopsis napaulensis* (endemic to Langtang National Park) as *Meconopsis dhwojii*, which is found about 75km to the east. Indeed the morphological similarity of these two species is striking, with perhaps the most consistently discerning feature the presence of dark blotches on the leaf trichome bases in *M. dhwojii*, which are absent in *M. napaulensis*. This character

is also absent from the closely related *Meconopsis gracilipes*, a species which has previously been recorded from the Langtang region; but again this entity must now be regarded as 'true' *M. napaulensis*. However, given the distribution and degree of similarity of some of these species of the series Robustae, perhaps closer taxonomic relationships exist than are currently recognised, which requires further investigation.

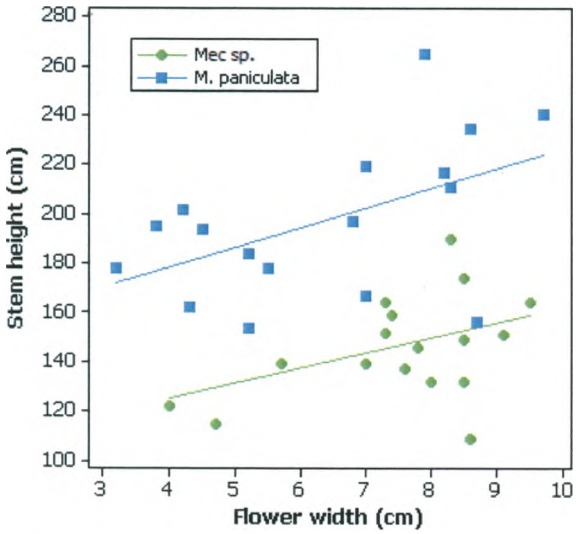


Figure 11 Stem height against flower width in Mec. sp. and *M. paniculata*

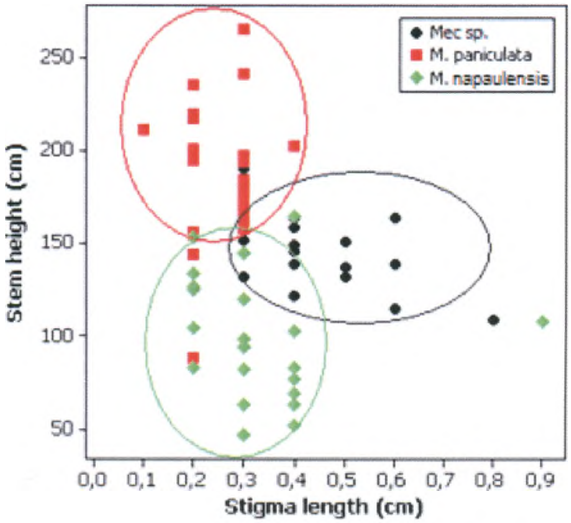


Figure 12 Stem height against stigma length in Mec. sp., *M. paniculata* and *M. napaulensis*

5.3.5 A new species of Himalayan Poppy

In a paper recently submitted for publication, a new species of the genus from the Ganesh Himal of northern central Nepal has been described and illustrated as a result of its discovery made during field research. The species' relationship with closely allied members of the series Robustae is examined, including *Meconopsis paniculata* (D. Don) Prain, from which it is readily delimited morphologically and by apparent pre-zygotic reproductive isolation. Figure 13 below illustrates some differences in capusle morphology between the two species.

Figure 13 Contrast in capsule morphology between *M. panicula*(left) and *M. autumnalis* (right). The apressed fawn bristles and small stigma of *M. paniculata* are in contrast to the more ginger and ascending bristles and large stigma size exhibited by *M. autumnalis*. In addition, the presence of a prominent distinctively coloured receptacle in the latter species is also significant, and is another consistently discerning feature between the species in relation to capsule morphology alone.

6 Budget & Expenditure

6.1 Funding received

A total of £16204 was raised for purpose of the project, received from 21 different funding bodies as listed in 8.2 below. A total of 78 individual funding applications were made, with an overall 4:1 ratio of success. A bare minimum of £15000 in funding was aimed for, with this figure finally reached by the end of May 2008, approximately 6 weeks before the initiation of the project and departure to Nepal.

6.2 Expenditure

		Revised Budget	Spent	Over/under spent
1. Preliminary costs				
Literature (scientific, maps, travelguides)	£	200.00	216.65	16.65
Language study materials	£	50.00	58.98	8.98
Funding applications	£	300.00	400.47	100.47
Interviews	£	50.00	105.00	55.00
Total preliminary costs	**£**	**600.00**	**781.10**	**181.10**
2. Travel				
International Flights	£	2520.00	2794.24	274.24
Transport to/from London Heathrow	£	800.00	837.73	37.73
Other in-country travel	£	200.00	262.78	62.78
Carbon Offsetting	£	113.00	138.81	25.81
Total travel	**£**	**3633.00**	**4033.56**	**400.56**
3. Health & Safety				
Vaccinations	£	350.00	443.08	93.08
First aid training	£	178.00	150.00	-28.00
Team & personal medikits	£	100.00	216.21	116.21
Total health & safety	**£**	**628.00**	**809.29**	**181.29**
4. Administration				
Insurance	£	0.00	0.00	0.00
Research Permits, trekking fees	£	1500.00	1420.77	-79.23
Visas	£	300.00	116.05	-183.95
Total administration	**£**	**1800.00**	**1536.82**	**-263.18**
5. Subsistence				
Food	£	800.00	1045.22	245.22
Non-edible consumables (kerosene, toiletries etc)	£	400.00	265.58	-134.42
Accommodation	£	700.00	897.00	197.00
Communication	£	0.00	90.77	90.77
Total subsistence	**£**	**1900.00**	**2298.58**	**398.58**
6. Equipment				
General	£	800.00	1175.11	375.11
Personal	£	1200.00	1200.00	0.00
Satellite phone	£	520.00	669.75	149.75
Botanic	£	800.00	1057.53	257.53
Anthropological	£	700.00	862.56	162.56
Miscallaneous costs	£	250.00	215.96	-34.04
Total equipment	**£**	**4270.00**	**5180.91**	**910.91**
7. University collaboration				
Collaboration with Tribhuvan University	£	300.00	291.87	-8.13
Guide Fees	£	400.00	311.78	-88.22
Total university collaboration	**£**	**700.00**	**603.65**	**-96.35**
8. Lab work				
Use of laboratory facilities	£	0.00	0.00	0.00
Laboratory consumables and chemicals	£	950.00	520.00	-430.00
Total lab work	**£**	**950.00**	**520.00**	**-430.00**
9. Post-expedition costs				
Final reports	£	256.87	106.87	256.87
Presentations (incl. materials and transport)	£	183.03	83.03	183.03
Total post-expedition	**£**	**439.90**	**189.90**	**439.90**
10. Contingency (%)	**£**	**1473.10**	**0.00**	**-1473.10**
TOTAL		**16204.10**	**16203.80**	**-0.30**

7 Outputs

7.1 Film & Photography

A short anthropological documentary will be produced from footage and sound recordings made during field research. The film aims to present a largely un-narrated cultural depiction of the Tamang ethnic group. Upon completion it is planned for the film to be made available on the project website for download or to view as streaming content. Additionally, during field research a great number of photographs were taken of alpine plants (>1000). These are being continuously identified and distributed to relevant sources appreciative of such images. So far photography has been hosted on the websites of Meconopsis World (www.meconopsisworld.co.uk) and The Meconopsis Groups' 'Portraits of species in the wild' (www.meconopsis.org).

7.2 Herbarium collection

An output of the project is also in the form of herbarium specimens, over 100 of which were collected. These remain to be disseminated to three herbariums, namely Tribhuvan University Central Herbarium, National Herbarium of Nepal, and the Royal Botanic Garden Edinburgh Herbarium.

7.3 Talks

Several presentations based on the research have been made to varied audiences, both in Nepal and the UK, and are summarised in the below table. We have been very pleased at the feedback from these events, and feel that they have been generally well received. Some future talks concerning aspects of the research are also anticipated.

Regrettably, following kind invitation of the University of Aberdeen Expedition Society, the team were unable to present at the Societies talks evening, but have nonetheless provided support to those interested in organising similar ventures from the University.

Figure Marloes Eeftens opening our research project talk held at Tribhuvan University, Kathmandu, Nepal – September 2008

Date	Title	Event/Location
7th September 2008	The ENH08 project	Central Department of Botany, Tribhuvan University, Kathmandu, Nepal
18th October 2008	The ENH08 project	'RGS Destinations 2008' seminar, University of Edinburgh, UK
15th November 2008	Ecology and ethnobotany of some *Meconopsis* of Nepal	Biennial meeting of The Meconopsis Group, Royal Botanic Garden Edinburgh, UK
March 2010	New findings on *Meconopsis*	Biennial meeting of The Meconopsis Group, Royal Botanic Garden Edinburgh, UK

7.4 Reports, articles & scientific papers

A summary of the Final Report is to be made available in Nepali. Reports will be presented to the Department of National Park & Wildlife Conservation and several other Nepali governmental and non-governmental organisations. The prospect of publication of data collected from the botanical study, and during subsequent lab studies, will be explored in either international or Nepalese plant science/botanical journals. Already a taxonomic paper resulting from field work has been prepared and submitted for publication. The Scottish Rock Garden Club has also invited submission of an article which is due to be published in the organisation's journal 'The Rock Garden'. The article is a largely informal account of the expedition, supplemented with images, also covering some of the research topics and findings.

7.5 Project website

A project website was provisionally hosted by the University of Aberdeen during 2008, but is now offline for redesign and relocation to a new server. The University of Aberdeen Herbarium has generously agreed, in kind, to host the new website. A launch date is anticipated in the coming months coordinated with a major revamp of the Herbarium website. In addition to the above mentioned multimedia, the project website is planned to include detailed information on each of the studies, acknowledgements, and several blog entries recorded during fieldwork describing our experiences. It is hoped that the website will evolve along with future research activities, in addition to its primary archival function.

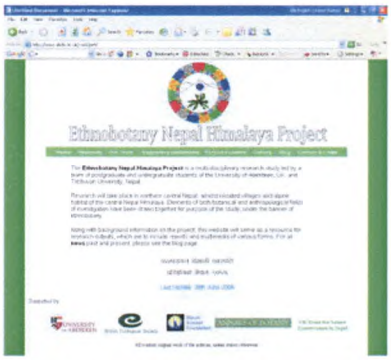


Figure Project homepage as online during 2008

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- **Dr. Mark Watson & Dr. Colin Prendy**, Flora of Nepal, Royal Botanic Garden Edinburgh, UK.

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- **Prof. Dr. Krishna Shrestha**, Prof & Head, Central Department of Botany, Tribhuvan University, Nepal. President, Ethnobotanical Society of Nepal.

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Carnegie Trust for the Universities of Scotland
British Ecological Society
Scottish Mountaineering Trust
Anonymous personal donation
The Hardy Plant Society
Vegetarian Charity
American Alpine Club
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UK Trust for Nature Conservation in Nepal
Southdown Trust

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