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Remarks on the main forest and shrub communities of the Langtang Khela Valley (Langtang Range, Central Himalayas, Nepal)

Krzysztof Świerkosz

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Abstract: During the observations carried out in the Langtang Khela Valley (Langtang National Park) six mains, easy to recognise, plant communities were recorded. Their distribution depends mainly on two most important factors – altitude and the level of anthropopressure. There are three natural forest communities in the Langtang Khela Valley: the moist temperate laurel-oak forest (*Litsea-Quercus leucotrichophora* community – 1800-2600 m a.s.l., in the deep valley of the Langtang Khela), dry mixed temperate forest (*Pinus-Rhododendron arboreum* community – 1800-ca 3000 m a.s.l., on dry rocky slopes) and moist mixed coniferous forest (*Tsuga dumosa-Quercus semecarpifolia* community – 2400-3400 m a.s.l., in the upper part of the valley). The two kinds of shrub communities (temperate *Elscholtzia-Colquohinia coccinea* and subalpine *Rhododendron-Cotoneaster affinis* community) and subalpine meadows up to 3600 m probably have anthropogenic origin.

Keywords: Mountain plant communities, Mountain forests, Vertical distribution of plant communities, Mountains national parks, Langtang - Central Himalayas, Nepal, Asia.

Introduction

In spite of many years' research on the vegetation of the Himalayas, the picture of its vertical and horizontal distribution is still incomplete. This stems from the study area being extensive and also from the climatic and habitat differences between particular sections of this mountain range (Polunin & Stainton 2000). The rapidly advancing degradation of the Himalayas, consequent both on very intense tourism and exploitation by the local people (Numata 1993), requires that the state of ecosystems preserved in different parts of these mountains be promptly described. It will result in more rational management of the Himalayan natural resources in the future and active protection of the ecosystems hitherto preserved.

Material and methods

In early September 2000, I had an opportunity to stay within the Langtang Khela valley in the Langtang National Park. The present paper is a summarisation of the information collected during this period, which includes a preliminary description, details about the species composition and distribution of the basic plant communities. The nomenclature of higher plants adopted is that used by Stainton (1997), Storrs & Storrs (1998) and Polunin & Stainton (2000). The documentation is stored as a part of the WSRL audio collection.

Area of investigation

The area under investigations lies about 70 km N of Kathmandu, in the Central Himalayas, and constitutes a part of the Langtang National Park.

Langtang National Park is the nearest national park to the capital city, Kathmandu, Nepal. This park lies in Rasuwa Nuwakot and Sindhupalchowk Districts of Bagmati Zone of Nepal. The area extends from 32 km north of Kathmandu to the Nepal-China (Tibet) border. The total area of the park covers 1778 sq. km and the Buffer Zone covers 448 sq. km. This is the second largest national park established in 1976 to preserve a unique ecosystem of significant value to the world biodiversity. The complex topography and geography together with the varied climatic patterns have enabled a wide spectrum of vegetation type to be established. These include small areas of subtropical forest (below 1000 m), temperate oak and pine forests at mid-elevation, with alpine scrub and grasses giving way to bare rocks and snow.

About 45 villages (c a. 4500 people) are situated within the park boundaries, but they are not under park jurisdiction. In total, about 16 200 people depend on the park resources for wood and firewood (Shrestha & all. 2001).

There are about 1000 species of vascular plants including many medicinal and endangered species (Malla & all. 1976, Miehe 1988, 1990, 1993). Shrestha & all. (2001) have preliminary described of differentiation of the main forest types of Langtang National Park and Beug & Miehe (1998) characterised the anthropogenic vegetation.

I observed vertical distribution of plant communities in the lower part of the Langtang Khela Valley – from Bharku (1800 m a.s.l.) to Langtang village (3600 m a.s.l.). My trek expedition was going by Barabal (2200 m a.s.l.), Sabryu (2200 m a.s.l.), Bamboo (2000 m a.s.l.), Brigde (2250 m a.s.l.), Rimche (2900 m a.s.l.), Brijsait (3100 m a.s.l.), Gumnachok (3200 m a.s.l.) and Tangsep (3400 m a.s.l.).

The valley being described is flanked by high mountain ranges. The Langtang Range and Pangsang Lekh form the northern edge of the valley. The highest peaks reaching 7245 m a.s.l. (Langtang) and 6571 m a.s.l. (Chenge Liru). The border from the south is created by Goisakund Lekh (reaching 4868 m a.s.l.) and Chimisedang Lekh (up to 5870 m a.s.l.). The area under observation was about 20 km long and covered about 60 km^2.

Climatic data are lacking, but another, comparable area (Bir & all. 1987; Kikuchi & Ochba 1988a) displays general climatic aspects that are also typical of the one discussed in this paper. The temperature shows usual montane variation. The daily temperature decreases with the vertical temperate gradient, which ranges from 0.44 to 0.56°C/100 m (Kikuchi & Ochba 1998a), and in the monsoon season in the Rolwaling Himal (Central Nepal, about 90 km east of Langtang) reaches from 20°C (2000 m a.sl.) to 15°C (3000 m a.s.l.). The mean winter temperature at 2000 m a.s.l. is about 4°C, but at 3000 m a.s.l. and higher up, it is around the freezing point. In the Western Himalayas (Garhwal, North India, 500 km west of Langtang) the annual rainfall in the temperate zone varies from 1000 mm to 2500 mm, and in the area of mixed coniferous forest (1800-2500 m) reaching 1100-1800 mm (Bir & all. 1987). Winter snowfalls are heavy from 2500 m a.s.l. and higher up.

The Langtang range and its neighbourhood are built by various kinds of effusive rock – leucogranites, mylonites and pseudotachylytes (Schramm & all. 1998). Reynolds & all (1998) investigated the hydrochemistry of streams in this range.

Results

1. *Litsea-Quercus leucotrichophora* community

Moist temperate laurel-oak forest. The canopy is dense and evergreen, many trees reaching 35-40 m. The dominating species are *Quercus leucotrichophora* and *Lithocarpus pulcherrimus* with *Castanopsis indica* and *Schima wallichii*. *Alnus nepalensis* is locally dominant on riverbanks, where it composes purely, homogeneous patches. The second storey is not so dense and it is made up by many evergreen species. The commonest are *Litsea doschia*, *Lindera pulcherrima*, *Quercus floribunda*, *Lyonia ovalifolia*, *Brassaiopsis hainla*, *Rhus succedana* and *Gmelina arborea* (on the riverbanks). The shrubby undergrowth is not so dense either, its place being taken by tall herbs. In the herb layer the most important for recognising this community are subtropical species such as *Peperomia tetraphylla*, *Rhapidophora glauca* and some species of *Adiantum*. The soil is moist and humid with many nitrophilous species growing here (*Boehmeria platyphylla*, *Urtica dioica*, *Pteracanthus urticifolius*, *Impatiens urticifolia*, *Pilea scripta*, *Arisaema tortuosum*, *Commelina paludosa*, *Arundinaria* sp. and *Girardinia diversifolia*). Climbers are locally common – the most frequent are *Smilax aspera*, *Hedera nepalensis*, *Ampelocissus rugulosa*, *Herpetospermum pedunculosum* and *Dioscorea deltoidea*. *Selaginellaceae*, ferns (*Polystichum* cf. *aculeatum*, *Blechnum*

cf. *orientale*, *Polypodium* sp. and others), epiphytic lichens and mosses occur very commonly as well.

This community covers the lowest part of the Langtang Khela Valley, from the Bhote Kosi river to Bridge village, and some small valleys of the streams opening to the Langtang Khela river in areas covered by *Pinus-Rhododendron arboreum* community. The border of *Litsea-Quercus leucotrichophora* community vertical distribution lies at about 2300-2600 m a.s.l., only occasionally higher.

2. *Pinus-Rhododendron arboreum* community

Dry mixed temperate forest. The canopy is rather lax and built mainly by *Pinus roxburghii* (only in the lowest part) and *Pinus wallichiana* (from about 2200 m a.s.l.). In some parts of this forest the Pine builds probably only the early successional stages (Bargali & Bargali 1999). In the second storey, oaks (*Q. lanata, Q. floribunda*) and *Rhododendron arboreum* are very common, but we can also meet *Hydrangea aspera*, *Lyonia ovalifolia*, *Lindera pulcherrima*, *Rhus succedanea* and *Rhus javanica*. The shrub understorey is locally very dense with *Colquohounia coccinea*, *Mahonia nepaulensis*, *Osbeckia stellata*, *Berberis* cf. *aristata*, *Elchotzia flava* and other species. The common plants of the herb layer include *Pteridum aquilinum*, *Pteris cretica*, *Hedychium* cf. *spicatum*, *Solidago virgaaurea*, *Delphinium denudatum*, *Anaphalis triplinervis*, *Rubia tinctoria*, *Anemone vitifolia*, *Cirsium wallichi*, *Desmodium* sp., *Agrimonia pilosa*, *Hypericum perforatum*, *Inula cappa*, *Polygala sibirica*, *Senecio chrysanthemoides* and *Senecio graciliflorus*.

Near springs, streams or in open spaces we can find moister species such *Saxifraga parnassifolia, Lilium wallichianum, Chlorophytum nepalense, Satyrium nepalense, Begonia picta, Cyanotis vaga, Commelina paludosa* and *Pedicularis* sp.

Many dwarf bamboos and ferns grow here. Epiphytic mosses, ferns (*Hymenophyllaceae*) and lichens are very common, mainly on the trunks of old oaks. Climbers are very rare.

This community covers the rocky slopes of the Bhote Kosi and Langtang Khela Valley from 1900 to about 3200 m a.s.l.

3. *Elscholtzia-Colquohinia coccinea* community

A shrub community in cleared forests, with *Erythrina arborescens, Elscholtzia flava, Elscholtzia fruticosa, Colquohinia coccinea, Mahonia napaulensis, Berberis* cfr. *aristata, Gaultheria fragrantissima, Pieris formosa*, *Rosa* sp., *Osbeckia nepalensis* and *Osbeckia stellata* (both to 2400 m a.s.l.). In the Langtang Khela Valley dwarf bamboos (*Arundinaria* sp. dif.), *Cyathula tomentosa* and *Debregeasia longifolia* cover numerous patches of this community. Many herbaceous plants occur here, too. These are *Chlorophytum nepalense, Lobelia seguinii* var. *doniana, Pteracanthus urticifolius, Dipsacus inermis, Thalictrum virgatum, Senecio* sp., *Geranium wallichianum* and *Anaphalis triplinervis*.

In the neighbourhood of villages and in areas disturbed by grazing cattle, many nitrophilous species are recorded (e.g. *Boehmeria platyphylla, Pilea scripta, Girardinia diversifolia, Lecanthus peduncularis, Cirsium verutum* and others). At lower altitudes (up to 2200 m a.s.l.) *Zanthoxyllum armatum* and *Boehmeria rugulosa* are also common components of this community. In the older stands of this association we can meet a single specimens of *Pinus wallichiana, Alnus nepalensis, Quercus* spp. dif., *Rhus javanica* or other trees. This community occurs between 1800 and 2700 m a.s.l.

4. *Tsuga dumosa-Quercus semecarpifolia* community

Moist mixed oak-coniferous forest. The dominant trees are *Quercus semecarpifolia*, *Tsuga dumosa, Picea smithiana* and *Quercus leucotrichophora*; the highest trees reaching 25-30 m,

and the canopy is very dense (about 70-90%). The second storey is fairly dense and contains *Rhododendron arboreum, Acer cappadocicum, Acer* cf. *acuminatum, Sorbus rhamnoides, Pyrus paschia* and other species. The shrub understorey is fairly lax. In the biggest gaps in the canopy *Colquohounia coccinea, Gaultheria fragrantissima* (up to 2900 m a.s.l.), *Pieris formosa, Rubus paniculatus, Rhododendron campanulatum* and *Piptanthus nepalensis* grow.

The most typical herbs here are *Delphinium denudatum, Dubyaea hispida, Senecio wallichii, Thalictrum virgatum, Aconogonum molle, Arisaema tortuosum, Boehmeria platyphylla, Oxalis latifolia, Pteracanthus urticifolius* and various species of *Hedychium*.

This community occurs in the Langtang Khela Valley from 2400 to 3400 m a.s.l. At lover elevations (up to 2700 m) the dominant trees are deciduous oaks and maples, with an admixture of coniferous species. In the highest section of the valley coniferous species play a more important part, and about the timberline they compose almost pure patches.

5. *Rhododendron-Cotoneaster affinis* community

Dense subalpine shrub forest with a group of *Rhododendron* species as a dominant. This community is building by many species. The commonest are *Aster albescens, Cotoneaster affinis, C. frigidus, C. microphyllus, Juniperus recurva, Hedysarum campyocarpon, Hippophae salicifolia, Piptanthus nepalensis, Rhododendron campanulatum, Rh. lepidotum, Vaccinium vacciniaceum, Viburnum mullacha, Zanthoxyllum nepalense, Rosa* (2 sp.) and *Berberis* sp. In the stream valleys and on the fronts of moraine elevations, small trees of *Larix himalaica, Tsuga dumosa, Picea smithiana* and *Sorbus rhamnoides* occur in this community, too. Its herb layer contains both forest (*Thalictrum virgatum, Polygonatum verticillatum, Delphinium denudatum, Dubyaea hispida, Corydalis juncea*) and subalpine meadow species (*Allium wallichi, Aconogonum molle, Bistorta amplexicaulis, Cirsium falconeri, Chlorophytum nepalense, Erigeron multiradiatus, Roscoea purpurea, Rubus nepalensis, Satyrium nepalense*). The alpine shrub community occurs from 3200 to 3400 m a.s.l., and is probably of anthropogenic origin, but, on the other hand, *Rhododendron campanulatum* and *R. arboreum* were reported as species separating the alpine zone from the timberline (Semwal & Gaur 1981).

6. Subalpine meadows

The subalpine meadows grow from about 3300 to 3600 m a.s.l. (occasionally higher) and they have probably anthropogenic origin. The commonest species include *Allium wallichi, Cremanthodium retusum, Cyananthus lobatus, Delphinium denudatum, Erigeron multiradiatus, Euphorbia wallichi, Festuca* cf. *rubra, Geranium donianum, Herminium monorchis, Iris goniocarpa, Juncus thomsonii, Morina longifolia, Morina polyphylla, Oxyria digyna, Parnassia* cf. *nubicola, Pedicularis megalantha, Polygonatum hookeri, Leontopodium* sp., *Ranunculus brotherusii, Rheum australe, Rhodiola bupleuroides, Satyrium nepalense, Saussurea fastuosa, Saxifraga* cf. *brachypoda, Saxifraga parnassifolia,* and *Spiranthes sinensis*, in its autumn form with pink flowers (Sadruddin 1989). The species composition is very close to the association occurring in the Rolwaling Himal south-eastern fringe (eastern part of Central Nepal) at 4100-4800 m a.s.l. and described by Kikuchi & Ochba (1988b) under the name of "*Kobresia hookeri* community".

Discussion and conclusions

The communities growing in the Langtang Khela Valley (Fig. 1) are very interesting and, in the most, well preserved in spite of disturbance by anthropopressure. Their vertical distribution and floristic composition are very close to those of the communities known from the Garhwal Himal range (Western Himalayas, North India) described by Bir & all. (1987) and from the neighbourhood of Khatling Glacier (Negi & all. 1987). The natural Himalayan plant communities of many

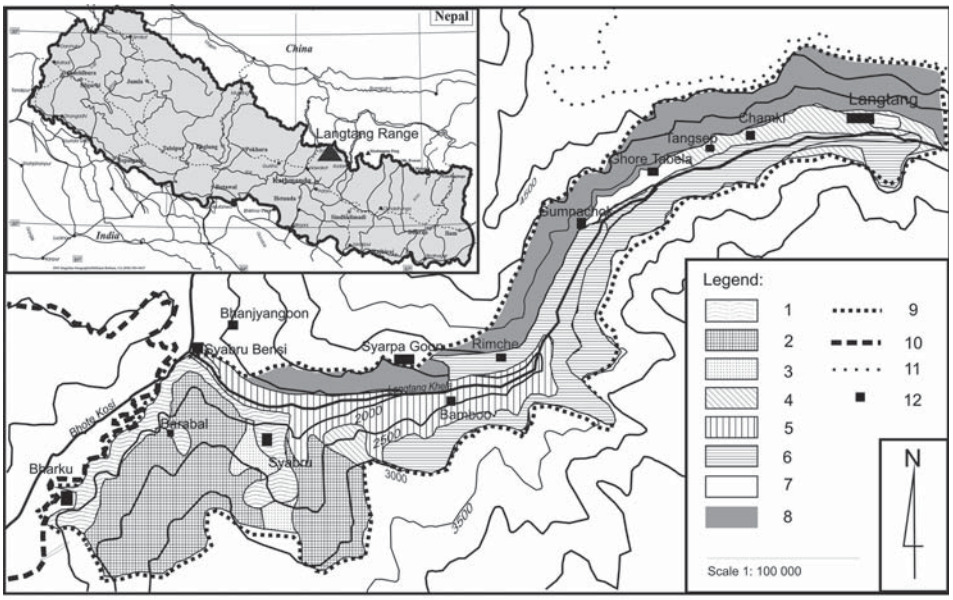

Fig. 1. The map of real vegetation of Langtang Khela valley (scale 1:100 000)

1 – the rice-fields, gardens and synanthropic communities
2 – *Pinus-Rhododendron arboreum* communitity
3 – *Elscholtzia-Colquohinia coccinea* community
4 – *Rhododendron-Cotoneaster affinis* community
5 – *Litsea-Quercus leucotrichophora* community
6 – *Tsuga dumosa-Quercus semecarpifolia* community
7 – rocks and rock's plants communities
8 – alpine meadows
9 – area of investigation
10 – roads
11 – ice line
12 – villages

other investigated areas have almost completely been destroyed by human pressure and now there is no possibility to compare it with the Langtang Khela valley vegetation (a. g. Kapahi & Sarin 1977, Pant & Naithani 1981, Bhattacharyya & Uniyal 1982)

The moist temperate laurel-oak forest (*Litsea-Quercus leucotrichophora* community) occurring between 1800 and 2300 (2600) m a.s.l., highly resembles the "moist temperate Oak-forest" (Fig. 2) with *Quercus leucotrichophora, Rhododendron arboreum, Lyonia ovalifolia, Litsea elongata, Neolitsea umbrosa, Persea odoratissima* and others (Bir & all. 1987), which occupies the lowest zone of the temperate belt in Garhwal (1500-2200 m a.s.l.). Similar kind of forest, with *Pinus roxburghii, Eurya acuminata, Junglans regia* and *Ilex dipyrena*, was recorded from the Khatling valley (Negi & all. 1987), however, the floristic composition of its undergrowth suggests that it may represent quite a different type of community.

The moist mixed oak-coniferous forest (*Tsuga dumosa-Quercus semecarpifolia* community) has almost the same vertical distribution and floristic composition as "Kharsu Oak forest" distributed between 2500-3300 m a.s.l., although in the area of the Garwahl Himalaya – instead of *Tsuga dumosa – Cedrus deodara* and *Abies pindrow* are important components of the composition (Bir & all. 1987, Negi & all. 1987). In the Nanda Devi Massif this kind of forest, with dominance of *Abies pindrow* and lacking deciduous trees except for *Rhododendron arboreum* and *Betula utilis*,

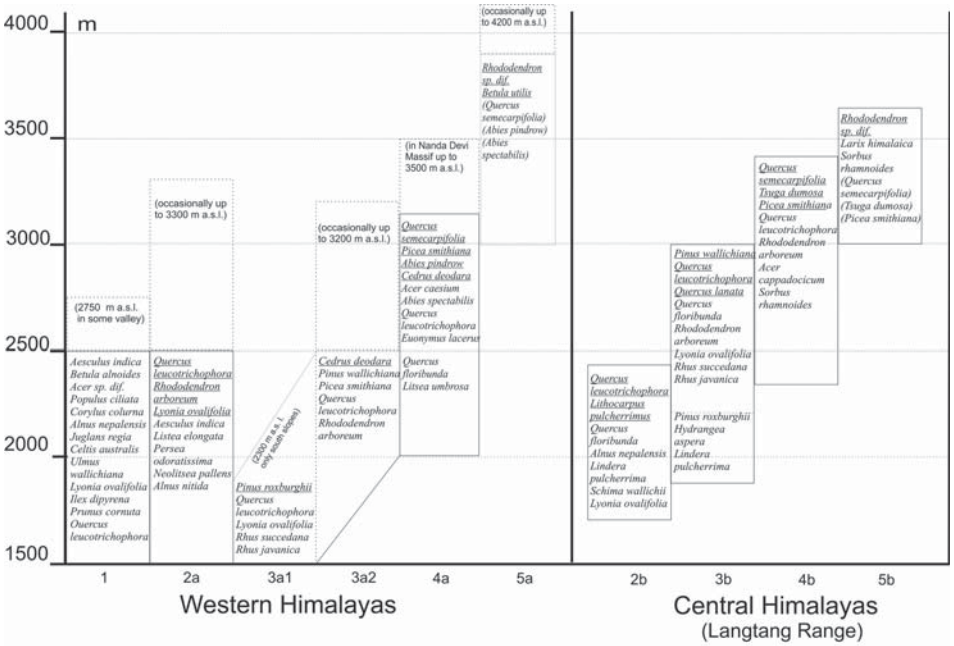

Fig. 2. The vertical distribution and the main tree species composition of the forest communities in the Western Himalayas and the Central Himalayas (Langtang Range).

Western Himalayas (Bir & all. 1987; Negi & all. 1987 and Lavkumar 1978):
1 – Moist Temperate Deciduous Forest (no similar community in the Langtang Khela Valley)
2a – Himalayan Chir Pine Forest
3a1 – Moist Temperate Oak Forest
3a2 – Moist Deodar Forest
4a – Kharsu Oak Forest (incl. Moist Mixed Coniferous Forest)
5a – Birch-Rhododendron Shrub Forest
Central Himalayas (Langtang Valley):
2b – *Pinus-Rhododendron arboreum* communitity (similar to 2a)
3b – *Litsea-Quercus leucotrichophora* community (similar both to 3a1 and 3a2)
4b – *Tsuga dumosa-Quercus semecarpifolia* community (very similar to 4a)
5b – *Rhododendron-Cotoneaster affinis* community (very similar to 5a)

reaches up to about 3500 m a.s.l., to Ramani in the Rishi valley (Lavkumar 1978).

A kind of equivalent of *Pinus-Rhododendron arboreum* community in the Gharwal Himalaya is the "Himalayan Chir Pine forest" (Bir & all. 1987), of clearly subtropical characters, but reaching up to 1800 m a.s.l. and devoid of *Pinus wallichiana*, which in the region concerned occurs in the moist deodar forest between 1700 and 2500 m a.s.l. South-east from Nepal, the Meghalaya Range (Assam, North-East India) area between 1200 and 1900 m a.s.l. is occupied by a similar forest, composed of *Pinus kesiya*, *Alnus nepalensis*, *Schima khasiana* and some species of *Quercus* (Rao & Kharkongor 1978). The floristic composition of its herb layer, however, has a more termophilous character and the forest is called "subtropical" (Rao & Kharkongor 1982).

The community of *Elscholtzia-Colquohinia coccinea* has almost the same floristic composition as the shrub communities observed by Negi & al. (1987) in the Khatling valley (North India), near Ghutoo village (1500 m a.s.l.). In this case the dominating species are *Alnus nepalensis, Zanthoxyllum armatum, Rhus parviflora, Debregeasia salicifolia*, with an admixture of various species of *Rosa*, *Berberis* and *Desmodium*.

Another shrub community dominated by *Ribes grossularia* and *Rosa sericea* (or *R. webbiana*),

occurs in areas more disturbed by anthropopressure. It was reported from the vicinity of Burphu and Tola villages in Kumaon at an altitude about 3000 m a. s. l (Pant & Naithani 1981), and from Lahaul district (Kapahi & Sarin 1977). Some species of *Berberis*, *Rubus, Cotoneaster* and *Juniperus* (common in Langtang Khela) are only additional elements in its composition.

Subalpine meadows observed in the Langtang Khela valley are very close to the communities with domination of *Kobresia hookeri*, which are very common throughout the alpine zone (4000 m a.s.l and more) from the Western Himalayas (Miehe 1982 after Kikuchi & Ochba 1988b) and Tibetan Plateau (Hou 1983). In the Langtang Valley, however, its distribution moves down to 3300 m a.s.l., probably due to destruction of the primeval forest communities for fuel, house building and intensive grazing. The natural alpine meadow in the Himalayas occurs from about 4000 m a.s.l. to the alpine mat at an elevation of about 5000 m a.s.l. (Numata 1993).

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Poznámky k hlavním lesním a křovinným společenstvům údolí Langtang Khela (pohoří Langtang, Střední Himálaj, Nepál)

Autor popisuje hlavní lesní a křovinná společenstva v údolí Langtang Khela a přidává též charakteristiku alpínských luk. Studované území leží v intervalu 1800 až 3600 m n.m. Komentuje také ekologické podmínky a lidské zásahy v tomto území.

Author address: Krzysztof Świerkosz, Museum of Natural History, Sienkiewicza 21, PL-50-335 Wrocław, Poland; krissw@biol.uni.wroc.pl