

Biogeographic delineation of the Indian Trans-Himalaya: need for revision

Biogeography based conservation planning is an important and effective tool for locating, configuring and maintaining the natural areas that are protected and managed to promote the persistence of biodiversity¹. In the absence of this approach, countries are likely to have a biased representation of ecosystems². India is one of the few countries which has done a massive exercise to prepare a biogeography based protected area planning^{3,4}. This classification has recognized three hierarchical units, viz. the biogeographic zone, the biotic province and the sub-regions. The classification separates Indian Trans-Himalaya (TH; Zone I) from the main Himalaya³. The former is located in the rain-shadow zone beyond the Greater Himalaya covering 5.6% of India's total geographical area^{3,4}.

While analysing the floristic and faunal diversity of the Northwest and Western Himalaya, the present authors realized that the biogeographic delineation of the Indian TH needs slight modification. This communication deals with the justification for revision of Biogeographic Zone I.

The TH is characterized by sparse treeless vegetation, often dominated by alpine dry scrub (scrub steppe), alpine dry pastures (desert steppe) or mixed herbaceous formations and low primary productivity with a short growing season. Owing to its location on the leeward side of the Himalaya that blocks much of the annual monsoon-bearing winds, thus creating desert-like conditions, short growing season and low temperature due to high elevation, this area is also referred to as 'high-altitude cold desert'. In India, the cold deserts are spread across three biogeographic provinces, viz. 1A, i.e. Ladakh mountains: Kargil, Nubra and Zaskar in Jammu and Kashmir, and Lahaul and Spiti in Himachal Pradesh; 1B, i.e. Changthang Plateau in eastern Ladakh which is contiguous with the Tibetan Plateau^{3,4}. These provinces are usually located more than 4000 m amsl, and their ecology and biogeography are unique. Owing to the extensive use of these areas for livestock grazing, they are often referred to as 'Trans-Himalayan rangelands'. These rangelands are character-

ized by harsh climatic conditions such as high diurnal fluctuation in temperature scanty and erratic rainfall (<50 mm), heavy winds during summer and heavy snowfall during winter. This region is also home to a large number of threatened species of flora and fauna. Wild mammals such as snow leopard (*Panthera uncia*), Himalayan marmot (*Marmota himalayana*), Tibetan woolly hare (*Lepus oiostolus*), Blue sheep (*Pseudois nayaur*), Tibetan argali (*Ovis ammon hodgsoni*), Tibetan gazelle (*Procapra picticaudata*), kiang (*Equus kiang polyodon*) and Himalayan ibex (*Capra sibirica*) inhabit and utilize these rangelands for food and shelter. As a result of aridity, this region is floristically impoverished compared to the adjacent high-altitude areas of the Greater Himalaya^{5,6} which receive greater amount of rainfall. The vegetation of this region has been described as *Caragana-Lonicera-Artemisia* formation⁷, Alpine steppe⁸, dry Alpine scrub⁹ and Alpine stony deserts¹⁰.

Uttarakhand contributes approximately 1.5% (ca. >1500 km²) of the total cold-arid region of India (ca. 98,660 km²) covering upper catchments of Nilang (Jadh Ganga, Uttarkashi) and Niti and Mana (Chamoli) valleys in Garhwal region, and Johar, Darma and Byans

(Pithoragarh) valleys in Kumaon region (Figure 1). Kinnaur in Himachal Pradesh covering valleys such as Satluj, Hangrang, Ropa, Sangla and Bhaba represents a cold-arid region. Similar to the TH region, these arid mountainous tracts constitute the sediments of the Tethyan sea bed. The dry and undulating slopes in these areas are characterized by dwarf and thorny bushes such as *Caragana* spp., *Kraschennikovia ceratoides*, *Hippophae tibetana*, *Astragalus* spp., *Lonicera spinosa*, *Potentilla rigida* and cushioned vegetation comprising species of *Thylacospermum*, *Androsace* and *Arenaria*¹¹⁻¹³. Compared to other areas of the main Himalayan range, the plant diversity is relatively low due to high aridity. The dry sub-alpine forests (*Betula utilis*; remnant patches) and dry temperate forests (*Pinus wallichiana*, *Pinus gerardiana* and *Cedrus deodara*) in the lower reaches of the interior valleys in Western Himalaya are relatively absent in Northwest Himalaya (Ladakh mountains, and Lahaul and Spiti)¹⁴. Due to comparatively narrow valleys in cold-arid regions of Uttarakhand and Kinnaur, the characteristic landforms such as table lands and marshy meadows are absent¹⁴. Although TH vegetation is distinguishable from that of Himalayan alpine by

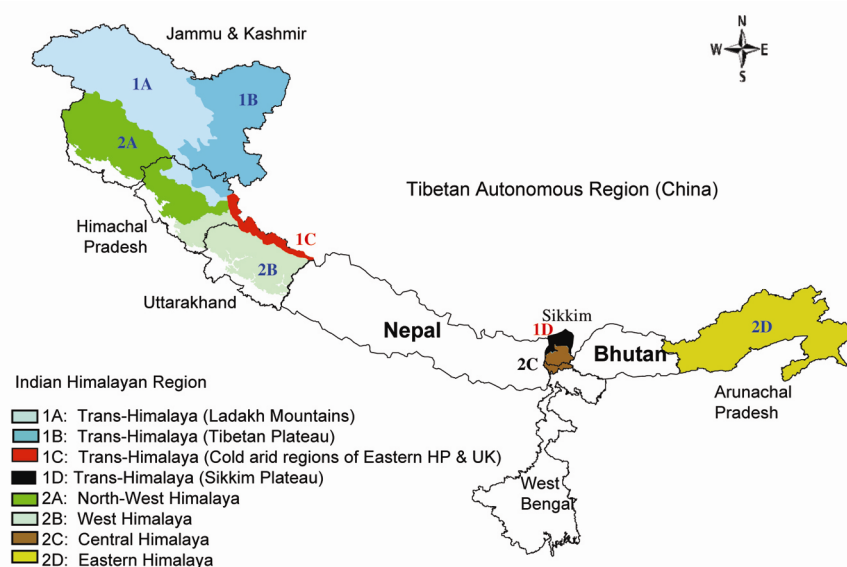


Figure 1. Map showing the proposed areas under the new Trans-Himalayan Biogeographic Province (1C: HP, Himachal Pradesh; UK, Uttarakhand) of India.

Table 1. Biogeographic classification of the Indian Trans-Himalaya

| Biogeographic zone | Province | Details | Remarks |
|----------------------------|----------|---|--|
| Trans-Himalaya (Zone 1) | 1A | Ladakh mountains in the northwest | Diversity of dry habitats, rugged mountains inhabited by Ibex and wide variety of wildlife |
| | 1B | Tibetan Plateau comprising Eastern Ladakh and adjacent parts of Spiti | Characterized by alpine-arid pastures, desert steppe, marsh meadows and brackish water lakes |
| | 1C | Cold-arid regions of Kinnaur, Himachal Pradesh and Uttarakhand | Comparatively narrow and rugged valleys; table lands and marshy areas are negligible |
| | 1D | Sikkim Plateau | Characterized by moist alpine scrub, morainic scrub, Tibetan argali, Tibetan gazelle, southern kiang, etc. |

virtual absence of krummholz formations and extensive moist meadows¹⁵, presence of species having similar appearances such as *Juniperus indica*, *Juniperus communis*, *Rhodiola quadrifida* and *Rheum moorcroftianum* found in the main Himalayan range, and *Juniperus recurva*, *Juniperus pseudosabina*, *Juniperus semiglobosa*, *Rheum tibeticum*, *R. spiciforme* and *Rhodiola tibetica* in the TH often creates ambivalence. Apart from the characteristic geology and floristic diversity, these cold-arid regions have a variety of TH mammal species such as snow leopard, Himalayan brown bear, blue sheep, Himalayan musk deer, Himalayan marmot, Himalayan stoat, red fox, Royle's pika and Tibetan woolly hare¹⁶.

Although these cold-arid areas are currently placed under the 'West Himalaya Biotic Province' (2B), they pronouncedly exhibit geological, botanical and faunal affinities with the TH region¹¹⁻²². The current classification of Indian Biogeographic Zones does not consider this geo-botanical affinity to the TH. Therefore, considering the unique floristic diversity, fauna and geology of the cold-arid regions of Kinnaur, HP and Nilang, Niti, Mana, Johar, Darma and Byans valleys in Uttarakhand along the Northern frontiers, we propose inclusion of these valleys as a new Trans-Himalayan Biogeographic Province (1C) of India (Table 1). As a result, the Sikkim Plateau which is currently under '1C' should be denoted as '1D' in the revised Biogeographical Classification of India.

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