



GENETIC EVIDENCE OF ALLOPATRIC SPECIATION OF SIBERIAN IBEX IN INDIA

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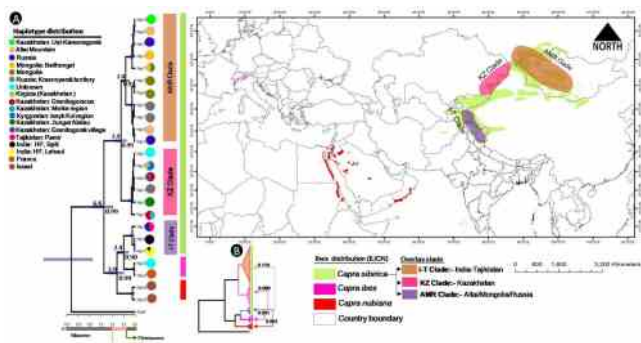
Siberian ibex (*Capra sibirica*) is distributed in the diverse habitats ranging from cold desert, rocky outcrops, steep terrain, high land flats and mountain ridges to low mountains and foothills. In Mongolia, its distribution is patchy and mainly distributed in the rugged terrain throughout the western half of the country, in the central and south-central Mongolia. Its distribution further extends towards Altai, Hangai, Gobi-Altai and Hurkh Mountain Ranges and it also inhabits in the Sayan Mountains near the Russian border with scattered populations in the small mountains of Trans-Altai Gobi. In Asia, Ibex is distributed in the montane habitats, ranging elevation from 500-6700 m asl in different range countries such as India, Kazakhstan, Kyrgyzstan, Tajikistan, Mongolia, Pakistan and southern Siberia and China. In India, the Siberian ibex is distributed mainly in the Trans-Himalayan ranges of Union Territory of Ladakh and Jammu & Kashmir Jammu & Kashmir, and Himachal Pradesh up to the river Satluj. Interestingly, it has not been yet established whether, the Siberian ibex is a distinct species or a subspecies of *Capra ibex* (Shackleton 1997). However, it has been advocated in the past that Siberian ibex should be considered as a distinct species from the *Capra ibex*.





To unravel the complexity in species recognition of Indian ibex, we collected thirty faecal samples of ibex from the Lahaul and Spiti, Himachal Pradesh, India that yielded two haplotypes. However, the inclusion of the available sequences of Siberian ibex from various ranges countries/areas viz. Altai Mountain, Kazakhstan, Kyrgyzstan, Russia, Mongolia, Tajikistan: Pamirs regions yielded 20 haplotypes, and Bayesian-based phylogeny clustered them into three major clades i.e. I-T, KZ and AMR Clades. I-T clade represented India and Tajikistan; the KZ clade represented Kazakhstan and AMR clade represented sequences from Altai mountain, Mongolia and Russia. Surprisingly, I-T clade (presently known as Siberian ibex) was estimated to have diverged from the Alpine ibex during the early Pleistocene epoch (~ 2.4 mya) than the Siberian ibex during Miocene-Pliocene boundary (~6.6 mya, Fig 1 a&b). I-T clade was found to be adequately diverged from the KZ clade found in Kazakhstan and AMR clade

found in Mongolia (Fig 1 a & b) on the set 10x threshold of mean intra-specific distance criterion-. This piloted observation indicated that I-T clade, found in India and Tajikistan is not the same species of Siberian ibex distributed in KZ and AMR clade. This unique observation was corroborated by the species divergence during the Pliocene (~ 3.9 mya) between I-T clade and the Nubian ibex.





ZSI conducted this research with the financial support received from Ministry of Environment, Forest and Climate Change (MoEF&CC) under the National Mission on Himalayan Studies. ZSI scientists found a strong phylogeographic structure with respect to the geographical origin of the samples, including different haplotypes in Lahaul and Spiti valley from India that supported the hypothesis of long isolation histories under the influence of climatic-topographic oscillations. Further, the paraphyletic arrangement of clades in the Bayesian phylogeny strongly evident that there are species complexes in Siberian ibex, plausibly comprising of at least two species i.e. one - the I-T clade and the other is the KZ - AMR clades, which are then divided into three to four subspecies (one each in I-T & KZ clade and two in AMR clade). Evolutionary history suggested that the genus *Capra* radiated from central Asia from the 'Ibex type' and 'bezoar-type' ancestors, and among these, ibex subsequently bifurcated to westward and isolated in two separate species e.g., *Capra ibex* and *Capra nubiana*. Furthermore, ibex dispersed to India, forming an edge population and restricted only up to Trans-Himalayan ranges of Himachal Pradesh, Western Himalayas.

In conclusion, the present study demonstrated that ibex found in India to Tajikistan are adequately diverged from the Siberian ibex found in Altai mountain, Russia and Mongolia and showed relatively recent divergence from Alpine and Nubian ibex. Further, the Siberian ibex of Altai mountain, Russia and Mongolia also significantly diverged from the Kazakhstan, proving a strong signature of genetic isolation throughout this large landscape.



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