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Genetics, habitat, diet, and predator prey relationships of brown bears and other carnivores in the Himalayas, Nepal

(ネパール・ヒマラヤにおけるヒグマおよびその他の肉食動物の遺伝子、生息地、食性ならびに捕食被食の関係)

Abstract

High altitude ecosystems of the Nepal Himalayas harbor a unique assemblage of large carnivores whose ecological roles, evolutionary histories, and conservation status remain poorly understood due to extreme terrain, low population densities, and limited research. Among them, the brown bear (*Ursus arctos*), particularly the Tibetan subspecies (*U. a. pruinos*us), is one of Nepal's rarest and least studied mammals. This thesis provides the first comprehensive, multi-disciplinary investigation of carnivore genetics, habitat suitability, diet, and predator–prey dynamics in the trans-Himalayan landscapes of the Upper Mustang. By integrating non invasive molecular genetics, species distribution modeling, dietary analysis, and camera trap based ecological monitoring, the study generates new baseline knowledge essential for evidence-based conservation planning in the region.

Chapter I establishes the first molecular confirmation of the Tibetan brown bear in Nepal. Using 10 non-invasive samples collected between 2022 and 2024, mitochondrial DNA sequencing and microsatellite genotyping identified two genetically distinct individuals one from Shey-Phoksundo National Park (Dolpa) and one from the Annapurna Conservation Area (Upper Mustang). Phylogenetic analysis of the control region (D-loop) places these individuals firmly within the *U. a. pruinosus* lineage, revealing strong genetic affinity with populations from the Tibetan Plateau. This discovery extends the known distribution of the subspecies westward and highlights the importance of Dolpa and Mustang as potential corridors for brown bear conservation. The successful use of non-invasive samples demonstrates the applicability of genetic monitoring in remote, high-altitude environments.

Chapter II assesses the current and future habitat suitability of Nepal's three bear species

sloth bears (*Melursus ursinus*), Asiatic black bears (*Ursus thibetanus*), and brown bears using 419 confirmed occurrence records. Species Distribution Models (SDMs) developed using BIOMOD2 indicate that 10,971.75 km², 29,470.75 km², and 6,152.97 km² of habitat are currently suitable for sloth bears, black bears, and brown bears, respectively. Climate projections under the SSP2–4.5 scenario suggest dramatic habitat losses by 2050 and 2070, particularly for brown bears (up to 82.20% loss by 2070). The Annapurna Conservation Area remains a critical refuge for both brown bears and black bears, while Chitwan National Park supports the largest contiguous sloth bear habitat. Overlapping habitat zones among species further highlight areas of potential interspecific interaction and management concern.

Chapter III evaluates the diet of red foxes, Himalayan wolves, and snow leopards using 111 scat samples from Upper Mustang. Distinct dietary strategies were observed: red foxes specialized on rodents and pika, wolves selectively consumed large ungulates such as blue sheep, and snow leopards exhibited a generalist diet with strong preference for pika. Pianka's overlap index shows minimal dietary overlap between foxes and the larger carnivores, but high biomass-based overlap between wolves and snow leopards. Despite wild prey dominance, livestock contributed disproportionately to biomass consumption, underscoring ongoing risks of human–carnivore conflict.

Chapter IV synthesizes community-level patterns through a multi-species camera trap survey spanning 6,506 trap days. Sixteen mammal species were documented, including eight predators and eight prey. Bayesian hierarchical modeling revealed variable occupancy influenced by ruggedness, forest cover, and human disturbance. Temporal overlap analysis demonstrated strong predator prey coupling in fox and hare pairs, and snow leopard and blue sheep pairs, whereas marmot related interactions showed temporal avoidance.

Collectively, this thesis highlights the ecological complexity of Himalayan carnivore communities and underscores the urgent need for integrated, landscape scale conservation strategies in the face of habitat loss, climate change, and escalating human pressures.