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Editorial: Protected area management and large and medium-sized mammal conservation

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Editorial on the Research Topic

Protected area management and large and medium-sized mammal conservation

The crisis facing the world's medium-to-large sized mammals—from the great cats of the Himalayas to the freshwater cetaceans of the Ganga—is fundamentally a crisis of space. These species, essential to ecosystem integrity, demand vast, connected territories to maintain viable populations. However, they increasingly encounter severe habitat fragmentation, intense human development, and the accelerating impacts of climate change. While protected areas (PAs) are the bedrock of global conservation, recent studies suggest the existing global PA network is often inadequate for safeguarding large-bodied, wide-ranging species (Farhadinia et al., 2022; Santangeli et al., 2023; Williams et al., 2022).

This Research Topic, “*Protected Area Management and Large and Medium-Sized Mammal Conservation*”, examines the efficacy of current PA systems and proposes paradigm-shifting approaches to species survival. The unifying message emerging from this Research Topic is that PAs are necessary, but insufficient for securing the long-term future of large and medium-sized mammals. Future conservation success hinges on moving beyond the fixed PA boundary mentality, embracing sophisticated multi-species connectivity planning, and deeply integrating socio-economic realities into conservation management strategies. PA management must be expanded to address systemic, external environmental changes, not just immediate, localized threats.

Beyond boundaries – connected populations

One of the most powerful themes explored in this Research Topic is the necessity of transitioning from a single-species PA design to a multi-species connectivity approach.

Penjor et al. identify a crucial spatial disconnect: in the Himalayan biodiversity hotspot of Bhutan, only 40% of critical multispecies core habitats and a mere 24% of dispersal corridors lie within the existing PA network. This finding is a stark global wake-up call,

emphasizing that the majority of land required for functional connectivity—the ecological arteries of the landscape—exists outside formal protection. Furthermore, the study presents a compelling challenge to the umbrella species concept, finding that certain large ungulates, such as the Asian elephant (*Elephas maximus*) and muntjac (*Muntiacus muntjak*), may be more effective surrogates for core habitat and corridor protection, respectively, than carnivores. This suggests that effective conservation planning requires a data-driven, rather than purely charismatic, approach to species selection.

The study on large mammal connectivity across Panama (Cushman et al.) provides a methodological benchmark for conservation corridor modeling. Delineating and maintaining connectivity in the Panama Canal Zone, linking the Nearctic and the Neotropics, constitutes one of the most important examples of a global conservation challenge. Cushman et al., by analyzing multiple distinct dispersal models for species like the jaguar (*Panthera onca*) and puma (*Puma concolor*), confront the inherent uncertainty in large-scale connectivity planning. Their work demonstrates that model averaging and rigorous sensitivity analysis are essential for identifying robust, high-certainty linkage zones. This approach is vital for policymakers, as it moves connectivity mapping from a theoretical exercise to an actionable plan with quantified confidence, directly informing where resources should be invested to maintain the uninterrupted flow of genetic material between continents. The management implication is profound: conservation resources must be strategically directed to bolster existing PAs by protecting abutting habitats and prioritizing the establishment of officially recognized high-priority, multi-species corridors in the matrix outside reserve boundaries.

Insights from aquatic mammal conservation

The challenges of PA management are not confined to terrestrial landscapes. The Research Topic broadens its scope by examining the critically endangered Ganges River dolphin (*Platanista gangetica*), a large aquatic mammal, in the lower stretch of the Ganga River (Das et al.). The conservation of riverine systems presents unique, complex threats—a confluence of hydrological disruption (dams and barrages), intense pollution, and direct human interaction (bycatch).

In this highly contested human-dominated environment, the traditional PA model not only needs to be spatially expanded but also converted into a multifaceted, adaptive, and socially integrated management strategy. As Das et al. argue, the key to the dolphin's survival is not just law enforcement but a fundamental shift in the socio-economic relationship between river-dependent communities and the ecosystem.

The methodological challenges in aquatic conservation are further explored by Rodríguez-Pérez et al. through a study on the critically imperiled vaquita (*Phocoena sinuata*). This work uses stable isotopes of carbon and oxygen, extracted non-invasively from vaquita bones, to infer crucial details about their habitat use within the highly restricted Upper Gulf of California (UGC). With an existing vaquita population of only 10 individuals this non-invasive forensic methodology can help to understand how vulnerable the vaquita is to long term potential environmental and trophic changes in its habitat, caused by damming the Colorado River. This work also stresses the critical need for transboundary cooperation and measures when thinking about species conservation.

Integrating knowledge systems

The perspectives paper of Finerty et al. highlights the necessity and challenges of comprehensive species monitoring in ecosystems where animals exist at low densities. This paper emphasizes that relying solely on conventional methods leads to underestimated populations and flawed management plans.

The authors propose that effective monitoring must stand at “the crossroads of tradition and modern technology”. This integrative approach champions the formal incorporation of indigenous knowledge in conservation science alongside cutting-edge tools to collect and analyze data. By combining local community-based knowledge with the scientific precision of modern methods, conservationists can achieve unparalleled monitoring accuracy, leading to more targeted, efficient, and socially accepted conservation actions. This methodological framework provides a crucial toolkit for achieving the “spatially expansive” and “socially inclusive” goals of modern PA management.

Conclusions

The success of any protection measure, whether a terrestrial corridor or a river sanctuary, depends ultimately on the custodians who share the landscape. By embracing a spatially expansive and socially inclusive vision, we can ensure that our protected areas, and the corridors that link them, continue to serve as true havens for the world's most magnificent and vulnerable mammals.

Author contributions

ŽK: Writing – original draft, Investigation, Conceptualization, Writing – review & editing.

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