Concepts of Landscape Planning and Design for the Conservation of Target Species and Target Ecosystems in Biodiversity Management for Sustainable Tourism

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ABSTRACT

Conservation-based landscape planning is an increasingly important strategic approach in addressing the challenges of ecosystem degradation and species extinction due to land use change, habitat fragmentation, and climate change. This article aims to analyze how landscape planning can effectively support the conservation of target species and target ecosystems within the framework of sustainable biodiversity management. Through a systematic literature review of 30 articles of reputable international journals (2005–2025), this study identifies the main principles, planning methods, and indicators of success in integrating conservation into landscape spatial planning. The results show that ecosystem-based approaches, connectivity planning, and multi-stakeholder participation are the main foundations in conservation landscape planning. Indicator species and umbrella species are often used as proxies to identify priority areas, while target ecosystems are selected based on their level of uniqueness, threat, and ecological function. The integration of GIS-based spatial data and habitat modeling allows for effective identification of ecological corridors and conservation core areas. Studies also found that long-term success relies heavily on supportive policies, institutional capacity, and local community involvement. This article concludes that holistic and adaptive landscape planning is key to achieving conservation goals while supporting sustainable development. Policy recommendations include strengthening cross-sectoral landscape governance and building technical capacity in evidence-based planning.

***Keywords**: landscape planning, species conservation, target ecosystems, biodiversity, sustainable management*

INTRODUCTION

Global biodiversity is currently under severe and accelerating pressure as a consequence of anthropogenic activities such as agricultural intensification, urban expansion, resource extraction, and climate change (IPBES, 2019). Recent assessments indicate that nearly one million species are at risk of extinction within the coming decades if prevailing trends persist. Under these circumstances, conventional conservation strategies centered on isolated protected areas are increasingly viewed as insufficient, as they fail to accommodate broader landscape dynamics and ecological connectivity beyond reserve boundaries (Margules & Pressey, 2009).

In response to these shortcomings, conservation-oriented landscape planning has gained prominence as a more integrative framework. This approach underscores the necessity of addressing the entire landscape matrix—including productive lands, settlements, and infrastructure networks—as part of biodiversity protection efforts (Wu, 2013). By integrating concepts from landscape ecology, spatial planning, and social sciences, conservation-based landscape planning seeks to develop multifunctional landscapes capable of reconciling ecological sustainability with human development needs (Fischer et al., 2006; Paembonan et al., 2024; Pangemanan, et al., 2025; Dumumpe et al., 2025).

Landscape planning for biodiversity conservation in sustainable tourism requires moving beyond isolated protected areas toward integrated socio-ecological systems. In this framework, target species and target ecosystems function as strategic planning anchors that guide spatial prioritization, zoning, and design interventions (Wardiningsih et al. 2017; Saroinsong, 2020). Target species—such as umbrella or indicator species—serve as ecological proxies to determine habitat connectivity, buffer design, and development limits. Target ecosystems represent habitats with high ecological value due to uniqueness, vulnerability, or ecosystem service provision. Embedding these targets into landscape design ensures that tourism infrastructure, circulation patterns, and visitor facilities are spatially aligned with conservation priorities. Thus, conservation-oriented landscape planning becomes both a spatial and governance tool that balances ecological integrity with tourism development, contributing to long-term biodiversity management and sustainable destination resilience (Plumptre et al., 2025).

The concepts of "target species" and "target ecosystems" are the pillars of this strategy. Target species typically include rare, endemic, or endangered species that have high conservation value, while target ecosystems refer to habitat types that are unique, threatened, or provide important ecosystem services (Brooks et al., 2006). The selection of these targets allows for efficient resource allocation and more targeted measurement of conservation success. The target-based approach is also aligned with global frameworks such as the Aichi Biodiversity Targets (2011–2020) and the Global Biodiversity Framework (2022–2030), which emphasize the need to protect 30% of land and sea area by 2030 ("30x30"). However, implementation at the landscape level requires cross-sectoral integration, active stakeholder participation, and evidence-based planning tools (CBD, 2022).

This article aims to answer the question: How can landscape planning be designed and implemented to effectively protect target species and target ecosystems in the context of sustainable biodiversity management? Through a synthesis of the latest scientific literature, this research provides a conceptual and practical framework to strengthen the integration of conservation in landscape planning.

METHODOLOGY

This study uses a systematic literature review (SLR) approach to identify, analyze, and synthesize findings from international scientific journal articles relevant to the topic of landscape planning for the conservation of target species and ecosystems. The SLR methodology was chosen because of its ability to provide a comprehensive and objective picture of the development of knowledge in a particular field (Tranfield et al., 2003). The literature search process was carried out through the academic databases Scopus and the Web of Science, with a publication range between January 2005 to March 2025. Keywords used in searches include a combination of the following terms: ("landscape planning" OR "landscape conservation planning") AND ("target species" OR "umbrella species" OR "flagship species") AND ("target ecosystem" OR "priority ecosystem") AND ("biodiversity conservation" OR "sustainable biodiversity management"). Filters are applied to ensure only peer-reviewed journal articles in English are considered.

Inclusion criteria include: (1) a focus on landscape planning as a conservation tool; (2) explicitly mentions the target species and/or target ecosystem; (3) present methods, outcomes, or conceptual frameworks relevant to sustainable biodiversity management; and (4) published in a reputable journal (Q1 or Q2 according to Scimago Journal Rank). Articles that only discuss conservation within protected areas without a landscape perspective are issued. The selection process follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Of the 412 initial articles, 87 passed title and abstract screening, and 30 articles eventually met all inclusion criteria after full-text assessment. Data from selected articles are categorized based on: (1) geographic context; (2) the type of target

species/ecosystem; (3) the planning method used; (4) success indicators; and (5) implementation challenges. Thematic analysis is conducted to identify patterns, common principles, and knowledge gaps. In addition, conceptual frameworks are integrated from landscape ecology theory (Forman, 1995), systematic conservation planning (Margules & Sarkar, 2007), and landscape-based approaches (Sayer et al., 2013).

RESULTS AND DISCUSSION

The Role of Target Species in Landscape Planning

The target species serve as a proxy to represent the conservation needs of other species in the landscape. The three main categories of commonly used target species are: umbrella species, flagship species, and indicator species (Caro, 2010). Umbrella species, such as the tiger (Panthera tigris) in Southeast Asia or the jaguar (Panthera onca) in Latin America, require extensive roaming areas and high-quality habitats. Protection of these species indirectly protects many other species that share habitats (Rondinini et al., 2006).

A study by Grantham et al. (2010) showed that the use of umbrella species in landscape planning in Africa increases the efficiency of conservation area allocation by up to 40% compared to the randomized approach. However, its effectiveness depends on the selection of the right species and a deep understanding of the ecology of the species. For example, in the Amazon rainforest, the selection of endemic birds as target species has been shown to be more effective in protecting plant diversity than large mammals (Vergara & Simonetti, 2011). In sustainable tourism contexts, this target-based framework ensures that tourism development does not fragment habitats, disrupt ecological corridors, or degrade ecosystem functions. Instead, landscape design becomes a mediating instrument that aligns visitor experiences with biodiversity objectives. Core conservation zones, ecological corridors, transitional buffers, and visitor-use areas can be structured through systematic conservation planning principles, supported by GIS-based spatial analysis and habitat modeling. Such an approach contributes directly to global biodiversity targets, including the post-2020 Global Biodiversity Framework, while also enhancing the ecological authenticity and long-term attractiveness of tourism destinations. Thus, landscape planning for conservation in sustainable tourism is not limited to spatial arrangement; it represents a strategic governance tool that integrates ecological science, spatial design, and participatory management into a coherent biodiversity management framework.

Identify and Prioritize Target Ecosystems

The target ecosystem was selected based on criteria such as biogeographic uniqueness, threat level, ecosystem function, and ecosystem services provided (Oliver et al., 2015). For example, mangrove and seagrass ecosystems are often targeted due to their role in climate change mitigation and shoreline protection (Barbier et al., 2011). In the Mediterranean region, maquis and garrigue ecosystems are prioritized due to high endemism and urbanization pressures.

Approaches such as Key Biodiversity Areas (KBA) and Ecological Distinctiveness Assessment are used to objectively map priority ecosystems (Eken et al., 2004). In Indonesia, the identification of tropical peat ecosystems as conservation targets has prompted a moratorium policy on peatland permits since 2016 (Murdiyarso et al., 2019).

Spatial Data-Based Landscape Planning Methods

The integration of Geographic Information Systems (GIS) and habitat modeling is the backbone of modern landscape planning. Tools such as Marxan, Circuitscape, and Linkage Mapper allow planners to identify conservation core areas, ecological corridors, and buffer zones (Watts et al., 2009). For example, in the Andes Mountains, landscape connectivity modelling using

Circuitscape successfully identified migration corridors for spectacular bears (Tremarctos ornatus) that are threatened with fragmentation (Figueroa et al., 2017).

The systematic conservation planning (SCP) approach offers a goal- and constraint-based framework. SCP allows planners to balance conservation goals with socio-economic costs, such as loss of agricultural land or tenure conflicts (Kukkala & Moilanen, 2013).

Socio-Ecological Integration and Landscape Governance

The long-term success of landscape planning relies heavily on stakeholder participation and inclusive governance mechanisms. Studies in Mesoamerica show that conservation landscapes that involve indigenous peoples in decision-making have a 30% lower deforestation rate than top-down managed landscapes (Garnett et al., 2018).

The concept of the Landscape Approach developed by CIFOR and FAO emphasizes the importance of negotiations between sectors (agriculture, forestry, conservation) to achieve win-win solutions (Sayer et al., 2013). In Ethiopia, this approach has successfully rehabilitated 15 million hectares of degraded land through the integration of agroforestry and soil conservation.

Implementation Challenges and Gaps

Although many studies demonstrate theoretical effectiveness, implementation on the ground faces significant challenges, including: (1) policy fragmentation between sectors; (2) lack of technical capacity at the local level; (3) conflicts of interest between conservation and development; and (4) climate uncertainty that alters the distribution of species and ecosystems (Watson et al., 2018)

In addition, geographic bias in the literature—with studies dominated in North America, Europe, and Australia—leads to a lack of representation of tropical and developing contexts, even though it is there that biodiversity is highest and under greatest pressure (Di Minin & Toivonen, 2015).

Integrating Target Species and Target Ecosystems into Landscape Design for Sustainable Tourism

The synthesis of the reviewed literature demonstrates that effective biodiversity management in tourism landscapes requires the explicit translation of conservation targets into spatial design strategies. Rather than treating biodiversity as a background variable, successful cases operationalize target species and ecosystems into measurable planning components (Grantham et al., 2010; Vergara & Simonetti, 2011; Kukkala and Moilanen, 2013; Oliver et al., 2015; Watson et al., 2018; Plumptre et al., 2025).

First, the presence of target species informs habitat zoning and connectivity design. Umbrella species with large home ranges require landscape-scale connectivity, leading to the establishment of ecological corridors and the minimization of infrastructure barriers. Indicator species, conversely, guide microhabitat design and environmental quality standards within tourism zones. This dual-scale application ensures that conservation objectives are reflected both at macro- and site-design levels.

Second, the identification of target ecosystems enables prioritization of conservation cores and restoration zones within tourism landscapes. For example, mangrove forests, peatlands, or montane cloud forests are often designated as strict conservation areas due to their high ecological function and climate regulation capacity. Surrounding these cores, buffer landscapes may incorporate low-impact ecotourism facilities designed with minimal footprint, permeable surfaces, and vegetation-based screening to reduce ecological disturbance.

Spatial modeling tools such as Marxan and connectivity analysis software support this translation by quantifying trade-offs between conservation goals and tourism development

pressures. The results indicate that landscapes designed with explicit conservation targets demonstrate higher ecological coherence, lower habitat fragmentation, and improved ecosystem service retention compared to ad hoc tourism expansion models.

Importantly, the literature also highlights that landscape design effectiveness depends on socio-ecological integration. Participatory governance ensures that conservation zoning aligns with local livelihoods, thereby reducing conflict and enhancing compliance. In tourism settings, community-based stewardship programs linked to flagship species or iconic ecosystems strengthen local identity while reinforcing biodiversity objectives.

From a sustainability perspective, integrating target species and ecosystems into landscape planning contributes to multiple dimensions simultaneously: ecological resilience, economic viability through nature-based tourism appeal, and social legitimacy through participatory processes. The findings therefore support the argument that conservation-driven landscape design is not a constraint on tourism development but a foundational strategy for its long-term sustainability.

However, adaptive management remains critical. Climate change may shift species distributions and alter ecosystem boundaries, requiring flexible zoning and periodic reassessment of conservation targets. Future research should therefore focus on dynamic spatial modeling and monitoring indicators that integrate biodiversity outcomes with tourism carrying capacity metrics.

CONCLUSION

Landscape planning that focuses on target species and target ecosystems is a crucial strategy in efforts to conserve biodiversity in a sustainable manner. Through a synthesis of 30 international journal articles, this study confirms that this approach is most effective when integrating landscape ecological principles, advanced spatial data, and multi-stakeholder participation. Umbrella species and unique ecosystems serve as guides in determining conservation priorities, while tools such as Marxan and GIS allow for precise and efficient planning. However, successful implementation depends not only on technical aspects, but also on inclusive governance, cross-sectoral policies, and local capacity building. Key challenges—such as policy fragmentation, land conflicts, and climate change—require adaptive and flexible approaches. Going forward, research needs to explore more tropical and developing contexts, as well as develop success indicators that include the socio-ecological dimension holistically.

The reviewed studies indicate that effective biodiversity management in tourism landscapes depends on explicitly translating conservation targets into spatial design strategies. Target species inform habitat connectivity, corridor establishment, and infrastructure placement to minimize fragmentation. Species with large home ranges require landscape-scale planning, while indicator species guide site-level environmental quality standards. To achieve global targets such as "30x30", landscape planning must be an integral part of national and local development policies. Policy recommendations include: (1) integration of conservation targets into regional spatial plans; (2) development of economic incentives for biodiversity-friendly landscape practices; and (3) investment in education and training of ecosystem-based landscape planners.

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