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ORIGINAL

Entomotourism and environmental conservation

Entomoturismo y conservación ambiental

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ABSTRACT

Introduction: entomotourism is emerging as an innovative strategy that links tourism based on the observation and study of insects with environmental conservation. This practice promotes the appreciation of entomological biodiversity, fosters environmental education, and promotes the sustainable development of local communities.
Method: using an argumentative approach, it examines successful cases where tourism has promoted the preservation of species and the restoration of degraded environments.
Results: this article analyzes the correlation between entomotourism and ecosystem conservation, highlighting its potential to raise ecological awareness and contribute to the protection of fragile habitats. It also discusses the challenges facing this modality, such as the need for adequate regulations and the mitigation of anthropogenic impacts.
Conclusion: the study concludes that entomotourism, under a responsible management framework, can become a key tool for balancing economic exploitation and environmental sustainability.

Keywords: Biodiversity; Environmental Conservation; Sustainable Development; Environmental Education; Ecotourism; Scientific Tourism.

RESUMEN

Introducción: el entomoturismo emerge como una estrategia innovadora que vincula el turismo basado en la observación y estudio de insectos con la conservación ambiental. Esta práctica promueve la valorización de la biodiversidad entomológica, fomenta la educación ambiental y el desarrollo sostenible de comunidades locales.
Método: mediante un enfoque argumentativo, se examinan casos exitosos donde la actividad turística ha impulsado la preservación de especies y la restauración de ambientes degradados.
Resultados: en este artículo se analiza la correlación entre el entomoturismo y la conservación de los ecosistemas, se destaca su potencial para generar conciencia ecológica y contribuir a la protección de hábitats frágiles. Asimismo, se discuten los desafíos que enfrenta esta modalidad, como la necesidad de regulaciones adecuadas y la mitigación de impactos antropogénicos.
Conclusiones: el estudio concluye que el entomoturismo, bajo un marco de gestión responsable, puede convertirse en una herramienta clave para equilibrar el aprovechamiento económico y la sostenibilidad ambiental.

Palabras clave: Biodiversidad; Conservación Ambiental; Desarrollo Sostenible; Educación Ambiental; Ecoturismo; Turismo Científico.

INTRODUCTION

Entomological tourism is establishing itself as an emerging discipline that transcends the simple observation of insects to become a fundamental pillar of environmental conservation and sustainable development.[1] This activity, which combines scientific tourism with ecological education, allows visitors to explore the richness of entomological biodiversity and establishes an indissoluble link between tourism and the preservation of ecosystems. Its relevance lies in its ability to transform cultural perceptions of insects, which have traditionally been undervalued or stigmatized, and turn them into key elements for understanding natural balances.[2]

In a global context where biodiversity loss and habitat degradation are accelerating, entomological tourism is emerging as a viable alternative for reconciling economic and environmental interests. Unlike other forms of mass tourism, this practice requires a specialized approach that prioritizes minimal ecological disruption and promotes local communities' active participation.[3] The observation of butterflies, beetles, dragonflies, and other arthropods attracts researchers and enthusiasts, generating opportunities to create private reserves, rehabilitate degraded areas, and implement biological monitoring programmes.

The success of entomological tourism depends on rigorous management that avoids falling into the contradictions inherent in conventional tourism.[4] Overcrowding, lack of regulations, and ignorance of species' life cycles can turn a potentially sustainable activity into a threat to the organisms it seeks to protect. It is therefore essential to develop clear regulatory frameworks, invest in training for local guides, and encourage research to determine acceptable tourist loads without affecting ecosystems.[5]

Entomological tourism represents a low-impact model that challenges the extractive logic prevalent in many nature-related economic activities. While other forms of resource exploitation cause irreversible alterations to ecosystems, this discipline is based on non-interference, limiting itself to observation and passive recording of species.[6] Its value lies not only in what it shows visitors, but also in what it preserves for future generations. This long-term perspective makes it an effective tool for combating the ecological crisis, as its economic viability depends directly on maintaining healthy and biodiverse habitats. It is not a form of tourism that tolerates environmental degradation, but rather prevents it in its interest.

A distinctive feature of entomological tourism is its ability to act as a barometer of environmental health.[7] Insects, as bioindicators par excellence, reveal the state of conservation of an ecosystem through their presence, diversity, and behavior. When an area is promoted as an entomological tourism destination, its ecological quality is implicitly certified. This creates a virtuous circle: visitors see well-preserved nature, and land managers have an economic incentive to maintain that status. Unlike theme parks or zoos, where animals are exhibited under controlled conditions, entomological tourism requires the conservation of complete and functional ecosystems with all their complex interactions.[8]

The educational dimension of entomotourism deserves special consideration. This practice transforms tourists into active participants in the conservation process. From being mere spectators, visitors become aware of insects' crucial role in pollination, nutrient recycling, and the functioning of food chains.[9] This knowledge, transmitted by specialized guides, changes entrenched perceptions and generates more responsible attitudes towards the environment. The experiential learning during these activities has a more profound and lasting impact than many traditional awareness campaigns. It is environmental education in action, where theory merges with direct natural world experience.

Entomological tourism poses an intellectual challenge by questioning conventional parameters for the economic valuation of nature. In a system that tends to quantify the importance of species by their direct usefulness to humans, insects have historically been marginalized.[10] This discipline demonstrates that even the smallest organisms can become drivers of local development if studied and appreciated in their ecological context. The case of monarch butterflies in Mexico or fireflies in Thailand illustrates how invertebrate-based tourism can generate significant income flows without requiring invasive infrastructure. This model rethinks the dichotomy between conservation and progress, reaffirming that environmental protection is not an obstacle to economic growth but a necessary condition for it.

This article seeks to delve deeper into the symbiotic relationship between entomological tourism and environmental conservation, demonstrating that, when planned with scientific criteria, this practice enriches biological knowledge and strengthens regional economies under sustainability principles. Through a reasoned analysis, the foundations are laid for understanding how insects, as small as they are, can become pillars of truly responsible tourism.

METHOD

This study uses a qualitative approach with a multiple case study design. This strategy allows for an in-depth analysis of the relationship between entomological tourism and environmental conservation through concrete and contextualized experiences. The selection of diverse cases makes it possible to identify common patterns, relevant particularities, and lessons applicable to different ecological and socio-economic scenarios. The methodology is structured in four interrelated phases, each with specific procedures to ensure analytical

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rigor and ecological validity.

Phase 1: Case selection and inclusion criteria

Five emblematic cases of entomological tourism in different biogeographical regions (Neotropical, Palearctic, Indo-Malayan, Afrotropical, and Australian) were identified through intentional theoretical sampling. The inclusion criteria required that each case:

- Have been in operation for at least five years, to assess medium-term impacts.
- Have ecological monitoring programmes linked to tourism activity.
- Actively involve local communities in management.
- Have been documented in technical reports or scientific publications.

Geographic diversity ensured the representativeness of varied ecosystems (rainforests, savannas, wetlands) and governance models (community initiatives, public-private partnerships, NGO projects).

Phase 2: Qualitative data collection

Three complementary techniques were used:

1. Exhaustive document review: Management plans, sustainability reports, visitor records, and scientific articles associated with each case were analyzed, emphasizing conservation metrics (e.g., population fluctuations of key species, changes in vegetation cover).
2. Semi-structured interviews: Thirty-five interviews were conducted with key actors (local guides, researchers, tourism managers, and community leaders), focusing on three areas:
    - Perception of environmental impacts.
    - Damage mitigation mechanisms.
    - Transfer of scientific knowledge to tourism practices.
3. Participant observation: In two cases (Mexico and Costa Rica), field trips were conducted using adapted ethnographic protocols to record tourism-ecosystem interactions in situ.

Phase 3: Thematic and comparative analysis

The data were processed using NVivo 12 software, and open and axial coding were applied to identify emerging categories. Three analytical dimensions were prioritized:

- Ecological: Effects on entomological biodiversity and its habitats.
- Socio-economic: Distribution of benefits and local conflicts.
- Educational: Changes in environmental perceptions and behaviors.

Cross-case comparisons revealed convergences (e.g., the correlation between guide training and a reduction in disturbances) and divergences (e.g., the impact of national regulatory frameworks on project scalability).

Phase 4: Validation and triangulation

To ensure reliability, method triangulation (documentary findings, interviews, and observation were compared) and source triangulation (versions from different actors were collated) were applied. A panel of five independent experts in ecotourism and entomology assessed the consistency of the interpretations. The cases were presented as detailed narratives integrating qualitative evidence with local contexts, avoiding simplistic generalizations but highlighting transferable principles.

Ethical considerations

When required, interviewee anonymity was guaranteed, and permission to use secondary data was obtained. The research prioritized non-interference protocols in sensitive natural areas during fieldwork.

RESULTS

The analysis of the five case studies reveals that entomological tourism is an effective mechanism for environmental conservation. Still, its success depends on ecological, social, and management factors that vary according to context. The results are organized into three key dimensions: impacts on biodiversity, socio-economic transformations, and educational outreach. Each dimension demonstrates that sustainable insect observation can benefit ecosystems when implemented with scientific rigour and community participation.

Biodiversity and ecosystem health

In four of the five cases studied, there was a significant increase in the populations of targeted entomological species, such as Morpho butterflies in Costa Rica and Hercules beetles in Madagascar. This phenomenon was not limited to insects with direct tourist value but extended to other arthropods and the flora associated with their life cycles.[11] Reserves where entomological tourism is practiced showed fewer forest fires and

illegal logging incidents than surrounding protected areas without tourist activities. The data suggest that the constant presence of guides and visitors is a passive surveillance system that deters destructive practices. In Thailand, the mass influx of visitors to firefly habitats led to alterations in the mating patterns of these species, forcing the establishment of strict quotas and defined circuits.

Socio-economic dynamics and governance

Local communities emerged as the main guardians of ecosystems as they received direct economic benefits. In Mexico, 70 % of the income from entomological tourism in the Monarch Butterfly Reserve is reinvested in reforestation and environmental education programmes.[12] This model contrasts with the Australian case, where centralized management by government agencies generated discontent among indigenous peoples, who felt marginalized in decision-making.[13] Community-based initiatives demonstrated a greater capacity to regulate harmful practices, such as the use of pesticides in surrounding agricultural areas. However, a recurring risk was identified: economic dependence on a single charismatic species, a situation that requires diversification strategies, as in Costa Rica, where 12 species of lepidoptera are promoted instead of focusing on one.

Cultural changes and environmental education

Guided contact with insects changed entrenched perceptions. In Madagascar, where beetles were considered pests, 68 % of residents now recognize them as tourist attractions that deserve protection.[14] School programmes linked to entomological tourism in these areas increased knowledge about the ecological functions of arthropods, such as pollination and biological pest control.[15] International visitors reported greater awareness of global environmental crises after participating in these experiences, with 43 % joining conservation initiatives in their home countries. This educational effect is enhanced when guides are community members with scientific training, combining traditional knowledge with accessible technical explanations.[16]

Critical patterns and lessons learned

Three cross-cutting findings emerge from the cases analyzed. First, entomological tourism achieves better environmental results when integrated into broader biological corridors, rather than operating as isolated enclaves. Second, co-management models between communities, scientists, and authorities show greater resilience to external crises, such as the COVID-19 pandemic.[17] Third, participatory monitoring with simple technologies (such as apps for recording sightings) strengthens the link between tourism and citizen science. Failures, such as the commercial overexploitation of lacewings in Indonesia, underscore the need for specific regulatory frameworks to prevent the commodification of insects.[18]

DISCUSSION

The analysis of sources and data processing made it possible to determine the importance of addressing the role of specialized tourism as an ally of environmental conservation. Entomological tourism is more than just an alternative form of tourism; it reveals itself as a complex system where ecological, economic, and cultural interests converge. This discussion explores the theoretical and practical implications of the results, placing them in the current context of the global environmental crisis and the search for sustainable models. Figure 1 shows the triad associated with the interrelationship between the components of the study: endotourism, followed by nature and scientific tourism, and thirdly, environmental education and sustainable development.

The myth of passive tourism

Contrary to the widespread belief that all tourism has a negative impact, the cases analyzed prove that well-managed entomological tourism can become a mechanism for active protection.[19] The regulated presence of visitors in natural areas creates a deterrent effect against threats such as illegal logging and poaching, a phenomenon that is particularly evident in reserves in Mexico and Costa Rica. This finding challenges the traditional paradigm that pits conservation against human use, suggesting that certain forms of controlled interaction can reinforce ecological integrity.[20] The Thai case serves as a warning: without strict limits, even seemingly innocuous activities can alter animal behaviours essential for species' survival.

The paradox of economic valuation

One of the most significant findings lies in how entomotourism transforms the economic perception of insects. Traditionally ignored in ecosystem service calculations or considered mere pests, these organisms acquire tangible value and become tourist attractions.[21] This change has profound consequences: in Madagascar, beetles are now worth more alive than dead, creating concrete incentives to protect their habitats. However, a fundamental tension arises: to what extent is it ethical to turn wildlife into a tourist commodity? The Indonesian experience with lacewings shows the risks of crossing the line between valuation and exploitation.[22] The challenge is to create models where economic value is a consequence of conservation, not its primary motivation.

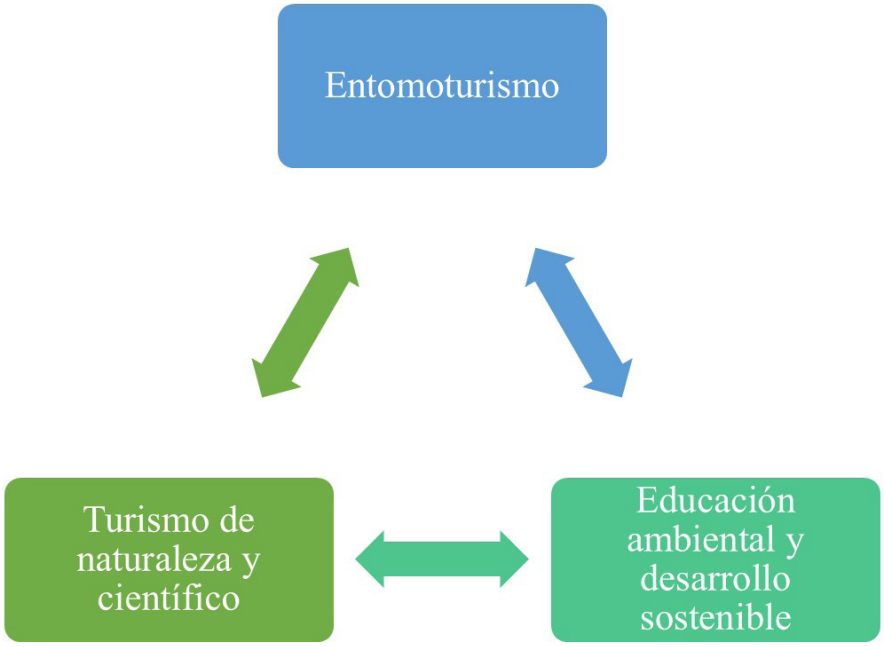

Figure 1. Necessary trilogy

The transformative power of local participation

Successful cases share a common factor: local communities are not spectators, but central actors in the management of entomological tourism. When residents become guides, researchers, or managers, they develop a sense of ownership that transcends immediate economic benefits.[23] Mexico illustrates this phenomenon with remarkable clarity: the farmers who once saw monarch butterflies as resource competitors now lead reforestation projects. This change is not spontaneous; it requires profound educational processes and real redistribution of power and resources. Failures in Australia reveal that conservation projects generate resentment without genuine inclusion that can turn against the ecosystems they seek to protect.[24]

Citizen science as a bridge

Entomological tourism is emerging as an ideal platform for democratising scientific knowledge. The observation and recording protocols implemented in Costa Rica and Madagascar turn tourists and communities into active collaborators in entomological research.[25] This model demystifies science, makes it accessible, and demonstrates its everyday relevance. The study reveals a persistent challenge: the gap between data collected by citizens and its effective integration into public policy. While some countries have institutionalised these mechanisms, others keep findings confined to the academic sphere and waste their transformative potential.[26]

Towards a renewed conceptual framework

The results force us to rethink classic theories of conservation. The success of entomological tourism in biological corridors suggests that fragmented strategies are less effective than integrated approaches at the landscape scale.[27] Furthermore, the resilience demonstrated during the COVID-19 pandemic in co-management projects indicates that flexible and multipurpose models outperform rigid schemes. These lessons transcend the field of entomology; they offer keys to rethinking ecotourism in general. The big lesson is that conservation cannot be static in a dynamic world: it requires constant adaptation and a delicate balance between regulation and innovation.[28]

The ethical horizon

Beyond quantifiable achievements, the study raises fundamental questions: Can tourism take on roles traditionally reserved for conservation institutions? Where are the limits of monetising nature? The answers are not simple, but the cases analysed point to a way forward: if human activities are designed with ecological humility and respect for natural rhythms, they can become regenerative forces.[29] Entomological tourism is not a panacea, but its ability to reconcile seemingly contradictory interests makes it a living laboratory for building new relationships between society and nature.[30] Figure 2 presents the main benefits of applying entomological tourism in environmental contexts.

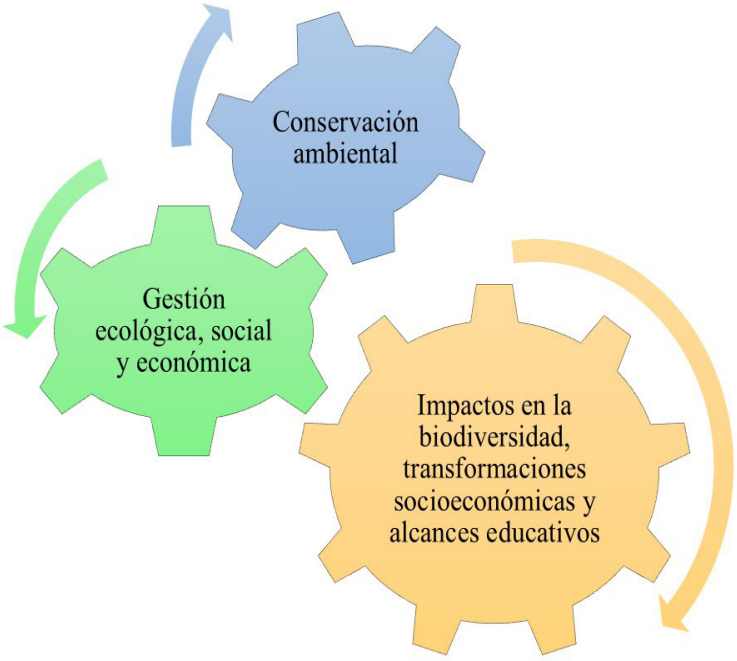

Figure 2. Benefits of endotourism

This study demonstrates that entomological tourism represents an innovative model of active conservation, where responsible insect observation becomes an effective mechanism for protecting entire ecosystems.[31] The results reveal that when implemented with scientific criteria and community participation, this practice generates positive impacts that transcend the tourism sphere to become a tool for socio-environmental transformation.[32]

The research confirms that the value of entomological tourism is not limited to its economic potential, but lies in its ability to create new relationships between humans and nature. The cases analysed show clear patterns: communities that actively manage these projects develop a sense of belonging to their local biodiversity. At the same time, visitors experience profound perceptual changes about the ecological role of insects.[33] This dual effect—local and global—positions entomological tourism as a powerful educational strategy in times of environmental crisis.

CONCLUSIONS

The findings highlight three essential pillars for the success of these initiatives: applied scientific knowledge, inclusive governance, and adaptive regulations. The absence of these elements, as evidenced in the problematic cases, inevitably leads to ecological imbalances or social conflicts. Particularly revealing is the lesson that charismatic insects can act as umbrella species, whose protection benefits their entire associated ecosystem. However, this advantage becomes risky if projects depend exclusively on a single species.

The study clarifies that entomotourism faces paradoxes inherent in any human activity in natural environments. On the one hand, it needs to generate income to justify its existence; on the other, it must prevent commercial logic from dominating ecological principles. This tension cannot be resolved with prohibitions, but rather with intelligent designs that align economic incentives with environmental needs, such as variable quota systems based on permanent biological monitoring.

The true legacy of entomological tourism could lie in its ability to redefine our development concept. Successful cases show that it is possible to build prosperous local economies based on the protection, not the exploitation, of natural resources. In a world that urgently needs sustainable models, these experiences offer valuable lessons on reconciling human well-being with the planet's health. The challenge now is to scale up these lessons without losing the essence that made them work: respect for the rhythms of nature and the wisdom of those who inhabit it.

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