Zoonoses Emergence
across Degraded and Restored
Forest Ecosystems

Policy brief I

Introducing ZOE and first policy recommendations

www.zoe-project.eu

Funded by
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1 **Nature**: R = Report; P = Prototype; D = Demonstrator; O = Other

2 **Dissemination Level:**
PU = Public;
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Project Summary

What and Who

The ZOE project (www.zoe-project.eu) aims at advancing the understanding of the effects of ecosystem degradation in the form of deforestation and associated biodiversity loss on the risk of emergence of zoonotic and vector-borne diseases, and at better defining the protective value of forest ecosystem restoration. The project embraces an inter- and transdisciplinary One Health approach to the links between human, animal, and environmental health and builds on a wide interdisciplinary consortium with experts in geography, landscape ecology, geobotany, plant, animal, and disease ecology, virology, immunology, epidemiology, modelling, sociology, psychology, anthropology, and science dissemination, from 7 European and 2 Latin American academic partner institutions and 3 associate academic and NGO partners from Mexico and the US.

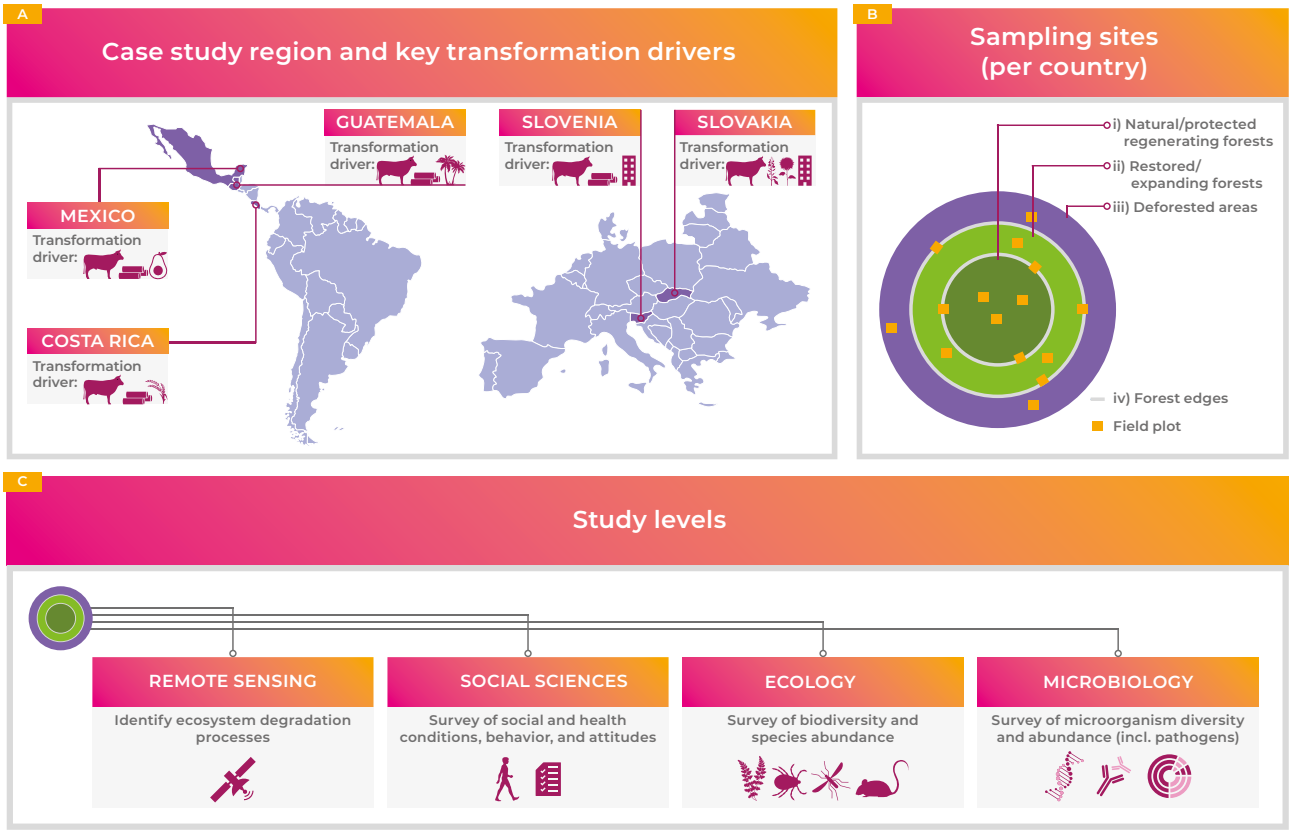
Where

In particular, the project targets the effects of forest degradation and associated biodiversity loss on the risk of emergence of rodent- and vector-borne zoonotic diseases in tropical forests in Mesoamerica (Costa Rica, Guatemala and Mexico) and in temperate forest ecosystems in Europe (Slovenia and Slovakia). Building on an extensive dissemination and collaboration platform, and supported by key stakeholders (including members and representatives from IPBES, EKLIPSE, WHO Health Emergency programme, Biodiversa+, International Alliance against Health Risks in Wildlife Trade, BioAgora, Network for Ecohealth and One Health), ZOE works towards shifting the pandemic preparedness and response paradigm towards pandemic prevention by illuminating some of the root causes of disease emergence arising from human-mediated ecological disruption.

How

ZOE is carried out through five interlinked scientific workpackages with WP1 assessing (forest) ecosystem degradation, habitat changes and biodiversity loss at the landscape level using remote sensing; WP2 following a social science community engagement approach on the behavioural, social and cultural pathways that connect ecosystem degradation, biodiversity loss and disease emergence; WP3 assessing the on-site macro-organism biodiversity, with sample collection at case study sites categorized by level of forest ecosystem degradation; WP4 analyzing and identifying on-site microbiological biodiversity and human exposure to zoonotic pathogens; and WP5 synthesizing data and results at the health-biodiversity nexus. In addition, knowledge exchange and dissemination, including through a novel knowledge exchange platform (KEP) at the health-biodiversity nexus is deployed through WP6.

ZOE study plan



Case studies

ZOE's case study regions contain the European mixed forested temperate region (Slovenia and Slovakia) and Mesoamerican rainforest and tropical dry forest areas (Costa Rica, Guatemala and Mexico).

In Europe, Slovenia and Slovakia are considered important biodiversity hotspots, with Slovenia hosting over 3,000 vascular taxa and many endemic species, supported by 65.2% forest cover, which provides habitats for carnivores and ecosystem functioning despite a 1.2% tree cover loss from 2001 to 2020. Slovakia, a mountainous landlocked country with 49.2% forest cover, similarly supports ecological balance and a multitude of species, including large carnivores, although it experienced a forest area loss of about 1.6% from 2000 to 2020. Both countries face challenges of deforestation due to agricultural and urban expansion, threatening their rich biodiversity.

Slovenia, natural forest. Credits: Gašper Grubelnik

Slovenia, deforested site. Credits: Nadja Kabisch

Slovenia, regenerated site. Credits: Gašper Grubelnik

Bratislava, deforested site. Credits: Nadja Kabisch

The Mesoamerican subregion, despite only covering roughly 1% of the Earth's land surface, is a biodiversity hotspot with about 10% of the world's terrestrial biodiversity and is the second most significant neotropical diversity source after the Amazon forest. This region's rainforests and tropical dry forests facilitate species movement between the American landmasses, but from 2002 to 2021, Costa Rica lost 11% of its tree cover, including 1.8% of humid primary forest due to the expansion of agriculture, livestock production, and illegal logging, similar to Guatemala and Mexico. Guatemala experienced a loss of 6 % of its tree cover with a 21% decline of humid primary forest. From 2001 to 2024, México lost 17% of its total tree cover with a 10% decrease of humid primary forest.

Costa Rica, natural forest. Credits: Nadja Kabisch

Mexico, deforested site. Credits: Nadja Kabisch

Costa Rica, natural forest. Credits: Nadja Kabisch

Mexico, regenerated forest. Credits: Nadja Kabisch

Costa Rica, deforested site. Credits: Nadja Kabisch

Guatemala, natural forest. Credits: David Moran

First policy recommendations

The following recommendations for the prevention and mitigation of zoonotic diseases are based on preliminary findings from Workpackage 2 - stakeholder workshops conducted in all five ZOE project case studies. Marked regional asymmetries and diverse local dynamics must be considered when designing and implementing policies. These preliminary recommendations are general guidance; more context-specific briefs will follow as analysis advances.

Outdoor leisure activities and human–wildlife contact

All case studies show increased participation in outdoor activities, partly linked to post-pandemic behavioural shifts. While beneficial for public health, this trend has intensified direct and indirect contact with wildlife. Common practices—such as rescuing or keeping wild animals, feeding wildlife, and allowing domestic animals to interact with wild species—pose significant zoonotic risks. Public communication strategies should discourage these behaviours and promote environmental education that explains their health and ecological consequences for humans, pets, and wildlife.

Participatory workshop in México. Credits: Carlos Ibarra (CINVESTAV)

Participatory workshop in Costa Rica. Credits: Bernadeth Cubillo (CeNAT-CENIBiot)

Hunting practices

Hunting remains common across case studies, including illegal practices. Regulatory enforcement is generally stronger in Europe than in Latin America, where gaps between policy and practice persist. Game meat consumption is culturally embedded, including the use of endangered species in some contexts. Policies should combine environmental education on zoonotic risks with broader awareness of biodiversity's role in ecosystem stability, recognising that cultural practices may need to evolve. Additionally, demand for wildlife as pets should be addressed through targeted awareness campaigns.

Knowledge and prevention

Knowledge of vector-borne diseases varies but is often limited. Public health campaigns tend to focus on specific diseases (e.g., dengue or borreliosis), which may hinder recognition of other zoonoses with similar symptoms. Diagnostic delays are common due to limited awareness and, in some contexts, barriers to healthcare access. Preventive strategies should adopt a One Health approach, emphasizing ecological understanding of vectors, reducing human–vector contact, and improving public knowledge of disease transmission. Overreliance on chemical control methods should be discouraged, as improper use contributes to resistance. Instead, integrated, knowledge-based prevention—particularly in livestock farming contexts—should be prioritised.

Participatory workshop in Slovenia. Credits: Johannes Richter (UNIVIE)

Participatory workshop in Guatemala. Credits: Jorge Paniagua (UVG)

ZOE Knowledge Exchange Platform

To promote synergy across stakeholders and foster international collaborations, we have developed, together with our sister project RESTOREID, a Knowledge Exchange Platform that links stakeholders interested and/or involved in research activities aiming at understanding and mitigating the risks of zoonotic and vector-borne disease emergence in relation to ecosystem degradation and associated biodiversity loss. An interactive map shows projects funded by the European Commission and other funding agencies that address research questions at the Biodiversity-Health Nexus. The KEP is growing and will be established by the end of the project by existing initiatives to ensure sustainability beyond ZOE and RESTOREID. You can explore the map here to find out about projects addressing specific questions of relevance to your community.

www.biodiv-health-kep.com

Interested in joining the research?

Get in touch and be part of this collaborative effort for the health of people, animals, and ecosystems.

Photo by Shane Rounce on Unsplash

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