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REPORT

THE EMPIRICAL RELATIONSHIP BETWEEN HABITAT AND EXTINCTION RISK: A STUDY OF THE IUCN RED LIST

Photograph: Joshua Woroniecki, Unsplash

This research investigates how changes in habitat size affects extinction risk. More precisely, we study how a change in habitat affects the likelihood to change the protection status in the IUCN red list. We distinguish between an immediate effect on the likelihood of switching and a long term gradual effect. The IUCN red list contains 166,000 species and attributes to each of them one of the following statuses: Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct.

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Empirical extinction risk

Research and policy question

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Methodological approach

For all species of a given status, we estimate the likelihood of switching to another status with an ordered probit model. We have three habitat-related variables explaining the likelihood of changing IUCN protection status: the mean habitat of a species, the deviation from it's mean habitat and the change with respect to the preceding habitat. These variables explain 1) natural differences between species, 2) permanent long term causal effects of a habitat change and 3) short term causal effects of a habitat change. Technically, the first regressor is the equivalent to a species fixed effect so that the 2 other effects can be interpreted as causal effects (Mundlak approach).

The ordered probit can be reorganized as a Markov Switching model conditional on habitat. We use the Markov Switching model to forecast the effect of changes in habitat today on likelihoods of IUCN status in the future, which includes the likelihood of going extinct.

We are currently working on repeating the exercises for different subgoups: Mammals, birds, amphibians & reptiles, other vertebrates (mainly fish), invertebrates, plants & fungi.

Findings

Figure 1 shows one of the key outcome of the study. It reports the effect of a 10% permanent change in habitat today on the likelihood of extinction 100 years later. The result compares a baseline scenario where a species maintains a constant habitat equal to the habitat in 2001-2025 (reported on the X axis), to a scenario where habitat is 10% lower. For example, for a species which had on average a habitat of 1000 km^2 over the period 2001-2025, a permanent reduction to 900km^2 will increase the likelihood of extinction by 0.17%. In fact, Figure 2, yellow line, shows that the likelihood of extinction increases from 5.70% to 5.87%, resulting in an elasticity of extinction likelihood with respect to habitat of 0.3. The convex lines in figure 2 show that the marginal effect of a 10% reduction in habitat becomes worse as the species has already lost more habitat in the past.

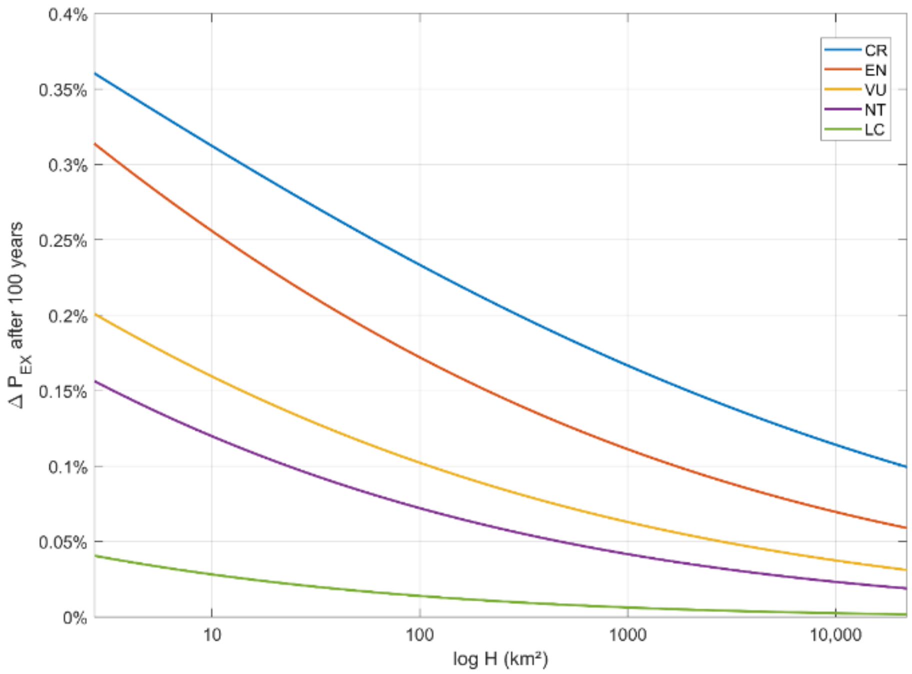

Figure 1: The increase in extinction likelihood for a permanent reduction of habitat by 10% in 2026. The mean habitat in 2001-2025 is plotted on the X-axis. Habitat measured as Extent of Occurrence. Extinction risk at 100 years.

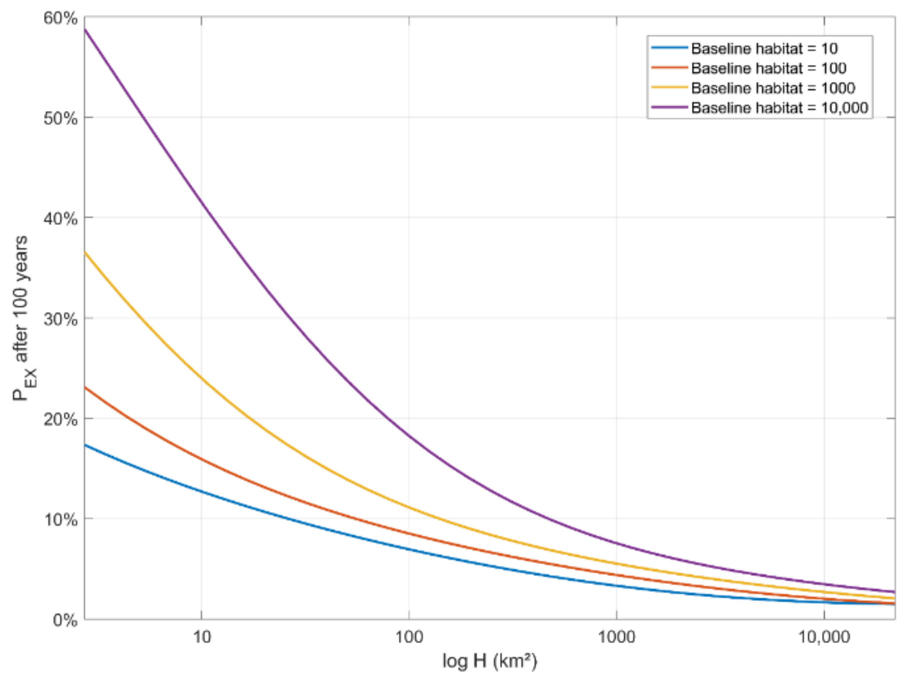

Figure2. Total extinction risk for a Critically Endangered species as a function of habitat. Different colours correspond to different baseline habitat, that is, mean habitat in 2001-2025. Habitat measured as Extent of Occurrence. Extinction risk at 100 years.

Policy implications

Dividing the cost to protect habitat by its marginal extinction risk reduction for all the species living in that area, we obtain the 'cost of a statistical species'. Spending a given conservation budget on the habitats with the lowest cost of a statistical species, is a necessary and sufficient condition to minimize extinction risk by creating habitat.

As we are the first to empirically exploit the relationship between habitat and extinction risk, we can also give guidance for other metrics. For example, the STAR biodiversity metric values a Critically Endangered species 4 times more than a Near Threatened species. We show that to minimize extinction risk, the ratio should be higher.

Also, most former studies on habitat conservation have used the Species Area Relationship (Strassburg 2020). This very popular but empirically contested measure states that in the long run, the number of species in a given area is a power function of its size (size of a field, an island or a continent). We show that the empirical dynamics of a transition towards less habitat follows a different functional form. This allows us to give a more refined view on how to maximize the impact of conservation measures.

B. B. Strassburg, A. Iribarrem, H. L. Beyer, C. L. Cordeiro, R. Crouzeilles, C. C. Jakovac, A. Braga Junqueira, E. Lacerda, A. E. Latawiec, A. Balmford, et al. Global priority areas for ecosystem restoration. Nature, 586(7831):724–729, 2020.

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Economic Policy Decision Making for Biodiversity

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