Saving genetic information☆

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Abstract

We find plot-specific adjustments to cutting ages of Swedish forest plots which maximize—for a given conservation budget—expected fungal diversity according to criteria from conservation biology. The optimal policy is essentially bimodal: the majority of plots belong to one of two subsets, on one of which cutting is delayed by several decades, while on the other cutting is scarcely delayed at all. This shows how inhomogeneity across plots—both with regard to the lost profits from delay, and the benefit in terms of boosting the survival chances of threatened fungal species—should play a crucial role in conservation policy. Our work is one of only a handful of applications of Weitzman's famous 'Noah's ark' approach to conservation of genetic information, and the first to use rigorous econometric methods to tackle a large-scale problem of competition between extraction of market goods from the land, and conservation of genetic information.

1. Introduction

Paraphrasing Weitzman (1998), how do we choose between alternatives for preserving fungal biodiversity in Swedish forests? To answer this question we assemble a dataset from 1812 Swedish forest plots—on both the presence of fungal species based on DNA sampling and sequencing, and characteristics such as tree age and volume, soil quality, and fire risk—and use it to estimate forest owners' profits as a function of cutting age, and the probability of detecting each fungal species on each plot as a function of stand age. Given these functions, we find cost-effective, plot-specific adjustments to cutting ages which maximize expected fungal diversity according to criteria from conservation biology.

Conservation of biodiversity is rising to the top of the global sustainability agenda, but despite Weitzman's seminal work (1992; 1993; 1998) we still lack even an agreed definition of what it is we are trying to conserve.[1] We are frequently concerned about the preservation of one or more specific—often charismatic—species, such as the Bengal tiger or the blue whale. In other cases we may be concerned about the ecosystem services provided by a group of species, such as pollinators. These concerns, while related to the desire for biodiversity preservation, are clearly not equivalent to it. In the former case the concern regards particular species rather than biodiversity per se, and in the latter it regards the ecosystem service; if for instance we develop cheap and effective nano-drones which remove the need for living pollinators, the concern about their preservation disappears if it is purely based on the service they provide. Clearly, an overarching goal to protect biodiversity must either be justified on the basis that it is an imperfect proxy for other goods, or it must be grounded not on the phenotypes of individual species but on their genotypes, it must be about *saving genetic information*.[2]

☆Thanks to ...

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[1] See also Solow et al. (1993).

[2] Note that many authors have argued for the opposite conclusion, that to study loss of genetic information in isolation is a mistaken approach. See for instance Fenichel et al. (2024) and Brock and Xepapadeas (2003). Frank and Sudarshan (2024) provide a striking example of how undreamed-of ecosystem services provided by a species are understood once a species disappears and its role in the ecosystem is thus revealed; if such cases are the rule rather than the exception then this would be an argument for using biodiversity as a proxy