# Accurate estimation of biodiversity is now possible on a global scale

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We know remarkably little about the diversity of life on Earth, which makes it hard to know with any certainty whether we're succeeding in our efforts to conserve it. The goal of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) is to provide policymakers with objective scientific assessments about the status of the planet's biodiversity and its services to people. The Convention on Biological Diversity (CBD) has also set its ambitious Aichi Targets on better monitoring and reporting of biodiversity.

However, many countries and regions are limited in their capacity to do so as biodiversity surveys are difficult and extremely costly. Thus we need to design clever and robust methods to estimate the number of species in a large area from a limited number of small samples. Over the past two decades, a growing number of methods have been developed to attempt this, but until now most have only been shown to upscale by maximum two orders of magnitude in spatial scales, the equivalent of estimating the number of species in an area of a hundred square metres from a sample of only one square metre.

In a new study, published in *Ecological Monographs* today, nearly the entire global research community addressing this problem was asked to put their techniques to the test by applying them to the same dataset - the 1999 Great Britain Countryside Survey.

In this study, the task required estimating the biodiversity of an area five orders of magnitude larger than the total area sampled - equivalent to

estimating the species richness of the land plants across the entire globe based on samples that cover only 3,000 km2.

More than a dozen methods belonging to five conceptual groups were tested, including the influential maximum entropy model developed by Prof John Harte at the University of California, Berkeley. The predictions of the models were then tested against the "true" species-area relationship for British plants, derived from contemporaneously surveyed national atlas data.

Prof William Kunin, an ecologist from the University of Leeds and lead author on the article, says policymakers are often concerned with the preservation of biodiversity at national, continental or global scales, but most biodiversity monitoring is conducted at very fine scales.

"This mismatch between the scales of our policies and of our data creates serious challenges, especially when assessing biodiversity change."

Of all the models tested, the model making the most robust estimates for total species richness was one based on the sampling theory developed by Prof Fangliang He (University of Alberta, Canada) and Prof Tsung-Jen Shen (National Chung Hsing University, Taiwan), which provided estimates within 10% of the true value. However, this model was not appropriate for estimating the shape of the "species-area relationship" - making it a poor choice for estimating the number of species found in areas smaller than Britain as a whole. The single best method for estimating the shape of species-area relationship was proposed by Prof Cang Hui from Stellenbosch University, based on his concept of species' occupancy ranking. A third model, proposed by Dr. Arnošt Šizling (of the Czech Academy of Sciences), combined well with the Shen-He method to allow even closer estimates of this curve.

Other models performed less well; while there are around 2,300 plant species in area in question, some models' up-scaled species richness estimates were far off the mark, ranging from 62 to 11,593.

Prof Kunin says while there remains substantial room for improvement in upscaling methods, the results suggest that several existing methods have the potential for practical application to estimate species richness at coarse spatial scales.

"We have shown that mathematical modelling of biodiversity upscaling has come of age. These methods will greatly facilitate biodiversity estimation in poorly-studied taxa and regions, and the monitoring of biodiversity change at multiple spatial scales," he concludes.

**More information:** *Ecological Monographs*, DOI: 10.1002/ecm.1284 , onlinelibrary.wiley.com/doi/10 … 02/ecm.1284/abstract

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