How does biodiversity change globally? Detecting accurate trends may be currently unfeasible

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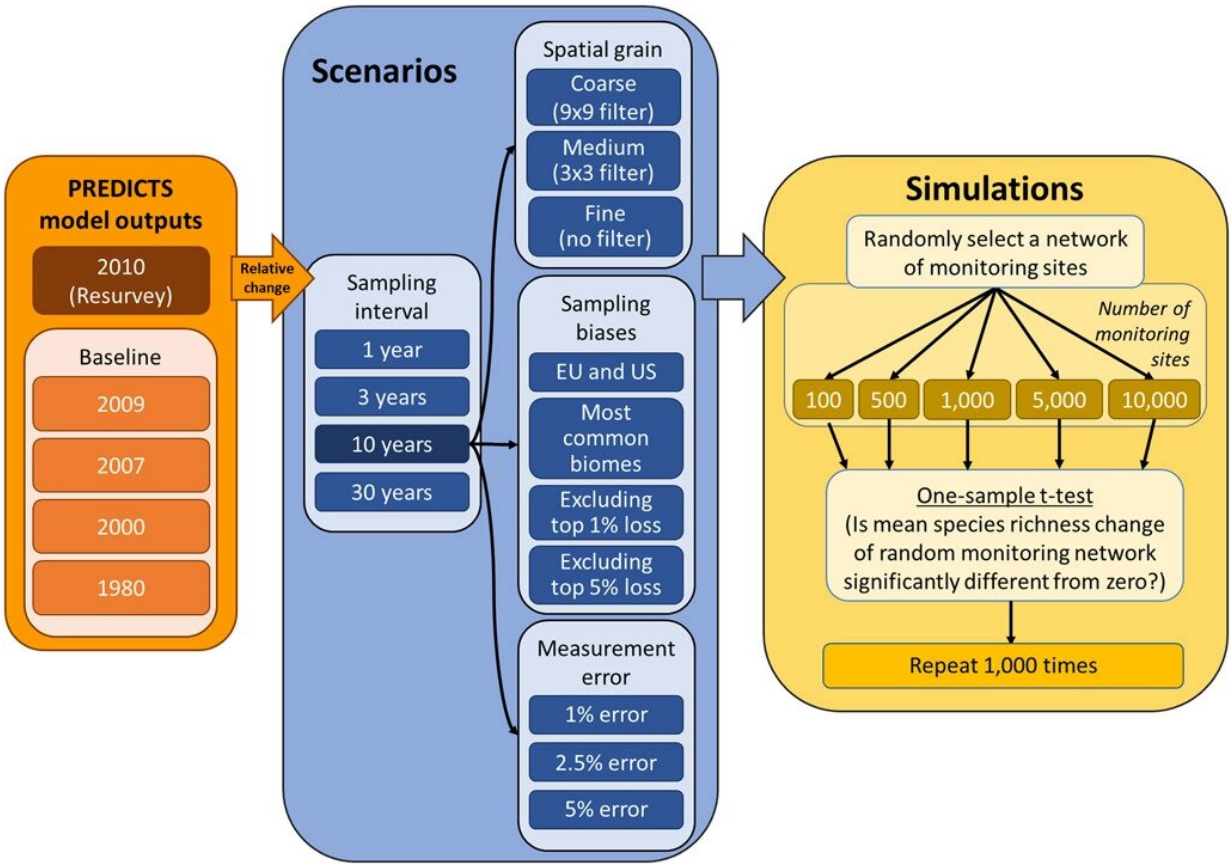

Diagram of the workflow used to build datasets of simulated time series of biodiversity monitoring across various sampling designs. Credit: *Ecography* (2023). DOI: 10.1111/ecog.06604

Existing data are too biased to provide a reliable picture of the global average of local species richness trends. This is the conclusion of an international research team led by the German Centre for Integrative Biodiversity Research (iDiv) and the Martin Luther University Halle-Wittenberg (MLU).

The authors recommend prioritizing local and regional assessments of biodiversity change instead of attempting to quantify global change and advocate standardized monitoring programs, supported by models that take measurement errors and spatial biases into account. The study was published in the journal *Ecography*.

The global loss of biodiversity has been recognized by society and politicians as one of the most urgent challenges facing humanity in the coming generations. At the World Biodiversity Conference COP15 that recently took place in Montréal, the member states of the UN Convention on Biological Diversity (CBD) adopted new goals and rules accordingly to slow down and eventually reverse this decline. In order to be able to measure the successes of this new agreement, one of these targets calls for improved biodiversity monitoring to record and evaluate trends.

While there are many different ways to measure biodiversity, the most common is species richness at the local scale. However, although species are being lost at alarming rates at the global level, this does not always reflect what is occurring at the local scale. Previous global syntheses have indicated conflicting results on the extent and even direction to which local species richness is changing.

"There has been a heated debate on the scientific community on why major global syntheses so far have not found negative trends of local species richness," states Prof Henrique Pereira, head of the Biodiversity and Conservation Research Group at iDiv and MLU and last author of

the study. "We show that the declines in local species richness are likely to be much smaller than many anticipated and that, in those conditions, even minor spatial biases and errors in monitoring lead to the lack of detection of global trends."

In order to create a global picture of what is occurring at the local scale, all available observation data must be compiled and evaluated across time. "The occurrence of species is recorded locally all over the world by many different people and organizations," says first author Dr. Jose Valdez, a postdoctoral researcher at iDiv and MLU.

"The problem with the data is that they were and are recorded under completely different conditions and mostly not under standardized rules. If you then pile them together, the errors and deviations add up, making the result very inaccurate."

The researchers were able to show that the monitoring results are significantly influenced by various factors, such as the time intervals between sampling, the size of the sampling sites, or small errors in counting the number of species at a site. A significant problem in recording global biodiversity trends is also the regional imbalance.

For example, most of the data is collected in world regions such as Europe and the United States, particularly habitats such as temperate deciduous and mixed forests. The underrepresentation of the tropical regions and habitats, areas with the highest species richness and also the largest losses, can lead to a significantly distorted impression of the global biodiversity status.

To find out whether and how these biases can be compensated for, the researchers simulated thousands of monitoring networks that varied in the above-mentioned factors. The basis for this was provided by the PREDICTS projections of local species richness trends, based on a

model developed with a globally comprehensive compilation of data from over 32,000 sites worldwide and over 51,000 species.

The researchers found that global changes in biodiversity could theoretically be determined in hundreds of perfectly sampled sites within a decade and thousands of sites within a 3-year period.

Changes in species richness on a global scale only detectable with unrealistically many sampling sites

However, perfect sampling does not exist in reality. Studies show that monitoring data typically contain 10% to 30% errors due to missing or misidentifying species during sampling. By just adding very small measurement errors of up to 5%, the researchers found that it drastically reduced the ability to detect any global change. With more realistic errors and further imprecision factors, detecting the average global trend may simply be impossible.

"Our results demonstrate that capturing accurate trends in local species richness would require monitoring an unfeasibly large number of perfectly sampled sites," adds Jose Valdez.

"However, the question is whether this would even be useful or meaningful for effective and responsive biodiversity conservation. Conservation strategies and measures are coordinated and implemented not on a global level, but at local and national scales. Measuring biodiversity trends at these smaller scales is not only more practical but also helps in understanding the drivers of biodiversity loss and assessing the progress of conservation policies."

"A substantial increase of biodiversity monitoring is needed, combined with analysis that uses models to fill in data gaps," says Henrique

Pereira. The authors advise establishing a representative network of sampling sites around the world that provides independent, integrated, and regularly updated biodiversity data. Such an approach is currently being developed for the European Union with the EuropaBON project.

More information: Jose W. Valdez et al, The undetectability of global biodiversity trends using local species richness, *Ecography* (2023). DOI: 10.1111/ecog.06604

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