The different facets of biodiversity

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Professor F. Guillaume Blanchet from Université de Sherbrooke explores the various aspects of biodiversity and the challenge involved in monitoring it

During the 2022 United Nations Biodiversity Conference of the Parties (COP15), the Kunming-Montréal Global Biodiversity Framework was adopted. This framework has given prized mediatic attention to biodiversity as a topic that needs to be given the same importance as climate change. Arguably, the most publicized part of the Kunming-Montréal Global Biodiversity Framework was defined by media from around the world as the 30 by 30 target.

In the final text, the 30 by 30 target is actually divided into Target 2 and Target 3. Briefly, Target 2 emphasizes the importance of restoring 30% of the degraded area to enhance biodiversity. At the same time, Target 3 focuses on ensuring that 30% of the Earth's land, freshwaters and oceans be protected for biodiversity. Both Target 2 and Target 3 aim to reach this goal by 2030, hence the "30 by 30". If we want to protect and restore the terrestrial and aquatic areas and better manage them for biodiversity, we need to know what biodiversity is.

By definition, biodiversity encompasses every aspect of living things. But concretely, what does this really mean? Generally, when we picture biodiversity, we typically think of large animals (e.g. elephants, sharks, snakes, frogs and birds) commonly displayed in zoos and colourful plants typically exhibited in botanical gardens. Although worms, fungi, mosquitoes, mosses, and lichens are rarely considered when thinking of biodiversity, they are part of it as well. When thinking of biodiversity in these terms, we consider biodiversity by grouping organisms into different species. As such, if we want to assess whether a particular location is important for biodiversity, we can count the number of species found at this location.

A large number of species would suggest high biodiversity and may lead us to think that it is a high-priority location for biodiversity. Because so much effort has been put into species identification, as a society, we are surprisingly good at monitoring species' biodiversity.
Almost any street corner library has field guides to identify birds or plants, not to mention the many smartphone applications dedicated to species identification (e.g. Seek by iNaturalist). Although counting species is a valuable way to monitor biodiversity, it is only one of many facets of biodiversity.

Instead of counting the number of species at a location, biodiversity also includes the number of interactions that exist among the species found in a location. In other words, we can measure biodiversity by evaluating the complexity of food webs and by learning

who eats who at a particular location.

In practice, gathering information about who eats who is much more challenging than counting species simply because seeing a species eating another species requires timing, and sometimes a bit of luck. For some species, it can be reasonably straightforward to see them interact. For example, buffalos eat grass regularly, and it is easy to see them in action. However, for other species, it is much more challenging to know if they are interacting. It is only recently that sperm whales have been confirmed as predators of the giant squid.

If we think of what makes two individuals of the same species differ from each other (e.g. two cats, two dogs, you and your neighbour), we are considering biodiversity from a genetic perspective. Genetic diversity is valuable, especially when working with endangered species because it can be used to assess how much inbreeding there is in a population. From a management perspective, a species where many individuals come from a small number of ancestors has a low genetic diversity.

An extreme example of a species with low genetic diversity is the black robin. In 1980, only five black robins existed, of which only one was a fertile female. Although there are now around 300 black robins, their genetic diversity is very low because they all came from the same female that lived 45 years ago. Why is this problematic? The lack of genetic diversity in a species makes it much more fragile to illnesses and sensitive to change. The main problem with genetic diversity is that it requires technical manipulations in science labs to measure it.

Upon gathering information on genetic diversity, another way to measure biodiversity has emerged. From genetic information, we can learn a lot about ancestry. For example, this is how scientists found that humans and orangutans have a common ancestor. Suppose all species in a particular location have a single ancestor, from a historical perspective. In that case, it is less diverse than another area with the same number of species but with multiple ancestors. For example, Madagascar is reputed to have high biodiversity, not only because there are many plant and animal species found on this island but also because many of them come from multiple historical lineages.

The types of biodiversity presented above are only a few ways to consider biodiversity. To ensure that all components of living things are accounted for when monitoring biodiversity, we need to consider how nature is organized, from genes to ecosystems. The different facets of biodiversity that need to be monitored to have a complete understanding of it are known as Essential Biodiversity Variables.

The challenge of monitoring biodiversity

From a management perspective, if we aspire to reach the goals and targets defined in the Kunming-Montréal Global Biodiversity Framework, it is essential to monitor all aspects of biodiversity. The complexity of biodiversity pushes us to be creative in monitoring the multiple facets of biodiversity using advanced technology such as satellite imagery, artificial intelligence, citizen science, etc. Even with these resources, monitoring

biodiversity is costly and time- consuming not only because of the complex nature of biodiversity but also because Earth is big and changing. As such, biodiversity assessments need to be made continuously.

If governments want to achieve their goal of restoring and protecting biodiversity, monitoring biodiversity should not be left to academics; all levels of society, including citizens, industries, and governmental and non-governmental organizations, need to be involved in this task.

It is only with the combined efforts and resources of everyone that we will be able first to know which organisms live on our land and sea and later to understand how their distributions and abundances change. Only then will we have enough information to make enlightened decisions about how to best protect and manage biodiversity.

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