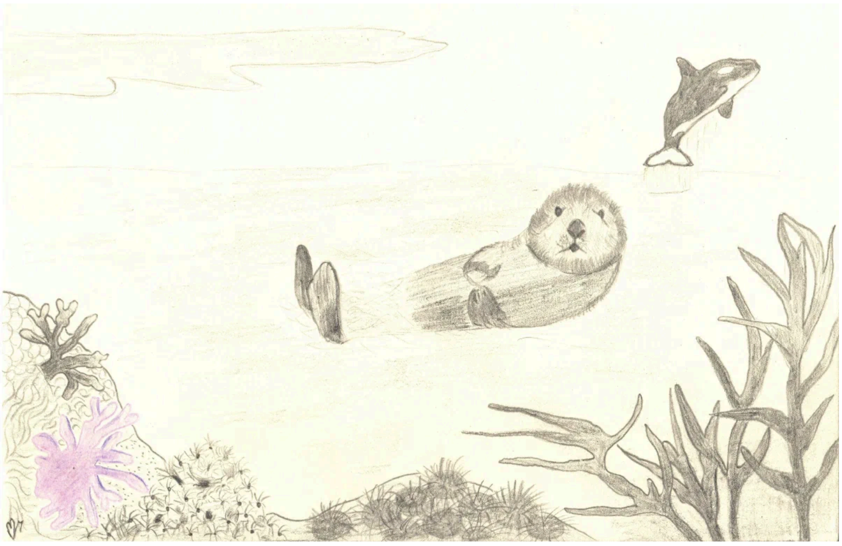
Q&A

Why is biodiversity important?

Biodiversity is not just a measure of nature's richness. It is the foundation on which all life, including ours, depends.



We can define biodiversity as the combination of genetic diversity within species, the variety of living species, and the breadth of ecosystems on Earth. Let's see what happens when we take away diversity at each of those levels to show why biodiversity is important for all life.

No genetic variation means no survival of the "fittest". Genetic diversity is the variation in DNA that is present in a population or species. One of the most striking (but not so natural) examples are dogs. Dogs all belong to the same species, but differ greatly in appearance and behaviour, from cuddly curly Poodles and fast Greyhounds to loyal and stealthy Rottweilers. These differences are due to genetic variation. When we started breeding dogs as companions from wild wolf ancestors, we started moulding that diversity into different directions depending on our own interests [1].

The same genetic diversity is used to create crops for our food. Maize is an example that was domesticated by ancient Mexican indigenous communities[2]. Maize is derived from a wild grass called teosinte, a plant that looks nothing at all like the maize that we know and eat. Generating such differences is possible through years and years and years, about 9000 actually, of artificial selection: choosing plants with the best kernels and largest cobs led from an original plant with barely edible kernels and small cobs to the large nutritious food staple that we know today. What artificial selection does is reduce natural variation that was present in teosinte to produce highly similar maize strains.

As is the case in maize, crossing closely related individuals or inbreeding often has negative effects. A good example can be found in a research project that I contributed to on spider mites[3]. These tiny arachnids feed on many different plants, including maize and other crops. When genetic variation was low, the spider mites were dumber: Inbreds were not able to learn from previous experiences, while genetically more diverse outbreds avoided less favourable plants.

Natural populations have similar problems when genetic variation becomes low. Despite more than 50 years of conservation efforts and increased protection, the so-called Southern Resident population of North Pacific killer whales is the smallest and most threatened[4]. Capture for aquaria in the 1970s shrunk the Southern Resident population perhaps irreparably. By breeding amongst kin, survival and reproduction are severely reduced preventing healthy population growth. Southern Residents are further reproductively isolated, meaning that while they do encounter killer whales from other populations, females choose not to mate with them. Future prospects for the Southern Residents are thus low, unless a Southern Resident Juliet accepts a Romeo from another North Pacific killer whale population. As killer whales are matrilineal with offspring staying in the mother's pod, at least the Shakespearean drama of feuding families is avoided, as male mates from other pods do not stick around.

Every species has its place. Ecological communities are not random collections of species. Species interact and depend on one another, sometimes in more than one way. For some species the ecological purpose is blatantly clear, such as for apex predators like killer whales. Killer whales feed on sea otters, which in turn play a key role as intermediary predators in regulating the abundance of creatures lower in the food chain. Sea otters were hunted extensively by humans in the 18th and 19th century for the fur trade. This nearly led to the extinction of sea otters in the Eastern North Pacific[5]. When sea otter numbers are low, fewer sea urchins are eaten, leading to an overwhelming increase in urchin abundance. High sea urchin numbers then lead to a negative cascading effect inhibiting the growth of kelp forests, which provide habitat and food for many other organisms.

Yellow-legged hornets provide an example where the addition of a species disrupts the ecological balance. Yellow-legs are insects that are native to South-East Asia, but were introduced accidentally in Europe in 2004[6]. Yellow-legged and native European hornet species occupy roughly the same ecological niche, but have a very different effect on the ecosystem around them. While the predatory behaviors of hornets in general are quite impressive, the yellow-legged variety is particularly fierce for native honeybees. Yellow-legs hover in front of bee hives in anticipation of returning bees through a behavior called hawking[7]. In essence, they are waiting at the front door for thousands of bees that return to the hive. Clearly a successful strategy, the predation pressure on European honeybees becomes very high, lowering bee abundance, reducing the collection of pollen and nectar, and jeopardizing colony survival[8]. That matters, because European honeybees are responsible for pollinating a large proportion of flowering plants, including many wild species and crops. Without sufficient bee numbers, pollination services collapse, leading to the loss of many primary producers at the base of terrestrial food chains.

Are all species important? Yes. Are all species equally important? No, but each species has some role to play in an ecosystem. After all, we can't all be beavers or "ecosystem engineers" modifying the environment and boosting biodiversity.

Ecosystem loss = biodiversity loss. When you consider the immense impact the loss of genetic diversity, the loss of a species or the introduction of an unwanted invasive species can have, it is no surprise that losing entire ecosystems is disastrous. Corals, some of the simplest animals on Earth, are considered foundation species by hosting more than a third of all marine biodiversity globally[9]. Corals are, however, dependent on algal photosynthetic symbionts that are expelled under temperature stress. Coral bleaching is the result. About 50% of coral cover has already been lost and increasing temperatures by 1.5 to 2°C due to climate change will lead to the loss of almost all corals[10].

The importance of preserving and restoring corals and other high-diversity ecosystems, such as tropical rain forests, mangroves, and islands (among others) is clear. But even Antarctica, which is barely inhabitable for most life, still contains about 4000 species ranging from bacteria to sea birds and seals that are worth preserving[11].

To conclude, many pages can be written about the benefits of nature for humans, or the ecosystem services that the living world around us provides. But not everything needs to be useful for humans to be valuable. Nature needs nature. Humans need nature. But nature does not need humans. If humans were to cease the habitat destruction, pollution, overexploitation, and greenhouse gas emissions that are currently driving biodiversity loss, nature would not only be preserved but would begin to recover. That will, unfortunately, be too late for the last two remaining female Northern white rhinoceroses in Kenya[12], but it will be in time for the *at least* 9 million estimated species on our globe[13],[14].

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