Selected findings from the IPBES Global Assessment on Biodiversity and Ecosystem Services
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Nature in Crisis: Biodiversity Loss and its Causes, June 4 2019

Dr. Kate Brauman, Coordinating Lead Author of the IPBES Global Assessment
Lead Scientist, Global Water Initiative
at the University of Minnesota Institute on the Environment

I would like to thank the House Committee on Science, Space and Technology for the opportunity to provide a testimony based on the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). This testimony complements that provided by Sir Robert Watson.

In response to the request of the Committee, this testimony addresses: 1) major findings of the IPBES report related to trends in ecosystems services and how they are affected by the drivers of biodiversity loss, 2) issues of biodiversity in agriculture and ecosystem service benefits provided by non-marine ecosystems, 3) potential solutions identified in the IPBES Global Assessment, and 4) research gaps related to ecosystem services.

1) Trends in ecosystems services and how they are affected by the drivers of biodiversity loss

Since 1970, trends in agricultural production, fish harvest, bioenergy production and harvest of materials have increased, but 14 of the 18 categories of contributions of nature that were assessed, mostly regulating and non-material contributions, have declined. The value of agricultural crop production ($2.6 trillion in 2016) has increased approximately threefold since 1970, and raw timber harvest has increased by 45 per cent, reaching some 4 billion cubic meters in 2017, with the forestry industry providing about 13.2 million jobs. However, indicators of regulating contributions, such as soil organic carbon and pollinator diversity, have declined, indicating that gains in material contributions are often not sustainable. Currently, land degradation has reduced productivity in 23 per cent of the global terrestrial area, and between $235 billion and $577 billion in annual global crop output is at risk as a result of pollinator loss. Moreover, loss of coastal habitats and coral reefs reduces coastal protection, which increases the risk from floods and hurricanes to life and property for the 100 million–300 million people living within coastal 100-year flood zones.

Nature's contributions to people are often distributed unequally across space and time and among different segments of society. There are often trade-offs in the production and use of nature's contributions. Benefits and burdens associated with co-production and use of nature's contributions are distributed and experienced differently among social groups, countries and regions. Giving priority to one of nature's contributions to people, such as food production, can result in ecological changes that reduce other contributions. Some of these changes may benefit some people at the expense of others, particularly the most vulnerable, as may changes in technological and institutional arrangements. For example, although food production today is sufficient to satisfy global needs, approximately 11 per cent of the world's population is undernourished, and diet-related disease drives 20 per cent of premature mortality, related both to undernourishment and to obesity. The great expansion in the production of food, feed, fiber and bioenergy has occurred at the cost of many other contributions of nature to quality of life, including regulation of air and water quality, climate regulation and habitat provision. Synergies also exist, such as sustainable agricultural practices that enhance soil quality, thereby improving productivity and other ecosystem functions and services such as carbon sequestration and water quality regulation.

Figure 1. Global trends in the capacity of nature to sustain contributions to good quality of life from 1970 to the present, which show a decline for 14 of the 18 categories of nature's contributions to people analyzed. Data supporting global trends and regional variations come from a systematic review of over 2,000 studies {2.3.5.1}. Indicators were selected on the basis of availability of global data, prior use in assessments and alignment with 18 categories. For many categories of nature's contributions, two indicators are included that show different aspects of nature's capacity to contribute to human well-being within that category. Indicators are defined so that an increase in the indicator is associated with an improvement in nature's contributions.

The rate of global change in nature during the past 50 years and the related impact on ecosystem services is unprecedented in human history. The direct drivers of change in nature with the largest global impact have been (starting with those with most impact): changes in land and sea use; direct exploitation of organisms; climate change; pollution; and invasion of alien species. Those five direct drivers result from an array of underlying causes – the indirect drivers of change – which are in turn underpinned by societal values and behaviors that include production and consumption patterns, human population dynamics and trends, trade, technological innovations and local through global governance. The rate of change in the direct and indirect drivers differs among regions and countries.

The average per capita consumption of materials (e.g., plants, animals, fossil fuels, ores, construction material) rose by 15 per cent since 1980. This activity has generated unprecedented impacts: since 1980, greenhouse gas emissions doubled, raising average global temperatures by at least 0.7 degrees Celsius, while plastic pollution in oceans has increased tenfold. Over 80 per cent of global wastewater is being discharged back into the environment without treatment, while 300–400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are dumped into the world's waters each year. Excessive or inappropriate application of fertilizer can lead to run off from fields and enter freshwater and coastal ecosystems, producing more than 400 hypoxic zones which affect a total area of more than 245,000 km^2 as early as 2008.

2) Biodiversity in agriculture and ecosystem services provided by non-marine ecosystems

Nature plays a critical role in providing food and feed, energy, medicines and genetic resources and a variety of materials fundamental for people's physical well-being and for maintaining culture. For example, more than 2 billion people rely on wood fuel to meet their primary energy needs, an estimated 4 billion people rely primarily on natural medicines for their health care and some 70 per cent of drugs used for cancer are natural or are synthetic products inspired by nature. Nature, through its ecological and evolutionary processes, sustains the quality of the air, fresh water and soils on which humanity depends, distributes fresh water, regulates the climate, provides pollination and pest control and reduces the impact of natural hazards. For example, more than 75 per cent of global food crop types, including fruits and vegetables and some of the most important cash crops such as coffee, cocoa and almonds, rely on animal pollination. Marine and terrestrial ecosystems are the sole sinks for anthropogenic carbon emissions, with a gross sequestration of 5.6 gigatons of carbon per year (the equivalent of some 60 per cent of global anthropogenic emissions). Nature underpins all dimensions of human health and contributes to non-material aspects of quality of life – inspiration and learning, physical and psychological experiences, and supporting identities – that are central to quality of life and cultural integrity, even if their aggregated value is difficult to quantify. Most of nature's contributions are co-produced with people, but while anthropogenic assets – knowledge and institutions, technology infrastructure and financial capital – can enhance or partially replace some of those contributions, some are irreplaceable. The diversity of nature maintains humanity's ability to choose alternatives in the face of an uncertain future.

Biodiversity is particularly important for agriculture. Globally, local varieties and breeds of domesticated plants and animals are disappearing. This loss of diversity, including genetic diversity, poses a serious risk to global food security by undermining the resilience of many agricultural systems to threats such as pests, pathogens and climate change. Fewer and fewer varieties and breeds of plants and animals are being cultivated, raised, traded and maintained around the world, despite many local efforts, which include those by indigenous peoples and local communities. By 2016, 559 of the 6,190 domesticated breeds of mammals used for food and agriculture (over 9 per cent) had become extinct and at least 1,000 more are threatened. In addition, many crop wild relatives that are important for long-term food security lack effective

protection, and the conservation status of wild relatives of domesticated mammals and birds is worsening. Reductions in the diversity of cultivated crops, crop wild relatives and domesticated breeds mean that agroecosystems are less resilient against future climate change, pests and pathogens.

Many of nature's contributions to people are essential for human health and their decline thus threatens a good quality of life. Nature provides a broad diversity of nutritious foods, medicines and clean water, can help to regulate climate, reduce levels of certain air pollutants, and improve mental and physical health through exposure to natural areas, among other contributions. Nature is the origin of most infectious diseases (negative impact), but also the source of medicines and antibiotics for treatment (positive contribution). Zoonotic diseases are significant threats to human health, with vector-borne diseases accounting for approximately 17 per cent of all infectious diseases and causing an estimated 700,000 deaths globally per annum. The deterioration of biodiversity and ecosystem functions, and the consequent disruption of benefits to people, has both direct and indirect implications for public health. Emerging infectious diseases in wildlife, domestic animals, plants or people can be exacerbated by human activities such as land clearing and habitat fragmentation or the overuse of antibiotics driving rapid evolution of antibiotic resistance in many bacterial pathogens. The deterioration of nature and consequent disruption of benefits to people has both direct and indirect implications for public health and can exacerbate existing inequalities in access to health care or healthy diets. Shifting diets towards a diversity of foods, including fish, fruit, nuts and vegetables, significantly reduces the risk of certain preventable non-communicable diseases, which are currently responsible for 20% of premature mortality globally.

Most of nature's contributions are not fully replaceable, yet some contributions of nature are irreplaceable. Loss of diversity, such as phylogenetic and functional diversity, can permanently reduce future options, such as wild species that might be domesticated as new crops and be used for genetic improvement. People have created substitutes for some other contributions of nature, but many of them are imperfect or financially prohibitive. For example, high-quality drinking water can be achieved either through ecosystems that filter pollutants or through human-engineered water treatment facilities. Similarly, coastal flooding from storm surges can be reduced either by coastal mangroves or by dikes and sea walls. In both cases, however, built infrastructure can be extremely expensive, incur high future costs and fail to provide synergistic benefits such as nursery habitats for edible fish or recreational opportunities. More generally, human-made replacements often do not provide the full range of benefits provided by nature.

3) Potential solutions.

Nature and the benefits it provides can be conserved, restored and used sustainably while simultaneously meeting other global societal goals. Feeding humanity and enhancing the conservation and sustainable use of nature are complementary and closely interdependent goals that can be advanced through sustainable agricultural, aquacultural and livestock systems, the safeguarding of native species, varieties, breeds and habitats, and ecological restoration. Specific actions include promoting sustainable agricultural practices, such as good agricultural and agroecological practices, among others, multifunctional landscape planning and cross-sectoral integrated management, that support the conservation of genetic diversity and associated agricultural biodiversity. Further actions to simultaneously achieve food security, biodiversity protection and sustainable use are context-appropriate climate change mitigation and adaptation, incorporating knowledge from various systems, including the sciences and sustainable indigenous and local practices, avoiding food waste, empowering producers and consumers to transform supply chains and facilitating sustainable and healthy dietary choices. As part of integrated landscape planning and management, prompt ecological restoration emphasizing the use of native

species can offset current degradation and save many endangered species but is less effective if delayed.

Conservation actions, including protected areas, efforts to manage unsustainable use and address illegal taking and trade of species, translocations and invasive species eradications, among others, have been successful in preventing the extinction of some species. Although still few and spatially localized, documented examples show that with prompt and appropriate action, it is possible to reduce human- induced extinction rates. There are, however, few other counterfactual studies assessing how trends in the state of nature or pressures upon nature would have been different in the absence of conservation efforts.

Five main interventions ("levers") can generate transformative change by tackling the underlying indirect drivers of nature deterioration: (1) incentives and capacity-building; (2) cross-sectoral cooperation; (3) pre-emptive action; (4) decision-making in the context of resilience and uncertainty; and (5) environmental law and implementation. Employing these levers involves the following, in turn: (1) developing incentives and widespread capacity for environmental responsibility and eliminating perverse incentives; (2) reforming sectoral and segmented decision-making to promote integration across sectors and jurisdictions; (3) taking pre-emptive and precautionary actions in regulatory and management institutions and businesses to avoid, mitigate and remedy the deterioration of nature, and monitoring their outcomes; (4) managing for resilient social and ecological systems in the face of uncertainty and complexity to deliver decisions that are robust in a wide range of scenarios; and (5) strengthening environmental laws and policies and their implementation, and the rule of law more generally. All five levers may require new resources, particularly in low-capacity contexts such as in many developing countries.

Transformations towards sustainability are more likely when efforts are directed at the following key leverage points, where efforts yield exceptionally large effects: (1) visions of a good life; (2) total consumption and waste; (3) values and action; (4) inequalities; (5) justice and inclusion in conservation; (6) externalities and telecouplings; (7) technology, innovation and investment; and (8) education and knowledge generation and sharing. Specifically, the following changes are mutually reinforcing: (1) enabling visions of a good quality of life that do not entail ever-increasing material consumption; (2) lowering total consumption and waste, including by addressing both population growth and per capita consumption differently in different contexts; (3) unleashing existing widely held values of responsibility to effect new social norms for sustainability, especially by extending notions of responsibility to include impacts associated with consumption; (4) addressing inequalities, especially regarding income and gender, which undermine capacity for sustainability; (5) ensuring inclusive decision-making, fair and equitable sharing of benefits arising from the use of and adherence to human rights in conservation decisions; (6) accounting for nature deterioration from local economic activities and socioeconomic-environmental interactions over distances (telecouplings), including, for example, international trade; (7) ensuring environmentally friendly technological and social innovation, taking into account potential rebound effects and investment regimes; and (8) promoting education, knowledge generation and maintenance of different knowledge systems, including the sciences and indigenous and local knowledge regarding nature, conservation and its sustainable use.

Recognizing the knowledge, innovations and practices, institutions and values of indigenous peoples and local communities and their inclusion and participation in environmental governance often enhances their quality of life, as well as nature conservation, restoration and sustainable use, which is relevant to broader society. Governance, including customary institutions and management systems, and co-management regimes involving indigenous peoples and local

communities, can be an effective way to safeguard nature and its contributions to people, incorporating locally attuned management systems and indigenous and local knowledge. The positive contributions of indigenous peoples and local communities to sustainability can be facilitated through national recognition of land tenure, access and resource rights in accordance with national legislation, the application of free, prior and informed consent, and improved collaboration, fair and equitable sharing of benefits arising from the use, and co-management arrangements with local communities.

4) Research gaps in ecosystem services research

Since the Millennium Ecosystem Assessment was published in 2005, substantial data have been collected on biodiversity, ecosystems, ecosystem services and more generally on the co-production and impact of social, environmental, and climate change upon them. Despite this progress, however, large information gaps remain in assessing the status and trends of nature's contributions to people, and particularly their implications to the quality of life of different groups of people.

The extent of nature's contribution to good quality of life is not well understood for some of nature's contributions to people. The lack of understanding arises for several reasons. First, it is often hard to disentangle nature's contributions from other contributions. For example, though we have good data on status and trends of air quality across major cities in the world, how changes in vegetation impact air quality in cities is less well understood and is currently a frontier of scientific investigation. Second, understanding of key links between nature and impacts on good quality of life may be missing. For example, though we often have a good understanding of how changes in exposure affect disease incidence and impacts on human health, how changes in nature influence exposure is often complex and is poorly understood for some diseases. Exposure for vector-borne diseases depends on populations of vectors as well as how these vectors overlap with vulnerable populations of humans. Vector populations can depend on complex ecosystem interactions that give rise to unpredictable increases or decreases in populations as a function of anthropogenic induced changes to ecosystems. Exposure also depends on human behavior and public health measures designed to reduce the vulnerability of human populations to disease.

Even where the extent of nature's contribution to good quality of life is well understood, there is often a lack of systematic data collection, or systematic documentation, on which to base a comprehensive global assessment. Much of the literature on non-material contributions to people involves detailed case studies of specific groups. This literature provides a wealth of information but studies typically differ in focus and methodology, and there is uneven coverage across regions, which makes it difficult to combine results into a systematic global assessment. For most ecosystem services we lack systematic reporting on impacts of nature on good quality of life. Much of the natural science literature focuses on changes in ecosystems and biodiversity but does not report how these changes affects good quality of life. Much of the systematic data reporting on various aspects of good quality of life (such as income, livelihoods, health, and education) does not disentangle the impacts of nature on good quality of life from other impacts. It would be ideal to report quantitative measures of nature's contributions in terms readily understood by various decision-makers and the general public. While we have some measures of nature's contributions to people reported in monetary terms, health terms, or other measures related to good quality of life, we lack systematic indicators that can be reported in a variety of easily understood metrics for many of nature's contributions.

A general issue in doing a comprehensive global assessment is the existing fragmented state of knowledge with lack of integration between social and natural sciences, and between western science and ILK. This assessment has emphasized the importance of including multiple viewpoints

and sources of knowledge but this has not been matched with an ability to effectively integrate multiple sources of knowledge into a systematic assessment. Different world views are hard to integrate in substantive ways. Doing so will require increased dialog across communities and agreement on how to be more systematic in knowledge generation and data collection.

Measuring trends in nature's contributions requires having a time series of data measured in a consistent fashion. Consistent time series data exists for some aspects of some of nature's contributions but is lacking for many aspects of most of nature's contributions. For some environmental measures it is now possible to get consistent global data via remote sensing. However, many remote sensing data series begin with the satellite era, so that many of these time series are of fairly short duration. In contrast, measures of impact on good quality of life often require direct observation or survey work. Time series data exists for income, health and other measures of human well-being but typically does not report on the impact that nature has on good quality of life.