

Ecological collapse

Reviewed by

Philip Osano

Research Fellow, Natural Resources and Ecosystems, Stockholm Environment Institute, SEI

What is at stake?

Since the mid-1950s, many elements that ensure the habitability of the planet, including greenhouse gas concentration, forested areas or the health of marine ecosystems, have been declining at an accelerating pace, negatively affecting ecosystems which are the foundation for human life. Ecosystems perform a range of functions, referred to as environmental services, without which human societies and economies would not operate at their current level. We depend on environmental services for air, water, food and fiber, shelter and energy. Ecosystems can tolerate a measure of impact from human use and recover after a period of time with minimal negative effects – an attribute generally known as resilience – but beyond a certain threshold, or “tipping point”, sudden and radical disruption can occur, which may lead to “ecosystem collapse”. Under such conditions, soil quality, freshwater supplies and biodiversity diminish drastically, while agricultural capacity plummets and daily human living conditions deteriorate significantly.

“Ecosystems can tolerate a measure of impact from human use and recover after a period of time with minimal negative effects...”

Although little studied, new evidence is emerging on “ecosystem collapse” due to among other factors, including human pressure and climate impact. Several historical and current examples of “ecological collapse” have been recorded. The former includes Easter Island, and the latter include the ecological collapse in and around the Aral Sea which led to dramatic social and economic consequences before gradual recovery.

Another example is the ecological changes witnessed in and around Lake Chad that have affected human livelihoods with dramatic negative impacts on people and ecosystem of the region; the diminishing water resources and the decline in the lake’s ecosystem has led to severe health and economic impacts for the populations around Lake Chad, and has affected fishing communities and pastoralists, and generated resource-based conflicts.



In today's globalized and tightly connected world, local disruptions may sometimes also lead to unintended ecological effects on other far-flung areas. This might escalate into the rapid collapse of most ecosystems across the Earth. And with no time for effective recovery – and amplified by climate change impacts – drastically compromise the planet's capacity to sustainably support a large and growing human population.

How much do we know?

Ecosystems are complex entities, which consist of a community of living organisms in their non-living environment, linked together through flows of energy and nutrients. The behaviour of an ecosystem is relatively stable over time, but when the balance between some of its elements is altered beyond a certain threshold, it can experience a non-linear, possibly catastrophic transformation.

Human-induced factors that affect ecosystem stability and contribute to biodiversity loss may be classified into the following categories:

- Changes in the balance of local biodiversity caused by human activities, for example, the introduction of 'invasive' species or overharvesting of plants and animals
- Alteration of the chemical balance in the environment – soil, water and air – due to pollution
- Modifications in the local temperatures and water cycle because of climate change
- Habitat loss, whether through destruction or ecosystem fragmentation in terrestrial and water/sea systems.

Scholars describe the current historical moment as the start of a new geological era, called the Anthropocene, where humans as the predominant agent of change at the planetary level change the nature of nature itself. In 2009, an international group of experts identified nine interconnected planetary boundaries that underpin the stability of the global ecosystem, allowing human civilization to thrive. Recent assessment shows that humanity has exceeded the safe limits for five of the planetary boundaries and are now operating in a high-risk zone for biosphere integrity and biogeochemical flows. New evidence suggests that changing course to stop the pervasive human-driven decline of life on Earth requires transformative and immediate change.

What are key factors affecting risk levels?

Controlling the clearance and alteration of land and forests for other land uses, including agriculture (crop cultivation and pasture), mining, and infrastructure, among others is critical to controlling the risk of biodiversity loss and ecosystem collapse. Estimates show that the rate of deforestation has fallen globally by almost a third compared to the previous decade. The development and adoption of new technologies or production models that are less resource intensive and/or less polluting could reduce the risk of biodiversity loss and ecological collapse,



as would a shift towards more sustainable lifestyles, more specifically changing consumption patterns, possibly accompanied by behaviour change.

It is estimated that environmental services, should their contribution to human well-being be calculated, would be worth more than twice as much as the entire global GDP.

Integrating the valuation of ecosystems into economic decision making, reviewing our measures of economic success, and employing robust environmental accounting systems across businesses and national economies would contribute to reducing the risk²³. The latest assessments report that over 100 countries have now incorporated biodiversity values into national accounting systems.

Global governance mechanisms to conserve ecosystems and reduce pollution, in particular more integrated approaches between the global governance of ecosystems and economics and trade, are of particular importance, as many ecosystems do not overlap with national boundaries, and trade is an important driver of ecosystem collapse.

Ecosystem collapse in Australia and Antarctica

A recent study assessed evidence of collapse in 19 ecosystems (both terrestrial and marine) that cover approximately 1.5% of the Earth's surface extending from northern Australia to coastal Antarctica, looking at environmental changes over the past 30 years. The study applied four criteria to assess collapse (abrupt, smooth, stepped and fluctuating), and found evidence of local collapse for all the 19 ecosystems studied, although none has collapsed across the entire distribution.

The collapses were as a result of ecosystems experiencing multiple pressures simultaneously, including pressures from global climate change (such as temperature rise, altered precipitation and ocean acidification), and pressures arising from regional human impacts (such as habitat loss, pollution and water extraction) acting together to erode biodiversity. To deal with this challenge of ecosystem collapse, the authors recommend a three-step approach of promoting awareness of ecosystem values, anticipation of pressures, and taking action to manage the impacts through recovery, restoration, renovation and adapting to the changes.