

1. Introduction to ecology and planetary boundaries

Module objectives:

Adopt a systemic vision of the world and understand the issues related to planetary limits.

Courses related to the theme:

Climate changes

Biodiversity and preservation issues

Ocean acidification

Biogeochemical cycles

Global water use

Stratospheric ozone

Chemical pollution and atmospheric aerosols

Land use deforestation and agriculture

What is ecology?

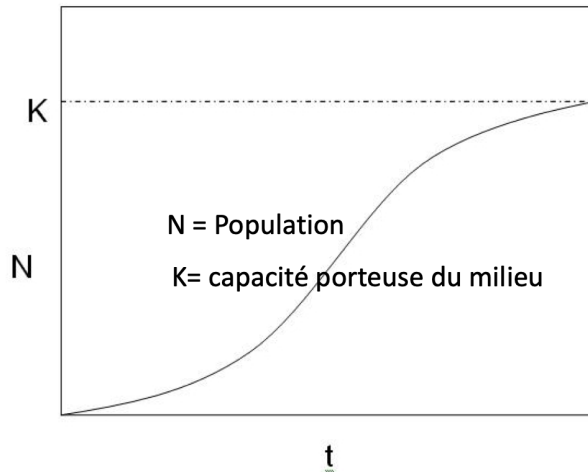
We distinguish Scientific Ecology: Science of the relationships between living organisms among themselves and with their environment. (Haeckel, 1866).

And Political Ecology: Taking into account of ecological issues in political action and in social organization (1970).

1.1. Scientific ecology and population growth

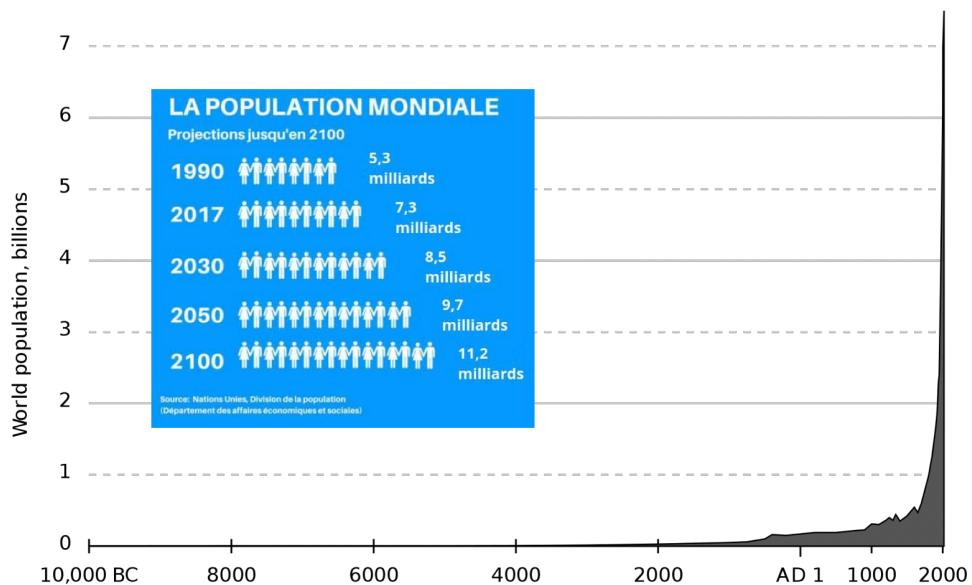
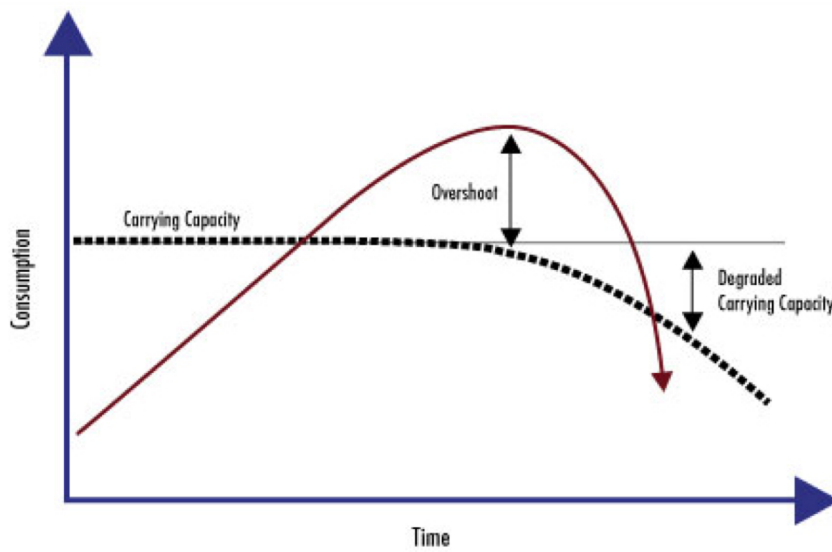
The object of study in ecology is the ecosystem. This term designates a whole formed by a community of living beings (biocenosis) within their environment (biotope). The richness of an ecosystem will therefore depend on the quality of the environment and the populations there. When an animal or plant population (denoted N) develops within an environment with favorable conditions (physicochemical properties favorable to its development, no predation ...) this population will follow an exponential growth until reaching a certain threshold called the carrying capacity of the environment (denoted by K). This carrying capacity K is the maximum size of the population of an organism that a given environment can support (in view of available resources, space, etc.).

Courbe de croissance des populations



When we exceed this carrying capacity, if the population grows too quickly for example, we observe an overshooting phenomenon leading to the degradation of the environment and therefore the decline of the population.

In the case of the human species, the environment considered is planet Earth. Our species is seeing its population evolve exponentially with a population explosion in the 1950s, going beyond the 5 billion people mark and nearly 8 soldiers today.

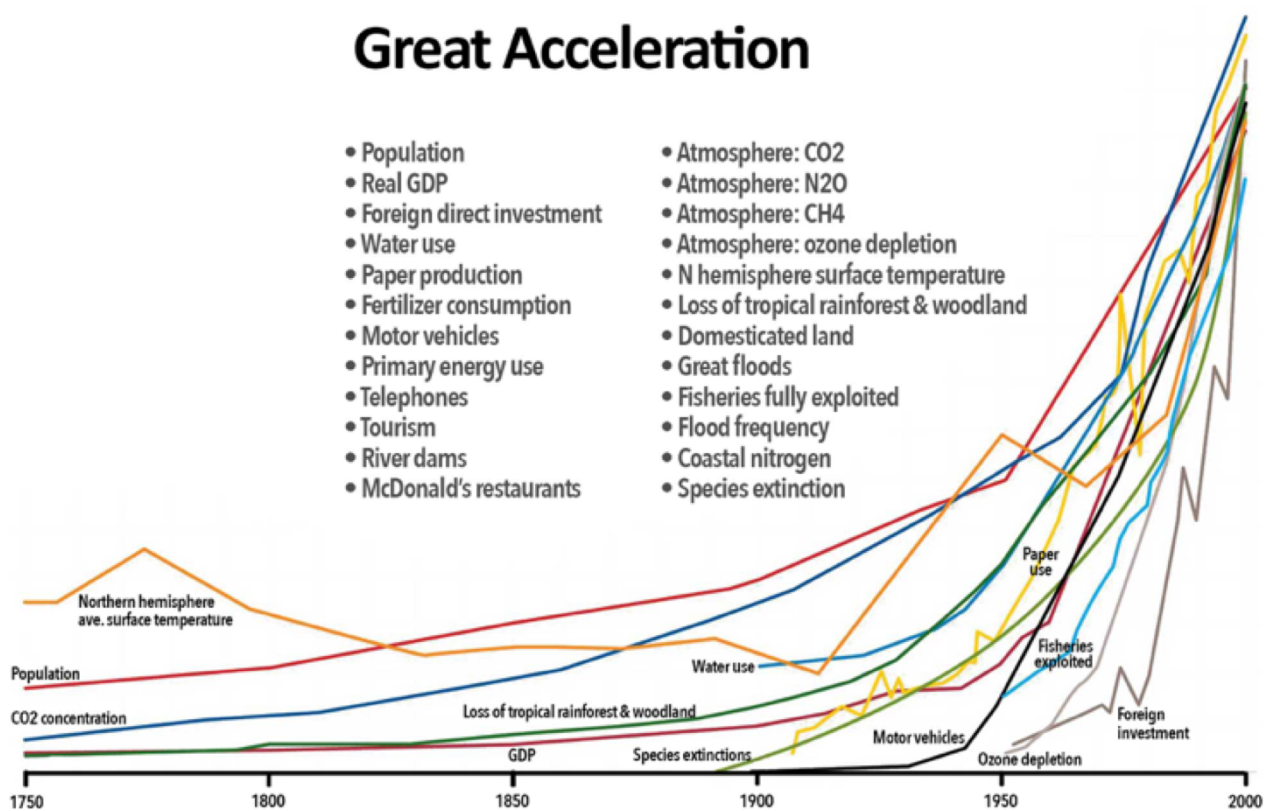


1.2. The great acceleration

This population increase is accompanied by an increase in a large number of parameters such as the average income per capita or the consumption of energy and resources. This phenomenon is thus called the great acceleration.

Steffen et al. (2015) The trajectory of the anthropocene: the great acceleration

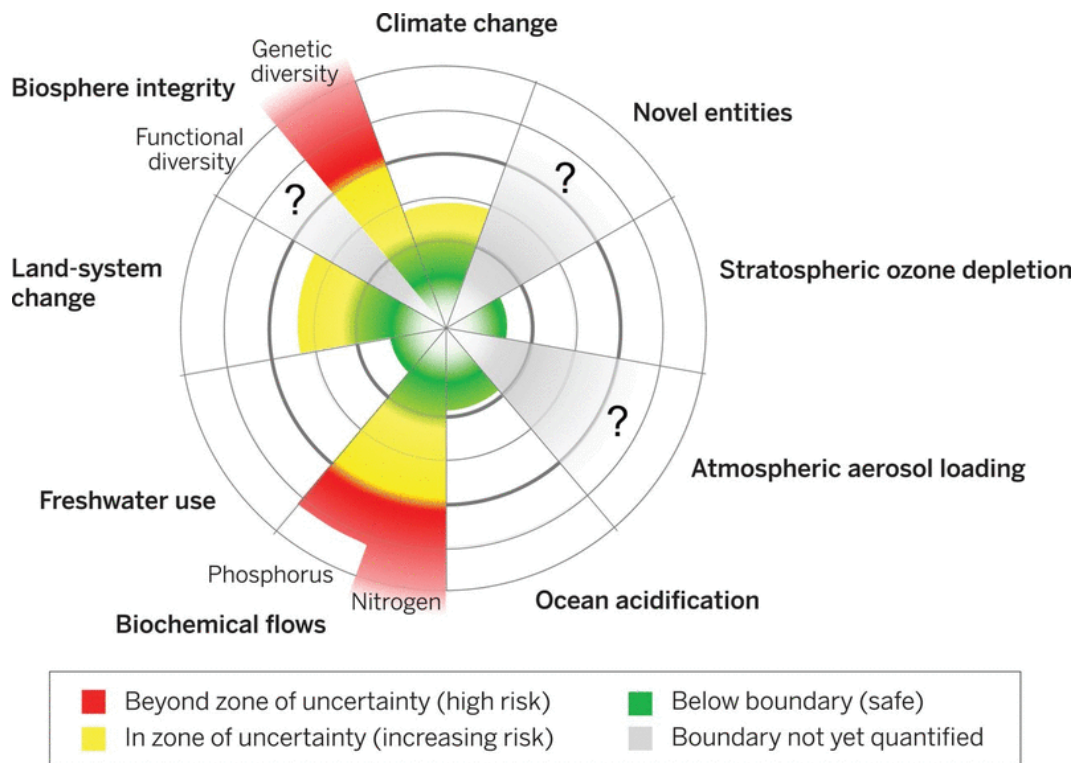
This exponential curve of human activities translated by the explosion of our economic activities and human demography exerts a massive effect on the Earth system, thus modifying the geological era of the planet. We thus switch from the Holocene, a geological period lasting 11,700 years, to the Anthropocene, a geological era which would have started the last 50 years. The Holocene separates us from the end of the previous Ice Age is characterized by a relative stability of conditions on Earth and creates conditions conducive to the flourishing of agriculture and great civilizations. The change of geological era therefore irreversibly leads to a modification of the terrestrial state that is most favorable to our activities and to the survival of our species.



1.3. Planetary boundaries

Since infinite growth in an environment with limited resources is not possible, it is therefore necessary to ask what is the real capacity that the Earth can support and what are the planetary limits not to be exceeded. These limits have been defined thanks to the work of Johan Rockström et al., 2009 and represent the thresholds that humanity must not exceed in order not to compromise the favorable conditions in which it has been able to develop and to be able to continue to live sustainably. To date, of the 9 limits that have been defined, 4 of them have already been crossed.

The first two limits of climate change and the erosion of biodiversity are enough on their own to change the geological era.



Useful links :

Planetary boundaries: Guiding human development on a changing planet :

<http://science.sciencemag.org/content/347/6223/1259855>

CRI sur « quelles pistes pour un monde soutenable? » : <https://youtu.be/GTP25MoU870>