From nature protection to biodiversity management: why and how the economy and the firms are affected and might be involved

Jean-Michel A Salles

Société Générale, Club Climat Énergie

From nature protection to biodiversity management: why and how the economy and the firms are affected and might be involved

Jean-Michel Salles, directeur de recherche CNRS,
Center for Environmental Economics, Montpellier (France)

February 9, 2021

Menu

1. Nature, environment, biodiversity, ecosystem services: what is it all about?
2. The economics of biodiversity
3. Biodiversity policies (and finance?)

Nature, environment, biodiversity, ecosystem services: what is it all about?

- Our Western societies have developed a representation of the universe based on the opposition between Nature and Culture. We know today that this representation is not universal (Descola, P. (2005). *Par-delà nature et culture*. Paris: Gallimard).
- Since the Renaissance and in particular with the Enlightenment, this Nature has been the companion and the model for the emergence of rational-legal societies.
- With the Industrial Revolution, Western societies developed the capacity to transform Nature. This observation rekindled existing fears about the fragility of nature and our dependence on it, which were expressed in 2 contrasting forms: hygienist thinking and the desire to protect Nature in its most remarkable sites.
- These two school of thought have evolved, but they still structure our relationship with nature.

Why protect nature?

An old debate ... which brings into play the values to which the actors refer

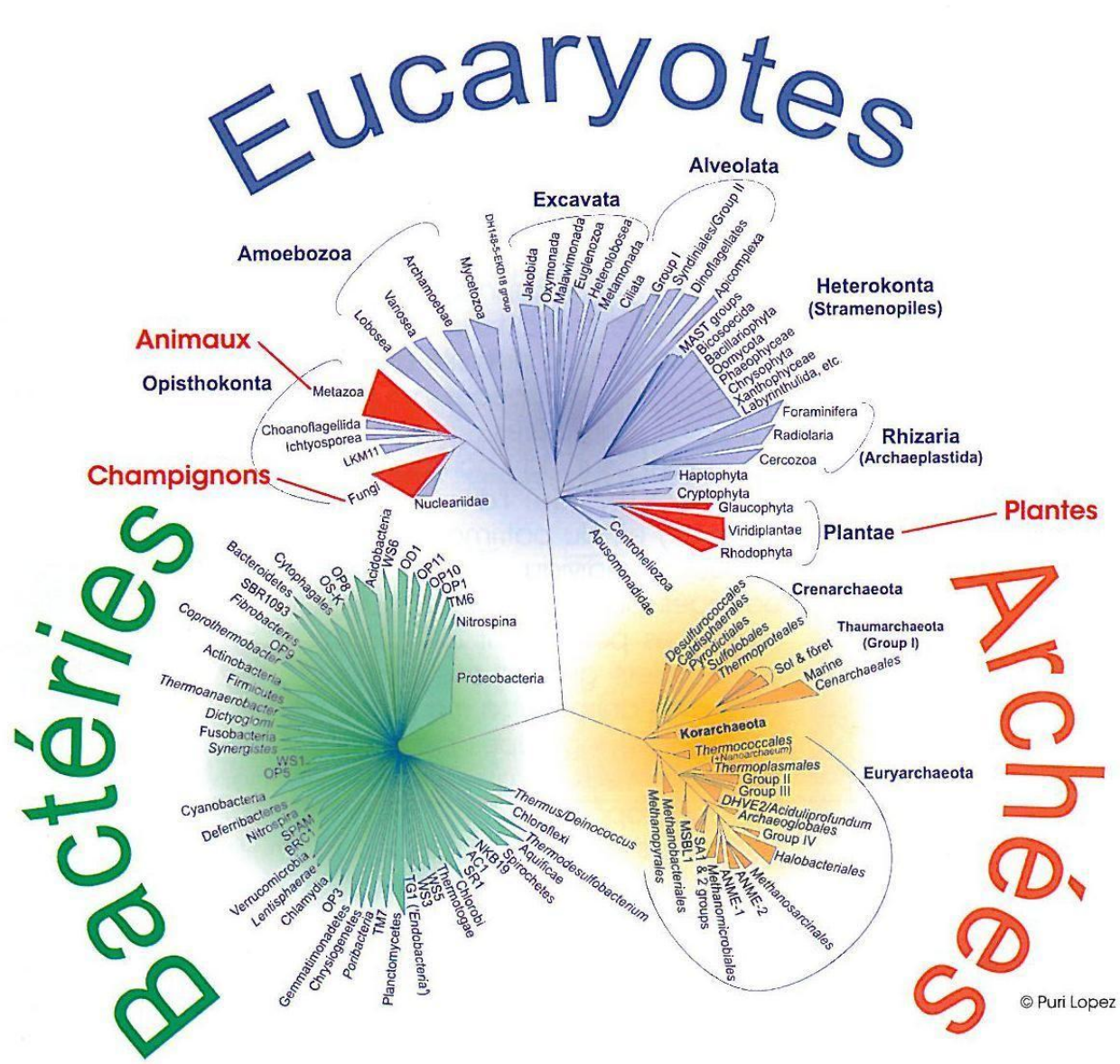
John Muir, naturalist, author and early advocate for the preservation of wilderness, co-founder of the Sierra Club and “Father of the national parks” in the USA, with Theodore Roosevelt

Gifford Pinchot, forester and founder of the US Forest Service, later politician, with Theodore Roosevelt

Chan, K. M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., ... & Turner, N. (2016). Opinion: Why protect nature? Rethinking values and the environment. *PNAS*, *113*(6), 1462-1465.

Biological divertsity, or *biodivertsity* for short, means the diversity of life in all its forms

- Biodiversity is sometimes regarded as the number of species of organisms that inhabit Earth. There are probably some 8-20 million of species of eukaryotes, of which 2 million have been identified and classified.
- There are in addition unknown and much larger number of archea and bacteries (prokaryotes),
- Our lack of knowledge, including whether viruses should be thought as living organisms, is enormous,



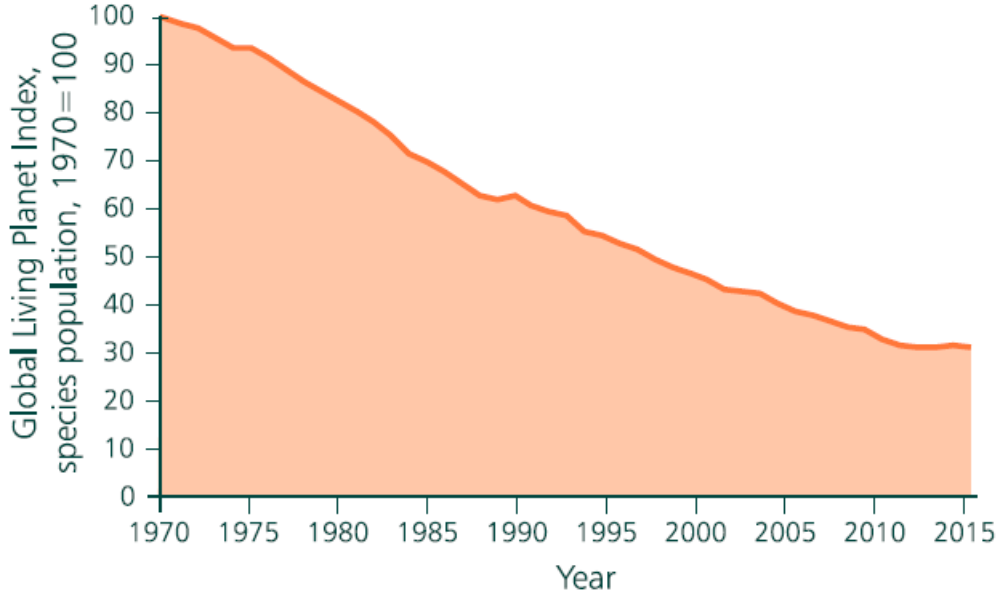
The biodiversity crisis

- The very word biodiversity was coined in 1985 by proponents of conservation biology to attract the attention of a broad public and policy makers.
- Establishing a measure of the decline in biodiversity remains a delicate question:
  - there is no one-size-fits-all measure of biodiversity decline; but there are a number of indicators which have been defined each for specific questions
  - biodiversity is a characteristic of ecosystems; its variations are therefore heterogeneous and their monitoring must necessarily be spatialized
- To dispute the reality of a rapid decline in biodiversity as a result of these difficulties is as ludicrous as to deny climate change on the grounds that the concept of average global temperature is ill-defined.

The difficulty in providing a synthetic indicator of the decline in biodiversity does not mean that this decline is not real, nor that one cannot develop meaningful measures of its various aspects.

On Borneo Island, vast tracts of species-rich forests have been cleared for production of palm oil.

Figure A2.3.1 Trends in Global Vertebrate Abundance as Measured by the LPI



Source: WWF/ZSL (2020). Note: based on 20,811 populations of 4,392 vertebrate species.

Understanding the decline of biodiversity

- *Global Biodiversity Outlooks* explain the decline of biodiversity through key drivers:
  - destruction and degradation of ecosystems
  - living resource over-exploitation
  - invasive species
  - pollutions
  - climate change
- The analysis of the decline in biodiversity can be structured through *DPSIR-like* frameworks (drivers, pressure, state, impact, response)
- This is what **biodiversity scenarios** do: they start from models describing socioeconomic dynamics, they deduce land use patterns which, by adding other sources of pressure on ecosystems, allow the construction of contrasting scenarios describing changes in biodiversity.

International expertise and biodiversity scenarios

- The concern for the decline of biodiversity has given rise to several international assessments thanks to which we have syntheses of a very abundant scientific literature, mainly in natural sciences, but also in social sciences.
  - The millennium ecosystem assessment (MA, 2003-2005)
  - The economics of ecosystems and biodiversity (TEEB, 2008-2010+)
  - The intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES, 2013-…)
- When it comes to predicting changes in biodiversity, the shared observation is that predictive ecology, despite recent significant progress, remains unreliable in the face of the Nature's complexities.
- The situation is even worse when it comes to predicting the feedback effects of these changes in ecosystems on socioeconomic dynamics

What to take away from biodiversity scenarios?

- The studies are not related to the impact of biodiversity losses on economic dynamics, but to the impact of economic dynamics on biodiversity losses
- The Millenium Assessment elaborated 4 contrasting scenarios, driven by visions of the future :
  - *Global orchestration*
  - *Order from strength*
  - *Adapting mosaic*
  - *TechnoGarden*
- More theoretical models allow studying the dynamics of regime shifts and tipping points
- Figure from: Pereira, H. M., Leadley, P. W., Proença, V., Alkemade, R., Scharlemann, J. P., Fernandez-Manjarrés, J. F., ... & Walpole, M. (2010). Scenarios for global biodiversity in the 21st century. *Science*, *330*(6010), 1496-1501.

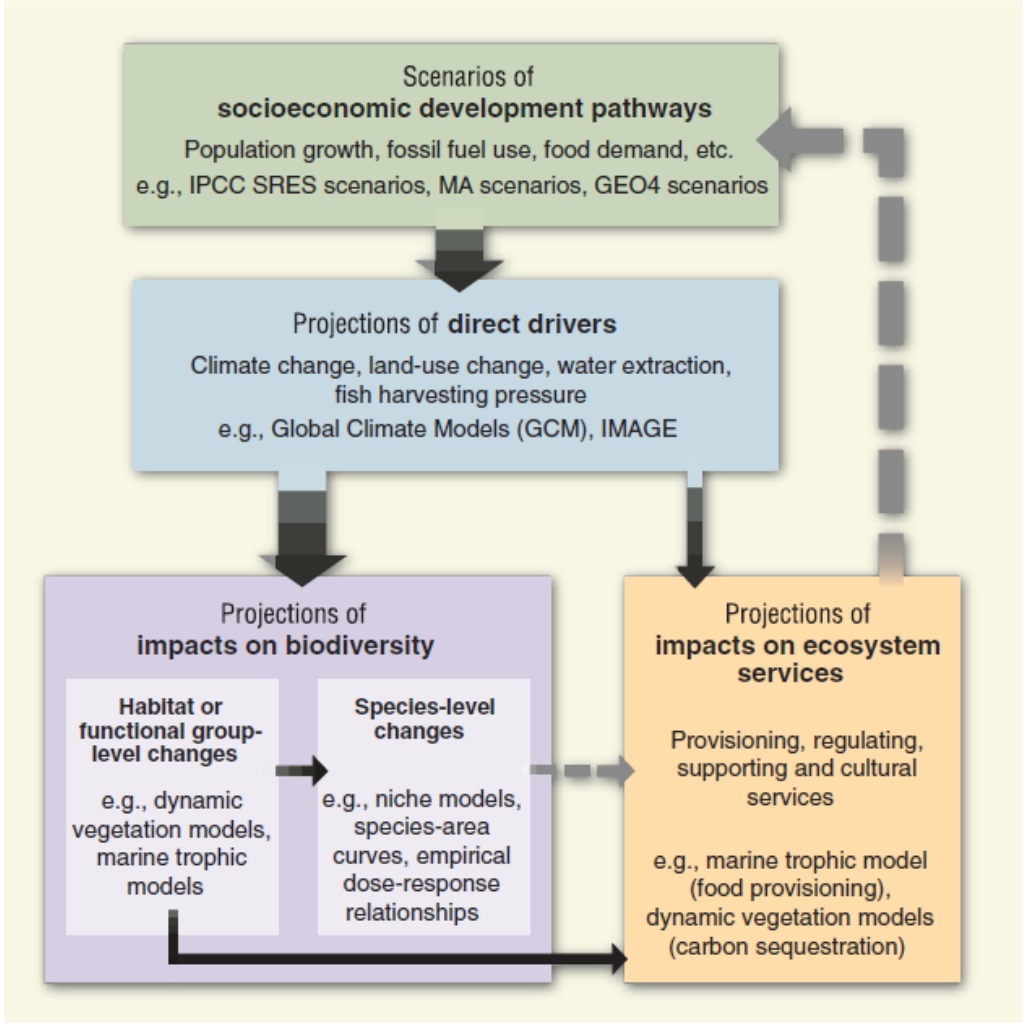
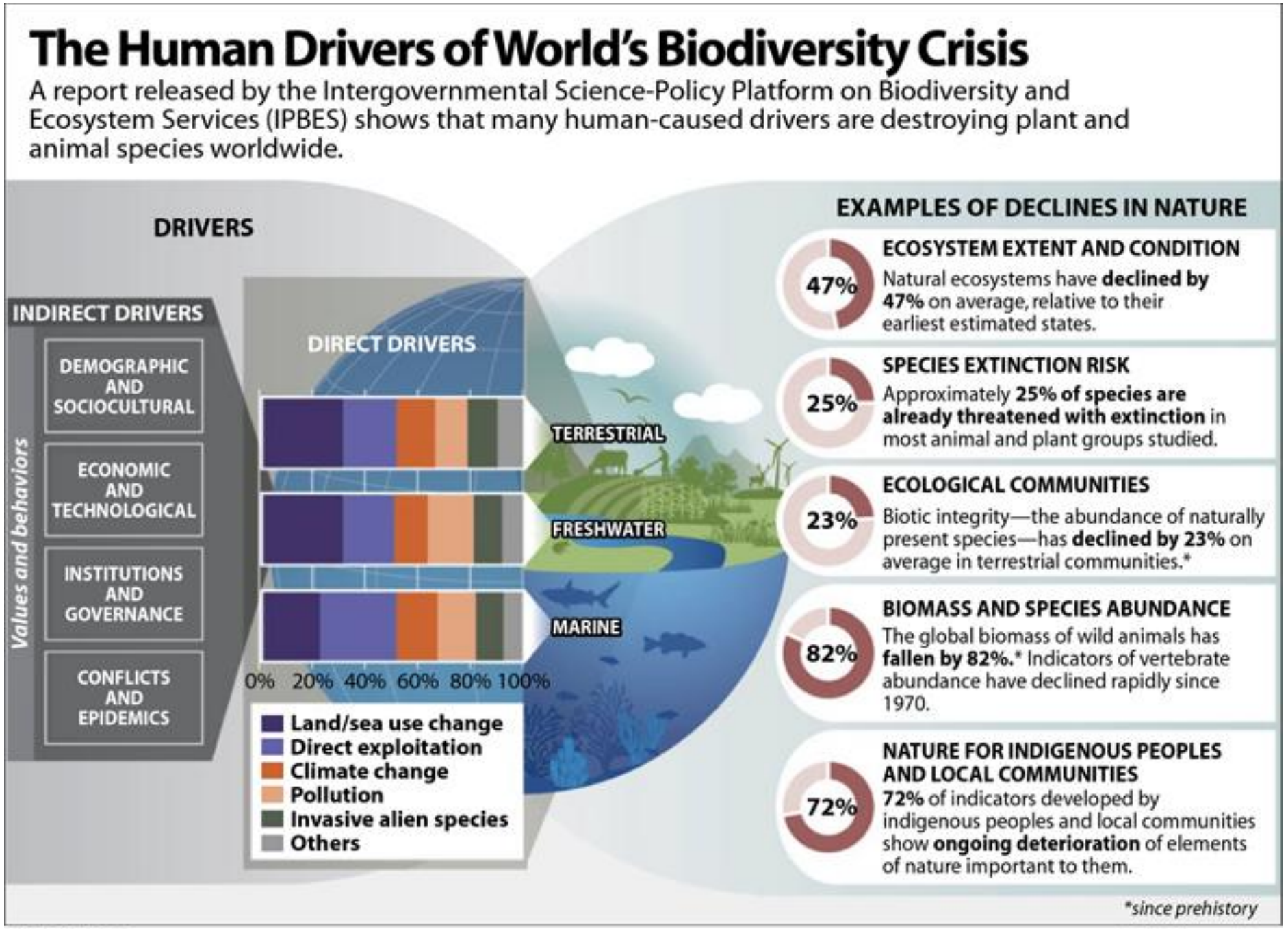


Fig. 1. Overview of methods and models commonly used for constructing biodiversity scenarios. Some models include several components of this figure, such as the integrated assessment model IMAGE (*1*) or the marine trophic model "Ecosim with Ecopath" (*23*). Black arrows indicate key linkages treated in biodiversity scenarios. Dashed gray arrows indicate linkages that are absent in current biodiversity scenarios. In some cases, impacts on ecosystem services may be mediated by changes in the abiotic condition of ecosystems (thin arrow from direct drivers to ecosystem services).

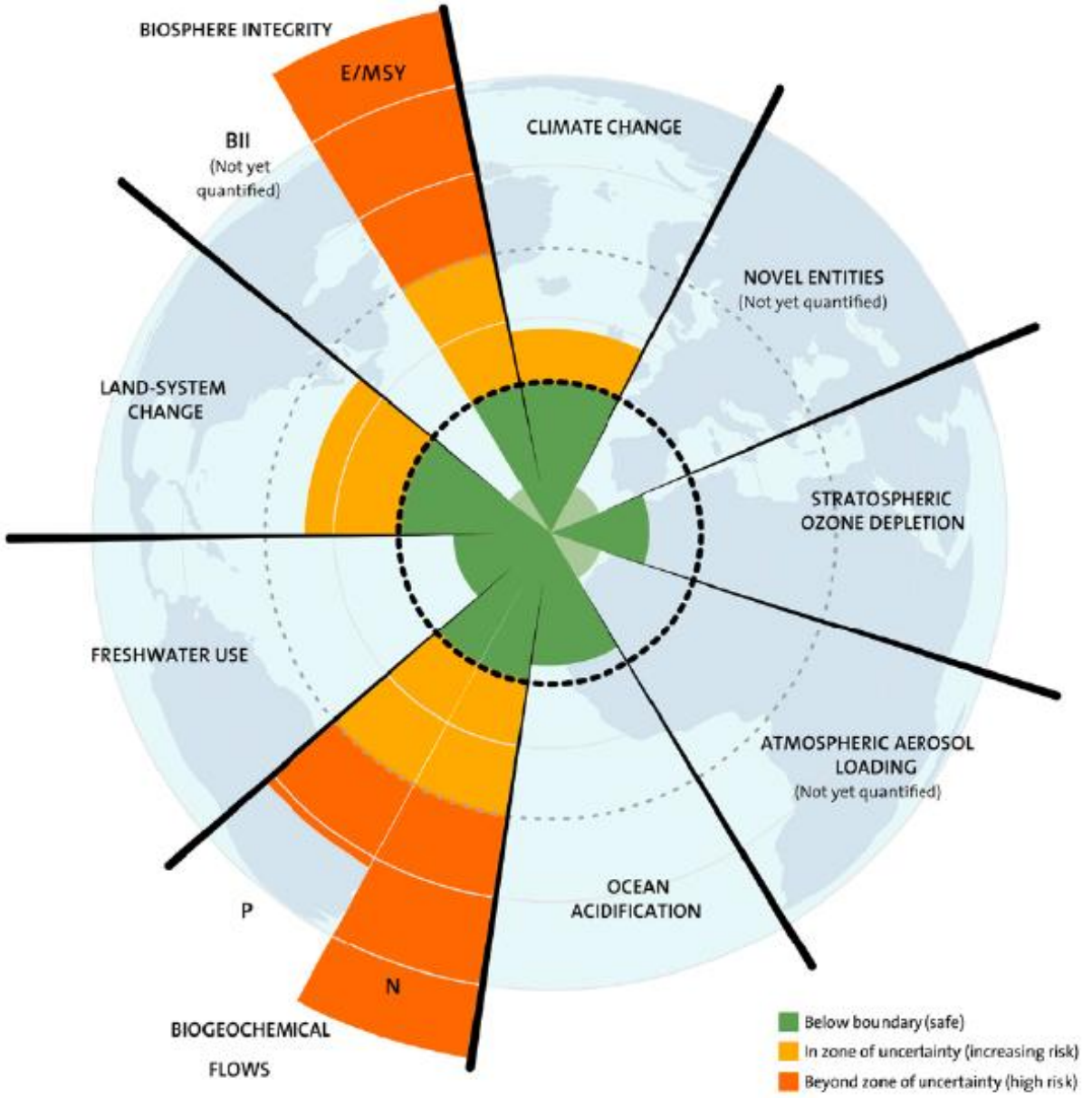
- W


The Human Drivers of World's Biodiversity Crisis
A report released by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) shows that many human-caused drivers are destroying plant and animal species worldwide.
DRIVERS
INDIRECT DRIVERS
Values and behaviors
DEMOGRAPHIC AND SOCIOCULTURAL
ECONOMIC AND TECHNOLOGICAL
INSTITUTIONS AND GOVERNANCE
CONFLICTS AND EPIDEMICS
DIRECT DRIVERS
0% 20% 40% 60% 80% 100%
Land/sea use change
Direct exploitation
Climate change
Pollution
Invasive alien species
Others
TERRESTRIAL
FRESHWATER
MARINE
EXAMPLES OF DECLINES IN NATURE
47%
ECOSYSTEM EXTENT AND CONDITION
Natural ecosystems have declined by 47% on average, relative to their earliest estimated states.
25%
SPECIES EXTINCTION RISK
Approximately 25% of species are already threatened with extinction in most animal and plant groups studied.
23%
ECOLOGICAL COMMUNITIES
Biotic integrity—the abundance of naturally present species—has declined by 23% on average in terrestrial communities.*
82%
BIOMASS AND SPECIES ABUNDANCE
The global biomass of wild animals has fallen by 82%.* Indicators of vertebrate abundance have declined rapidly since 1970.
72%
NATURE FOR INDIGENOUS PEOPLES AND LOCAL COMMUNITIES
72% of indicators developed by indigenous peoples and local communities show ongoing deterioration of elements of nature important to them.
*since prehistory
SOURCE: IPBES
InsideClimate News

Safe operating distance from planetary boundaries

"Anthropogenic pressures on the Earth System have reached a scale where abrupt global environmental change can no longer be excluded. We propose a new approach to global sustainability in which we define planetary boundaries within which we expect that humanity can operate safely. Transgressing one or more planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental- to planetary-scale systems. We have identified nine planetary boundaries and, drawing upon current scientific understanding, we propose quantifications for seven of them."

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., ... & Foley, J. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and society*, *14*(2).



Source: J. Lokrantz/Azote based on Steffen, W. et al. (2015) 'Planetary boundaries: Guiding human development on a changing planet', Science, 347(6223:1–10). Note: P = phosphorus; N = nitrogen; BII = Biodiversity Intactness Index and E/MSY = extinctions per million species per year.

The economics of nature

- For “ancient” economies, in which the relationship to land and ecosystems was at the heart of the production of wealth, Nature was obviously very present and its (technical) mastery and its (institutional) control were at the heart of economic thought.
- Classical economists have clarified how to make the most of the three main factors of production which are labor (wages), capital (interest) and land (rent)
- With the marginalist revolution, neoclassical economists focused their analyzes on the formation of equilibrium prices, then, with the development of macroeconomics, on the analysis of growth paths, both marginalizing Nature.

Scheme source: Gómez-Baggethun, E., De Groot, R., Lomas, P. L., & Montes, C. (2010). The history of ecosystem services in economic theory and practice: from early notions to markets and payment schemes. *Ecological Economics*, *69*(6), 1209-1218.

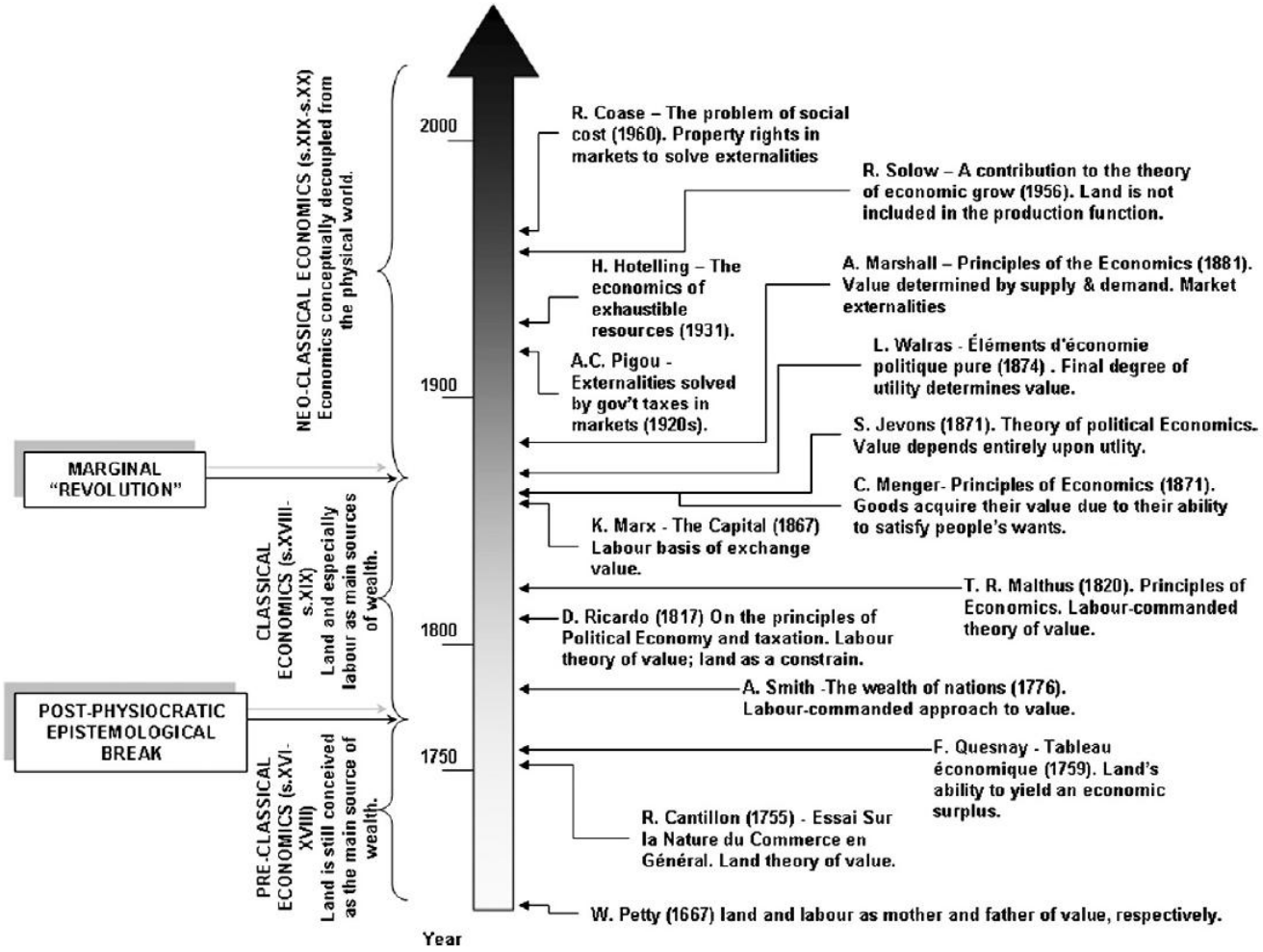


Fig. 1. Landmarks in the evolving conception of nature by economics.

The economics of nature : where do we stand?

Period	Economic school	Conceptualization of nature	Value–environment relationship
19th C.	Classical economics	Land as production factor generating rent (income)	Labor theory of (exchange) value Nature's benefits as use values
20th C.	Neoclassical economics	Land removed from the production function	Land as substitutable/ producible by capital, and thus monetizable
Since 1960s	Environmental and Resource Economics Ecological Economics	Natural capital substitutable by manufactured capital Natural capital complements manufactured capital	Nature's benefits as monetizable and exchangeable services Controversies on monetization and commodification of nature's benefits

- From WWI to decolonization, passing through the crisis of 1929 and WWII, economists have largely turned away from questions related to nature (except a little for exhaustible resources) since it was clearly not what society and policy makers were expecting of them. In the 1960s, the question of nature thus appeared quite new, when it came to economics, driven by social demand accompanied by warnings from experts,
- ***Environmental economics*** studies environmental issues as problems of regulating interactions between the economy and externalities involving nature. In the 1980s, some ecologists, disappointed by these approaches, collaborated with economists to try to integrate ecological dynamics in a less trivial way. Together, they founded ***ecological economics*** as a "post-normal science".

Economics and biodiversity: the chicken or the egg

- From a descriptive point of view, economic activity is only a part of the flows and phenomena that define life and the biosphere, and it is totally embedded in it.
- But from a prescriptive point of view, relations with ecosystems, in the broad sense, constitute only one part, sometimes marginal, of the reasons which motivate the behaviors and choices of the economic agents.
- Biodiversity and economics create a tangled hierarchy

Figure 4.11 The Economy is Embedded in the Biosphere

The economy of nature

- Nature has remained very present in the (real) economy and many elements are largely integrated into our market economies:
  - Access to land remains an important market, often quite speculative
  - The exploitation of forests (including natural and sometimes pristine ones) and fisheries remain significant activities.
- In recent decades, the evidence that ecosystems are not insulated entities, and that the biosphere is an intensely interconnected reality has been reminded us, sometimes cruelly.
- This updated observation of the dependence of our societies and our economies vis-à-vis an endangered nature was expressed through the two related ideas that:
  - Ecosystems are assets
  - Human societies derive multiple benefits from ecosystems

The economics of biodiversity

- The economics of biodiversity is a work in progress. Since the 1970s, various attempts can be identified in the scientific literature.
- In quantitative terms, the research was drawn by the US Endangered species Act: after a 1983 executive order made compulsory to submit all public expenditures to a cost-benefit analysis, access to public funds to protect species involved measuring the economic advantages linked to their conservation.
- Ecosystems are assets; organisms can be assets; biodiversity is a concept, a characteristic of ecosystems.
- The economics of biodiversity is therefore mainly related to and structured by the two categories of « ***ecosystem services*** » and « ***natural capital*** »

How ecosystem services became central: make a long story short

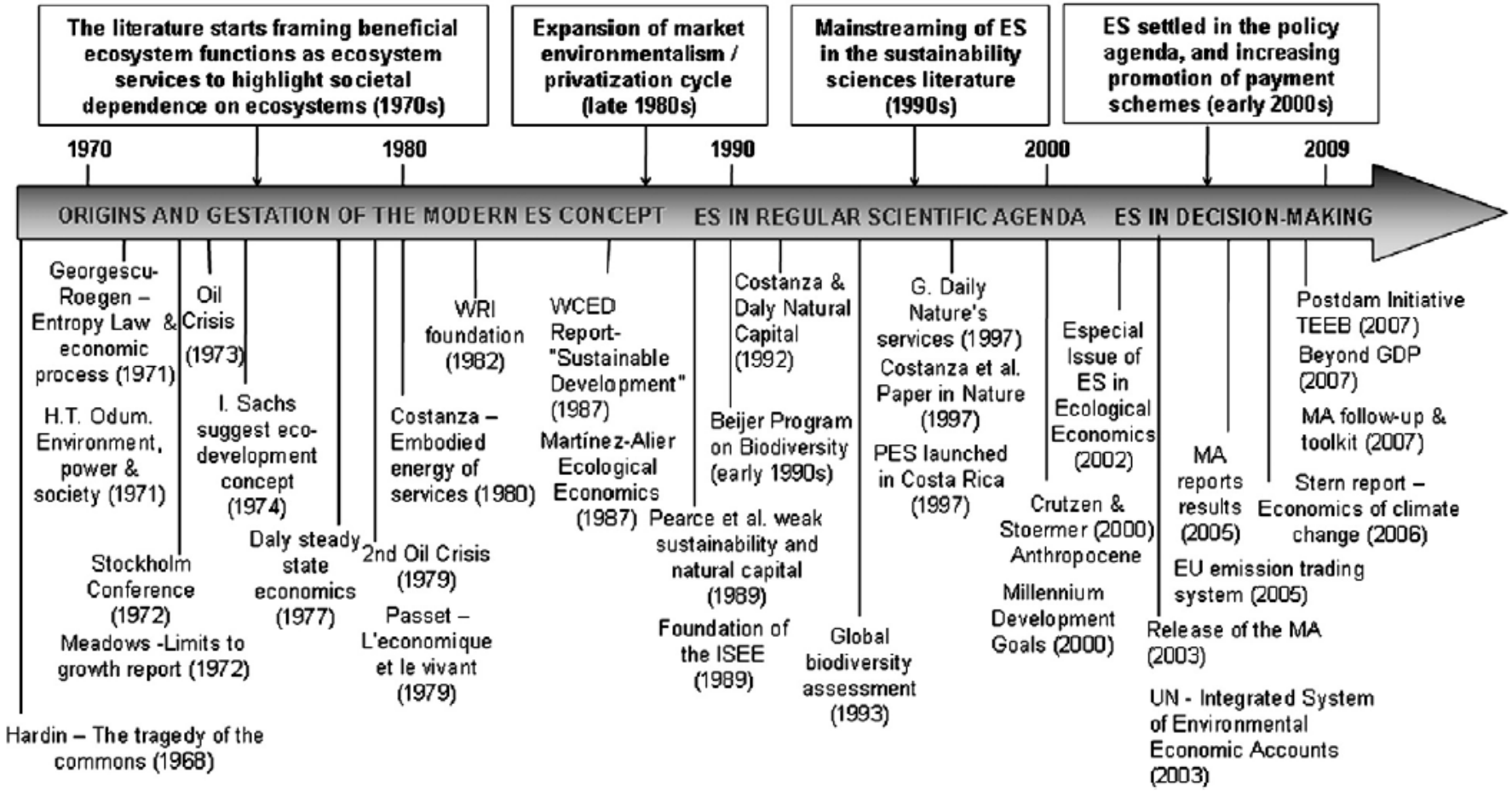
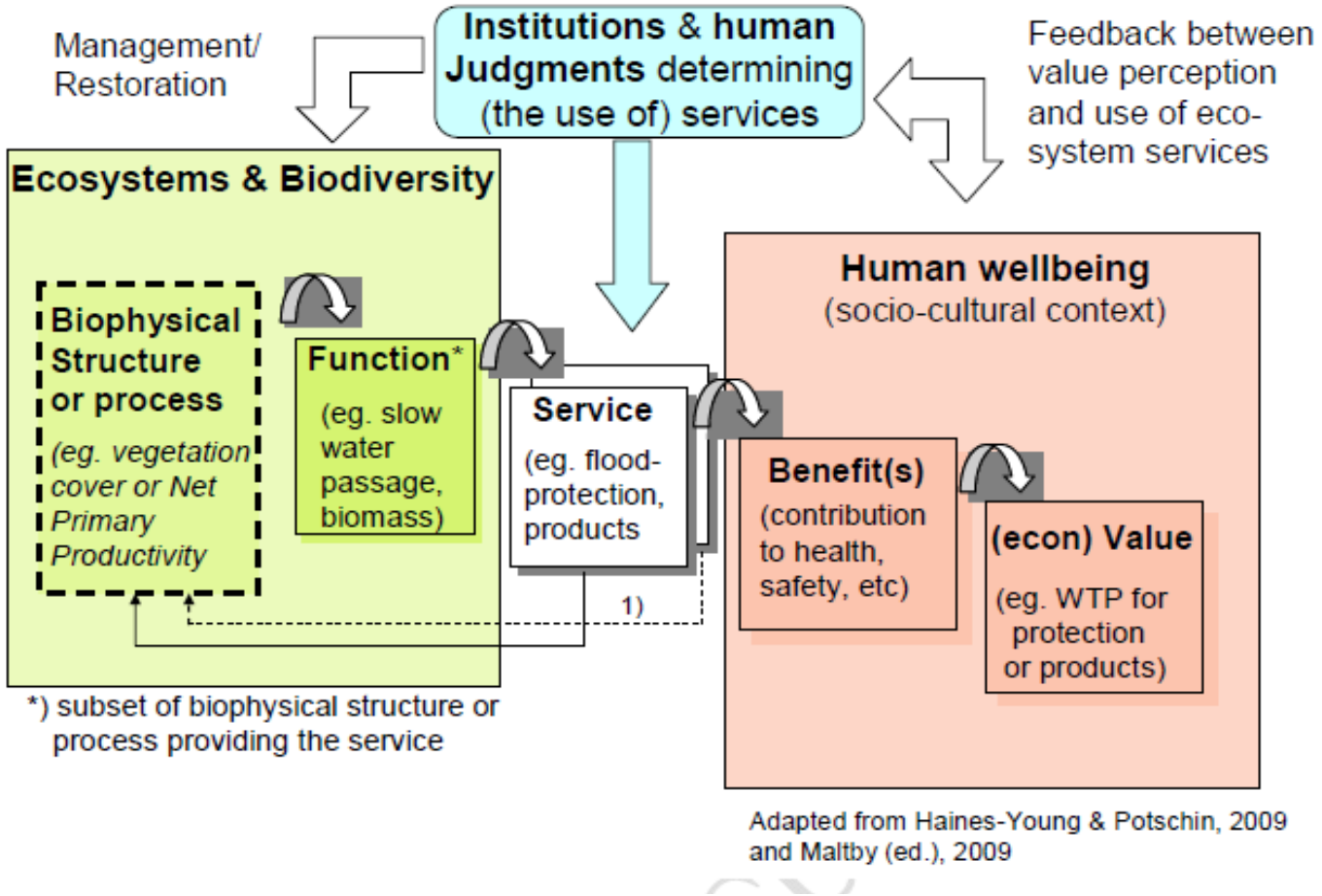


Fig. 2. Stages in the modern history of ecosystem services.

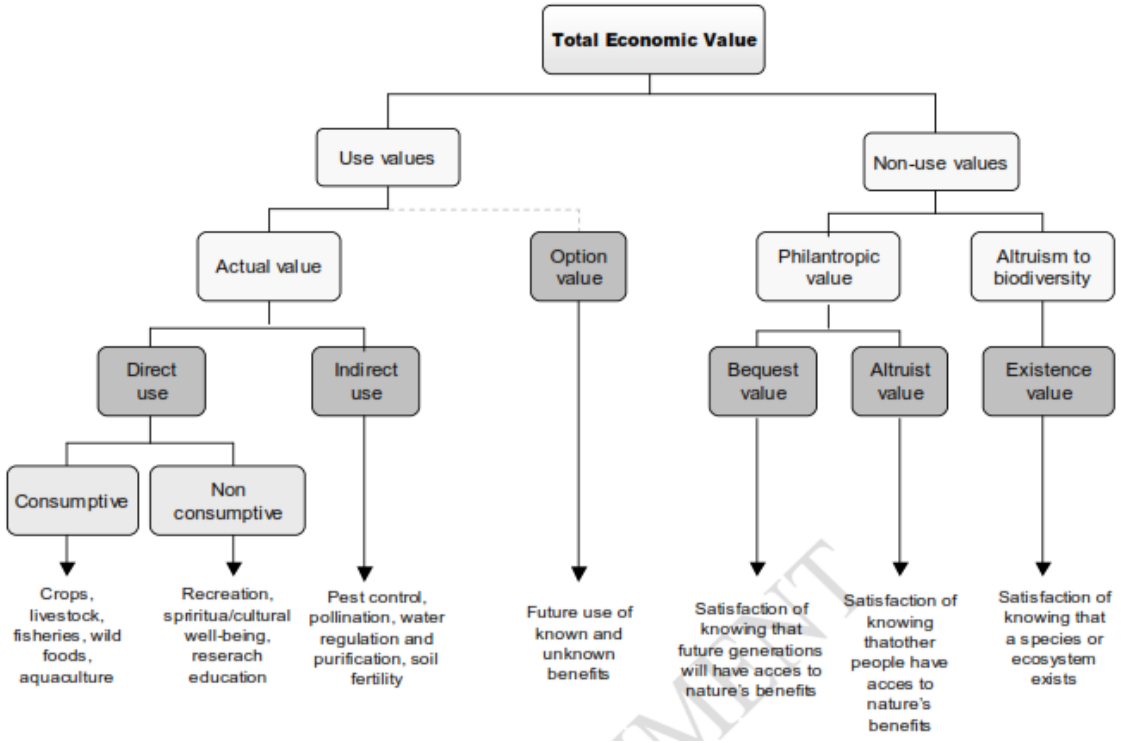
Source: Gómez-Baggethun et al., 2010

Assessing ecosystem services: the « cascade » framework



1) One function is often involved in the provision of several services and the use of services usually affects the underlying biophysical structures and processes in multiple ways. Ecosystem service assessments should take these feedback-loops into account

Valuing natural assets and ecosystem services: conceptual framework and methodological toolbox



Total economic value is an extension of the economic concept of value to encompass all the reasons people derive benefits from ecosystems

There are a number of techniques for estimating the economic value of non-market assets. All are directly or indirectly based on agent preferences; which is both their strength and their weakness.

Approach		Method	Value
Market valuation	Price-based	Market price	Direct and indirect use
	Cost-based	Avoided cost	Direct and indirect use
		Replacement cost	Direct and indirect use
		Restoration cost	Direct and indirect use
	Production-based	Production function approach	Indirect use
		Factor income	Indirect use
Revealed preference		Travel cost method	Direct (indirect) use
		Hedonic pricing	Direct and indirect use
Stated preference		Contingent valuation	Use and non-use value
		Choice modeling/conjoint analysis	
		Contingent ranking	
		Deliberative group valuation	

Natural capital: origin, definitions, issues

- The idea of natural capital as a stock of natural resources was implicit at various stages in the history of economic thought, but the first use of the expression is generally related to the book of EF Schumacher, *Small is beautifull* (1973). The concept was further developed by R. Costanza and H. Daly and other ecologist and economist in the field of ecological economics.

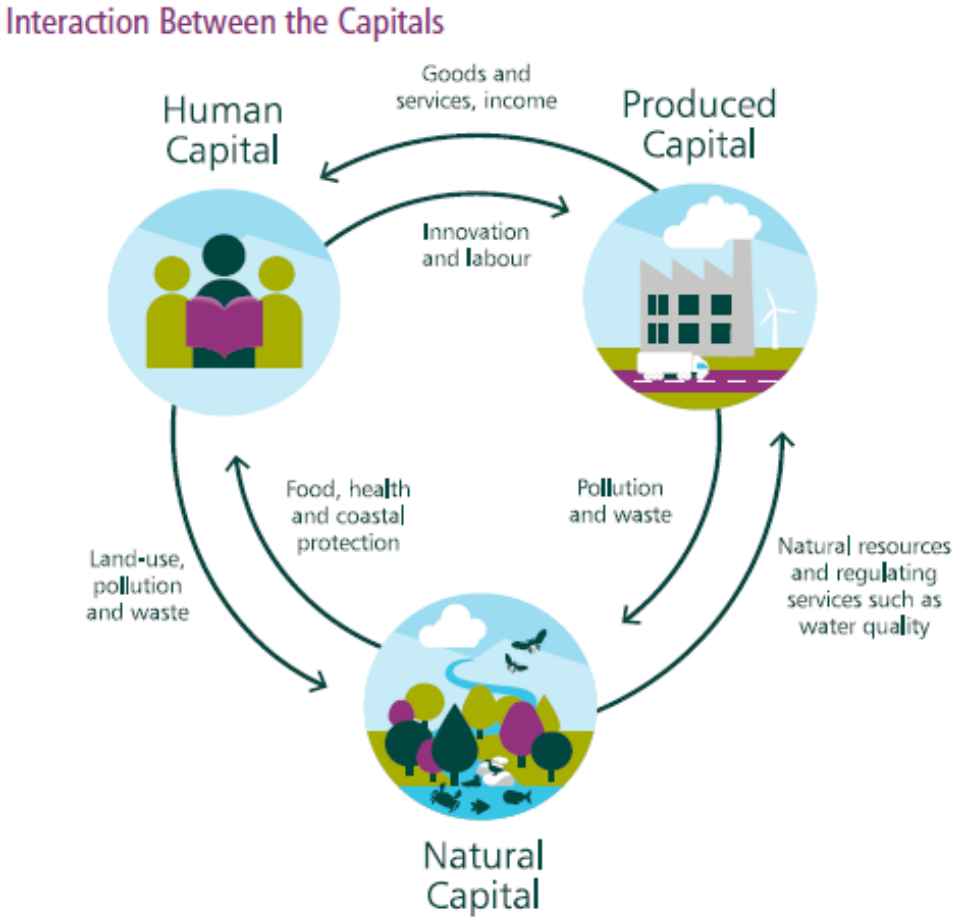
  Costanza, R., & Daly, H. E. (1992). Natural capital and sustainable development. *Conservation biology*, *6*(1), 37-46.

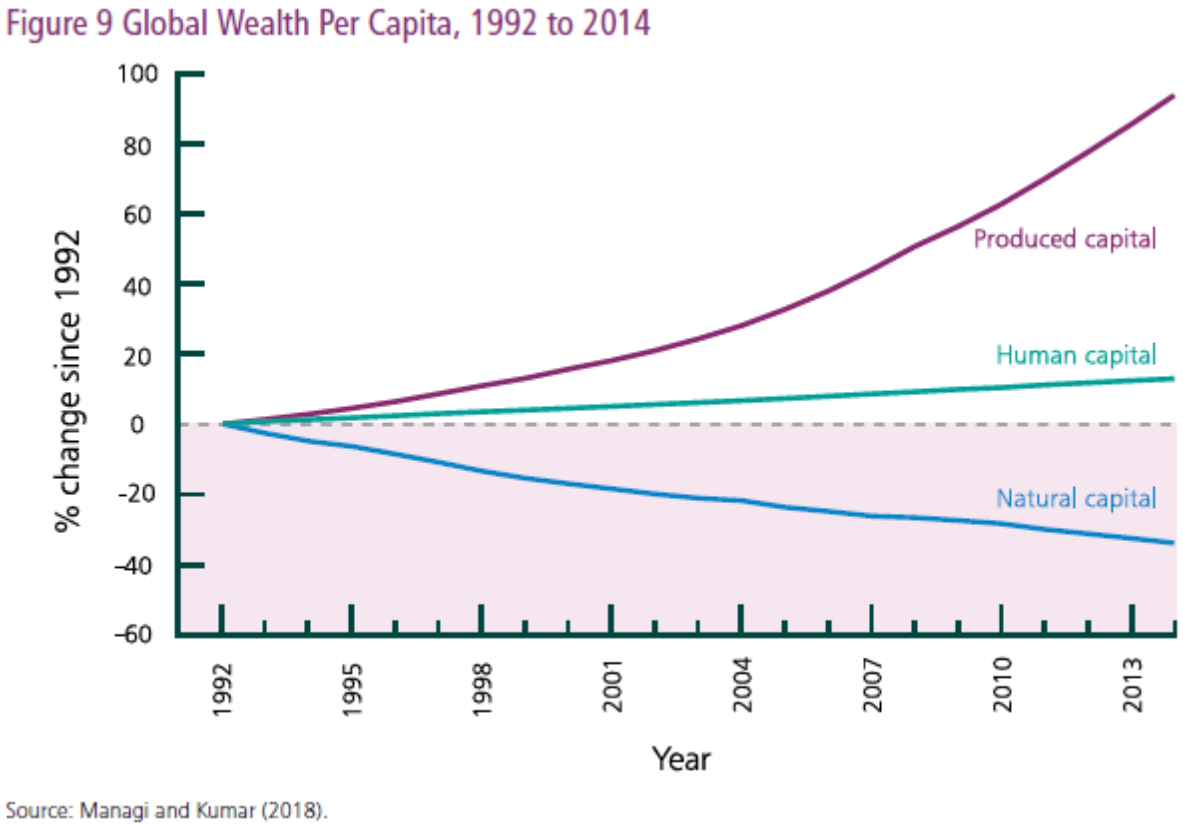
- Following the creation of the concept of "human capital" (Kh) (Becker, 1962) to designate investments in education or health that help improve production alongside produced capital (Kp), "natural capital" (Kn) designates natural assets that contribute to the production of goods and services and thus to social well-being.

  Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of political economy*, *70*(5, Part 2), 9-49.

Natural capital

(source: Dasgupta, P. (2021), *The Economics of Biodiversity: The Dasgupta Review*. London: HM Treasury, February, 602 p.)





Source: Managi and Kumar (2018).

Natural capital: origin, definitions, issues (2)

- The notion of Kn was clearly created with a controversial purpose: to fuel the debate on the limits to growth (Meadows report, 1972) by highlighting that:
  - the accumulation of Kp is done to the detriment of the Kn
  - the deterioration of the Kn can be monitored and measured
  - the objective is to include its measurement in the national accounts
- The first point contributed to the emergence of the notion of Environmental Kuznets Curve (U-shaped relationship between environmental quality and richness), the reality of which remains very controversial.
- The second opened several projects relating in particular to the consistency of heterogeneous measurement units.
- The third is a long-lasting debate in the community of national accountants on the articulation of Kn indicators with existing national accounts.

Biodiversity policies

- Since the 1970s, nature policies were mainly normative policies ("command-and-control") and the creation of protected areas and species.
- More recently, the multiplication of tensions with socioeconomic development, in developed or developing economies, has led to the design and implementation of more incentive policy tools.
- One of the well-known approaches is ***biodiversity offsetting*** which consists, in order to aim for a "no net biodiversity loss", to oblige project promoters to avoid impacts on ecosystems, reduce what could not be avoided and compensate losses that were neither avoided nor reduced with net off-site gains.
  - The most serious evaluations that have been made of this procedure judge it quite harshly: despite some progress, the no-net-loss goal is far from being achieved.

Will natural capital and ecosystem services enter market economies

- A first observation is that they already do.
- ***Biodiversity off-settings*** have created a market value for natural area or at least less artificialized ecosystems, as off-set units. In Europe, the mechanism remains modest, but it has existed for a longer time in the United States where an upstream creation process for off-setting units has led to the emergence of natural asset banks (mitigation banking) which operate in a more or less satisfactory manner.
- ***Payments for Environmental Services*** are growing, especially in developing countries because they allow NGOs to provide funding in contexts where governments are too weak to act. But the debate exists in Europe, in particular to make agri-environmental measures evolve toward an obligation of results.
- If the ***extension of national accounts*** to include ecosystems is implemented, we must expect that firms will be obliged to integrate their impacts into their own accounts, since it is difficult to imagine that the accounts national data will be informed and fed only by public data.

As a conclusion…

- Main conclusions of the Dasgupta Review (2021):
  - (i) Ensure that our demands on Nature do not exceed its supply, and that we increase Nature's supply relative to its current level.
  - (ii) Change our measures of economic success to guide us on a more sustainable path.
  - (iii) Transform our institutions and systems – in particular our finance and education systems – to enable these changes and sustain them for future generations.
- Living in the Anthropocene means that we no longer know what is natural (it is the reign of the artificial): the "protection of nature" has no obvious meaning. Humans have, unintentionally enough, become responsible for their environment. They must therefore make choices of their own and open the debate on the values that will guide their collective choices.

Thank you for your attention

Questions are welcome and hoped for