Natural resource crisis and the planetary boundaries

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Natural resource crisis and planetary boundaries

Thomas Malthus -1798

Population, when unchecked, increases faster than food production. Whereas population increases in geometric progression, food production increases in arithmetic progression.
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Jay Forrester (1950s)

*System Dynamics, a useful tool to catch complex systems dynamic*
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Limits to Growth

Modeling the Renewable Energy transition in Europe

www.medeas.eu
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Malthus model
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Vito Volterra – Umberto D’Ancona (1920s)

Vito Volterra helped by Umberto D'Ancona studied the fish catches in the Adriatic sea (Italy), formulating the Prey-Predator dynamic
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Lotka Volterra model: competition among 2 species

Criticized: describes only few real systems
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Lotka Volterra revisited: Overfishing

Rate of prey extraction

Overexploitation

Prey Predator Dynamic

Prey Predator Dynamic
Overfishing: Decline of Japanese Fisheries

Over-Exploitation

- Prey = fish stock
- R' = production (fish landing)
- Predator = Capital

Ecological Modelling
Volume 359, 10 September 2017, Pages 285-292

Dynamic patterns of overexploitation in fisheries
Ilaria Perissi a, b, c, Ugo Bardi a, b, Toufic El Asmar c, d, Alessandro Lavacchi d
Dynamic patterns of overexploitation in fisheries

Ilaria Perissi, Ugo Bardi, Toufic El Asmar, Alessandro Lavacchi
Pacific Sardines (1950)

Dynamic patterns of overexploitation in fisheries

Ilaria Perissi a, b, Ugo Bardi a, b, Toufic El Asmar c, Alessandro Lavacchi d
Iceland Fishery (now)

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[Image of fish and graph]
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UK bottom trawl fisheries

Catches of Northern Cod

Annual catch of Peruvian anchoveta
(1950-1979)
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What’s more? A third stock

RESOURCES

CAPITAL

POLLUTION

CO₂
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Ugo Bardi (2017)

*The Seneca effect.*

*Why growth is slow but collapse is rapid*
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Capital is dissipated to remove pollution
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Joseph Tainter (1988)

As these civilizations become larger, they become less efficient, to the point the economic returns they provide is smaller than their cost.

Tainter’s study is qualitative!
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Tainter’s study is qualitative!
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REsources PROduction Bureaucracy
socioeconomic system similar to an ecosystem
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Historical data about the rise and fall of Western Roman Empire

Sverdrup et al., 2013
The basic factor at the origin of the contraction and the crisis of a complex system is the phenomenon called “overexploitation” of resources.
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Coordinator of MEDEAS project
Despite quotas, however, there exist several historical and recent cases where stock collapses still occurred, as shown by the case of the closure of the sardine fishing season off the length of the U.S. West Coast, recommended by the Pacific Fishery Management Council (Decision Summary Document Pacific Fishery Management Council, 2016) in April 2016. It was closed mid-season in 2015 due to low stocks, but it has since fallen further. Federal rules mandate that the harvest must be closed if adult stocks fall below 150,000 tons, and the government estimates that there are now less than 65,000 tons.