Sustainable Development in Historical Perspective

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What is sustainability?

A **systemic state of indefinite equilibrium**, in which levels of anthropogenic material consumption and waste production remain below the threshold productive and absorptive capacities of the ecological system, while at the same time ensuring a quality of life that is considered acceptable by current and future members of that social system.

(Davidson, 2010: 1136)

Strictly speaking, **there is no such thing as 'environmental' sustainability**; only **sustainability—an irreducible synergy of social justice, ecological health, and economic vitality**, applied across present and future generations. Although the health of our ecological life support system is logically prior to and dominant among sustainability imperatives, **maintaining the health of ecosystems on a human-dominated planet** requires achievements in social welfare and economic vitality that are imperatives in their own right, and not just for environmental protection. **Hence, sustainability should be embraced as a primary concept. It cannot be reduced coherently to environmental, social, and economic components.** http://blueplanetunited.org/2011/10/,

John H. Gibbons, former assistant to the president for science and technology and former director of the congressional Office of Technology Assessment, is a member of the NAE. He chaired the

The fact is that our ability to cause planetary change through technology is growing faster than our ability to understand and manage the technical, social, economic, environmental, and ethical consequences of such Change.

(The Bridge, 2000, 1)
https://www.nae.edu/File.aspx?id=7327


ECONOMY
SOCIETY
BIOSPHERE
THE GLOBAL GOALS
For Sustainable Development


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS
For Sustainable Development

Degree - Weight the calculation using the "weight" field to get a count of the number of targets a given goal shares with other goals.

Betweenness - Betweenness measures the number of times a goal is on the shortest path between any two other goals.

Eigenvector - Eigenvector measures how well an element is connected to other well connected elements. In networks of people, eigenvector usually identifies the leaders in the network.

http://blog.kumu.io/a-toolkit-for-mapping-relationships-among-the-sustainable-development-goals-sdgs

The most influential factors based on the network analysis:

Degree

- **SDG 10 Reduced Inequalities**
- SDG 1 No Poverty
- SDG 12 Responsible Consumption and Production

Betweenness

- **SDG 12 Responsible Consumption and Production**
- SDG 10 Reduced Inequalities
- SDG 8 Decent Work and Economic Growth

Eigenvector

- SDG 12 Responsible Consumption and Production
- SDG 10 Reduced Inequalities
- SDG 1 No Poverty

GOALS SCORING

The influence of one Sustainable Development Goal or target on another can be summarized with this simple scale.

Interaction	Name	Explanation	Example
+3	Indivisible	Inextricably linked to the achievement of another goal.	Ending all forms of discrimination against women and girls is indivisible from ensuring women's full and effective participation and equal opportunities for leadership.
+2	Reinforcing	Aids the achievement of another goal.	Providing access to electricity reinforces water-pumping and irrigation systems. Strengthening the capacity to adapt to climate-related hazards reduces losses caused by disasters.
+1	Enabling	Creates conditions that further another goal.	Providing electricity access in rural homes enables education, because it makes it possible to do homework at night with electric lighting.
0	Consistent	No significant positive or negative interactions.	Ensuring education for all does not interact significantly with infrastructure development or conservation of ocean ecosystems.
–1	Constraining	Limits options on another goal.	Improved water efficiency can constrain agricultural irrigation. Reducing climate change can constrain the options for energy access.
–2	Counteracting	Clashes with another goal.	Boosting consumption for growth can counteract waste reduction and climate mitigation.
–3	Cancelling	Makes it impossible to reach another goal.	Fully ensuring public transparency and democratic accountability cannot be combined with national-security goals. Full protection of natural reserves excludes public access for recreation.

Måns Nilsson, Dave Griggs and Martin Visbeck, Nature 534, 16062016, 321

But…

Sustainable development does not start from a blank slate.

Side-effects of earlier interventions compromise our freedom of choice for future options

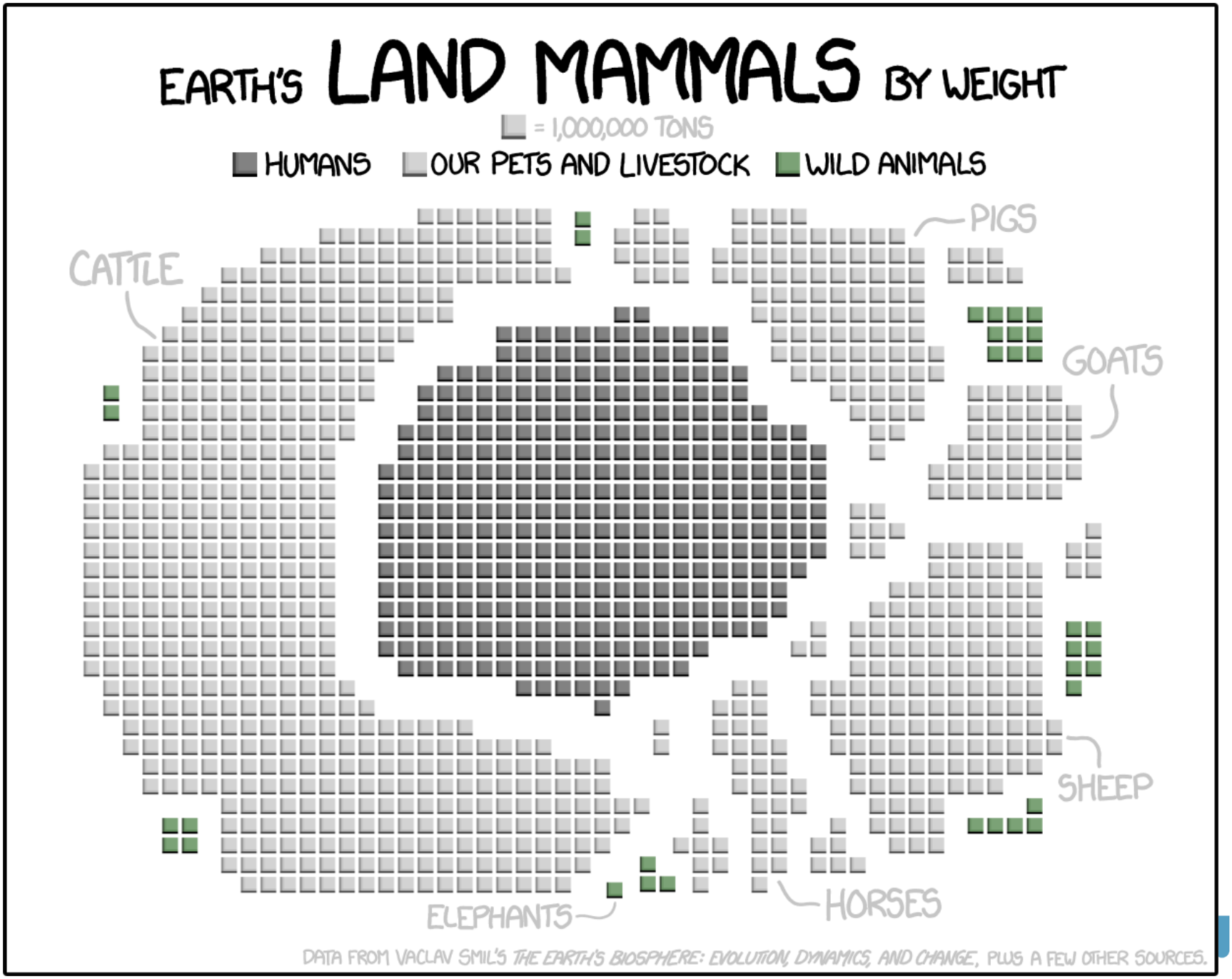
Appendix F

Estimates of the Biosphere's Heterotrophic Biomass

Organisms	Biomass estimates (Mt C)
Prokaryotes	
Soils	15,000–26,000
Waters	1,500–13,700
Subterranean	22,000–215,000
Subsea	?–303,000
Land	
Fungi	3,000–6,000
Invertebrates	400–1,000
Wild vertebrates	< 5
Land (continued)	
Elephants	0.1
Domesticated vertebrates	100–120
Humans	40
Ocean	
Invertebrates	300–500
Fish	< 40
Whales	5–15

Sources: Bowen (1966); Bogorov (1969); Whittaker and Likens (1973); Hinga (1979); Romankevich (1988); Smil (1991); Whitman et al. (1998); Wilhelm and Suttle (1999); and my new calculations based on the latest population estimates for elephants and whales collated, respectively, by the IUCN (2001) and by the IWC (2001).

Smil, Vaclav, The Earth's Biosphere: Evolution, Dynamics, and Change (MIT Press) 2002.



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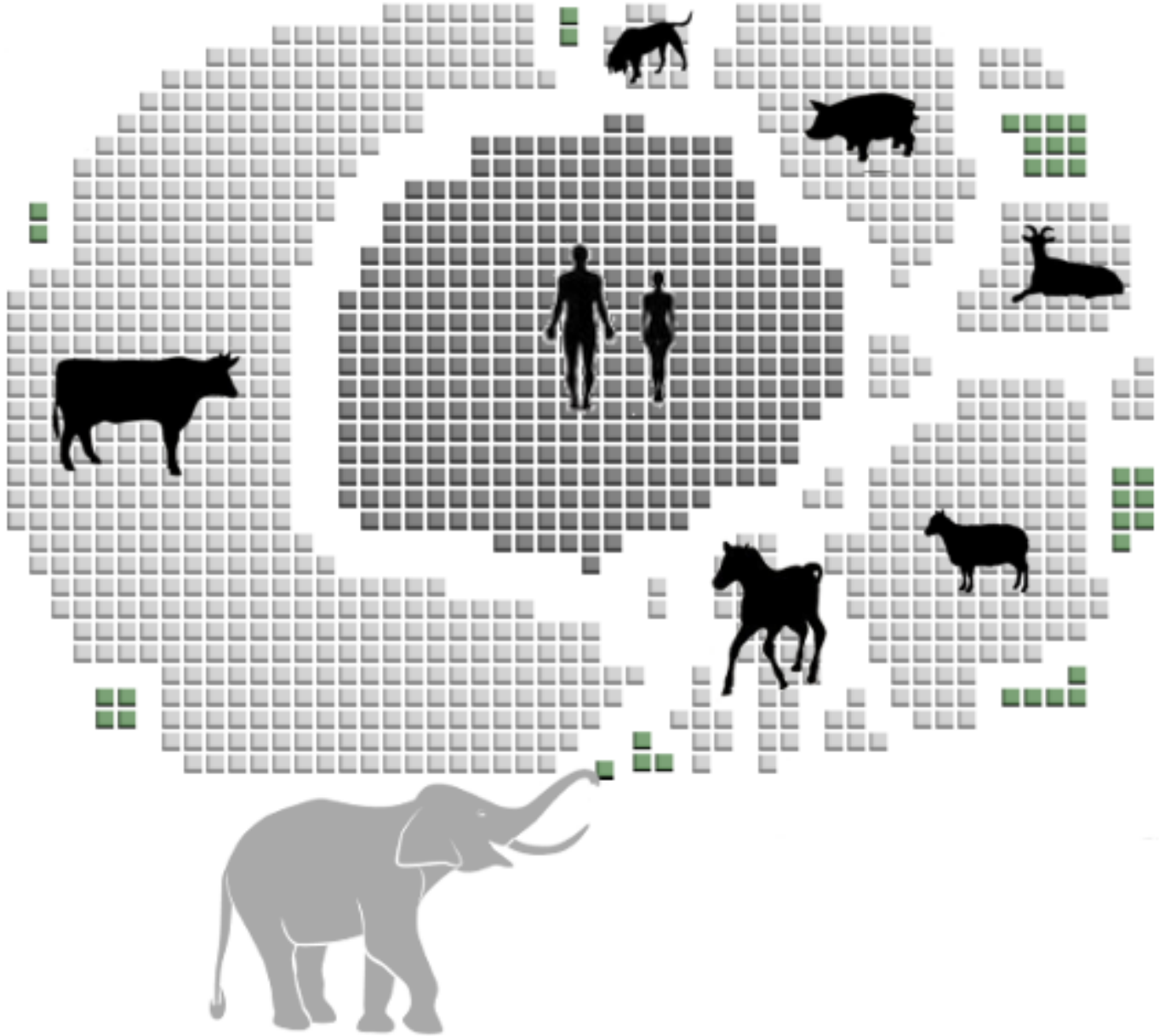
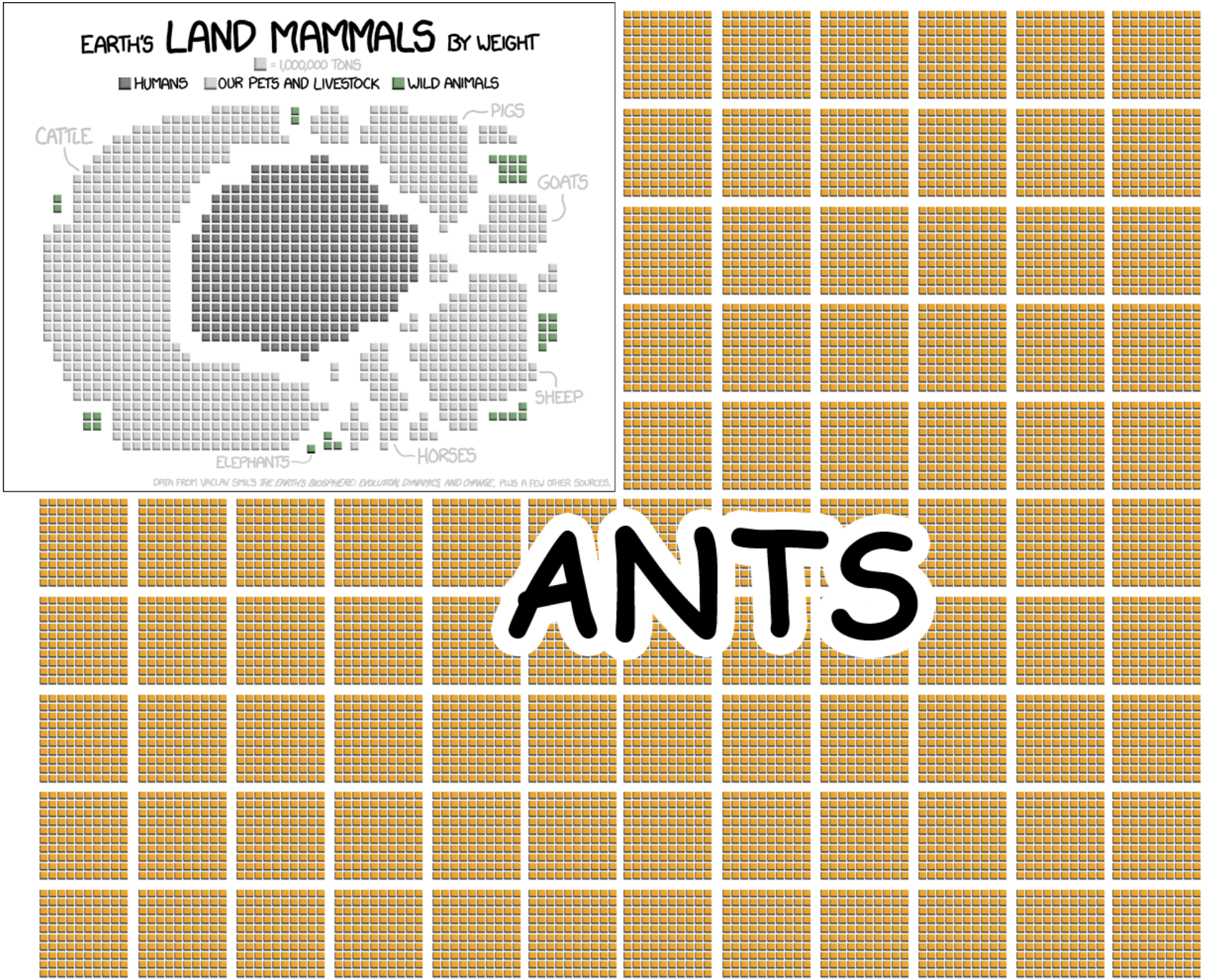
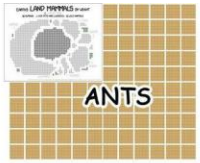


https://commons.wikimedia.org/wiki/File:Info_land_mammals_by_weight.png



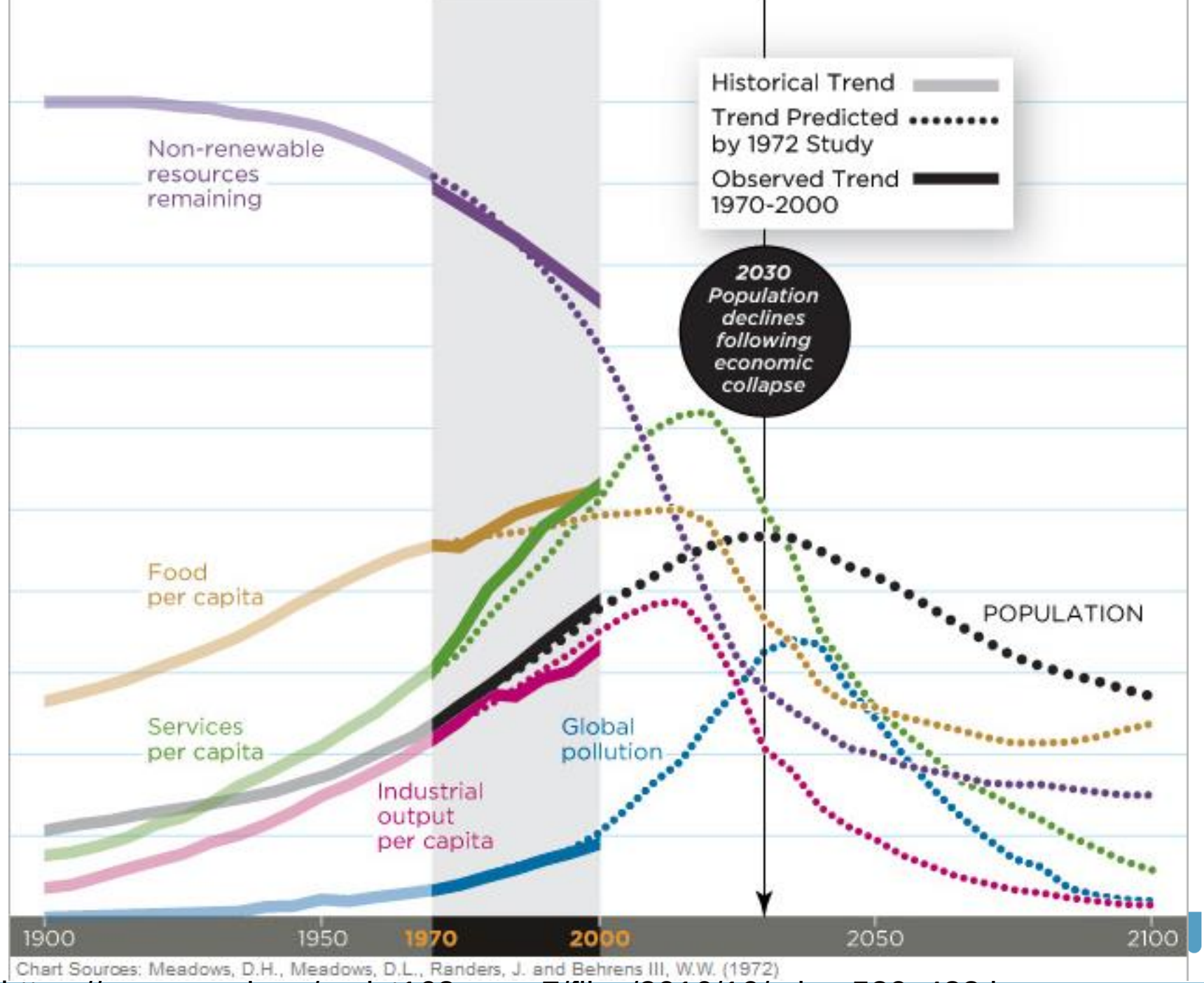
https://i.imgur.com/rD90eE4.png



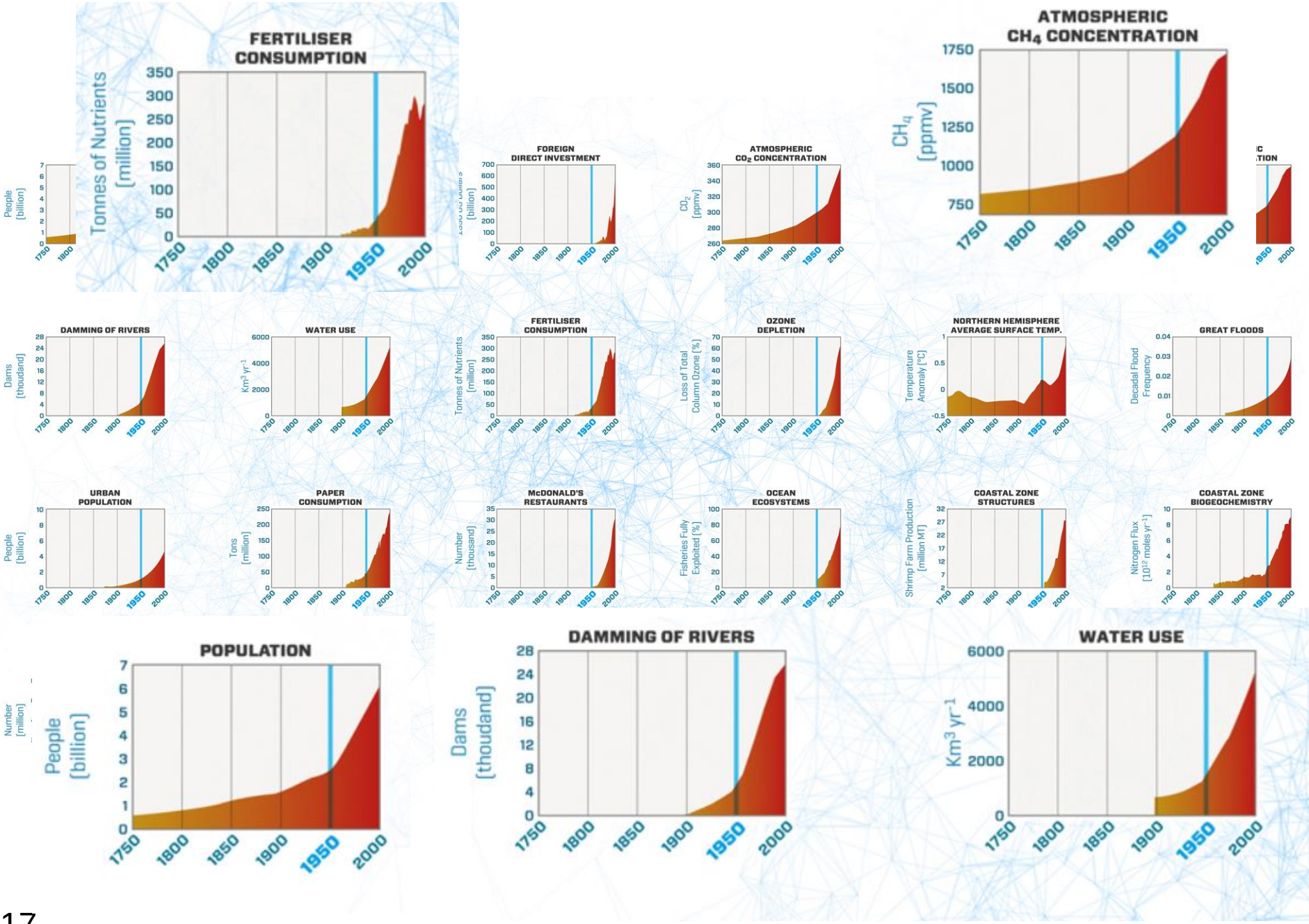
BACTERIA

http://i.imgur.com/UeGY9E6.jpg


What specific kind of insight can a historical perspective offer?



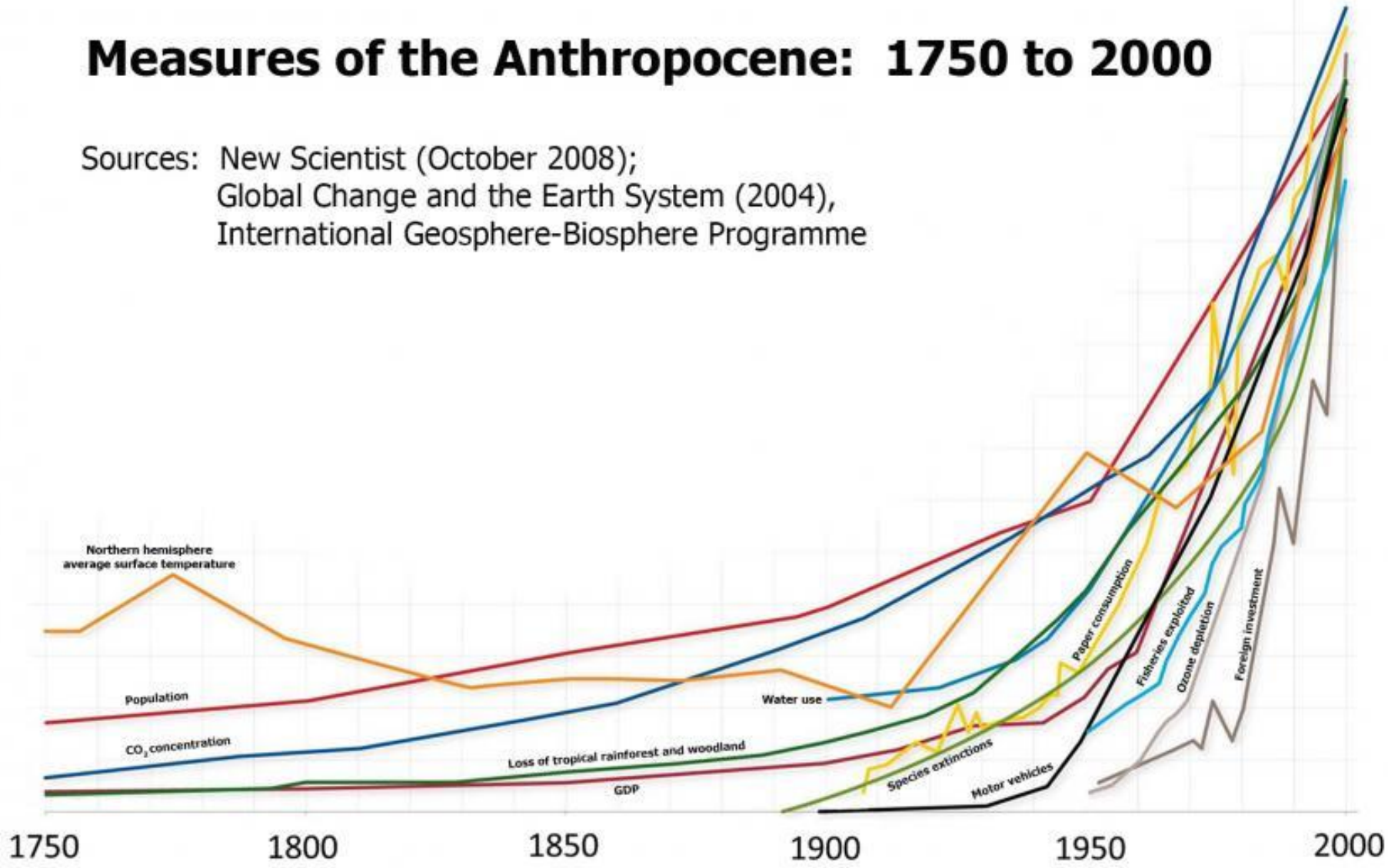
https://wpmu.mah.se/nmict162group7/files/2016/10/sdgs-580x483.jpg



Steffen et al 2004

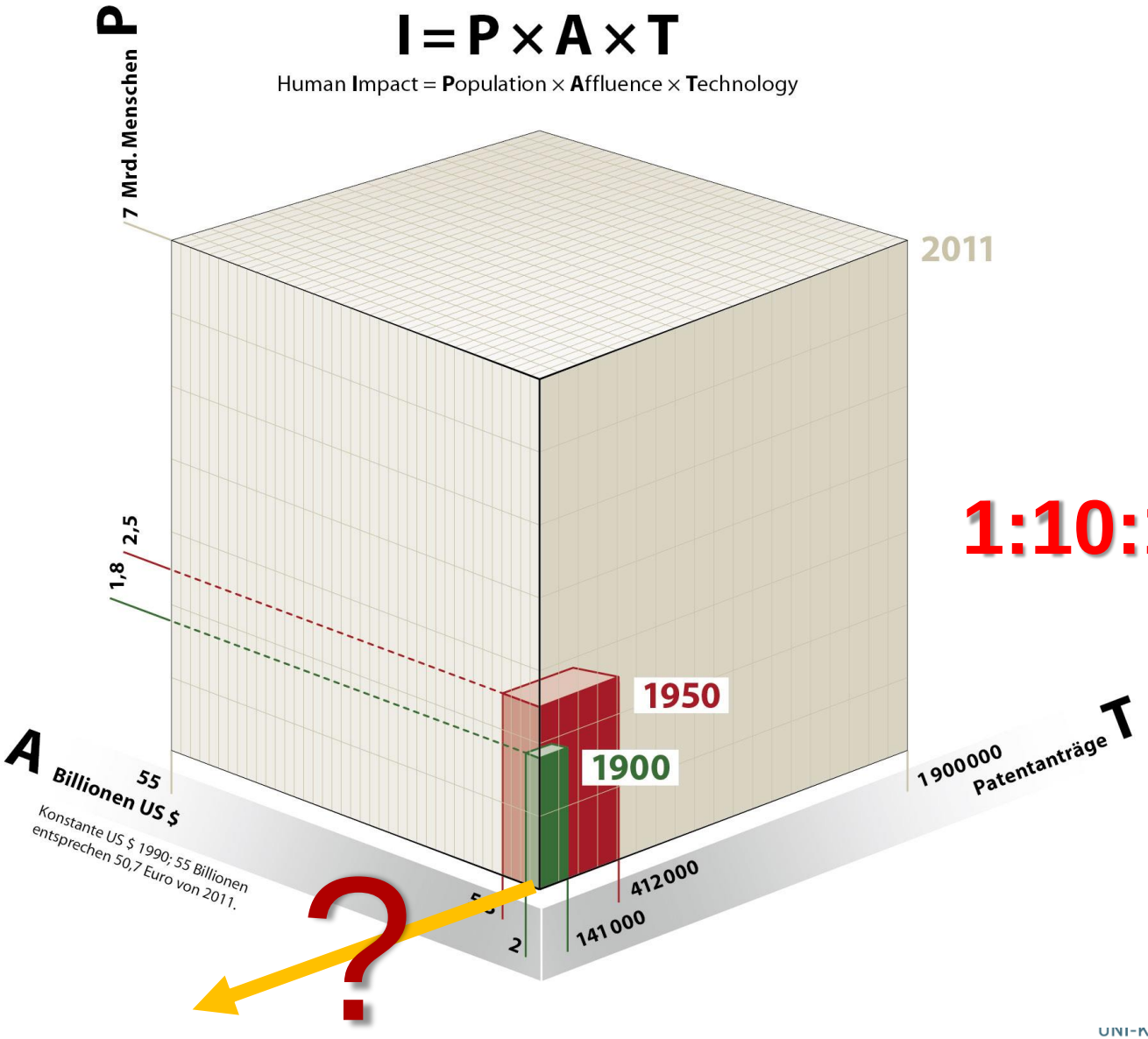
Measures of the Anthropocene: 1750 to 2000

Sources: New Scientist (October 2008);
Global Change and the Earth System (2004),
International Geosphere-Biosphere Programme



http://humanorigins.si.edu/sites/default/files/styles/home_slider_phablet/public/measures%20of%20the%20anthropocene.jpg?itok=Hqfbx9pp&timestamp=1418932578

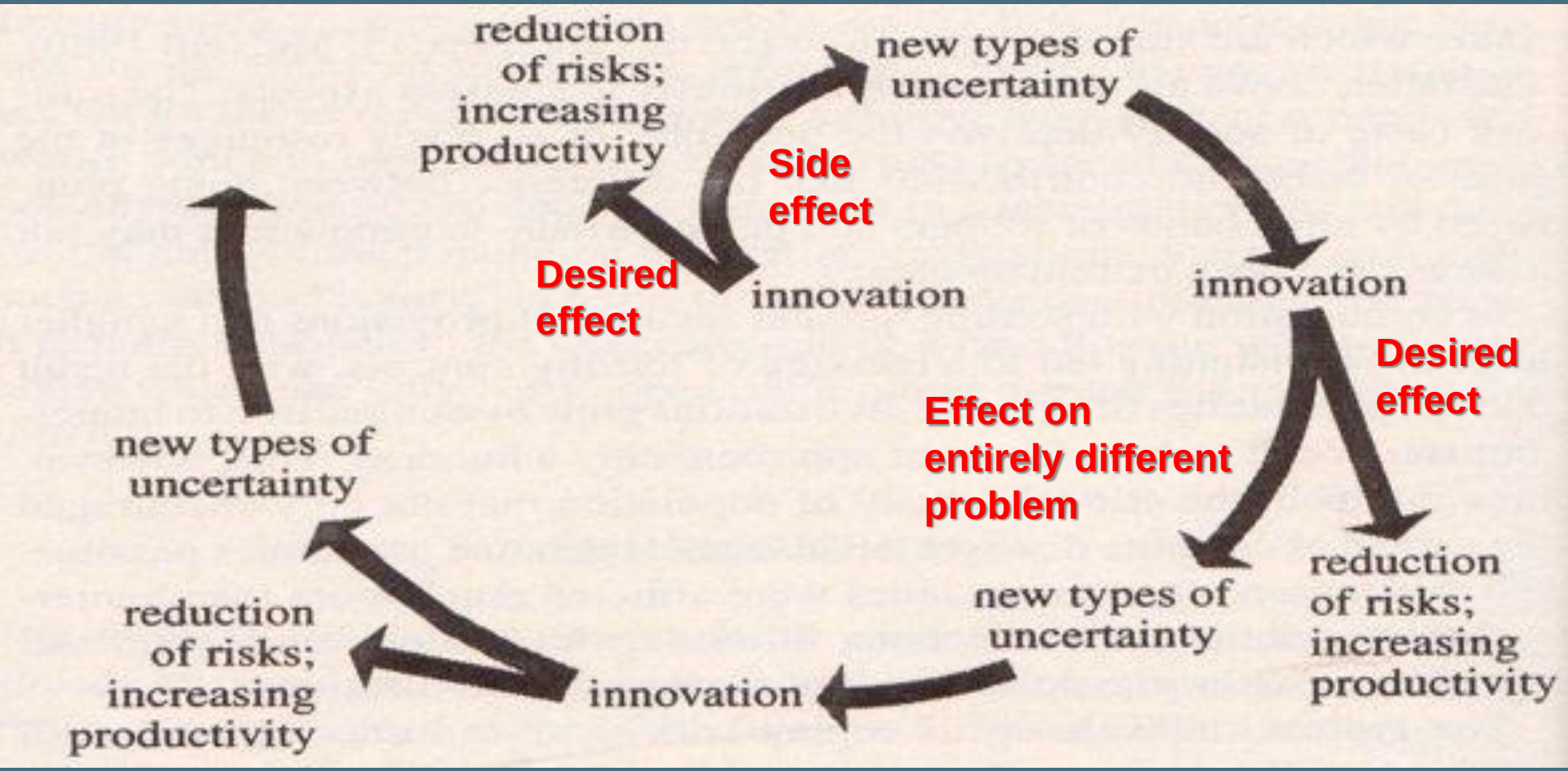
A long-term-view puts things in perspective



1:10:1000

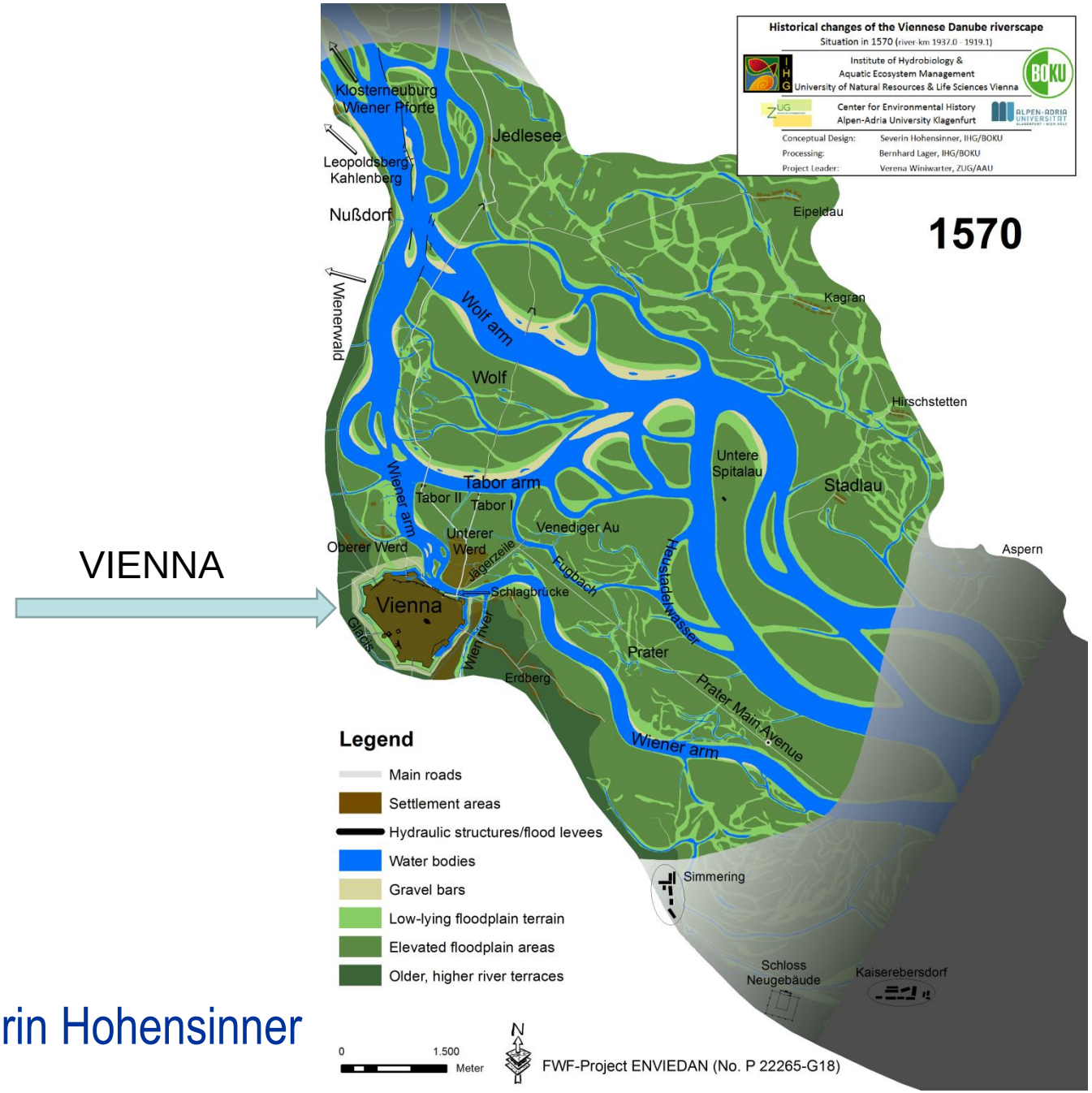
IPAT Formula: Barry Commoner, 1972

The Spiral of Risk

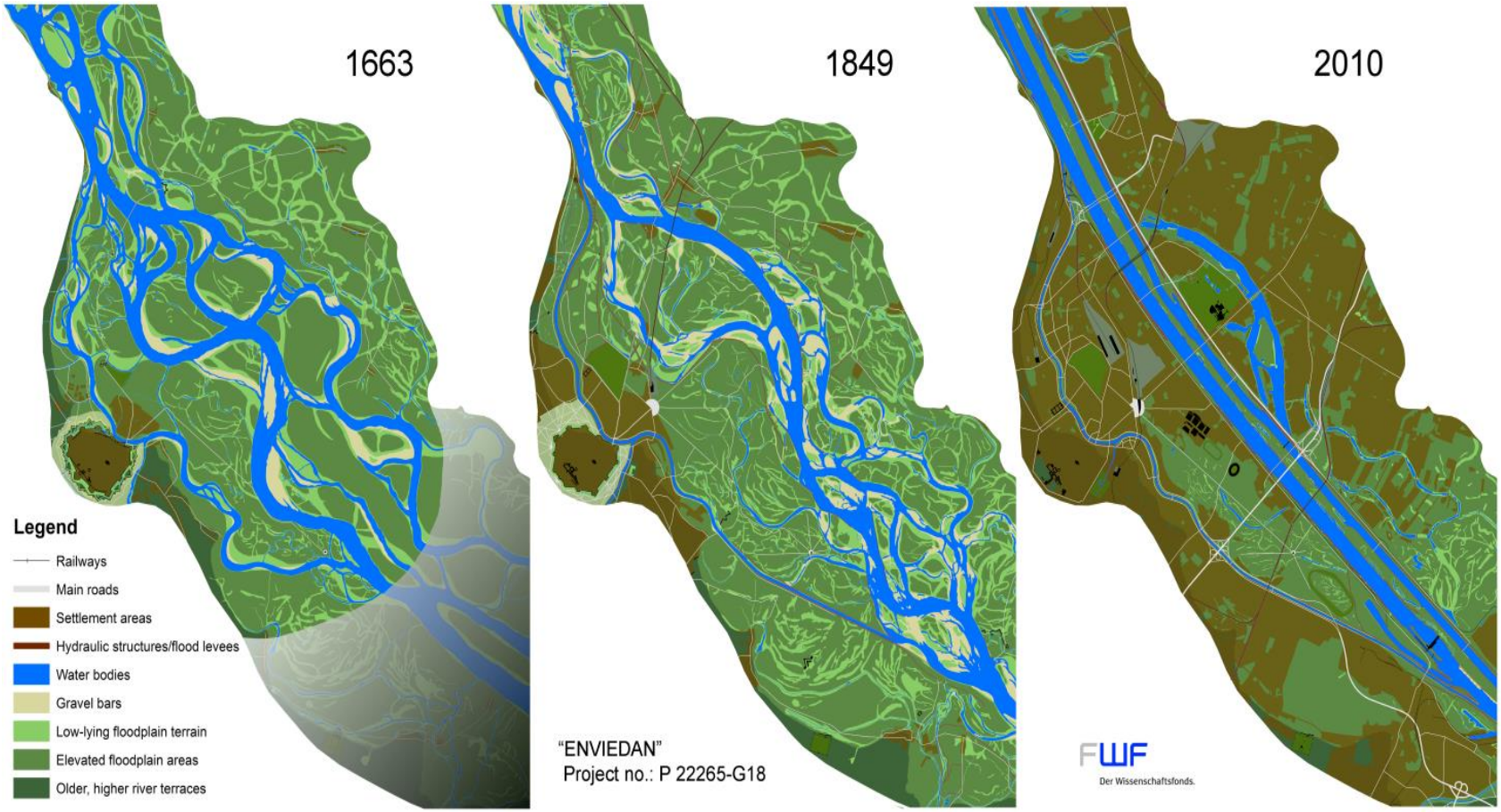


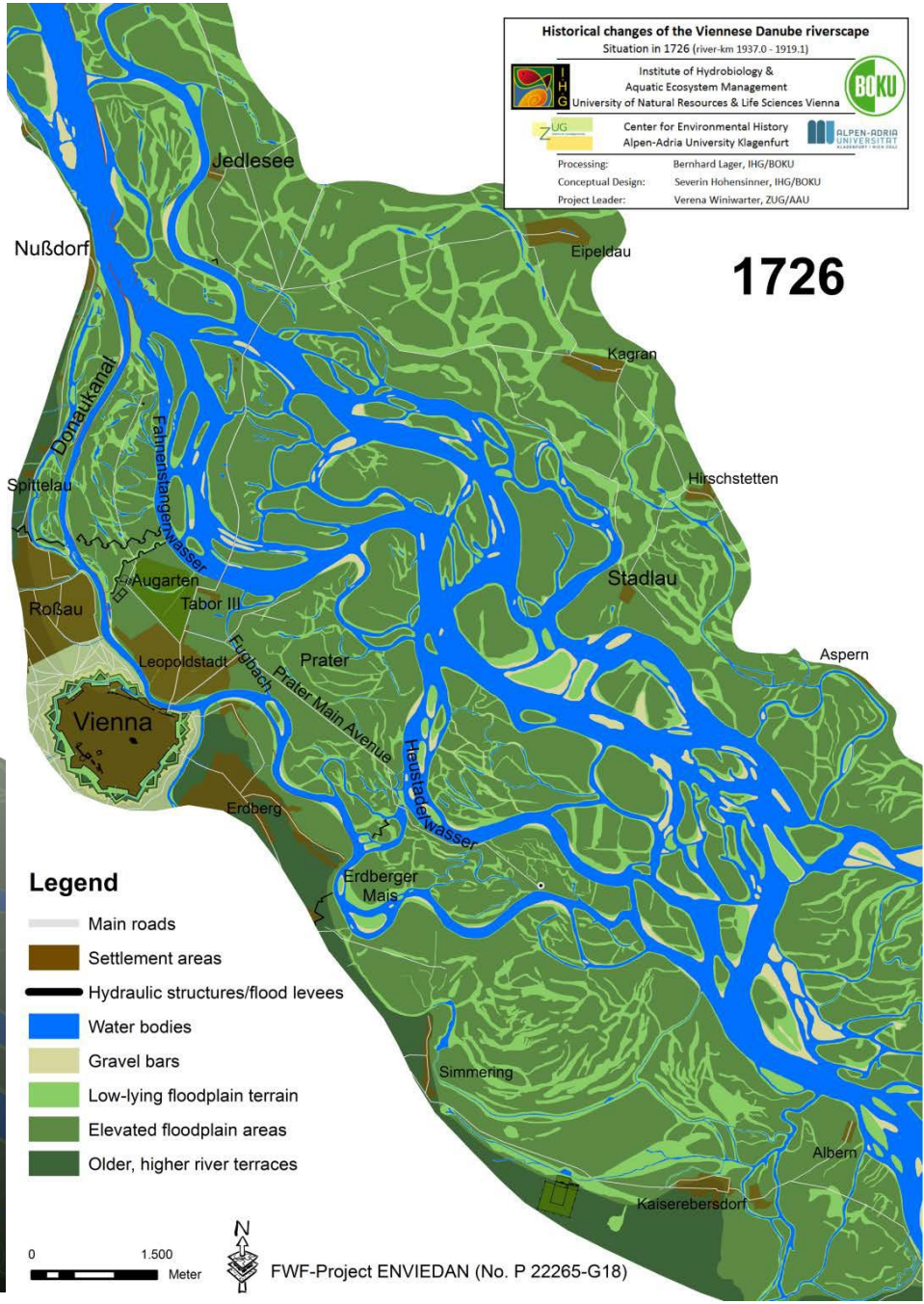
From: Sieferle, Rolf Peter; Müller-Herold, Ulrich: Surplus and Survival. Risk, Ruin, and Luxury in the Evolution of Early Forms of Subsistence. In: Advances in Human Ecology 6 (1997), S. 201-220.

VIENNA

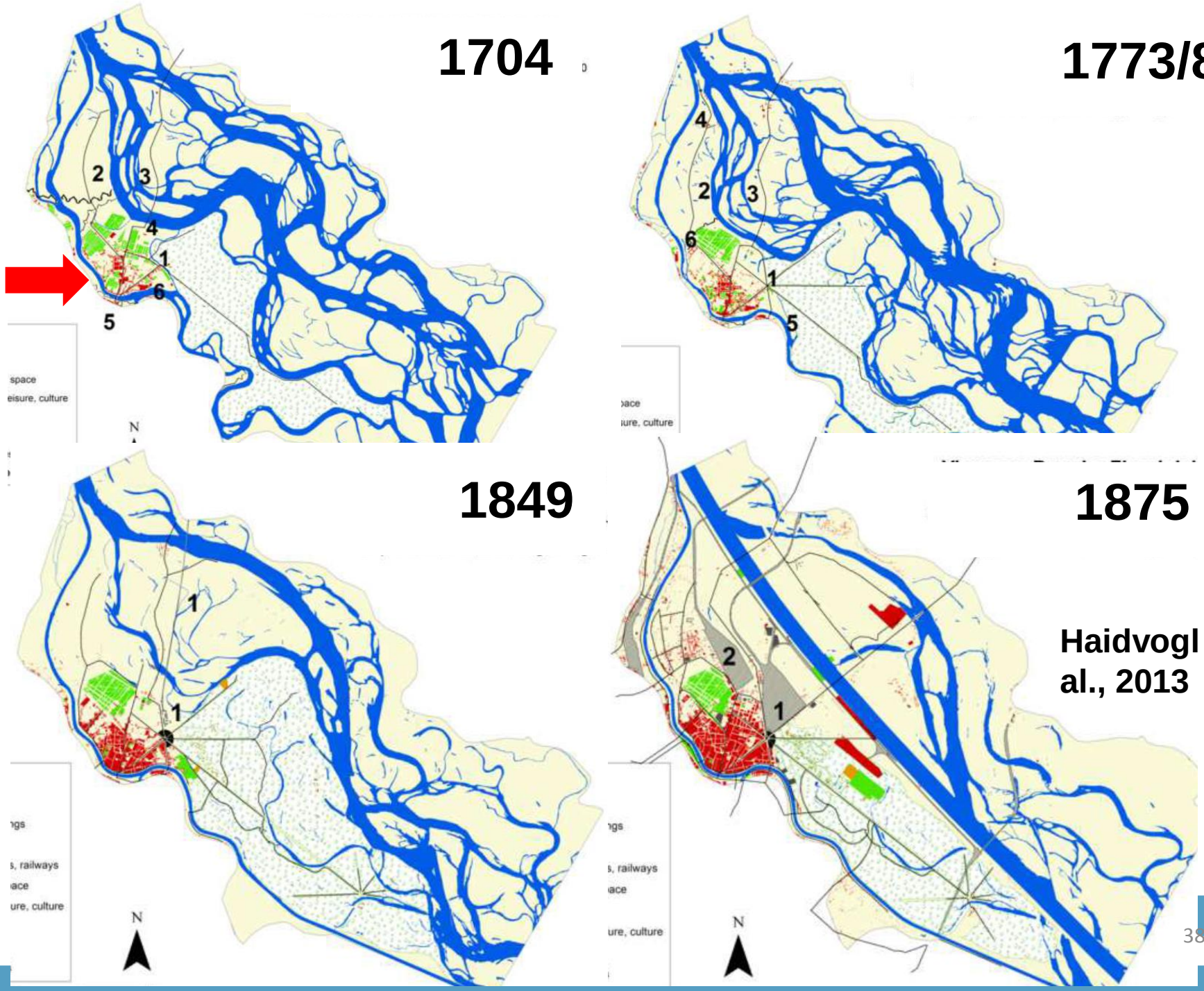


Reconstruction: Severin Hohensinner

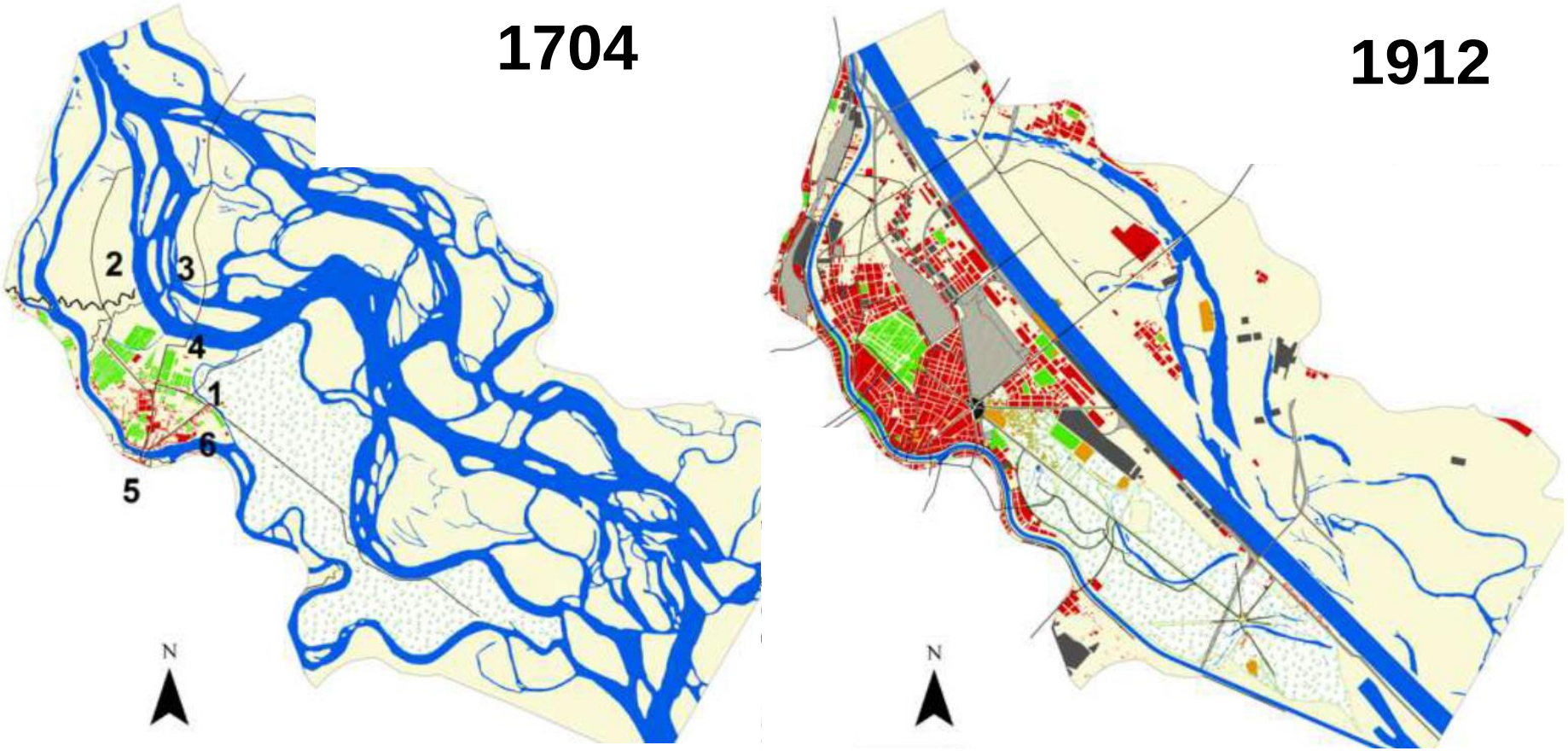

1663
1849
2010
Legend
Railways
Main roads
Settlement areas
Hydraulic structures/flood levees
Water bodies
Gravel bars
Low-lying floodplain terrain
Elevated floodplain areas
Older, higher river terraces
"ENVIEDAN"
Project no.: P 22265-G18
FWF
Der Wissenschaftsfonds.



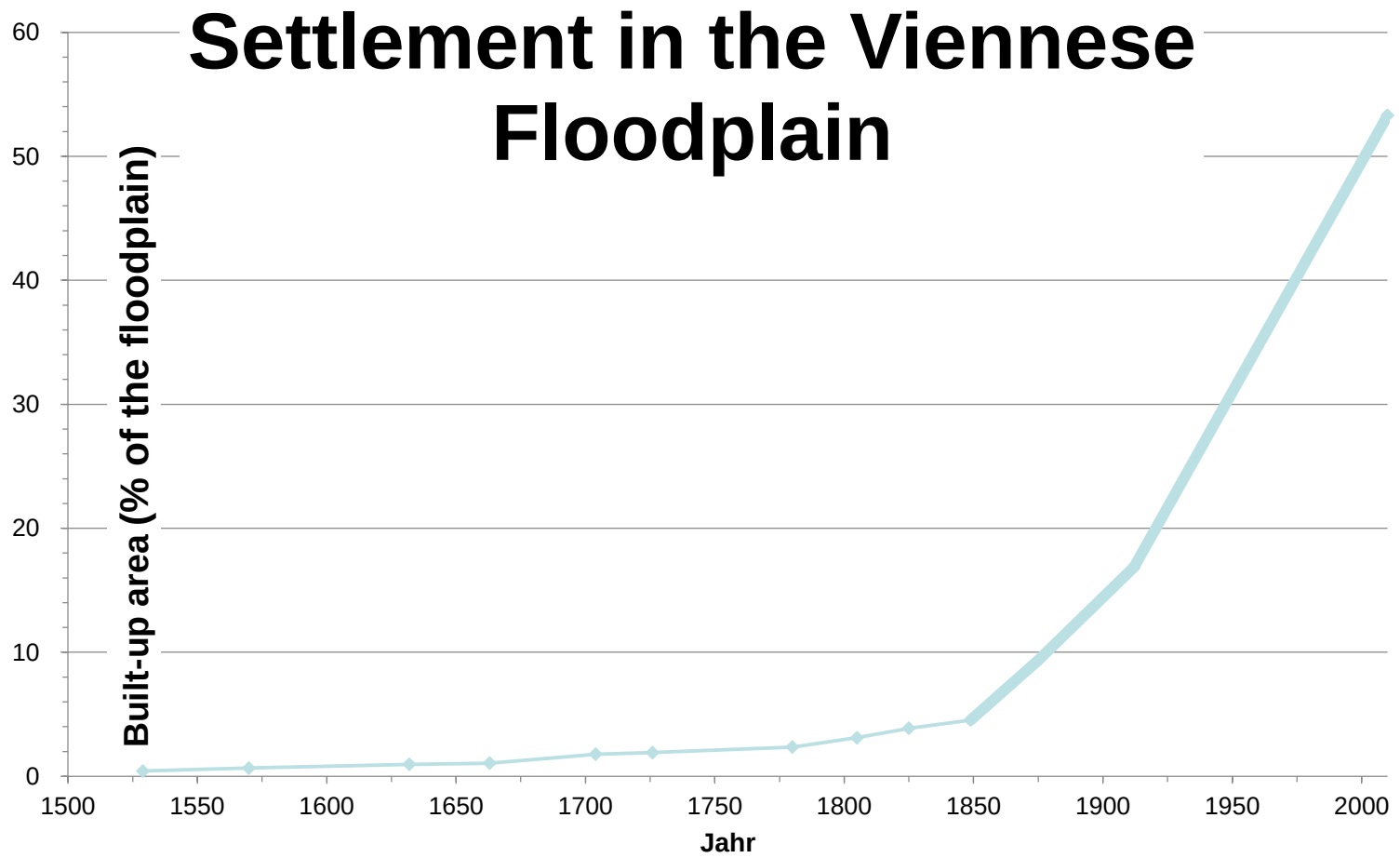
Hohensinner et al., 2013


1704
1773/81
1849
1875
Haidvogl et al., 2013
N

Human settlement in the floodplain (active zone)



Haidvogl et al., 2013



- ⇨ Increased human use of the floodplain increased the danger the river dynamic posed
- ⇨ Interventions into this dyanmic had unwanted side-effects
- ⇨ This led to increased human effort in flood protection
- ⇨ In 1875, the Vienna City Authorities declared the matter of flood protection settled once and for all.
- ⇨ Two devastating floods occured soon thereafter.
- ⇨ In 2013, the Vienna City Authorities declared the matter of flood protection settled once and for all.

Memories are short….

Iwaki, Fukushima prefecture

Oarai, Ibaraki prefecture, Japan, 03/11/2011

http://s1.reutersmedia.net/resources/r/?m=02&d=20110311&t=2&i=359502708&w=580&fh=&fw=&ll=&pl=&r=img-2011-03-12T032322Z_01_NOOTR_RTRMDNC_0_India-555148-1

Earthquake and tsunami destroy Reggio Calabria (across the strait of Messina from Sicily, Italy) in 1783

(Trustees of the British Museum, London)

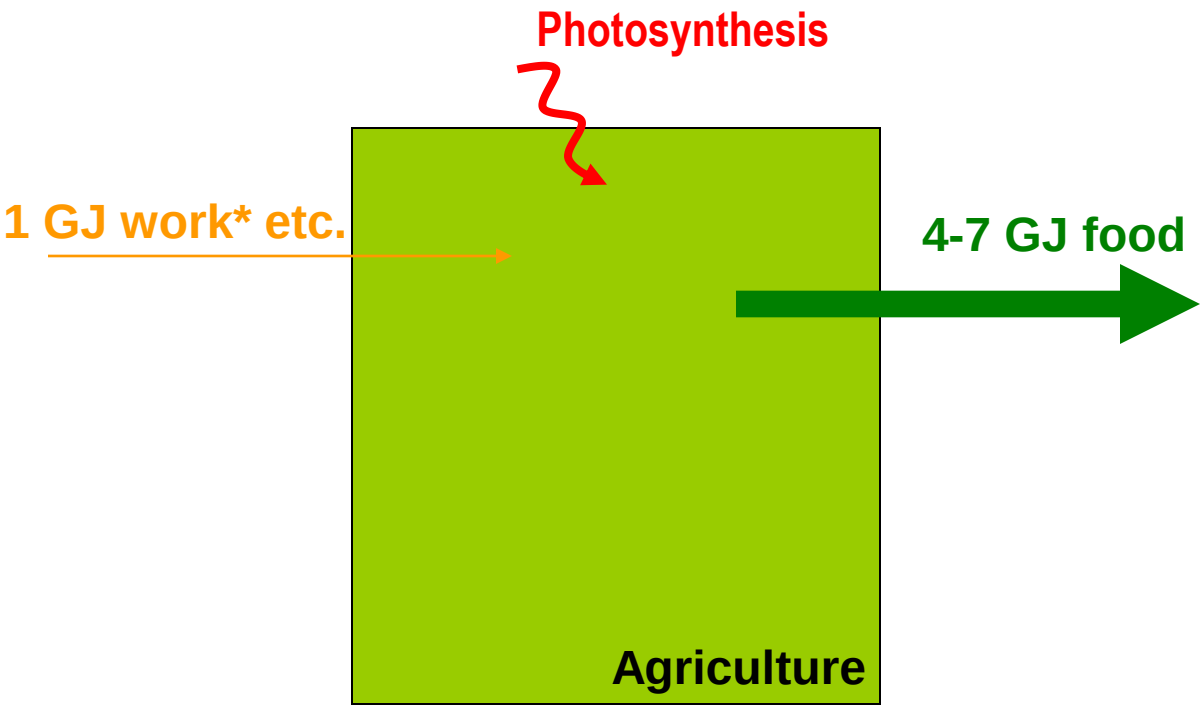
Reggio Calabria,1783

(Trustees of the British Museum, London)

.. and legacies abound:
WW I Legacy: **Arsenic** near Verdun at the Place à Gaz

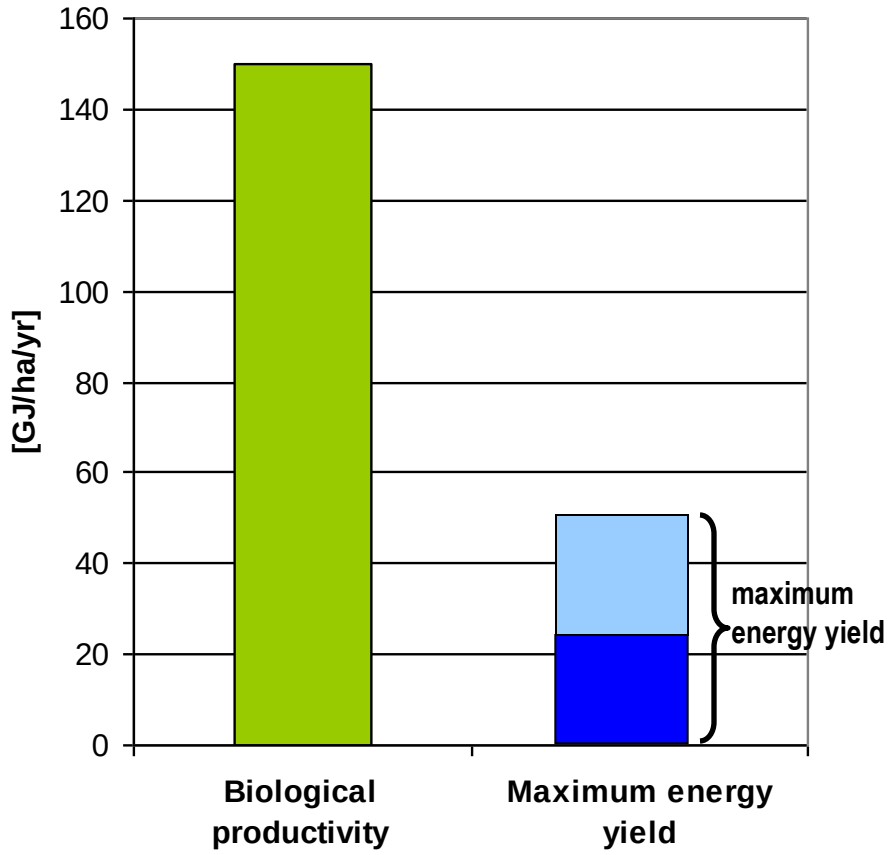
31

Agriculture as “source” of energy



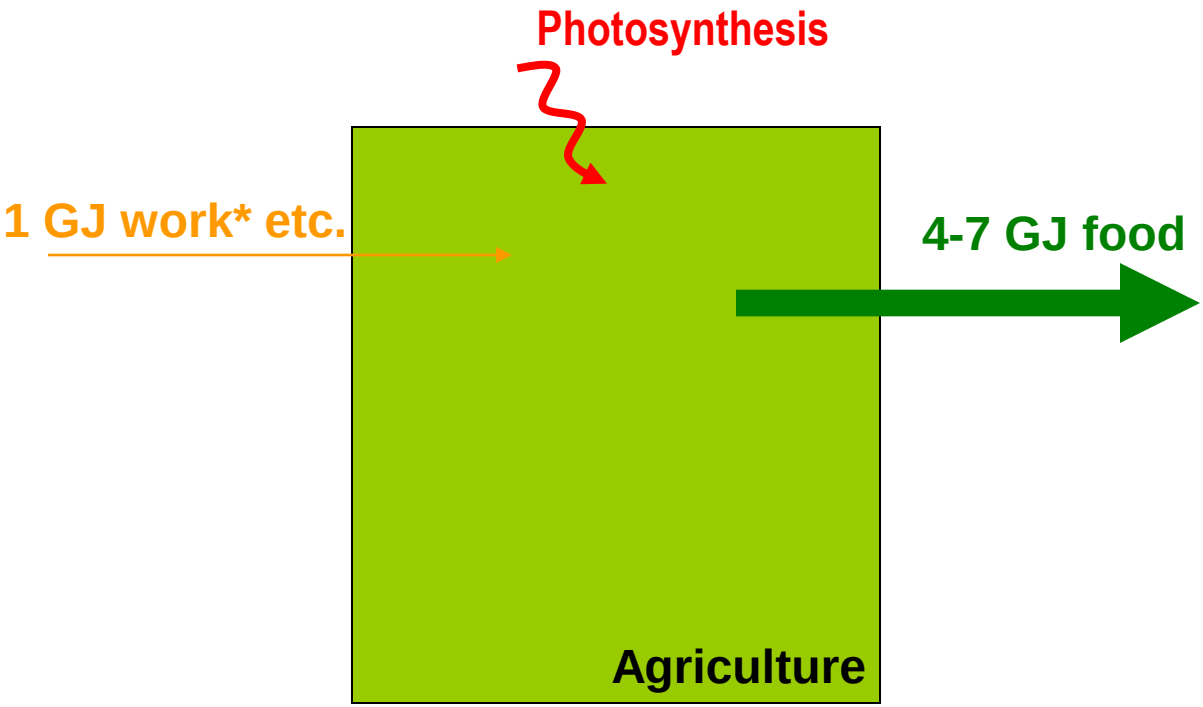
*primary energy equivalent of work

The limits of growth in the solar energy system



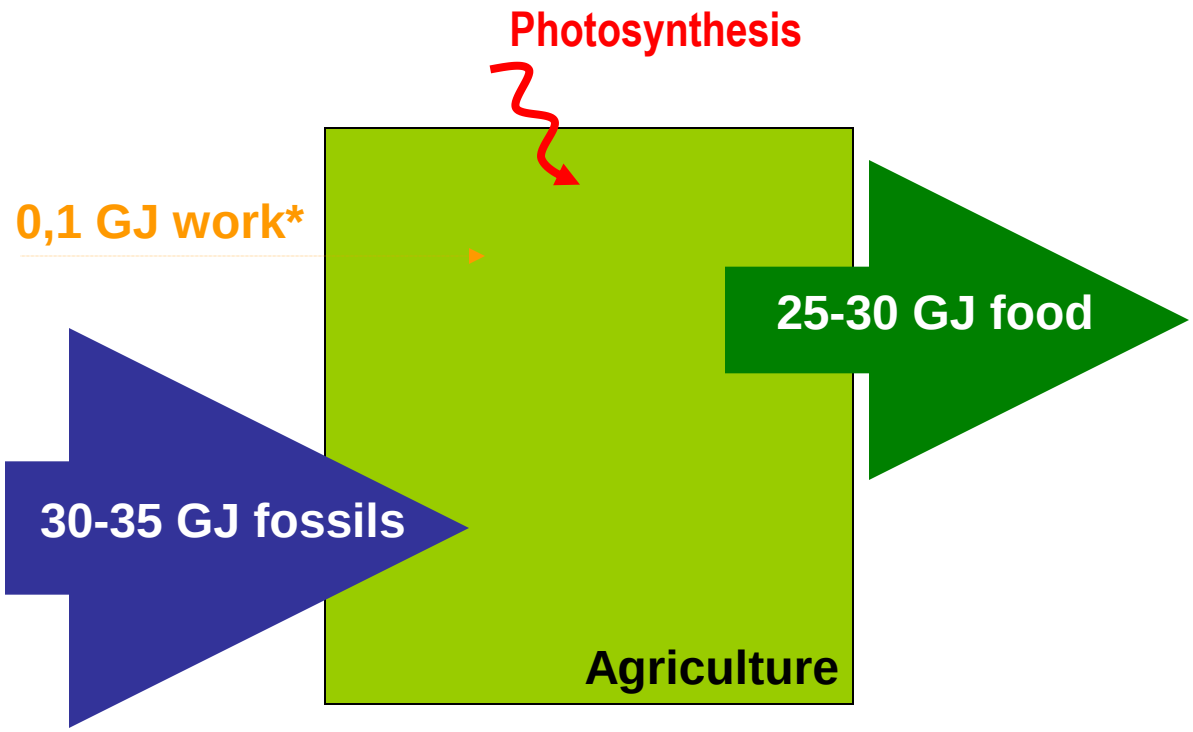
- **Biological productivity of natural vegetation: 130-150 GJ/ha/yr**
- **Maximum average primary energy density: 25-50 GJ/ha/yr**
- **Energy availability is determined by land area, land use technology and conversion**

The transformation of agriculture: From energy provision….



*primary energy equivalent of work

The transformation of agriculture: ….to an energy sink



*primary energy equivalent of work

Aspang, 1900

Aspang, 2001

Forests were indispensable for peasant, lord and miner in pre-modern Europe.

- One Venetian Galley needed 2 ha of forest (clearcut) or 300 ha of oak forest and 122 ha of conifer forest, selectively cut.
- In Early Modern Venice, oak wood demand was ca. 50.000-55.000 m^3 per year.

***LA CAPITANA IL VENETIA* (1569)**

The Venetian forest regulation of 1476

- PROTECTION OF OAKS FOR SHIPS IS PRIME GOAL
- No wood pasture
- No harvest of firewood (branches)
- No prescribed burning to remove understorey.
- 10-year cycle for wood harvest.
- → peasant use of forest is criminalized

Regulation is without apparent success in the eyes of the central administration.

The result?

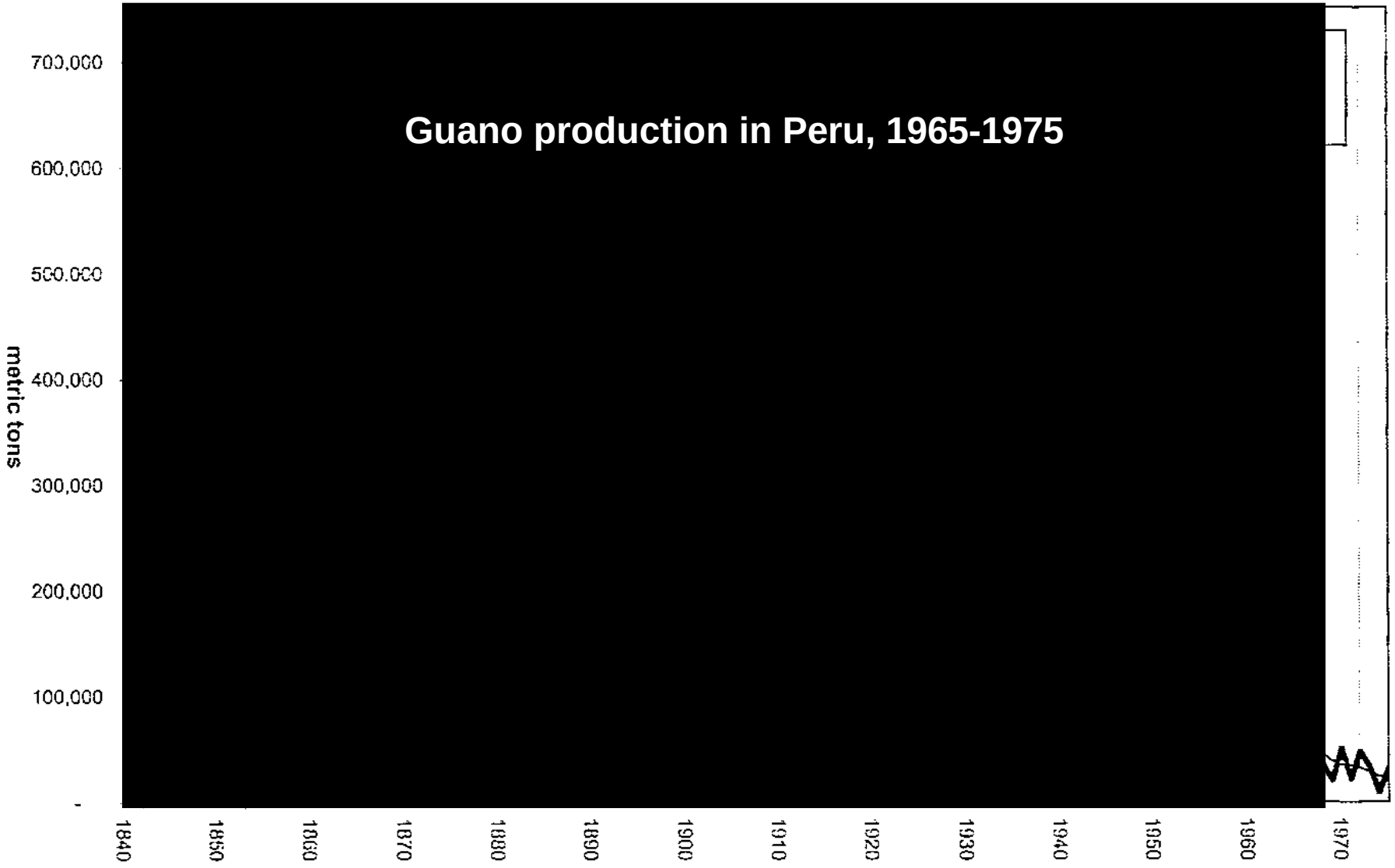
- 200 years later, and a few more regulations notwithstanding, oak yield had DECLINED.
- Explanation AT THE TIME: Peasants had violated regulations. Actually, things were the OPPOSITE:
- As long as peasants had removed understory and low-quality stems through pasture, firewood collection and burning, the few remaining oak saplings could mature into large, straight trees, as needed for shipbuilding.
- IF PEASANTS RESPECTED THE REGULATIONS, FEWER USEFUL OAKS GREW.

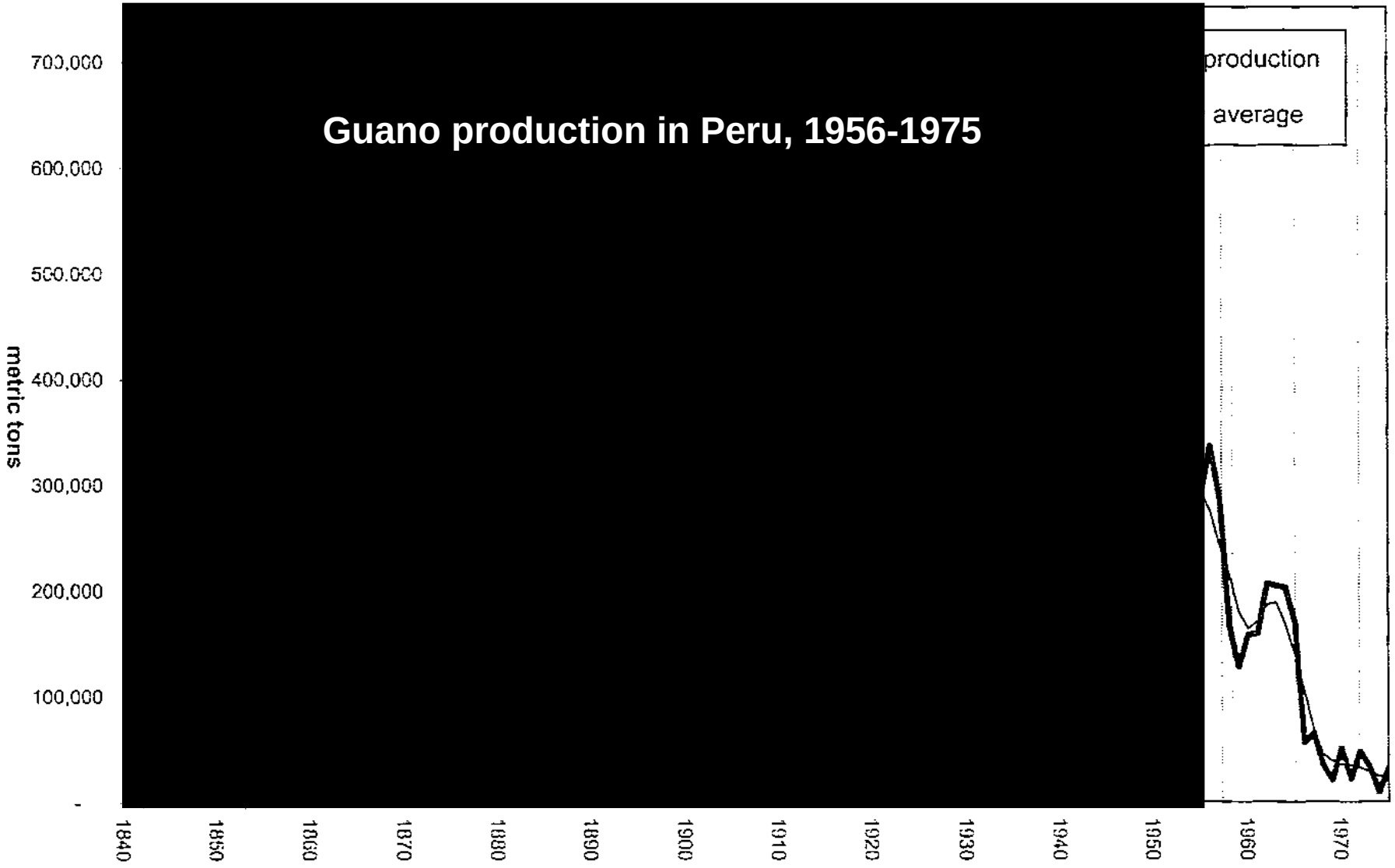
Using a scarce resource carefully?

- As long as the Arsenal took out oaks, oaks would grow. As soon as they limited their harvesting, oak regrowth dwindled. WHY?
- Cutting an oak creates a clearing. Young oaks will not grow UNDER other oaks, but will happily grow on a clearing.
- The disturbance created by harvesting (including taking out small stems and understory to enable transportation) is a prerequisite for oak growth.
- The fewer oaks the Venetians harvested, the fewer would grow.

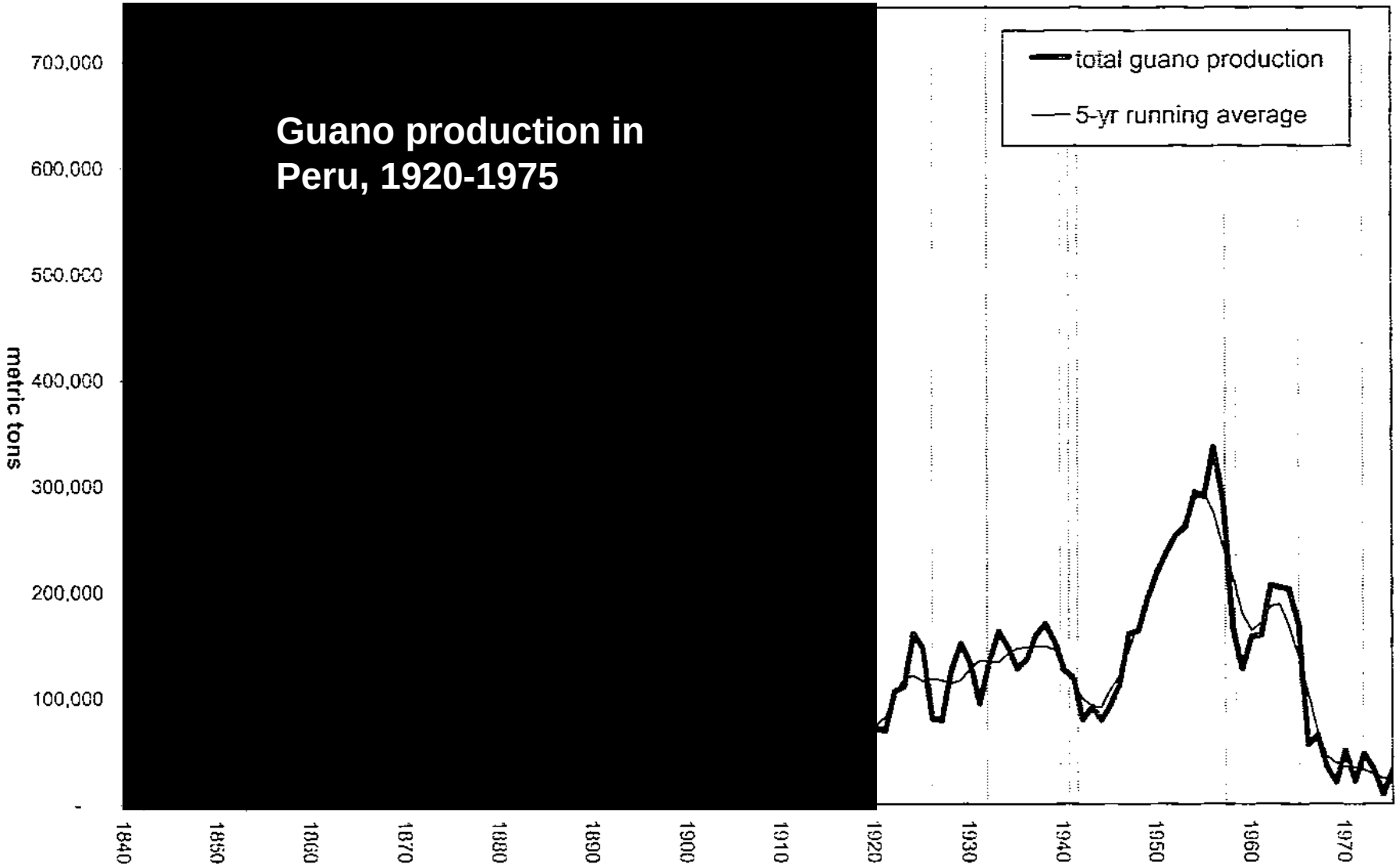
https://upload.wikimedia.org/wikipedia/commons/thumb/d/d2/Map_of_the_War_of_the_Pacific.en2.svg/450px-Map_of_the_War_of_the_Pacific.en2.svg.png

Greg Cushman, The most valuable birds, Environmental History 10,2, 2005, 477

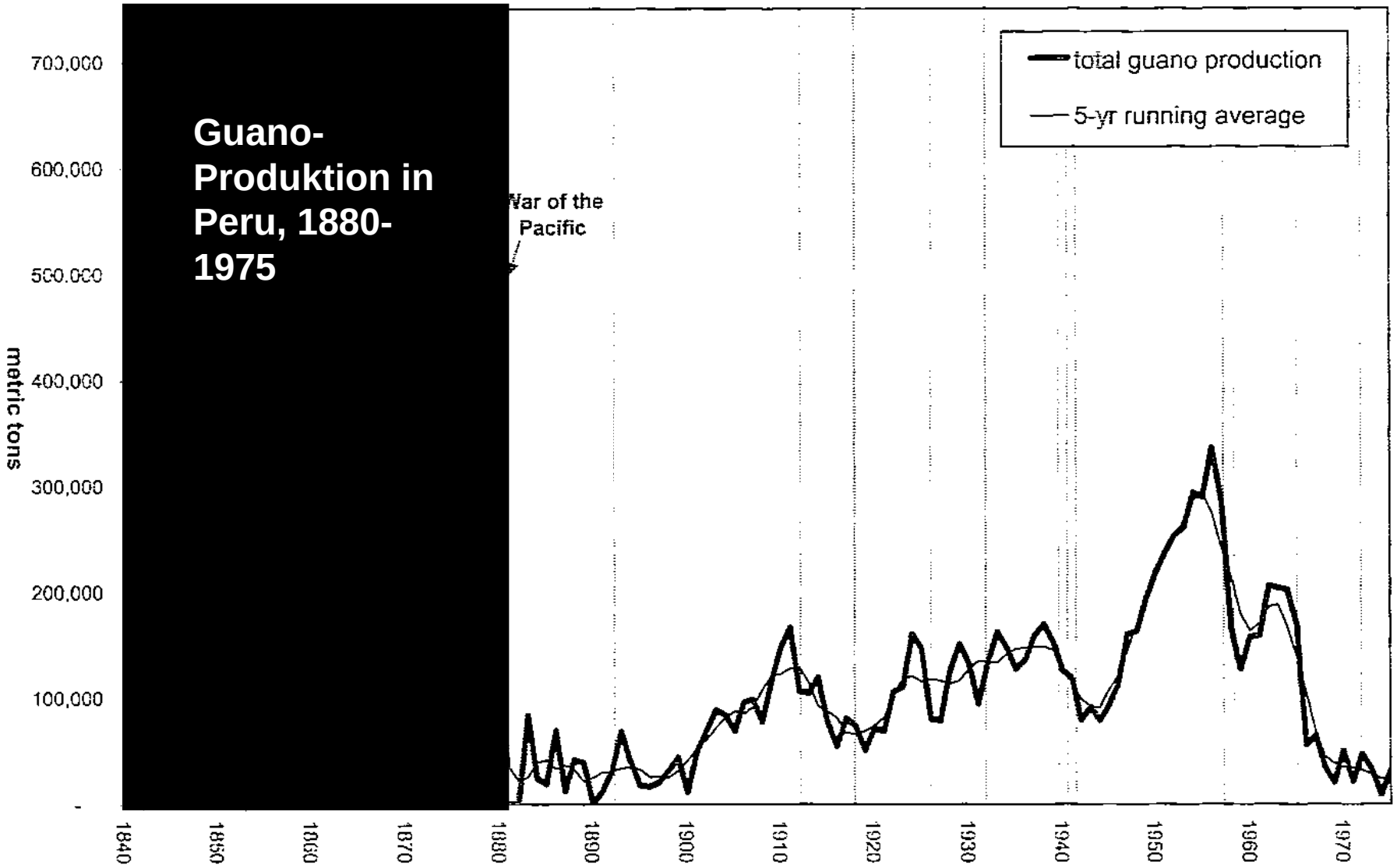



Guano production in Peru, 1956-1975
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
metric tons
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
production
average

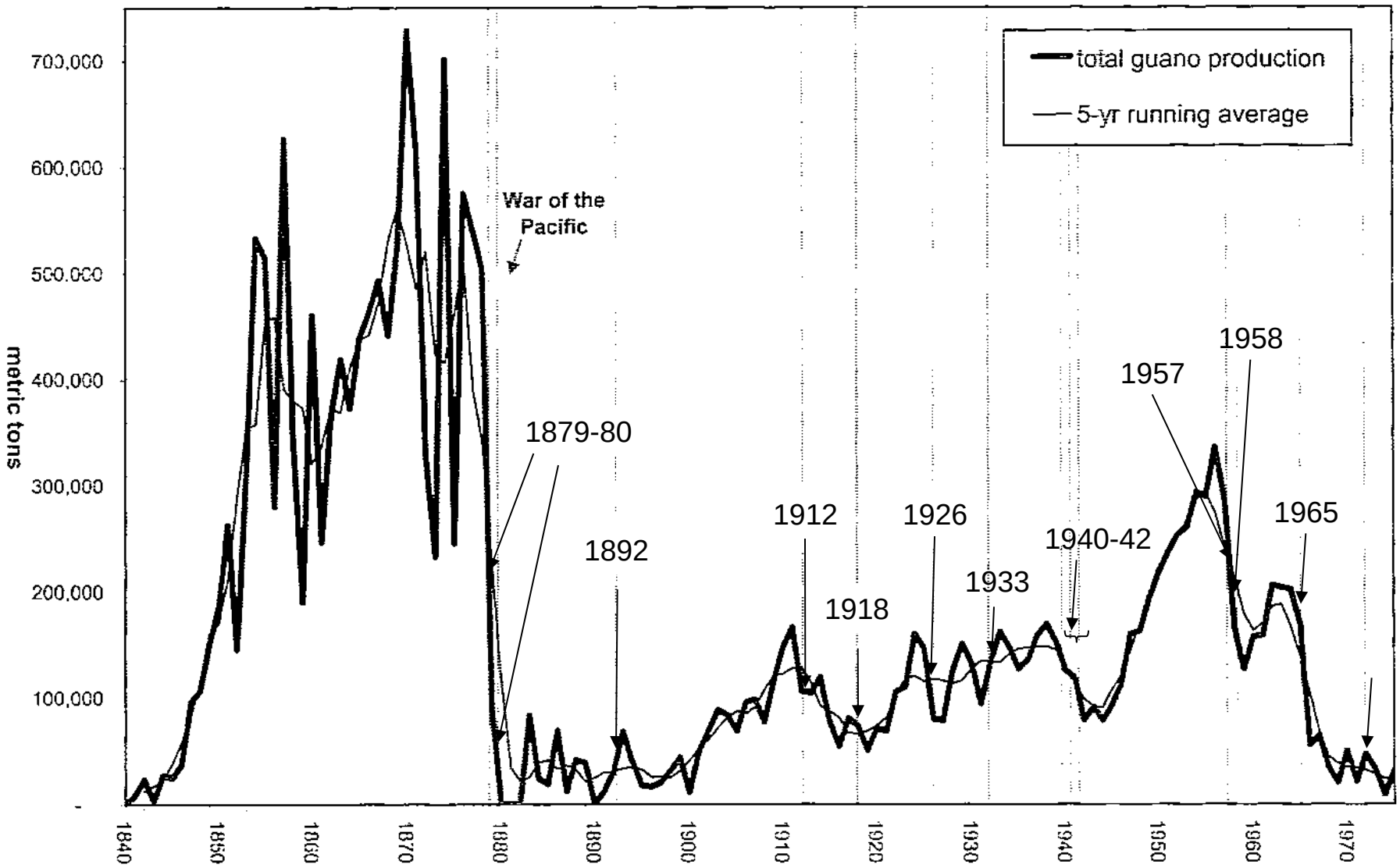
Guano production in Peru, 1920-1975



Guano-Produktion in Peru, 1880-1975



Guano production in Peru, 1840-1975



Lessons from a historical perspective?

Sustainable development needs a realistic idea of how much impact humans have already had on the earth … (mammals)

and when it happened (post 1950s)

Mind the side-effects – well meaning is not always well-doing. (Venetian oaks)

A long-term view puts modern agriculture into perspective (EROI)

Keep an eye on natural dynamics (e.g. earthquakes) and how humans enhance their effect (Danube regulation)

Learn from Guano‘s troubled history for sustainable resource management in the ecological web

References:
Debra J. Davidson, The Applicability of the Concept of Resilience to Social Systems: Some Sources of Optimism and Nagging Doubts.
Society & Natural Resources Vol. 23 , Iss. 12,2010.
Folke, C., R. Biggs, A. V. Norström, B. Reyers, and J. Rockström. 2016. Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society* 21(3):41.
http://dx.doi.org/10.5751/ES-08748-210341.