



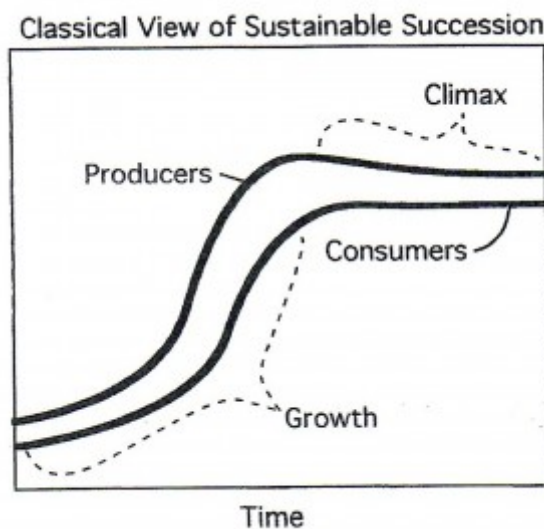
A Prosperous Way Down

Our civilization can thrive in a future where we live with less

Pulsing Paradigm

Apparently, all systems on all scales pulse. Gradual accumulation of one storage is followed by a short period of frenzied consumer use and development which disperses materials, setting up the next growth period. Pulses cause oscillations in energy, empower, and transformity. Inputs from pulses on smaller scale than the window of interest look like noise and can be averaged as if there was a steady state. The infrequent pulses from the larger scale than the window of interest are catastrophic with high transformity and effect (hurricanes, earthquakes, economic pulses, information storms, etc.) (Odum, Porto Venere, 1998).

Systems maximize power on each scale over time by pulsing consumption of mature structures that resets succession to begin again. Systems that pulse prevail. Nearly all ecosystems are hierarchical and pulsing. Growth and pulsing over a longer period can generate repeating patterns of pulsing pairs of producers and consumers such as the classic predator prey model portrayed in the video below. The first systems priority to maximize energy intake reinforces competitive exclusion during growth; the second systems priority to maximize efficiency in



http://www.upcolorado.com/book/A_Prosporous_Way_Down_Paper (Odum & Odum, 2001, p. 78)

energy processing reinforces cooperation during contraction. Pulsing cycles are called oscillation, succession, and evolution, depending on the scale. Succession viewed at a smaller scale of time may only present part of the cycle, as illustrated above.

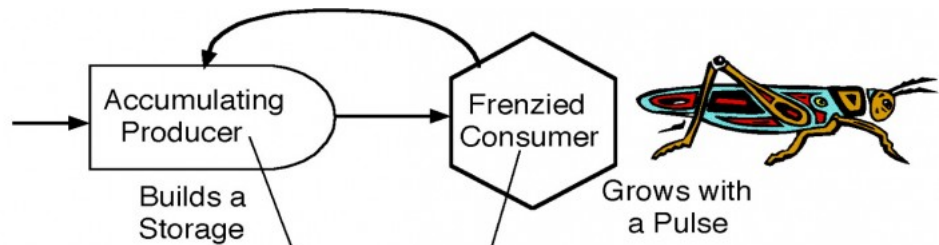
The cycle of assets, or growth cycle, has four stages: growth, climax-transition, descent, and low-energy restoration. Phases of system pulsing/cycling are:

- 1. Systems change through stages of growth called succession*
- 2. Colonization is the first stage of succession*
- 3. Next, growth develops complex assets*
- 4. Later, systems grow until all available resources are in use to maintain existing assets and growth stops*
- 5. Then systems downturn or collapse and go through a period of reset for the next cycle of pulsing*
- 6. Succession is a time span within the pulsing cycle; over the long run there is no steady state*
- 7. Landscapes can have areas producing assets next to areas with accelerated consumption. The diversified landscape increases performance and power (from Odum & Odum, 1987 draft PWD)*

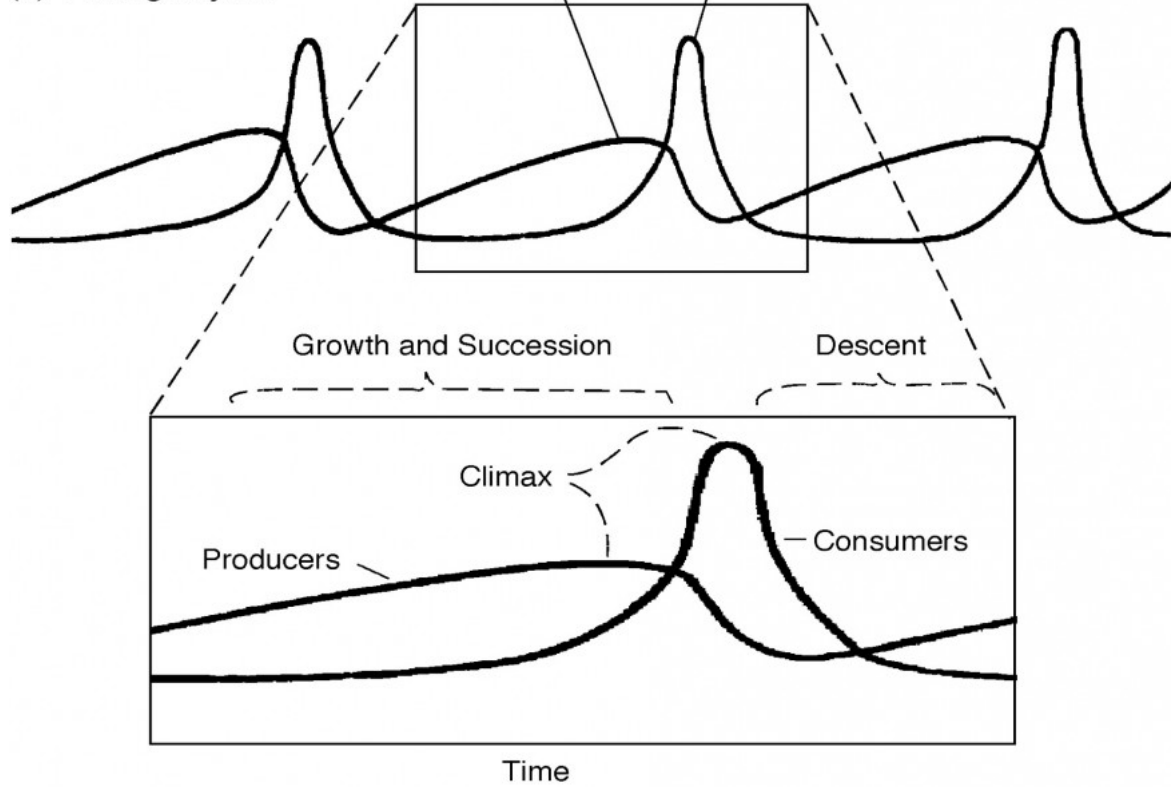
Over time:

“diversity and complexity increase. Species with symbiotic, co-operative relationships develop. There is more organization. Organisms divide their tasks rather than compete. A mature urban economy is similar to a mature eco system with many kinds of occupations, specialties and organizations. Regulations helps eliminate destructive competition. . . [At Stage 3,] assets decrease, either because the pulse of growth has used up the storage of available resources or because there is a surge of destruction by the pulse of a larger scale. By one means or another, the developed system has to adapt to coming down. (Odum).

(a) Pulsing Pair



(b) Pulsing Rhythm



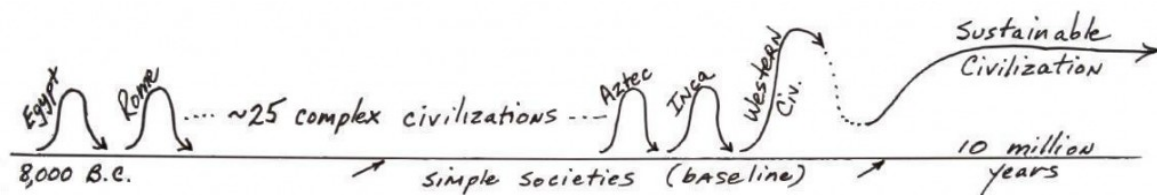
(c) Mayan Pyramid, a Climax Structure



Pulsing (Odum, 2007, p. 56) <http://cup.columbia.edu/book/978-0-231-12886-5/environment-power-and-society-for-the-twentyfirst-century>

from What Happened Here Before (Snyder, 1975)

Turtle Island swims
 in the ocean-sky swirl-void
 biting its tail while the worlds go
 on-and-off
 winking (Snyder, 1969, p. 80)



source unknown?

from Mother Earth, her Whales (Snyder)

... An owl winks in the shadow

A lizard lifts on tiptoe

breathing hard

The whales turn and glisten

plunge and

Sound, and rise again

Flowing like breathing planets

In the sparkling whorls

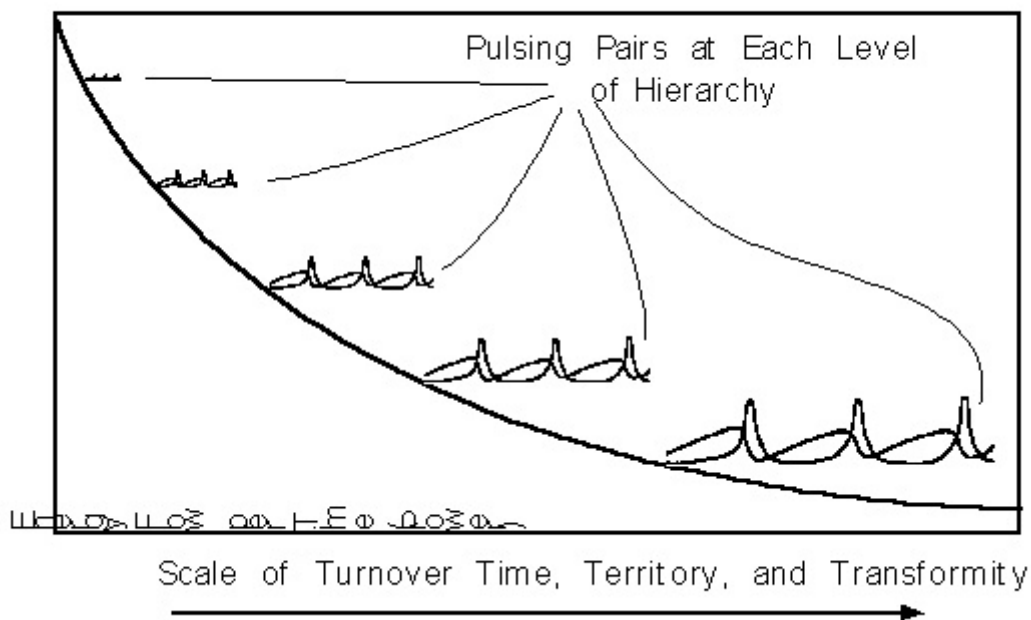
Of living light (Snyder, Turtle Island, 1969)

Bret Victor's Interactive Dynamical Display of a Lotka-Volterra Predator Prey Oscillation

How are power and efficiency related in pulsing systems that alternate periods of net production and times of net consumption? Odum suggested that all systems pulse, and that medium pulses enhanced productivity of the system overall. Pulsing of medium frequency and amplitude often provides an energy subsidy for the community thus enhancing its productivity. At the low end of the pulsing

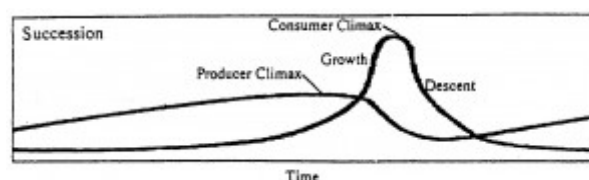
continuum, a steady state is not healthy. Too much effort to hold a system at steady state creates a build-up of pressure. Our current financial system is an example of this. At the high end of the pulsing continuum, a large pulse is not adaptive either. Since nearly all ecosystems are apparently hierarchical and pulsing, at least some of the time, the pulses of the smaller, faster species, being coupled to the larger slow-turnover species, produce chaotic oscillations. Chaos in the mathematical sense is the property of large pulsing flows passing through small storages so that one pulse shoves the storage very high—which causes the outflow to be very large so that in the next interval of time the storage jumps to very low. Chaos in this sense really has nothing to do with disorder. Mathematical chaos produces the same result each time you run it; it just looks random. (Odum, Odum, & Odum, 1995). Odum considered that adaptive systems with a domain of stability that can adapt to change required storages of at least two years worth to avoid chaotic pulses.

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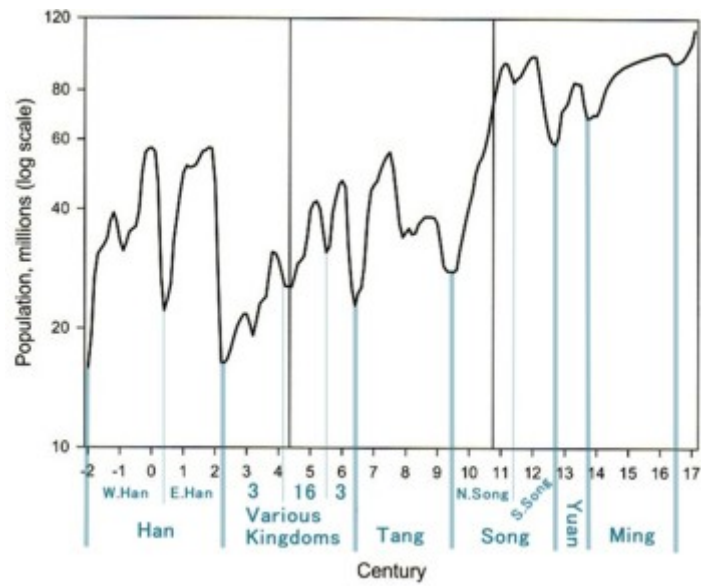


Odum, 1998 <http://www.emergysystems.org/emergy.php> Apparently, all systems on all scales pulse

- Do sustainable ecosystems operate with repeating oscillation poised on the edge of chaos? Does pulsing optimize creativity and work? How does this relate to resiliency and stability?
- It may be that systems in level steady state do not have the optimum efficiency for maximum power, whereas the pulsing systems do more production in the long run? Species maximize both their own power and that of the larger system of which they are a part (Odum, Odum, & Odum, p. 553)?



big pulse



<http://www.tabel.tcu.edu.tw/Abel-Proceedings2007- Ch37.pdf>
 Abel T. 2007 "Pulsing and Cultural Evolution in China"

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